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RESEARCH ARTICLE

Testing predictors of attitude strength as determinants of attitude stability and attitude–behaviour relationships: A multi-behaviour study

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Abstract

There has been relatively little study of multiple predictors of attitude strength. Eight predictors (attitude certainty; attitude importance; attitude subjective knowledge; moral basis of attitude; attitude elaboration; felt ambivalence; cognitive-affective potential ambivalence; cognitive-affective inconsistency) were tested for individual and combined impact on two defining features of attitude strength (attitude temporal stability; attitude–behaviour relationship), in a prospective study over one and two months across six COVID-19 protection behaviours ($N = 477$). All eight predictors were individually associated with attitude stability in individual (except elaboration) and simultaneous (except elaboration and potential ambivalence) tests. All eight predictors (except elaboration and potential ambivalence) were significant moderators of attitude–behaviour relationships in individual tests; attitude importance and inconsistency were significant moderators of attitude–behaviour relationships in simultaneous tests (only former remained significant controlling for stability). The findings highlight attitude importance as the strongest predictor of attitude strength reflected in their impact on attitude stability and attitude–behaviour relationships.

KEYWORDS
attitude, attitude strength, attitude–behaviour relationship, temporal stability of attitude

1 | INTRODUCTION

Strong attitudes are durable and have impact (Krosnick & Petty, 1995). Luttrell and Sawicki (2020) refer to these as the defining features of attitude strength. Durability can be further split into temporal stability and pliability (or persistence and resistance), while impact can be further split into effects of the attitude on behaviour and the processing of attitude-relevant information. Temporal stability and impact on behaviour are the defining features of attitude strength that have received the most attention (Krosnick & Petty, 1995), and

are also the focus here. These two features of strong attitudes are not unrelated, with attitude temporal stability being one important mechanism through which strong attitudes better predict behaviour (the prediction explanation; Fabrigar et al., 2005). As Schwartz (1978) noted, attitudes likely will not predict subsequent behaviour unless they persist over the intervening time interval between when the two are measured. A number of predictors of attitude strength have been identified. For example, Howe and Krosnick (2017) identified 11 'attitude features' related to strength: certainty, importance, ambivalence, accessibility, knowledge volume, extremity, cognitive-affective

inconsistency, intensity, moral conviction, elaboration, and vested interest. Similarly, Luttrell and Sawicki (2020) identified seven 'predictors' (the term used here) of attitude strength: accessibility, ambivalence, certainty, importance, elaboration, knowledge, and moralization. Although there is good evidence supporting each of these predictors, there are few studies that attempt to assess their individual and simultaneous effects on the defining features of attitude strength within a single study in the same sample. The current study aimed to help fill this gap by assessing attitude certainty, attitude importance, attitude subjective knowledge, moral basis of attitude, attitude elaboration, and three measures of correspondence between cognitive and affective attitudes (felt ambivalence, potential ambivalence, and inconsistency) as important predictors of attitude strength that might be expected to impact on attitude stability and moderate the attitude $_{T1}$–behaviour $_{T2}$ relationship in a single study. In addition, this study assessed the extent to which the effects of these predictors of attitude strength on moderating the attitude–behaviour relationship could be accounted for by their impact on attitude stability. Finally, the present research tested these effects within individuals across a set of behaviours, rather than across individuals with a single behaviour.

2 | PREDICTORS OF ATTITUDE STRENGTH

This section briefly reviews the evidence in relation to the eight predictors of attitude strength assessed here. These are considered in three groups: (i) perceptions of the attitude object, (ii) attitude-related knowledge/thought, and (iii) correspondence of cognitive and affective attitude components.

2.1 | Perceptions of the attitude object

Three aspects of perceptions of the attitude have been commonly used as predictors of attitude strength: attitude certainty, attitude importance, and moral basis of attitude. Attitude certainty refers to the degree of confidence an individual has that his or her evaluation of the attitude object is correct/clear to him or her. The conviction with which an attitude is held is included as part of other definitions of certainty (Tormala & Rucker, 2018). Simple single-item, meta-judgmental (Bassili, 1996) measures are often used to tap certainty (e.g., Fazio & Zanna, 1978) and studies have shown greater certainty to be linked to both greater stability of attitudes (Bassili, 1996) and stronger attitude–behaviour relationships (Fazio & Zanna, 1978; Warland & Sample, 1973). Cooke and Sheeran (2004) found significant effects of certainty on attitude–behaviour relationships across four studies with a small–medium magnitude average effect size.

Attitude importance is the degree to which an individual attaches significance to the attitude object. This is a predictor of attitude strength that has received considerable attention (e.g., it is the focus of the first *Annual Review of Psychology* article focusing on attitude strength; Howe & Krosnick, 2017). These authors suggest that attitude importance is a key predictor of attitude strength and reflects the

degree of priority a person attaches to an attitude and distinguishes it from concepts that link an attitude to one's values or self-image (e.g., centrality, involvement, ego-involvement, salience, personal relevance). The most frequently used measures of this construct tap how important the attitude or object is to the individual, how concerned they are about it, or how deeply they care about it (i.e., meta-judgmental measures; Gopinath & Neyer, 2009; Krosnick, 1989). A limited number of studies show greater attitude importance to be associated with stronger attitude–behaviour relationships in relation to product choices (Kokkinaki & Lunt, 1997), work behaviour (Ziegler & Schlett, 2016), and environmental behaviours (Bolson, 2013). There are fewer tests of the impact of attitude importance on attitude stability (Krosnick, 1988).

Moral basis of attitude is the degree to which an attitude is a strong and absolute belief that something is right or wrong or moral or immoral, or that it reflects core moral values and convictions (Skitka, 2014). It is measured by meta-judgmental measures and studies have shown such attitudes to be more stable (Luttrell & Togans, 2021) and to better predict behaviour (Judge et al., 2012; Skitka & Bauman, 2008).

2.2 | Attitude-related knowledge/thought

Two aspects of attitude-related knowledge/thought have been commonly used as predictors of attitudes strength: attitude knowledge and attitude elaboration. Attitude knowledge refers to the amount of information the person has about the attitude object. This is usually tapped by knowledge listing tasks or quizzes (i.e., operative indexes; Bassili, 1996), although meta-judgmental measures (labelled *attitude subjective knowledge* here) have also been used. For example, Davidson et al. (1985) asked respondents about how well-informed they were about the attitude object (completely uninformed—completely informed). Davidson et al. (1985) showed greater knowledge to be associated with stronger attitude–behaviour relationships and studies have also shown it to be linked to greater attitude stability (Bartle, 2000). Attitude elaboration is the degree of thought or careful consideration one has given to the attitude object's merits and shortcomings (Barden & Tormala, 2014). The classic measure is based on thought listing where participants list all their thoughts about an attitude object (i.e., operative measures; Petty & Cacioppo, 1977), although meta-judgmental measures of elaboration could be tapped by simple self-report. Studies have shown more elaborated attitudes to be more stable (Haugtvedt & Petty, 1992) and to better predict behaviour (Barden & Petty, 2008).

2.3 | Correspondence of cognitive and affective attitude components

Three aspects of the correspondence of cognitive and affective attitude components have been used as predictors of attitudes strength: felt ambivalence, potential ambivalence, and inconsistency. Attitudinal ambivalence focuses on differences between positive and

negative evaluations of an attitude object. Greater ambivalence is generally associated with less stable attitudes and weaker attitude–behaviour relationships. Cooke and Sheeran (2004) reported a significant effect of ambivalence on the attitude–behaviour relationship across six studies, although the average effect size was small. It is possible to distinguish measures of ambivalence along a number of dimensions. These include the nature of the differently valenced evaluations (e.g., overall, cognitive, affective, cognitive-affective) and whether the measure is meta-judgmental or operative (Conner & Sparks, 2002). *Felt ambivalence* focuses on meta-judgmental awareness of difference between positive and negative evaluations and is tapped by self-report measures (Conner & Sparks, 2002). In contrast, potential ambivalence directly measures the positive and negative evaluations of an attitude object and combines them (Conner & Sparks, 2002; Thompson et al., 1995) into an operative measure of ambivalence. Previous research has shown measures of felt ambivalence to be less consistent moderators of attitude stability and attitude–behaviour relationships compared to operative measures of ambivalence (Conner & Armitage, 2008). This may be because felt ambivalence can prompt a re-evaluation of attitudes and even behaviour (van Harreveld et al., 2009).

In relation to cognitive and affective components of attitudes (the focus here), felt ambivalence refers to perceived differences between cognitive and affective attitudes, while potential ambivalence refers to cognitive and affective evaluations of an attitude object that are oppositely valenced (Conner et al., 2021). Relatedly, cognitive-affective inconsistency is the absolute difference between the cognitive and affective evaluations of an attitude object (irrespective of whether these evaluations are oppositely valenced or not). Conner et al. (2021) found that a measure of (cognitive-affective) inconsistency, derived from bipolar measures of cognitive and affective attitudes, moderated the attitude–behaviour relationship, and was a stronger moderator than (cognitive-affective) potential ambivalence. Higher levels of (cognitive-affective) potential ambivalence and inconsistency were both associated with weaker attitude–behaviour relationships (Conner et al., 2021). There appear to be few tests of (cognitive-affective) inconsistency as a predictor of attitude stability (see Chaiken et al., 1995).

The different indicators of attitude strength discussed above are generally considered to be both conceptually and empirically distinct (Luttrell & Sawicki, 2020). Correlations and confirmatory factor analyses support the idea that each constitutes its own latent factor (Krosnick et al., 1993; Lavine et al., 1998), although they are intercorrelated. However, there are only a limited number of studies that examine the effects of more than one predictor of attitude strength at a time and the impact on more than one feature of attitude strength (Bassili, 1996; Luttrell & Togans, 2021; Prislin, 1996; see also Philipp-Muller et al., 2020 on predicting intentions). Studies looking at more than one predictor and more than one feature of attitude strength offer the opportunity to compare effects without the potential confounding factors that limit between study comparisons (e.g., sample, behaviour or measure differences). Such studies also allow exploration of the simultaneous effects of different predictors of attitude strength in order to assess if particular predictors dominate in their impact on the stabil-

ity of attitudes and the attitude–behaviour relationship. The current study therefore sought to test the effects of a number of predictors of attitude strength, both individually and simultaneously, on attitude stability and the attitude–behaviour relationship within the same sample across a common set of behaviours.

3 | ATTITUDE STABILITY AS A MODERATOR OF THE ATTITUDE–BEHAVIOUR RELATIONSHIP

As noted earlier, temporal stability of attitudes and the impact of attitudes on behaviour are not unrelated defining features of attitude strength. In particular, the attitude temporal stability is one mechanism via which strong attitudes may better predict behaviour (i.e., the prediction explanation; Fabrigar et al., 2005). A number of previous studies support this prediction (Davidson & Jaccard, 1979; Schwartz, 1978; see also Glasman & Albarracín, 2006). For example, one recent study (Conner et al., 2022) showed, across three studies with 2–4 waves of data collection (separating out stability measures from measures used to tap the attitude–behaviour relationship), that more stable attitudes were more predictive of subsequent behaviour. Another recent study indicated that attitudes that are temporally stable may even predict behaviour over periods as long as 10 years (Conner & Norman, 2020). The current research provides a further test of the extent to which stable attitudes are more predictive of behaviour. More importantly, the current research also explored whether any effects of each predictor of attitude strength on the attitude–behaviour relationship could be explained (i.e., mediated) by effects on attitude stability. Specifically, we tested if the moderating effect of each predictor of attitude strength on the attitude–behaviour relationship was attenuated by also controlling for attitude stability and the interaction between stability and attitude (i.e., whether attitude stability mediates the moderating effect of attitude strength predictors on attitude–behaviour relationships). A similar approach to examining if intention stability mediated the effects of moderators of the intention–behaviour relationship was reported by Sheeran and Abraham (2003).

4 | EXAMINING EFFECTS IN A MULTI-BEHAVIOUR DESIGN

A final aspect of the current research was exploration of the effects of predictors of attitude strength on defining features of attitude strength using a multi-behaviour design. The set of behaviours focused on were the six recommended by the World Health Organization as evidenced to affect SARS-CoV-2 transmission (see WHO, 2020). As the focus was on general relationships for attitudes across a set of related behaviours, we examined them simultaneously using a within-person approach based on hierarchical linear modelling (i.e., behaviours clustered within individuals). Such a within-person approach may be considered more appropriate in relation to the current aims compared to a between-persons approach that examines rank congruence, for example, whether those with highest levels of an attitude towards a

behaviour are also those with the highest levels of that behaviour. Such an approach has also been used in relation to examining SARS-CoV-2 transmission behaviours (Schüz et al., 2021) and also attitude stability effects (e.g., Conner et al., 2022, Study 2) in other studies.

5 | SUMMARY OF STUDY AIMS

The present research aimed to: (1) assess the relationships among attitude certainty, attitude importance, moral basis of attitude, attitude subjective knowledge, attitude elaboration, cognitive-affective felt ambivalence, cognitive-affective potential ambivalence and cognitive-affective inconsistency as predictors of attitude strength (i.e., tapped by attitude stability, attitude–behaviour relations) in a nationally representative sample across multiple behaviours; (2) assess the individual and simultaneous effects of these predictors of attitude strength on two defining features of attitude strength (i.e., stability of attitudes; attitude–behaviour relationship); and (3) assess if the effects of these predictors of attitude strength on the attitude–behaviour relationship are mediated when controlling for attitude stability effects.

6 | METHODS

The data including a codebook for variables is located at: https://osf.io/c5s42/?view_only=e27e069ff36443e8b1bd61d8c0f4314f. Table S1 provides further details (definitions, origin) of our attitude strength measures.

6.1 | Participants and procedure

Given the complexity of estimating power in multi-level analyses and logistic regressions we relied on the 10:1 ratio of cases to predictors 'rule of thumb' (Peduzzi et al., 1996) to provide an adequate power. With a maximum of 19 predictors this would require a minimum of least 190 participants. Participants were recruited using Prolific (prolific.co) and completed online surveys hosted on Qualtrics at three time points (T1, T2, T3) each separated by 1 month starting in December 2020. We used quota sampling to recruit participants (among individuals signed up to Prolific) who were representative of the UK adult population in terms of years of age (18–24: 12.0% (UK)/11.6% (study sample), 25–34: 17.0% (UK)/16.8% (study sample), 35–44: 17.7% (UK)/19.8% (study sample), 45–54: 17.6% (UK)/15.7% (study sample), 55+: 35.7% (UK)/34.6% (study sample); Office for National Statistics, 2020), sex (females: 50.6% (UK)/51.4% (study sample); Office for National Statistics, 2020) and ethnicity (non-white:15.0% (UK)/18.1% (study sample); gov.uk, 2020). Participants first read an information sheet and provided consent before starting the survey. The University of Sheffield Research Ethics Committee provided approval for the study (ref. 037341). In total, 602 participants started the study, and 477 completed all measures and were analysed. The retained sample were older than those not analysed ($M = 47.67.52$, $SD = 14.99$ vs. $M = 36.50$, $SD = 14.83$, $F(1,600) = 47.26$, $p < .001$) but otherwise comparable on reported variables.

6.2 | Measures

Prolific records provided participants' age (in years), sex (0 = male, 1 = female) and ethnicity (0 = non-white, 1 = white). The T1 questionnaires comprised measures in relation to each of six WHO recommended COVID-19 protection behaviours: wearing a face covering in public places; maintaining social distancing of at least 1 metre; hand sanitizing regularly; cleaning surfaces regularly; covering your mouth/nose when coughing/sneezing. The full list of items is provided in the codebook on the OSF site. Participants completed measures for each COVID-19 protection behaviour to assess: *attitudes* (six items per behaviour, for example, 'My wearing a face covering in public places in the next month would be: Unpleasant—Pleasant; Disagreeable—Agreeable; Useless—Useful; Harmful—Beneficial; Negative—Positive; Bad—Good'; all scored 1–7; Cronbach's $\alpha = .81$ to .91; items averaged for each behaviour), *attitude certainty* (two items; e.g., 'How certain are you about what you think about wearing a face covering in public places? Not at all certain—Extremely certain'; 'How certain are you about what you feel about wearing a face covering in public places? Not at all certain—Extremely certain'; scored 1–7; r's = .76 to .88; items averaged for each behaviour), *attitude importance* (two items; e.g., 'How important is wearing a face covering in public places to you? Not at all important—Extremely important'; 'How deeply do you care about wearing a face covering in public places? Not at all deeply—Extremely deeply'; scored 1–7; r's = .72 to .93; items averaged for each behaviour), *attitude subjective knowledge* (one item; e.g., 'How much do you know about the reasons/evidence for why you should wear a face covering in public places? A little—A lot'; scored 1–7), *moral basis of attitude* (one item; e.g., 'Morally, wearing a face covering in public places is the right thing to do? Strongly disagree—Strongly agree'; scored 1–7), *attitudinal elaboration* (one item; e.g., 'How much thought have you given to whether or not to wear a face covering in public places? No thought—A lot of thought'; scored 1–7), *felt ambivalence* (two items, e.g., 'In relation to wearing a face covering in public places my thoughts are: Not at all conflicted—Very conflicted'; 'In relation to wearing a face covering in public places my feelings are: Not at all conflicted—Very conflicted'; scored 1–7; r's = .85 to .93; items averaged for each behaviour). *Potential* (cognitive-affective) *ambivalence* was computed based on the cognitive (e.g., 'My wearing a face covering in public places in the next month would be: Useless—Useful; Harmful—Beneficial; $r = .67$ across behaviours) and affective (e.g., 'My wearing a face covering in public places in the next month would be: Unpleasant-Pleasant; Disagreeable-Agreeable; $r = .87$ across behaviours) attitude responses. When responses were oppositely valenced (i.e., different sides of the mid-point) they were scored as ambivalent (scored 1); when responses were not oppositely valenced they were scored as univalent (see Conner et al., 2021). Table S2 provides details of the results when using the continuous measure of cognitive-affective potential ambivalence

reported by Conner et al. (2021). *Inconsistency* (cognitive-affective) was computed as the absolute difference between the responses to the mean of the two cognitive and two affective attitude measures (range 0–6; similar to that used by Conner et al., 2021).

At T2 the same measure of *attitudes* (six items per behaviour, Cronbach's α = .79 to .91; items averaged for each behaviour) was taken. A measure of *attitude stability* for each behaviour, which was consistent with other research (e.g., Conner et al., 2000; Sheeran & Abraham, 2003), was computed based on four indices: (1) the within-person correlation between attitude items at T1 and T2; (2) the sum of the absolute difference between attitude items at T1 and T2; (3) the absolute difference between the mean of attitude items at T1 and T2; and (4) the number of attitude items that exhibited change between T1 and T2. Each measure was standardized and averaged for each behaviour (αs = .82 to .85). The measure was highly skewed towards high stability. Therefore, for all analyses, attitude stability was dichotomized at the median (0 = low stability; 1 = high stability), although the effects for using an alternative split (maximum stability vs. other levels of stability) were very similar (Tables S3 and S4).

Measures of *behaviour* were taken at T2 and T3. These were based on a measure of performance of the protection behaviour (e.g., 'To what extent have you done each of the behaviours listed below over the past month?—Worn a face covering in public places, Not at all—All the time'; scored 1–7) and performance of the corresponding risk behaviour (e.g., 'To what extent have you done each of the behaviours listed below over the past month? —Not worn a face covering in public places, Not at all—All the time'; scored 1–7). After reversing the second item the two measures were averaged (r = .74, .72 for T2 and T3, respectively). However, this measure was highly skewed towards full compliance (47.5% of responses were scored 7). We therefore dichotomized the measure into full compliance (scored 1) and less than full compliance (scored 0) as full compliance was the focus of health advice. It is worth noting that this coincides with a median split. The effects for using an alternative split (behaviour above mid-point vs. other levels of behaviour; 90.0% of responses in first category) were very similar (Tables S3 and S4).

7 | RESULTS

Analyses were conducted in SPSS (version 24, SPSS Inc.) and HLM (version 7, SSI). Participants with missing data on demographic variables or missing for one behaviour were excluded. Table 1 reports means, standard deviations and correlations among variables across the 477 participants (averaged across behaviours). All measures had reasonable variance. Attitude (T1) was significantly correlated with behaviour (T2). All predictors of attitude strength had significant positive correlations with attitude stability and behaviour (T2), apart from felt ambivalence, potential ambivalence and inconsistency, which had significant negative correlations with attitude stability and behaviour The predictors of attitude strength were moderately strongly intercorrelated with one another with the strongest relationship being between attitude certainty and importance.

7.1 | Predicting attitude stability

Table 2 (left-hand panel) reports the (multi-level) regression analyses of the relationships between individual predictors of attitude strength and attitude stability (dependent variable). The regression analyses used Hierarchical Linear Modelling in HLM7 (Raudenbush & Bryk, 2002) with fixed slopes given the limited number of behaviours and Bernoulli regressions given the outcomes were dichotomies. Variables were grand-mean centred. For each variable we report unstandardized coefficients, standard errors, odds ratios and significance (all based on the population-average model with robust standard errors). These analyses control for the fact that measures are taken in relation to multiple behaviours (i.e., total of 3210 person-behaviour data points spread across 477 individuals), but broadly parallel the findings in the simple correlations (Table 1). Attitude certainty, attitude importance, attitude subjective knowledge and moral basis of attitude were each significantly positively related to attitude stability (i.e., greater attitude certainty, attitude importance, attitude subjective knowledge and moral basis of attitude were each associated with higher attitude stability). In addition, felt ambivalence, potential ambivalence and inconsistency (of cognitive-affective attitudes) were each significantly negatively related to attitude stability (i.e., greater felt ambivalence, potential ambivalence and inconsistency were each associated with lower attitude stability). Attitude elaboration was non-significantly positively related to attitude stability.

Table 3 (left-hand panel) shows the effects of considering all the predictors of attitude stability simultaneously. In these analyses, attitude certainty, attitude importance, attitude subjective knowledge and moral basis of attitude remained significantly positively related to attitude stability, while felt ambivalence and inconsistency remained significantly negatively related to attitude stability. The effect for potential ambivalence became non-significant, while the previously non-significant positive effect for attitude elaboration remained non-significant. Attitude importance had the strongest effect on attitude stability when predictors were considered simultaneously (Table 3, left-hand panel).

7.2 | Moderation of the attitude–behaviour relationship

Table 2 (right-hand panel, step 1) reports the (multi-level) moderated regression analyses. These moderated regression analyses test the extent to which each predictor of attitude strength moderates the impact of attitude at T1 on behaviour at T2 (i.e., the significance of the interaction after controlling for attitude and the predictor of attitude strength). Variables were mean-centred before computing interaction terms (Aiken & West, 1991). Attitude certainty, attitude importance, attitude subjective knowledge, and moral basis of attitude each had significant positive interactions with attitude (controlling for attitude and the predictor of attitude strength) when predicting behaviour. In addition, felt ambivalence and inconsistency each had significant negative interactions with attitude (controlling for attitude and the

TABLE 1 Means, standard deviations and intercorrelation of measures ($N = 477$ participants)

	B$_{T2}$	A	ASTAB	CERT	IMP	KNOW	MORAL	ELAB	FAMB	PAMB	INCON
Behaviour (B$_{T2}$)	1.000	0.307	0.241	0.327	0.387	0.230	0.306	0.113	−0.198	−0.063	−0.089
Attitude (A)		1.000	0.494	0.514	0.782	0.408	0.745	0.091	−0.428	−0.316	−0.328
Attitude Stability (ASTAB)			1.000	0.376	0.418	0.288	0.355	0.07	−0.336	−0.180	−0.221
Attitude Certainty (CERT)				1.000	0.605	0.526	0.477	0.190	−0.515	−0.154	−0.109
Attitude Importance (IMP)					1.000	0.441	0.774	0.207	−0.405	−0.129	−0.086
Attitude Subjective Knowledge (KNOW)						1.000	0.383	0.245	−0.304	−0.094	−0.065
Moral Basis of Attitude (MORAL)							1.000	0.118	−0.334	−0.065	0.023+
Attitude Elaboration (ELAB)								1.000	0.060	−0.013+	0.002+
(Cognitive-Affective) Felt Ambivalence (FAMB)									1.000	0.185	0.120
(Cognitive-Affective) Potential Ambivalence (PAMB)										1.000	0.611
(Cognitive-Affective) Inconsistency (INCON)											1.000
M	0.475	6.065	0.551	6.306	5.969	6.168	6.368	4.842	2.051	−1.317	1.211
SD	0.499	1.070	0.942	1.053	1.439	1.050	1.198	1.990	1.596	0.649	1.230

Note: $p < .001$ for all except +. Analyses do *not* take account of difference between behaviours.

predictor of attitude strength) when predicting behaviour. There was no evidence of significant moderation for attitude elaboration and potential ambivalence. Attitude importance had the strongest moderation effect when the predictors of attitude strength were considered individually (Table 2).

Attitude stability also significantly moderated the attitude–behaviour relationship (Table 2, step 1, right-hand panel). However, the effect of attitude stability on attenuating the effects of other moderators was generally modest (Table 2, step 2, right-hand panel) with only the attitude subjective knowledge, moral basis of attitude, and felt ambivalence interaction effects changing from significant (step 1) to non-significant (step 2) after controlling for attitude stability and the interaction between attitude and attitude stability. A one-tailed Z-test was computed comparing the change in the unstandardized coefficients for the interaction between a moderator and attitude when controlling for the effects of attitude stability (step 2) or not (step 1). This indicated that the reduction in the unstandardized coefficients for the interaction was only significant for inconsistency ($Z = 1.690$, $p = .046$; largest other value for attitude importance, $Z = 1.320$, $p = .093$).

Simple slopes analyses were used to test the direction of moderation effects (Preacher, Model 1 at http://www.quantpsy.org/interact/hlm2.htm). This showed that as attitude stability, attitude certainty, attitude importance, attitude subjective knowledge and moral basis of attitude increased from low (M-1SD), to moderate (M) and to high (M+1SD)

then the impact of attitude at T1 on behaviour at T2 also increased (Table 4). This supports the view that increasing attitude stability, attitude certainty, attitude importance, attitude subjective knowledge, and moral basis of attitude were associated with increasing attitude–behaviour relationships. Simple slopes analyses further showed that as felt ambivalence and inconsistency increased from low (M-1SD), to moderate (M) and to high (M+1SD) then the impact of T1 attitude on T2 behaviour decreased (Table 4). This supports the view that increasing felt ambivalence and inconsistency were associated with decreasing attitude–behaviour relationships.

Table 3 (step 1, right-hand panel) showed that only the moderating effects for attitude importance ($p < .001$) and inconsistency ($p < .05$) on the attitude–behaviour relationship remained when all predictors of attitude strength were considered simultaneously. When also controlling for attitude stability (Table 3, step 2, right-hand panel) this analysis showed that only the moderating effect for attitude importance ($p < .01$) on the attitude–behaviour relationship remained significant along with attitude stability ($p < .001$). However, controlling for attitude stability did not significantly attenuate the moderating effects of either attitude importance or inconsistency (Zs < 0.343, ps > .366).

Repeating the analyses of the attitude–behaviour relationship reported in Tables 2 and 3 when using behaviour assessed at T3 was used to test the robustness of the findings and to ensure that any effects observed for attitude stability were not attributable to this measure, including an attitude measure taken at the same time as the

TABLE 2 Moderated hierarchical regression of attitude stability and T2 behaviour onto T1 attitude and individual T1 moderators, plus interactions ($N = 3210$; 477 participants)

Predictors	Attitude stability			T2 behaviour Step 1			Step 2		
	B	SE	OR	B	SE	OR	B	SE	OR
Attitude stability				0.684***	0.066	1.981	–		
Attitude	–			0.298**	0.095	1.347	–		
Attitude stability	–			0.472***	0.120	1.602	–		
Attitude × Attitude stability	–								
Attitude certainty									
Attitude	–			0.401***	0.049	1.494	0.443***	0.064	1.558
Attitude certainty	0.812***	0.058	2.252	0.598***	0.067	1.818	0.548***	0.069	1.703
Attitude × Attitude certainty	–			0.143***	0.036	1.153	0.108**	0.039	1.114
Attitude stability	–	–					0.203*	0.094	1.224
Attitude × Attitude stability	–	–					0.321**	0.113	1.378
Attitude importance									
Attitude	–			0.095	0.069	1.100	0.126	0.079	1.134
Attitude importance	0.732***	0.041	2.079	0.817***	0.062	2.263	0.790***	0.063	2.204
Attitude × Attitude importance	–			0.127***	0.022	1.136	0.082**	0.026	1.086
Attitude stability	–	–					0.152	0.102	1.164
Attitude × Attitude stability	–	–					0.464**	0.150	1.590
Attitude subjective knowledge									
Attitude	–			0.596***	0.050	1.815	0.629***	0.065	1.875
Attitude subjective knowledge	0.576***	0.047	1.779	0.220***	0.044	1.246	0.189***	0.044	1.208
Attitude × Attitude subjective knowledge	–			0.084*	0.035	1.088	0.051	0.035	1.053
Attitude stability	–	–					0.269**	0.095	1.309
Attitude × Attitude stability	–	–					0.423***	0.120	1.527
Moral basis of attitude									
Attitude	–			0.380***	0.064	1.462	0.406***	0.079	1.501
Moral basis of attitude	0.736***	0.065	2.088	0.580***	0.091	1.786	0.542***	0.089	1.719
Attitude × Moral basis of attitude	–			0.100**	0.031	1.105	0.049	0.034	1.051
Attitude stability	–	–					0.244*	0.099	1.276
Attitude × Attitude stability	–	–					0.507***	0.141	1.660
Attitude elaboration									
Attitude	–			0.634***	0.08-	1.887	0.680***	0.066	1.974
Attitude elaboration	0.027	0.022	1.027	0.079***	0.023	1.082	0.082**	0.023	1.085
Attitude × Attitude elaboration	–			−0.031	0.028	0.969	−0.028	0.024	0.972
Attitude stability	–	-					0.294**	0.096	1.342
Attitude × Attitude stability	–	–					0.482***	0.121	1.620
(Cognitive-Affective) felt ambivalence									
Attitude	–			0.600***	0.054	1.822	0.637***	0.066	1.890
Felt ambivalence	−0.449***	0.039	0.638	−0.116***	0.033	0.891	−0.091**	0.032	0.913
Attitude × Felt ambivalence	–			−0.060*	0.025	0.942	−0.032	0.024	0.968
Attitude Stability	–	–					0.264**	0.094	1.303
Attitude × Attitude stability	–	–					0.423***	0.119	1.526

(Continues)

TABLE 2 (Continued)

| | Attitude stability | | | T2 behaviour | | | | | |
| | | | | Step 1 | | | Step 2 | | |
Predictors	B	SE	OR	B	SE	OR	B	SE	OR
(Cognitive-Affective) potential ambivalence									
Attitude	–			0.723***	0.054	2.061	0.783***	0.074	2.188
Potential ambivalence	−1.373***	0.150	0.253	0.566*	0.252	1.762	0.802**	0.259	2.231
Attitude × Potential ambivalence	–			−0.032	0.202	0.969	0.184	0.195	1.203
Attitude stability	–	–					0.291**	0.097	1.338
Attitude × Attitude stability	–	–					0.521***	0.131	1.684
(Cognitive-Affective) inconsistency									
Attitude	–			0.707***	0.062	2.028	0.856***	0.100	2.354
Inconsistency	−0.378***	0.042	0.685	0.095*	0.039	1.100	0.190***	0.046	1.209
Attitude × Inconsistency	–			−0.161***	0.041	0.852	−0.090*	0.043	0.914
Attitude Stability	–	–					0.248*	0.106	1.281
Attitude × Attitude stability	–	–					0.652***	0.171	1.919

Note: For predictions of attitude stability: attitude certainty, −2 Log-likelihood = −4473.2; attitude importance, −2 Log-likelihood = −4521.4; attitude subjective knowledge, −2 Log-likelihood = −4431.2; moral basis of attitude, −2 Log-likelihood = −4554.0; attitude elaboration, −2 Log-likelihood = −4419.2; felt ambivalence, −2 Log-likelihood = −4449.7; potential ambivalence, −2 Log-likelihood = −4410.8; inconsistency, −2 Log-likelihood = −4418.6. For predictions of behaviour: attitude stability, −2 Log-likelihood = −4444.3; attitude certainty, step 1, −2 Log-likelihood = −4469.7, step 2, −2 Log-likelihood = −4464.9; attitude importance, step 1: −2 Log-likelihood = −4478.4, step 2: −2 Log-likelihood = −4490.2; attitude subjective knowledge, step 1, −2 Log-likelihood = −4446.8, step 2, −2 Log-likelihood = −4447.8; moral basis of attitude, step 1, −2 Log-likelihood = −4488.2, step 2, −2 Log-likelihood = −4490.8; attitude elaboration, step 1, −2 Log-likelihood = −4458.8, step 2, −2 Log-likelihood = −4454.1; felt ambivalence, step 1, −2 Log-likelihood = −4447.8, step 2, −2 Log-likelihood = −4448.6; potential ambivalence, step 1, −2 Log-likelihood = −4463.4, step 2, −2 Log-likelihood = −4452.2; inconsistency, step 1, −2 Log-likelihood = −4468.0, step 2, −2 Log-likelihood = −4465.6.

*p < .05.
**p < .01.
***p < .001.

behaviour measure (i.e., at T2). Considering the attitude strength variables individually (Table S5) produced results that were similar to those reported in Table 2. The only difference was that attitude subjective knowledge was no longer a significant moderator, while attitude elaboration became a significant negative moderator of the attitude$_{T1}$–behaviour$_{T3}$ relationship (both effects became non-significant when controlling for attitude stability effects). Considering the attitude strength variables in combination (Table S6) produced results that were similar to those reported in Table 3. The only difference was that felt ambivalence became a significant negative moderator, while the moderation effect for inconsistency became non-significant in relation to the attitude$_{T1}$–behaviour$_{T3}$ relationship. Attitude importance was a significant positive moderator in these analyses and remained so when controlling for the effects of attitude stability (a significant negative moderation effect for felt ambivalence also remained).

8 | DISCUSSION

8.1 | Summary of the main findings

Our three aims were to: (1) assess the relationships among predictors of attitude strength; (2) assess (individual and simultaneous) effects

of predictors of attitude strength on stability of attitudes and the attitude–behaviour relationship; and (3) test the attenuating effect of controlling for attitude stability effects on the power of predictors of attitude strength to moderate the attitude–behaviour relationship. In relation to these three aims, the current research indicates a number of notable findings. First, in relation to assessing the relationships among the eight predictors of attitude strength, correlations indicated varying degrees of overlap (Table 1). Strong overlap was notable between attitude certainty and attitude importance and subjective knowledge, plus between attitude importance and the moral basis of attitude, and also between (cognitive-affective) potential ambivalence and inconsistency. Weaker overlap was apparent between the measures of attitude certainty, attitude importance, attitude subjective knowledge, moral basis of attitude and felt ambivalence, and the measures of potential ambivalence and inconsistency. These relationships are in line with previous confirmatory factor analyses on the predictors of attitude strength indicating that, while intercorrelated, they are empirically distinct (Krosnick et al., 1993; Lavine et al., 1998). Simple correlations also indicated that all eight predictors of attitude strength were significantly correlated with the measure of attitude stability, although the magnitude of the correlation was more modest for attitude elaboration as well as for (cognitive-affective) potential ambivalence.

TABLE 3 Moderated hierarchical regression of attitude stability and T2 behaviour onto predictors ($N = 3210$; 477 participants)

Predictors	Attitude stability			T2 behaviour Step 1			Step 2		
	B	SE	OR	B	SE	OR	B	SE	OR
Attitude	–			0.111	0.112	1.118	0.195	0.121	1.216
Attitude Certainty	0.205**	0.075	1.228	0.253**	0.078	1.287	0.238**	0.078	1.269
Attitude × Attitude certainty	–			0.035	0.049	1.036	0.021	0.052	1.021
Attitude importance	0.354***	0.063	1.426	0.644***	0.072	1.904	0.634***	0.073	1.884
Attitude × Attitude importance	–			0.159***	0.046	1.173	0.139**	0.047	1.149
Attitude subjective knowledge	0.159**	0.056	1.172	0.033	0.053	0.968	−0.043	0.052	0.958
Attitude × Attitude subjective knowledge	–			0.063	0.039	1.065	0.061	0.040	1.063
Moral basis of attitude	0.215**	0.065	1.239	0.146	0.076	1.157	0.125	0.076	1.133
Attitude × Moral basis of attitude	–			−0.062	0.044	0.940	−0.073	0.044	0.930
Attitude elaboration	−0.018	0.024	0.982	0.005	0.026	1.005	0.008	0.026	1.008
Attitude × Attitude elaboration	–			−0.014	0.030	0.986	−0.013	0.030	0.987
Felt ambivalence	−0.196***	0.035	0.822	0.028	0.035	1.029	0.036	0.035	1.037
Attitude × Felt ambivalence	–			−0.031	0.029	0.969	−0.023	0.030	0.977
Potential ambivalence	−0.267	0.203	0.766	0.237	0.318	1.267	0.255	0.320	1.291
Attitude × Potential ambivalence	–			0.249	0.249	1.282	0.314	0.256	1.369
Inconsistency	−0.316***	0.052	0.729	0.028	0.055	1.028	0.071	0.057	1.073
Attitude × Inconsistency	–			−0.105*	0.053	0.901	−0.079	0.054	0.924
Attitude stability	–	–					0.125	0.104	1.133
Attitude × Attitude stability	–	–					0.454**	0.164	1.574

Note: For attitude stability, −2 Log-likelihood = −4601.4. For T2 behaviour, step 1, −2 Log-likelihood = −4512.8, step 2: −2 Log-likelihood = −4525.6.
*$p < .05$.
**$p < .01$.
***$p < .001$.

TABLE 4 Summary of the simple slopes analyses predicting T2 behaviour from T1 attitude at low (M − 1SD), medium (M) and high (M = 1SD) levels of the moderators ($N = 3210$; 477 participants)

Moderator	Effects of T1 attitude on T2 behaviour at different levels of moderator					
	Low		Medium		High	
	B	SE	B	SE	B	SE
Attitude stability	0.448***	0.0512	0.684***	0.0656	0.919***	0.1149
Attitude certainty	0.249***	0.0623	0.401***	0.0478	0.554***	0.0610
Attitude importance	−0.089	0.0660	0.095	0.0695	0.279**	0.0851
Attitude subjective knowledge	0.507***	0.0543	0.596***	0.0500	0.685***	0.0694
Moral basis of attitude	0.262***	0.0758	0.380***	0.0640	0.498***	0.0712
Felt ambivalence	0.696***	0.0767	0.600***	0.0543	0.504***	0.0567
Inconsistency	0.903***	0.0800	0.707***	0.0625	0.511***	0.0797

**$p < .01$.
***$p < .001$.

Second, in relation to the effects of the predictors of attitude strength on the stability of attitudes, simple correlations (Table 1) and individual analyses (Table 2) both indicated significant effects for all variables except attitude elaboration. Increasing attitude cer-

tainty, attitude importance, attitude subjective knowledge, and moral basis of attitude and decreasing felt ambivalence, potential ambivalence and inconsistency were individually associated with attitudes being more stable. Similar individual effects on attitude stability have

been reported for attitude certainty (Bassili, 1996), attitude importance (Krosnick, 1988), attitude subjective knowledge (Bartle, 2000), moral basis of attitude (Luttrell & Togans, 2021), and felt ambivalence (Conner & Armitage, 2008). There have been fewer tests of the individual effects of potential ambivalence (Conner & Armitage, 2008), potential cognitive-affective ambivalence and inconsistency in particular (Conner et al., 2021) on attitude stability. Haugtvedt and Petty (1992) found attitude elaboration to be significantly related to attitude stability, inconsistent with the current null findings, although they used an operative measure of elaboration.

Simultaneous consideration of these different predictors of attitude strength indicated that the pattern of prediction remained (Table 3), although (cognitive-affective) potential ambivalence became non-significant. It would be useful for future research to directly compare the simultaneous impact of these (and other) predictors of attitude strength using both meta-judgmental and operative measures where feasible on different measures of stability of attitudes (see Bassili, 1996). The strongest predictor of attitude stability in the simultaneous analyses presented here (Table 3) was attitude importance supporting claims that it is a key predictor of attitude strength (Howe & Krosnick, 2017).

In relation to the effects of the predictors of attitude strength on the attitude–behaviour relationship, increasing attitude certainty, attitude importance, attitude subjective knowledge, moral basis of attitude and decreasing felt ambivalence and (cognitive-affective) inconsistency were shown to be individually associated with stronger effects of attitude on subsequent behaviour (Table 2). This is consistent with previous research on attitude certainty (Fazio & Zanna, 1978; Warland & Sample, 1973), attitude importance (Bolson, 2013; Kokkinaki & Lunt, 1997; Ziegler & Schlett, 2016), attitude subjective knowledge (Davidson et al., 1985), moral basis of attitude (Judge et al., 2012; Skitka & Bauman, 2008), felt ambivalence (Conner & Armitage, 2008), and (cognitive-affective) inconsistency (Conner et al., 2021). The lack of a moderating effect for potential (cognitive-affective) ambivalence was inconsistent with findings reported by Conner et al. (2021), although their effects were only significant in one of three studies presented. The lack of a significant effect for attitude elaboration is inconsistent with previous research showing higher elaboration being associated with stronger attitude–behaviour relationships (Barden & Petty, 2008). The current study and that of Barden and Petty (2008) differ in relation to the use of a meta-judgmental versus operative measure of attitude elaboration. Future research could usefully further systematically explore the effects of meta-judgmental versus operative measures of attitude elaboration on different defining features of attitude strength.

The current research extends previous work by showing that consideration of these predictors of attitude strength simultaneously indicated that only attitude importance and (cognitive-affective) inconsistency were significant moderators of the attitude–behaviour relationship (Table 3). Notably the effects for inconsistency (but not importance) became non-significant when also controlling for the effects of attitude stability. These findings need to be confirmed in future studies but support the view that attitude importance in particular is the dominant predictor of attitude strength (Howe & Krosnick, 2017) as

tapped by the impact of a strong attitude on subsequent behaviour. It is worth noting that attitude importance was also a significant moderator (alongside felt ambivalence) when predicting behaviour over a 2-month time period (i.e., at T3; Table S6).

Third, in relation to our aim to assess if the effects of these predictors of attitude strength on the attitude–behaviour relationship is attenuated (or mediated) by controlling for attitude stability effects, the findings were mainly negative. Controlling for attitude stability effects only significantly attenuated the moderation effect for (cognitive-affective) inconsistency on the attitude–behaviour relationship, although a significant effect remained (Table 2). This suggests that the effects of these various predictors of attitude strength (i.e., attitude certainty, attitude importance, attitude subjective knowledge, moral basis of attitude, felt ambivalence, cognitive-affective inconsistency) do not *mainly* have their effect on moderating the attitude–behaviour relationship through attenuating the stability of attitudes. It may be that other mechanisms account for these effects on attitude–behaviour relationships (e.g., changing perceptions of the attitude object; Fabrigar et al., 2005). Nevertheless, we did observe a strong effect for attitude stability on the attitude–behaviour relationship (in both individual and simultaneous analyses) supporting previous studies on this issue (e.g., Conner et al., 2022; see review by Glasman & Albarracín, 2006). More stable attitudes were stronger predictors of later behaviour and this effect was replicated in predicting behaviour at T3 (Tables S5 and S6) when the attitude stability and behaviour measures did not share a data collection time point (i.e., T2).

8.2 | Implications in relation to covid-protection behaviours and other attitude objects

The principal implications of the current research are in relation to Covid-protection behaviours. The findings support the power of attitude towards these behaviours in predicting engagement with these behaviours, particularly when these attitudes are strong as indicated by greater stability, importance, certainty, subjective knowledge and moral basis and have less felt ambivalence and inconsistency. In terms of promoting these behaviours, that might suggest the value of targeting both attitudes and these predictors of attitude strength—especially the importance of these behaviours.

It is less clear the extent to which these findings would generalize to other related or unrelated behaviours or non-behaviour attitude objects more generally (e.g., is importance the key strength variable for other attitude objects?). Covid-protection behaviours may be seen as controversial and attitudes towards such behaviours plus the predictors of the strength of such attitudes may therefore possess unique characteristics not shared with other attitude objects. We are not aware of research systematically examining variation in the effects of predictors of attitude strength across different attitude objects. More narrowly in relation to attitudes towards behaviours, Fishbein and Ajzen's (2010) work suggests that the impact of attitudes (alongside other predictors) on intentions and behaviour may vary across both behaviours and populations and therefore needs to be

determined empirically. Future research might usefully assess the extent to which the effects of individual and combined predictors of attitude strength show similar variation across attitude objects and perhaps populations and the key characteristics determining any such variation.

8.3 | Strengths and weaknesses

There are a number of strengths and weaknesses to the reported research. Strengths include the test of eight separate predictors of attitude strength in relation to two different defining features of attitude strength in a large, nationally representative sample on a topical issue. As such, the observed effects for this set of behaviours should be expected to generalize to the UK population. In addition, testing both individual and simultaneous effects of the eight predictors of attitude strength and testing the effects within individuals across multiple behaviours in a prospective design are further strengths. Also, from an applied perspective, the findings highlight the value of targeting attitudes and predictors of attitude strength (particularly increasing importance) as ways to promote this set of behaviours that may have important health consequences within the context of a global pandemic.

There are also a number of weaknesses to the present research. First, the use of self-report behaviour measures may have opened the research to various biases, although recent research supports the validity of self-report measures compared to objective measures of behaviour (Gershuny et al., 2019). Nevertheless, the current findings would be considerably strengthened by the use of more objective behavioural measures. Second, showing these effects in a single study means the current findings need replication. Third, our tests were correlational and studies showing similar effects based on manipulations of attitude strength through targeting the predictors of strength would be valuable. Fourth, our analyses exploring the impact of attitude stability on the attitude–behaviour relationship used measures of stability taken at the same time point as the behaviour measure (i.e., T2). Analyses predicting behaviour at T3 (reported in Tables) suggest this did not unduly bias the results, although in those analyses the measure of behaviour was taken two rather than 1 month (i.e., time period specified in attitude measure) after the measures of attitude and predictors of attitude strength (T1). Reassuringly, Conner et al. (2022) showed similar effects for attitude stability with studies using two-, three- or four-wave designs.

Fifth, the validity of our measures of attitude strength could be criticized. Table S1 provides evidence of the face validity of each predictor of attitude strength in terms of a good match to established definitions on which they are based. Nevertheless, the measures of importance, moral basis and potential ambivalence plus inconsistency are open to criticism. For example, our measure of attitude importance might be considered as tapping the importance of the issue rather than the importance of the attitude (see Eaton & Visser, 2008 on this distinction). Similarly, our measure of the moral basis of attitude might be criticized for not sufficiently capturing the extent to which the atti-

tude is based on moral convictions (Skitka, 2014). In relation to our measures of potential ambivalence plus inconsistency, the measures might be criticized for partly using the same items that tapped attitude. However, additional analyses that used attitude measures not overlapping with these measures (i.e., Negative-Positive; Bad-Good) showed similar effects. The disagreeable-agreeable semantic differential item might be considered a weak measure of affective attitude, although it showed strong correlation with the other affective item and low overlap with the two cognitive attitude items and similar results were obtained when omitting this item. Relatedly, our scorings of potential ambivalence and inconsistency were taken from Conner et al. (2021), although alternative ways of scoring these constructs have been used (e.g., Maio et al., 2000). More generally, it may be useful for our findings to be confirmed using multi-item measures of the predictors of attitude strength, although this has implications for participant burden in a multi-behaviour study. In addition, the need to use dichotomous scoring of some measures (e.g., potential ambivalence) may have reduced their variance and attenuated effects on attitude strength outcomes.

Sixth, and finally, our research did not test all predictors of attitude strength (Howe & Krosnick, 2017; Luttrell & Sawicki, 2020). Importantly, attitude accessibility was not assessed in our online survey given the reliability of such reaction time measures taken online. Previous research has indicated accessibility to be a consistent moderator of attitude–behaviour relationships (Cooke & Sheeran, 2004) and that accessibility and stability of attitudes are linked which may help explain the impact of accessibility on the attitude–behaviour relationship (Glasman & Albarracín, 2006). Future research might usefully assess attitude accessibility alongside other predictors of attitude strength in simultaneous tests. Relatedly, we only looked at effects on one of two aspects of the durability and of the impact components of attitude strength (Krosnick & Petty, 1995). Future research could usefully assess the effect of these predictors of attitude strength both on the resistance to change aspect of durability and the biased information processing aspect of impact.

8.4 | Summary

Attitude certainty, attitude importance, attitude subjective knowledge, moral basis of attitude, felt ambivalence and cognitive-affective inconsistency were shown to be predictors of attitude strength in both individual and simultaneous analyses. Increasing attitude certainty, attitude importance, attitude subjective knowledge, moral basis of attitude and decreasing felt ambivalence, and cognitive-affective inconsistency were individually shown to moderate the impact of attitude on subsequent behaviour. Consideration of predictors of attitude strength simultaneously indicated that attitude importance and cognitive-affective inconsistency were the only significant moderators of the attitude–behaviour relationship (with only the former remaining significant when controlling for attitude stability effects). Evidence that these effects were attributable to effects on attitude stability was only found for cognitive-affective inconsistency, and any mediation

effects were only partial. Together these findings suggest that attitude importance is the dominant predictor of attitude strength in relation to their impact on two key features of attitude strength (i.e., attitude stability and attitude–behaviour relationships).

CONFLICT OF INTEREST

FUNDING INFORMATION

ETHICS STATEMENT

The University of Sheffield Research Ethics Committee provided approval for this study (ref. 037341).

DATA AVAILABILITY STATEMENT

The data and materials are available from the first author and online (details in method).

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