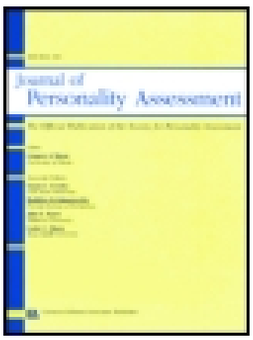

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Refining Anger: Summarizing the Self-Report Measurement of Anger

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ABSTRACT

The current paper presents a five-factor measurement model of anger summarizing scores on public-domain self-report measures of anger. Exploratory and confirmatory factor analyses of self-report measures of anger (UK, $n = 500$; USA, $n = 625$) suggest five replicable latent anger factors: anger-arousal, anger-rumination, frustration-discomfort, anger-regulation, and socially constituted anger. Findings suggested a 5-factor interpretation provided the best fit of the data. We also report evidence of measurement invariance for this 5-factor model of anger across gender, age, and ethnicity. The findings suggest a useful and parsimonious account of anger, summarizing over 50 years of research around the self-report measurement of anger.

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In 2020, Raymond Novaco, one of the forefathers in the theory and measurement of anger, stated in a news article, "We're living, in effect, in a big anger incubator" (Chang, 2020). Currently, there is a popular focus on anger within society, with descriptions of anger featuring in politics (e.g., alt-right (Ganesh, 2020)), some individuals' and populations' everyday experiences (police violence, legacies of racism, the death of George Floyd (Chang, 2020), and responses to legislation bringing in restrictions around the coronavirus pandemic (Smith et al., 2021).

However, it is through psychological theory and research that we can best understand the motivations for anger. Psychologically, anger stems from individual temperament, interpersonal contexts, and conflicts that can be characterized by several inward and outward emotional, cognitive and behavioral indicators such as rage, irritability, frustration, and verbal outbursts (Beames et al., 2019; Novaco, 2016; Spielberger, 2020). Anger can also reflect specific cognitive-emotional processes across all emotions, comprising cognitive appraisals and action tendencies (Frijda, 2004; Lazarus, 2000; Scherer, 2012). For example, anger can represent appraisals around individuals' typical attributions surrounding wrong-doing and an action tendency to address or undo wrong-doing in a variety of ways, from resistance to retaliation (Fernandez, 2008, 2013). Anger may also reflect social psychological processes, such as the protection of self-esteem or identity (Novaco, 2010). Anger is also considered in terms of its temporal nature. Typically, anger is thought to reflect levels of permanency, for example, in terms of (1) a stable temperament across the lifespan from early childhood (Mahon et al., 2010); (2) comorbidity with disease and general health (Chida & Steptoe, 2009; Ephrem Fernandez & Smith, 2015), or (3) internalizing expressions of general mood dysregulations (Dvir et al., 2014; Gillies et al., 2016). However, anger can also be truncated, shortened in duration or extent, as evidenced by attempts to minimize anger through intervention and treatment (DiGiuseppe & Tafrate, 2003; Richard et al., 2022).

The most common way to measure anger has been through the use of self-report measures. Reviews of self-report measures of anger identify over 40 possible measures of anger (Fernandez et al., 2015; Ronan et al., 2014). Self-report measures of anger draw on a series of different perspectives, and there is a divergence in how to best measure anger. The most-cited and well-used self-report measures of anger are the Spielberger State-Trait Anger Expression Inventory (Spielberger, 2020) and the Novaco Anger Scale and Provocation Inventory (Novaco, 2003), both focus on general temperament and outwards, inwards, and controlled expressions of anger. Other well-cited anger scales draw on a range of perspectives, including cognitive processes around anger rumination (Sukhodolsky et al., 2001), anger as behavioral and cognitive responses around avoidance, assertions, and social support (Linden et al., 2003), cognitive and emotional aspects of irritability (Craig et al., 2008), functional and dysfunctional responses and goal-orientated behavior around anger (Kubiak et al., 2011), considerations around experiences of anger (Sharkin & Gelson, 1991), and positive beliefs about anger (Moeller, 2016). Some approaches treat anger as having reciprocity with frustration and hostility

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(Birkley & Eckhardt, 2015; Pawliczek et al., 2013; Trip et al., 2020).

This expansive consideration of what comprises anger, from many theoretical and measurement self-report perspectives, provides a richness of measures to consider anger. However, having so many measurement approaches presents a risk to psychology's ability to properly account for how anger is best assessed and how it can apply optimally. Therefore, there is a requirement to accurately specify the underlying factors of anger to present the most parsimonious and accurate account. This is so researchers may be clear and confident that they are applying the best measures of anger and providing the most optimal analyses around anger. Therefore, simplifying the anger measurement literature from 40+ possible self-report measures into latent dimensions will lead to greater specificity and accuracy in measuring anger.

This simplification of the anger measurement literature can be pursued via factor analysis. Kline (Kline, 1986, 1999) has argued that the factor analysis of variables evidences the probity of latent indictors of key characteristics. Haig (2022) has argued that factor analysis (and principally exploratory factor analysis) is an abductive method for generating rudimentary explanatory theories from the "Common Causal Principle" (Reichenbach, 2003). This principle states that every correlation is due to either a direct causal effect concerning the correlated variables or is the result of a third factor. Moreover, confirmatory factor analysis verifies any proposed factor structure (DiStefano & Hess, 2005). Therefore, exploratory and confirmatory factor analysis procedures provide a suitable method for identifying an underlying and replicable latent factor model between measures of anger. By doing this, we can identify a parsimonious and accurate account of the main characteristics contained within self-report measures of anger.

We make three considerations around our inclusion of self-report measures suitable for pursuing this simplification. The first is to focus on characteristics that reflect anger in terms of tripartite of affect, cognition, and behavior that are separate from actual acts related to aggressive or hostile actions (e.g., aggressive acts; Fernandez et al., 2015). This may not be a straightforward consideration. However, for example, we aim to include self-report measures of anger that encompass characteristics such as verbal outbursts, aggressive feelings, displays of irritability, and hostile thoughts (e.g., experiencing problems with temper). As such, we want to exclude self-reports of aggressive and antisocial acts that have caused physical or psychological harm to another or oneself (e.g., hitting someone). Second, we are looking for characteristics of anger that might reflect a longer-term orientation around anger reflecting affective, cognitive and behavioral characteristics. Therefore, we focus on self-report measures of anger that reflect these characteristics of anger rather than anger in interpersonal, specific or situational contexts. The third is to emphasize that we only include measures that are free to use and do not require a qualification. There are many situations in which to assess anger. The cost of using a scale, or the need to have a psychological testing qualification, would be too prohibitive for use in, for example, schools, communities, or mental health settings.

Table 1. Gender, age, and ethnicity of samples by country (expected numbers for representative sample).

	UK ($n = 500$) EFA	USA ($n = 625$) CFA
Gender		
Female	255 (255)	320 (318.75)
Male	245 (245)	305 (306.25)
Age		
18–27	89 (88.33)	115 (114.58)
28–37	88 (88.33)	113 (114.58)
38–47	93 (93.33)	105 (102.08)
48–57	84 (83.33)	107 (108.33)
58+	146 (146.67)	185 (185.42)
Mean (SD) Age	45.66 (16.17)	45.14 (15.4)
Ethnicity		
Asian	50 (48.33)	54 (52.08)
Black	35 (33.33)	93 (93.75)
Mixed	20 (21.67)	29 (31.25)
Other	15 (16.67)	21 (20.83)
White	380 (380)	428 (427.08)

This study aimed to explore and summarize self-report measures of anger to develop a latent factor model and facilitate an accurate psychological account of the main factors of anger. These aims of the study were not preregistered as a protocol.

Method

Samples

We collected two samples from the Prolific crowdsourcing site: UK ($n = 500$) and US ($n = 625$) registered users. At least five hundred respondents satisfy the "very good" criterion of sample size for performing factor analysis (Comrey & Lee, 1992; Gorsuch & Hillsdale, 1983). The ratio of the number of participants (500/625) to variables (46) exceeded the recommended ratio for EFA of 10:1 (with a minimum number of participants of 150) (Cattell, 1978; Gorsuch & Hillsdale, 1983). Using a recruitment option provided by the Prolific software, both samples were nationally representative samples based on sex, five age groupings (18–27, 28–37, 38–47, 48–58, and 58+ years), and five ethnicity groups (Asian, Black, White, Mixed, Other), from the UK (based on the 2011 census) and USA (based on the 2015 census). Table 1 provides a breakdown by sex, age, and ethnicity for both samples. The samples provide 95% confidence (-/+ 4.38% for the UK sample and -/+ 3.91% for the US sample) that the findings represent the wider population.

Selection of measures

Figure 1 shows the process followed for the selection of the scales. This went through two main stages. The first stage (July, 2020) was to identify candidate anger scales for consideration. We examined Web of Science, SCOPUS, and general academic literature sources (e.g., Google Scholar) for anger scales that were available using these resources. Given we were interested in assessing affective and cognitive-based anger characteristics, the search terms were "Anger," "Irritability," "Hostile Emotions," "Hostile thoughts OR cognitions," and "Frustration" along with "scale," "questionnaire," and "assessment." In these searches, we included scales that (1) made statements intending

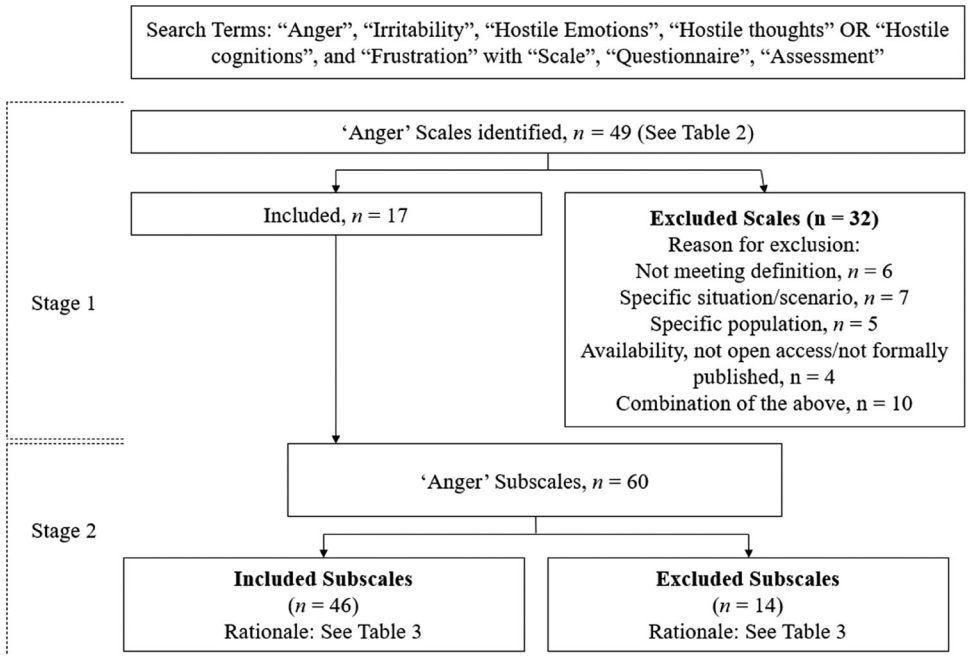

Figure 1. Inclusion and exclusion process for selection of anger scales and subscales.

to assess typical/trait/generalized affective or cognitive-based approaches and reactions around anger, and (2) were designed to be used among a general population sample. We excluded terms or papers that wholly assessed direct or behavioral aggression or harm to others, antisocial behavior, hostility (that referred to direct harm or aggression), violence, and blame—though we retained scales that contained subscales or referred to terms that met the inclusion criteria.

We identified 49 scales initially (see Supplementary Material 1) but excluded 32 scales due to their not either (i) measuring trait anger (as we defined in the inclusion criteria), or (ii) being designed for use among a specific population or (iii) being designed for using in a specific situation/scenario, or (iv) not freely available (e.g., never having been formally published, or not being free to use). Of note, we excluded two well-used anger scales (Novaco Anger and Provocation Scale, Novaco, 2003; State-Trait Anger Expression Inventory-2 Spielberger, 2020) due use involving a charge or requiring the user to hold a specific qualification. The exclusion of the Spielberger State-Trait Anger Expression Inventory (Spielberger, 2020) and the Novaco Anger and Provocation Scale (Novaco, 2003) is essential to consider in detail because they are the most well-known and well-cited in the literature. However, our selection of scales detailed in Table 2 covered the seven trait anger dimensions as measured by the Spielberger State-Trait Anger Expression Inventory and relevant aspects contained within the dimensions assessed by Novaco Anger and Provocation Scale. Details of how these scales map onto the scales we included in the study are detailed in Supplementary Material 2.

For the second stage, we considered the remaining 17 scales (see Supplementary Material 3). The inclusion of all 17 scales, comprising 60 subscales, required responses to over 440 items that would be burdensome to any respondent. Some of the anger scales included subscales that met our general exclusion criteria (e.g., aggression, sadness). Also, there were several definitional overlaps between scales. When carrying out factor analyses, one should avoid using identical constructs as this may lead to (additional) factors within the reported factor structure due to items being identical in wording or meaning rather than representing a broader latent structure (Blunch, 2013). Finally, we reduced the number of subscales contained within these 17 measures. Two of the researchers went through the self-report measures of anger separately to identify scales that made unique contributions to the consideration of anger. We ordered the consideration of the scales based on the number of times it had been cited according to the MIMAS Web of Science, and if this information was not available (due to it being an earlier measure of anger) then we ordered it based on Google Scholar citations (listed in Supplementary Material 3). The reason for choosing this method was that we would use the most prevalent self-report measure of anger in the anger literature when there were overlaps in measurement. The two researchers then agreed on the final inclusion of each scale. Table 2 provides the rationale for our inclusion and exclusion of scales, also detailing why the measure provides a unique measurement of anger.

The final remaining 46 subscales (listed in Supplementary Material 3, and named in Table 2), comprising 296 items, were administered to the UK sample ($n = 500$). Based on the exploratory factor analysis (EFA) reported later in the study, a selection of these scales was administered to the US sample ($n = 625$) for the confirmatory factor analysis (CFA) using AMOS 26 (Arbuckle, 2020).

The scales were presented to all participants in the same order as selected in the Table for Supplementary Material 3 (with the subset of scales in Sample 2 presented in the same order). Each scale was shown separately on a different page. The response format for items was presented as intended for each original scale.

Table 2. Mean, standard deviation, and Cronbach's Alpha (α) for all the scales for UK and USA.

	UK ($n = 500$)			USA ($n = 625$)		
	α	Mean	SD	α	Mean	SD
1. Anger Traits (BPAQ)	.86	15.99	5.98	.81	17.26	5.52
2. Hostility (BPAQ)	.89	18.76	7.80			
3. Trait Anger (TAS)	.91	30.98	9.05			
4. Anger Out (AEI-SF)	.84	14.97	4.63	.84	16.41	4.55
5. Anger In (AEI-SF)	.82	17.75	5.03			
6. Arousal (MAI)	.93	15.13	7.59			
7. Eliciting Situations (MAI)	.90	19.12	6.72			
8. Hostile Outlook (MAI)	.80	9.67	3.94			
9. Afterthoughts (AR)	.94	17.53	7.24	.90	18.80	6.34
10. Thoughts of Revenge (AR)	.84	8.06	3.93	.79	8.46	3.68
11. Anger Memories (AR)	.93	12.44	5.93	.91	13.33	5.55
12. Understanding of Causes (AR)	.87	10.25	4.55	.83	11.34	4.22
13. Discomfort Intolerance (FDS)	.86	18.18	5.78	.81	19.47	5.30
14. Entitlement (FDS)	.86	19.65	6.07	.82	21.21	5.56
15. Emotional Intolerance (FDS)	.85	19.14	6.49	.80	21.03	5.69
16. Achievement (FDS)	.85	19.85	6.06	.77	21.68	5.16
17. Inward Irritability (SIS)	.85	2.29	2.75			
18. Outward Irritability (SIS)	.68	3.07	2.16	.71	3.69	2.41
19. Avoidance (BARQ)	.78	17.31	4.75	.77	19.96	4.72
20. Assertion (BARQ)	.83	18.89	5.03			
21. Diffusion (BARQ)	.70	14.27	4.61			
22. Social Support-seeking (BARQ)	.87	17.23	5.93			
23. Irritability Intensity (IQ)	.81	26.45	9.15			
24. Irritability Frequency (IQ)	.80	25.83	8.74			
25. Frequency (DAR-5)	NA	2.15	0.90			
26. Intensity (DAR-5)	NA	1.81	1.05			
27. Duration (DAR-5)	NA	1.70	1.01			
28. Antagonism (DAR-5)	NA	1.33	0.77			
29. Social Relationship Impairment (DAR-5)	NA	1.62	0.96			
30. Control Anger In (SCS)	.88	31.73	5.51			
31. Control Anger Out (SCS)	.84	17.43	4.96			
32. Venting (ARGI)	.89	6.87	2.64	.88	7.46	3.08
33. Downplaying (ARGI)	.82	10.24	2.89	.77	11.00	2.85
34. Seeking Distraction (ARGI)	.83	9.37	2.71	.82	11.14	2.72
35. Giving Feedback (ARGI).	.86	9.69	2.88			
36. Submitting (ARGI)	.90	8.23	3.14			
37. Humor (ARGI)	.91	6.97	2.82			
38. Enforcing Personal Standards (ARGI)	.86	9.46	3.02	.83	9.92	2.92
39. Enforcing Social Norms (ARGI)	.86	11.03	3.01	.80	11.29	2.78
40. Protecting One's Reputation (ARGI)	.86	10.30	3.27	.82	11.15	3.06
41. Weighing Costs (ARGI)	.84	11.95	2.80			
42. Avoiding Conflict (ARGI)	.87	11.74	3.05	.82	11.66	2.89
43. Downregulating Affect (ARGI)	.89	12.95	2.88			
44. Discomfort (ADS)	.84	35.90	8.07			
45. Positive Beliefs (MAP)	.84	16.53	4.90			
46. Negative Beliefs (MAP)	.89	24.92	7.33			

Key: SIS = Snaith Irritability Scale; BPAQ = Buss Perry Aggression Questionnaire; ARGI = Anger-Related Reactions and Goals Inventory; AEI-SF = Anger Expression Inventory (Short Form); MAI = Multidimensional Anger Inventory; DAR-5 = Anger Reactions-5 Scale; SCS = Self-Expression and Control Scale; TAS = Trait Anger Scale; MAP = Metacognitive Anger Processing; AR = Anger Rumination scales; FDS = Frustration Discomfort Scale; BARQ = Behavioral Anger Response Questionnaire; IQ = Irritability Questionnaire; ADS = Anger Discomfort Scale. NA = Not applicable (1-item scale).

Ethical consent

Procedures for both studies reported in this article received ethical approval from a university Psychology Ethics Board, consistent with the APA Ethical Principles of Psychologists and Code of Conduct.

Results

Mean standard deviations and reliability statistics

Table 2 shows the Mean, Standard Deviations, and Cronbach's Alpha Statistics for all the scale administered among both samples. The Cronbach's alpha (Cronbach, 1951) coefficients suggest that all the subscales except one (Outward Irritability subscale of the Snaith Irritability Scale in the UK sample) exceeded the internal reliability criterion of $\alpha > .70$ as "good" (Kline, 1999; Nunnally, 1978), with the Outward Irritability subscale of the Snaith Irritability Scale in the UK sample exceeded the internal reliability criterion of $\alpha > .60$ as "acceptable" (Kline, 1999; Nunnally, 1978).

Exploratory factor analysis (UK, n = 500)

Preliminary analyses of the items demonstrated that the data had a small positive skew (M Skewness = 0.45; M Kurtosis = 0.15), and the salience of that skew across items, be it positive or negative ($M = 0.58$; M Kurtosis salience = 0.81), fell within skewness statistics of +/-1 to suggest "very good" symmetry of a normal univariate distribution (Curran et al., 1996). Therefore, we carried out a statistical analysis that assumed the symmetry of a normal univariate distribution.

To describe the latent factors of self-report measures of anger within the context of several theoretical perspectives, we used EFA to determine the factor structure of the 46 subscales administered. The Kaiser–Meyer–Olkin measure of sampling adequacy was .944 and Bartlett's test of sphericity was, $x^2 = 16570.44$, $df = 1035$, and $p < .001$, with both statistics suggesting the sample size was satisfactory (Cerny & Kaiser, 1977; Kaiser, 1974). We used EFA to allow any factor structure to emerge and properly assess the anger subscales' latent factors without using any predefined model structure. To determine the number of factors from the EFA, we used parallel analysis, following reports that it is the most appropriate and accurate method for determining the number of factors, demonstrating the least variability and comparing favorably to other methods (Fabrigar et al., 1999; Ledesma & Valero-Mora, 2007). The sixth eigenvalue (16.65, 4.17, 2.29, 2.17, 1.73, and 1.28) obtained from maximum likelihood extraction failed to exceed the sixth eigenvalue (1.64, 1.57, 1.52, 1.48, 1.44, and 1.41) generated from a series of Monte Carlo simulations calculated for 46 variables and 500 participants from 1,000 randomly generated datasets, suggesting a six-factor solution. Factors were then subjected to Promax rotation, as it was expected that the factors would be correlated, with delta set to 0. Meaningful loadings were assessed using the criteria of .32 (*poor*), .45 (*fair*), .55 (*good*), .63 (*very good*), and .71 (*excellent*) (Tabachnick & Fidell, 2014). The results are presented in Table 3, and loadings above .32 are indicated in bold. A substantive factor was considered to be one on which three or more variables loaded so as "to provide minimum coverage of the construct's theoretical domain" (Hair et al., 2010, p. 676).

The findings suggest five factors of item sets that are interpretable because they fall within recognizable theoretical contexts for anger. The first latent factor is an ***anger-arousal*** factor, reflecting the name given to the well-recognized presence of expressions of anger in everyday life resulting from physiological, cognitive, and emotional anger arousal (Beames et al., 2019; Gilam et al., 2016; Novaco, 2016). The subscales loading on this factor represent outward expressions

Table 3. Maximum likelihood with promox rotation. Factors determined by parallel analysis.

	Factor 1				
1. Outward Irritability (SIS)	.871	−.150	.109	.034	−.073
2. Anger Traits (BPAQ)	.852	−.052	.046	−.096	−.033
3. Venting (ARGI)	.850	−.202	.005	−.096	.083
4. Anger Out (AEI-SF)	.816	−.074	−.035	−.157	.195
5. Arousal (MAI)	.812	.214	−.102	.002	.000
6. Antagonism (DAR-5)	.770	−.119	−.169	.110	.046
7. Intensity (DAR-5)	.763	−.093	.070	.055	−.013
8. Control Anger Out (SCS)	.712	−.057	−.068	−.076	.229
9. Control Anger In (SCS)	−.668	.081	−.044	.278	.005
10. Trait Anger (TAS)	.663	.094	.168	−.132	.053
11. Duration (DAR-5)	.617	.233	−.114	.012	.001
12. Social Relationship Impairment (DAR-5)	.606	.107	−.001	.037	−.053
13. Frequency (DAR-5)	.582	.141	.068	.059	−.105
14. Negative Beliefs (MAP)	.533	.219	−.100	.254	.001
15. Inward Irritability (SIS)	.464	.271	.036	.083	−.233
16. Positive Beliefs (MAP)	.403	.056	.025	.011	.193
	Factor 2				
17. Rumination Memories (AR)	−.021	.975	−.092	−.119	.111
18. Rumination Afterthoughts (AR)	−.115	.905	−.023	−.118	.117
19. Rumination Understanding of Causes (AR)	−.007	.835	.005	−.055	.125
20. Rumination Thoughts of Revenge (AR)	.171	.620	−.065	−.106	.183
21. Anger In (AEI-SF)	.260	.563	.012	.141	−.040
22. Hostility (BPAQ)	.277	.468	.111	.057	.000
23. Eliciting Situations (MAI)	.292	.332	.224	−.072	.100
	Factor 3				
24. Entitlement (FDS)	.042	−.105	.934	−.100	.106
25. Discomfort Intolerance (FDS)	−.052	.005	.859	.032	−.082
26. Achievement (FDS)	.046	−.044	.747	.037	.080
27. Emotional Intolerance (FDS)	.031	.173	.706	.127	−.081
	Factor 4				
28. Seeking Distraction (ARGI)	.112	−.198	−.049	.677	.084
29. Downplaying (ARGI)	.029	−.152	−.147	.641	.076
30. Avoiding Conflict (ARGI)	−.234	.106	.063	.587	−.025
31. Avoidance (BARQ)	.005	−.152	.102	.547	−.129
32. Submitting (ARGI)	.054	.078	−.009	.498	−.190
33. Weighing Costs (ARGI)	−.081	.052	.102	.493	.315
34. Diffusion (BARQ)	.255	−.018	−.056	.406	.063
35. Assertion (BARQ)	−.275	−.130	.034	.400	.113
36. Downregulating Affect (ARGI)	−.139	.016	.176	.375	.241
	Factor 5				
37. Enforcing Social Norms (ARGI)	.010	.075	−.017	.101	.712
38. Enforcing Personal Standards (ARGI)	.137	.047	−.067	−.031	.643
39. Protecting One's Reputation (ARGI)	.037	.072	.122	.071	.609
	Cross-loading				
40. Irritability Intensity (IQ)	.421	.368	.168	.096	−.122
41. Irritability Frequency (IQ)	.405	.421	.150	.084	−.126
42. Discomfort (ADS)	.449	.281	−.099	.390	−.087
43. Humor (ARGI)	.158	−.386	.024	.320	.194
	Non-Loading				
44. Hostile Outlook (MAI)	.229	.268	.308	−.077	.076
45. Social Support-seeking (BARQ)	−.107	.127	.133	.186	.140
46. Giving Feedback (ARGI).	−.009	−.311	−.022	.174	.243

Key: SIS = Snaith Irritability Scale; BPAQ = Buss Perry Aggression Questionnaire; ARGI = Anger-Related Reactions and Goals Inventory; AEI-SF = Anger Expression Inventory (Short Form); MAI = Multidimensional Anger Inventory; DAR-5 = Anger Reactions-5 Scale; SCS = Self-Expression and Control Scale; TAS = Trait Anger Scale; MAP = Metacognitive Anger Processing; AR = Anger Rumination scales; FDS = Frustration Discomfort Scale; BARQ = Behavioral Anger Response Questionnaire; IQ = Irritability Questionnaire; ADS = Anger Discomfort Scale.

of irritability and anger (from the Snaith Irritability Scale, e.g., "I lose my temper and shout or snap at others" [item 4] and Anger Expression Inventory, e.g., "I express my anger" [item 1]), general anger traits such as irritation and temper (Buss and Perry Aggression Questionnaire, e.g., "I have trouble controlling my temper" [item 7]), and venting of temper and anger (Anger-Related Reactions and Goals Inventory, e.g., "I explode" [item 1]). The second latent factor is an *anger-rumination* factor, with all the subscales of the Anger Rumination Scale (Anger Memories, e.g., "I ruminate about my past anger experiences [item 1]; Afterthoughts, e.g., "Whenever I experience anger, I keep thinking about it for a while" [item 9]; Understanding of Causes, e.g., "I analyze events that make me angry" [item 11]; and Thoughts of Revenge, e.g., "I have long living fantasies of revenge after the conflict is over" [item 4]), loading on this factor. This factor characterizes anger as an *intra*-personal cognitive-emotional process around past anger experiences, of continuously thinking about anger experiences and expressions, and dwelling on those experiences (Sukhodolsky et al., 2001), as well as characterizing the wider context of anger including cognitive appraisals and action tendencies (Fernandez, 2008, 2013). The third latent factor is a *frustration-discomfort* factor, with all the subscales of the Frustration Discomfort Scale loading on this factor (Entitlement, e.g., "I can't stand it if other people act against my wishes" [item 6]; Discomfort Intolerance, e.g., "I can't stand having to persist at unpleasant tasks" [item 25]; Achievement, e.g., "I can't bear the frustration of not achieving my goals" [item 8]; and Emotional Intolerance, e.g., "I can't bear disturbing feelings" [item 19]). This factor represents the concept of anger as frustration intolerance. Authors of the Frustration Discomfort Scale have emphasized its closeness to Rational-Emotive Behavior Theory (Ellis, 1991) in explaining a range of unhelpful and absolutistic cognitive beliefs that reflect intolerance related to the demands and goals of the individual (Harrington, 2005). The fourth latent factor is an *anger-regulation* factor, reflecting the recognized presence of strategies comprising cognitive or automatic processes that adjust the expression and experience of anger (Beames et al., 2019; Gilam et al., 2016; Novaco, 1975). The subscales loading on this factor are the Avoiding Conflict (e.g., "I want to avoid disagreements" [item 10]), Seeking Distraction (e.g., "I try to think of other things" [item 2]) and Downplaying (e.g., "I tell myself there are much worse things" [item 15]) subscales of Anger-Related Reactions and the Goals Inventory and Avoidance (e.g., "I put the angering event out of my mind" [item 8]) subscales of the Behavioral Anger Response Questionnaire. The fifth latent factor is consistent with a social-constructionism account of anger (hereafter named "*socially constituted anger*"). This factor comprises three subscales of the Anger-Related Reactions and the Goals Inventory that represent enforcing personal standards (e.g., "I want to get the other person to do what I think is right" [item 1]) and enforcing social norms (e.g., "I want to get the other person to act according to how one would expect" [item 5]) in others whilst protecting one's reputation (e.g., I want the other person to respect me" [item 27])). These three scales reflect a socially constructed account of anger and that anger functions within social dominance and conflict dynamics (Averill, 1982, 1983). These three scales reflect that interpersonal provocation is considered a common cause of anger, within which anger is understood within social and norm

Table 4. Factor correlation matrix.

Factor	1	2	3	4	5
1. Anger-Arousal	–	.676	.609	−.222	.346
2. Anger-Rumination		–	.708	.074	.270
3. Frustration-Discomfort			–	.006	.395
4. Anger-Regulation				–	.007
5. Socially Constituted Anger					–

representations, and the extent to which anger can be socially perceived and constructed (Anderson & Bushman, 2002; Beames et al., 2019; Novaco, 2016). The subscales are consistent with the socially constituted view that anger occurs to protect sense of self and maintain self-esteem and is a mechanism to try to rectify wrong-doing, and to reassert expected norms when those norms have been violated (Averill, 1982, 1983; Frijda, 1987; Kubiak et al., 2011).

Therefore, five latent factors emerge from the EFA: (i) anger-arousal, (ii) anger-rumination, (iii) frustration-discomfort, (iv) anger-regulation, and (v) socially constituted anger. Table 4 shows the correlations between the five factors. Large effect size correlations between the first three factors account for between 37.1% and 50.1|% of shared variance. The correlations between the first three factors and the rest of the factors account for no more than 15.6% of the shared variance.

Confirmatory factor analysis (USA, n = 625)

CFA was used to examine whether the emerging factor structure from the EFA could be replicated and presented as a good fit to the data.

In choosing the CFA measures, we were guided by the criterion that three items "provide minimum coverage of the construct's theoretical domain" (Hair et al., 2010, p. 676). For the social factor only three scales loaded so these were adequate using the Hair et al. (2010) criterion. The anger-rumination and frustration-discomfort factors were best defined by the four subscales contained within the Anger Rumination Scale (Sukhodolsky et al., 2001) and the four subscales within the Frustration Discomfort Scale (Harrington, 2005), respectively. It was therefore decided to retain the four subscales from each of these scales to represent these factors. To provide an equal number (or as close as possible) of subscales for each latent factor considered, we also included the top four scales for the anger regulation and anger arousal factors. Therefore, we administered the following 19 measures to assess five factors of anger:

i. *Anger-Arousal* via self-reports of Outward Irritability (Snaith Irritability Scale), Anger Traits (Buss Perry Aggression Questionnaire), Venting (Anger-Related Reactions and Goals Inventory), and Anger-Out (Anger Expression Inventory (Short Form)) subscales.
ii. *Anger-Rumination* via Rumination Memories, Afterthoughts, Understanding of Causes, and Thoughts of Revenge (all Anger Rumination Scale) subscales.
iii. *Frustration-Discomfort* via Entitlement, Discomfort Intolerance, Achievement, and Emotional Intolerance (all Frustration Discomfort Scale) subscales.

Table 5. Fit statistics to assess model fit across the four proposed models.

	χ^2	*df*	*p* =<	CMIN/DF	CFI	NNFI	RMSEA	SRMR
Five-factor	552.008	142	.001	3.887	.935	.922	.068	.058
Unidimensional	3009.27	152	.001	19.798	.547	.491	.174	.134
Second Order	614.735	147	.001	4.182	.926	.914	.071	.070
Bi-factor	520.296	133	.001	3.912	.939	.921	.068	.065

Key: χ^2 = Chi-square, *df* = degrees of freedom, CMIN/DF = Relative chi-square, CFI = comparative fit index, NNFI = non-normed fit index, RMSEA = root mean square error of approximation, SRMR = Standardized Root Mean Squared Residual.

iv. *Anger-Regulation* via Avoiding Conflict, Seeking Distraction, Downplaying (all Anger-Related Reactions and Goals Inventory), and Avoidance (Behavioral Anger Response Questionnaire) subscales.
v. *Socially Constituted Anger* via the Enforcing Social Norms, Enforcing Personal Standards, and Protecting One's Reputation (all Anger-Related Reactions and Goals Inventory) subscales.

We assessed the acceptability of the five-factor model in two ways. The first way was to explore how well data fitted the model using standard goodness-of-fit indexes (Hu & Bentler, 1999; Kline, 2005): the relative chi-square (CMIN/DF), alongside the chi-square and degrees of freedom, comparative fit index (CFI), non-normed fit index (NNFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). It is determined whether data fit a proposed model via an "acceptable" fit as indicated by a CMIN/DF of less than 3, CFI and NNFI greater than .90, and an RMSEA and SRMR of less than .08 (Browne & Cudeck, 1993; Hu & Bentler, 1999; Tabachnick & Fidell, 2013).

The second way was to demonstrate the incremental value of the proposed model over other theoretically relevant models (Barrett, 2007). To this end, we compared the five-factor model to three additional models in terms of goodness-of-fit (see Table 5). The first was a unidimensional model representing an underlying latent factor structure of general trait anger among the variables. The second and third models tested higher-order explanations of the variables. Typically, two solutions are considered within higher-order factor models: second-order factor and bi-factor models. Second-order factor models use a hierarchical structure to present the relationship between the factors and variables. The variance of all variables (at the bottom of the hierarchy) is explained by group factors, and a general latent factor explains the group factor variance. The explained variance between the items is simultaneously considered between the general and group factors with a bi-factor model. First, a single common construct is suggested to explain the shared variance between all the variables. Second, to recognize the multidimensionality of the construct, group factors are suggested to also explain some of the shared variance between the variables. However, in this context, the consideration of the second-order and bi-factor analysis is potentially valuable, even though studies suggest fit statistics are biased in favor of bi-factor models (Bonifay et al., 2017; Morgan et al., 2015). The consideration of a general factor is important to the current analysis because

Table 6. Fit statistics for multi-group factor confirmatory factor analysis for the 5 factor model for the 19 anger subscales by gender, age, and ethnicity.

	χ^2 (*df*)	RMSEA	SRMR	CFI	NNFI	ΔRMSEA	ΔSRMR	ΔCFI
	Gender (Male, $n = 305$; Female, $n = 320$)							
Configural	685.41 (284)	0.048	0.059	.936	.923			
Metric	690.12 (298)	0.046	0.059	.938	.929	−0.002	0.000	0.002
Scalar	740.02 (312)	0.047	0.059	.932	.925	0.001	0.000	0.006
Residual	772.76 (331)	0.046	0.059	.930	.928	−0.001	0.000	0.002
	Age (18–54 years, $n = 419$; 55+ year, $n = 206$)							
Configural	702.48 (284)	0.049	0.055	.934	.920			
Metric	722.85 (298)	0.048	0.056	.933	.923	−0.001	0.001	0.001
Scalar	733.24 (312)	0.047	0.056	.933	.927	−0.001	0.000	0.000
Residual	752.36 (331)	0.045	0.056	.933	.931	−0.002	0.000	0.000
	Ethnicity (White, $n = 428$; Black, Asian or minority ethnicity, $n = 197$)							
Configural	703.87 (284)	0.049	0.062	.934	.920			
Metric	714.95 (298)	0.047	0.062	.934	.925	−0.002	0.000	0.000
Scalar	738.59 (312)	0.047	0.062	.933	.926	0.000	0.000	0.001
Residual	757.09 (331)	0.045	0.063	.933	.931	−0.002	0.001	0.000

Key: CFI = comparative fit index, RMSEA = root mean square error of approximation, SRMR = Standardized Root Mean Squared Residual.

Metric (configural to metric) invariance is found if the change in CFI is no more than a decrease > .01, and the change in RMSEA is no more than an increase of .015, and a change in SRMR is no more than an increase of 0.30. Scalar (metric to scalar) invariance is found if the change in CFI is no more than a decrease of 0.01, and the change in RMSEA is no more than an increase of .015, and a change in SRMR is no more than an increase of 0.01. Residual (scalar to residual) invariance is found if the change in CFI is no more than a decrease of 0.01, and the change in RMSEA is no more than a decrease of .015, and a change in SRMR is no more than a decrease of 0.01.

evidence of a general factor will demonstrate the value of summarizing the self-report measures of anger literature if the factors together reflect a general capacity for anger. The consideration of the group factors alongside the general factor is also useful, particularly as a bi-factor model, because it considers the plausibility of group factors in representing separate subscales of anger. Therefore, the current consideration aims to provide a full consideration of alternate models.

The 5-factor model and higher order (hierarchical, bi-factor) models demonstrated acceptable fit. However, neither of the higher order models showed improved fit (by way of ΔCFI>.01) over the 5-factor model. The variance accounted for by the general and group factors in the bi-factor model tended toward the group factors, with the general factor accounting for 44.6% of the variance and the group factors accounting for 55.4% of the variance: anger-arousal = 8.3%, anger-rumination = 8.7%, frustration-discomfort = 12.3%, anger-regulation = 14.4%, and socially constituted anger = 11.8%. Therefore, given that the group factors are favored in the bi-factor model, and the-factor model does not show incremental fit over the 5-factor model, the current findings suggest the use of a 5-factor model.

Multi-group confirmatory factor analysis (USA, n = 625)

We carried out multi-group CFA to assess the measurement invariance of the five factor model by sex, age, and ethnicity. As research suggests not using small subsample sizes for testing for measurement invariance (Chen et al., 2008; Meade, 2005; Yoon & Lai, 2018), we adjusted for this by devising two groups based on recognized broad assessments of gender (male, $n = 305$; female, $n = 320$), age (18–54 years, $n = 419$; 55+ year, $n = 206$), and ethnicity (White, $n = 428$; Black, Asian or Mixed or Other ethnicity, $n = 197$). For age, the two main groups, below and above 54 years, came from a distinction used in several government documents (Australian Institute of Health & Welfare, 2015; Bardsley et al., 2016; Sweiry & Willitts, 2012). Specifically, this distinction sees those aged between 18 and 54 years as falling into the range of "youth" and "young adults," and as either of "early" or "prime working age," and those 55 years and above as being "middle-aged adults" or "elderly," falling within "mature working age" or "retirement" (Australian Institute of Health & Welfare, 2015; Bardsley et al., 2016; Sweiry & Willitts, 2012).

Successively stricter constraints were tested across groups to evaluate configural, metric, scalar, and residual invariance using established criteria (Chen, 2007). Measurement invariance between constraints was assessed by looking at the following change criteria: Metric (configural to metric) invariance is found if ΔCFI is no more than a decrease of .010, ΔRMSEA is no more than an increase of .015, and ΔSRMR is no more than an increase of .030. Scalar (metric to scalar) invariance is found if ΔCFI is no more than a decrease of .01, ΔRMSEA is no more than an increase of .015, and ΔSRMR is no more than an increase of .010. Residual (scalar to residual) invariance is found if ΔCFI is no more than a decrease of .010, ΔRMSEA is no more than a decrease of .015, and ΔRMR is no more than a decrease of .010. Table 6 presents the fit statistics from the multi-group factor CFA for the 5-factor model by gender, age, and ethnicity. These findings suggest measurement invariance was supported for gender, ethnicity, and age up to the residual level.

Discussion

The findings in this study suggest a replicable five-factor structure emerges from the consideration of 46 subscales of publicly available self-report measures of anger. The five-factor structure focuses on the domains of; anger-arousal, anger-rumination, frustration-discomfort, anger-regulation, and socially constituted anger. This five-factor model reflects a series of distinct theoretical contexts to consider these five domains of anger.

First, the *anger-arousal* domain reflects the well-recognized presence of expressions of anger in everyday life

(Beames et al., 2019; Gilam et al., 2016; Novaco, 2016). This domain recognizes the general dispositional characteristic of frequent and intense anger experiences, and provides opportunities to consider anger as representing an individual's overall tendency to respond to situations in stable and predictable ways (Buss, 1961; Carroll, 2013).

Second, the *anger-rumination* domain recognizes the intra-personal cognitive-emotional processes surrounding anger and cognitive appraisals and action tendencies around attributions of wrong-doing (Fernandez, 2008, 2013; Sukhodolsky et al., 2001). This domain provides opportunities to consider anger within the broader theoretical context of rumination and how metacognitive beliefs around emotional stress, such as anger, lead to behavioral and emotional dysregulation, such as depression (Kovács et al., 2020; Nolen-Hoeksema et al., 2008; Watkins, 2008).

Third, the *frustration-discomfort* domain contains specifically designed measures reflecting Rational-Emotive Behavior Theory (Ellis, 1991), specifically absolutistic and demand-related beliefs relating to entitlement, achievement, and alleviating discomfort (Harrington, 2005). The opportunity here is to consider a domain that focuses on how our cognitive beliefs form expressions of anger.

Fourth, the *anger-regulation* domain identifies cognitive strategies or processes that adjust the expression and experience of anger (Beames et al., 2019; Gilam et al., 2016; Novaco, 1975). This domain allows an opportunity to focus on coping strategies (i.e. avoidance, seeking distraction, and downplaying) as typical ways of managing stressful situations around anger (Deffenbacher, 2006; Kubiak et al., 2011; Miers et al., 2007; Rusting & Nolen-Hoeksema, 1998). This factor, however, does not contain measures commonly used to measure anger self-control, such as the Self-Expression and Control (SCS) Scale's Control Anger-Out subscale (e.g., "I lose my self-control [item 49]) and Control Anger-In subscale (e.g., "I try to relax" [item 5]) scales (which load on the arousal factor). The current finding might reflect a distinction (albeit accepting a limitation note made in the discussion) that can be made between abilities to *control* and *regulate* anger. That is, within the current measures, the anger control measures reflect the extent that one can or does control their own anger, aligning it more closely to low versus high arousal conception. However, in terms of the anger-regulation factor here, the scales represent a much more complex cognitive process and negotiation of anger through complex cognitive coping strategies (e.g., low avoidance, seeking distraction, and downplaying). This latter view, is more analogous to the description of anger-regulation as anger representing cognitive appraisals and action tendencies.

Fifth, the *socially constituted anger* domain reflects a socially constructed approach to anger in which anger functions within social dominance and conflict dynamics, and the recognition of anger in others reveal the possible motivations of others and potential disagreements between the values of individuals (Averill, 1982, 1983). In this study, this dimension of anger is understood within the protection and enhancement of the self, the consideration of social norms, and the extent to which anger is examined within jointly constructed understandings of the world (Anderson & Bushman, 2002; Beames et al., 2019; Novaco, 2016). This domain can facilitate research that focuses on anger within the concept of the self, self-identity, social structures, and norms that inform socially constituted anger. We see these factors replicated across representative UK and US samples and showing measurement invariance across broad gender, age, and ethnicity characterizations.

Anger assessment practice

Our findings also suggest how we might best consider anger. From the current examination of the data, we arrive at a five-factor and bi-factor model of anger showing a better fit to the data. However, our findings find that the weight of the variance within the bi-factor models is on the group factors and as the CFA findings suggest the five-factor model shows a similar level of acceptable fit, we suggest it would be most helpful to concentrate on this model as a five-factor model of anger. We also note (from the Exploratory Factor Analysis) that the first three factors are highly correlated, sharing between 37.1% and 50.1% of variance. At the same time, the other associations between all the factors account for no more than 15.6% of the shared variance. This suggests, if we consider the proposed five factors as representing an overall anger self-report domain, that three factors (anger arousal, anger rumination, and discomfort intolerance) may be ancillary factors, while the anger-regulation and socially constituted anger factors could be mainly considered separate from these factors and one another.

Study limitations

We identified three limitations to the current study. First, we only employed self-report measures, available in the public domain, reflecting a particular definition of anger. This consideration, therefore, did not include non-self-report measures (e.g., behavioral, facial expressions, or neurological measures around anger) or measures that bear a cost to the researcher (Novaco, 2003; Spielberger, 2020). Furthermore, it did not consider fully measures that might reflect (a) corollary considerations such as direct aggression or harm to others, antisocial behavior (Hawes et al., 2016) (b) finer-grained considerations of concepts such as irritability or anger-regulation (Toohey & DiGiuseppe, 2017), or (c) the aspects of anger in the context of social changes (Wohl et al., 2006).

Therefore, the results should be considered within these parameters, possibly reflecting biases within the selection criteria. For example, most measures reflect negative aspects of anger. Therefore, our current consideration may be biased toward only presenting anger as representing a negative perspective (albeit this may reflect the broader bias within the anger measurement literature over the last 50 years). Therefore, further consideration of how the five-factor structure maps or builds onto these other ways of thinking about anger would be helpful.

The second limitation of the study was the order in which the scales were presented. Given that the items were largely dealing with the same theme across nearly 300 items there are implications for the findings in terms of participants' capacity to maintain focus and differentiate items/scales. For example, it may be that scales completed contiguously have higher correlations; therefore, it is a risk whether some of the factors or distinctions may not be as fine-grained. In addition, had the scale presentation been randomized or completion of a series of anger scales been interrupted by scales dealing with other content (e.g., personality), the resulting factor structure might have changed. Therefore, it could be argued that some results are a methodological artifact and why some scales loaded on one factor, not another. For example, it may explain why the anger duration subscale from the DAR-5 does not load on the rumination factor, albeit it does load alongside measures that reflect general perseverance around experiencing anger (e.g., anger traits). Also, notwithstanding our explanation presented above (a distinction between control and regulation around anger) it may explain why the SCS Anger Control scales may unexpectedly load on Anger-Arousal factor and not onto the Anger-regulation factor. We include this latter interpretation because our explanation of a distinction between control and regulation anger is a post-hoc explanation. Therefore, it is of interest to employ more experimental approaches (e.g., items presented randomly and separately) to test to the robustness of the proposed factor structure reported in this current study.

The third limitation is the constraints on generalizability (Simons et al., 2017) and the reliance on representative UK and US samples in this study. To establish the integrity of the findings, representative samples are necessary. However, the samples are still predominantly Western and White. Therefore, further research is needed among samples that consider broader cultural demographics to assess the replicability of findings across several situations.

Future research directions

Together, there are two outcomes suggested from our findings. The first is how researchers might conceptualize anger, as presented through this summary of self-report assessment of anger. So that, instead of having to contend with multiple considerations of anger (e.g., nearly 50 measures of anger), one might have some reassurance that there is a broad consideration as presented by these five aspects of anger in the first instance. That is, though there are examples of anger that fall outside the current consideration, these broad conceptions provide a useful starting point for thinking about the main aspects with which to consider anger. Second, the findings also suggest how we might measure anger optimally. Faced with a wealth of anger measures, there are some indicators in the current study that one could consider as the five domains of anger. However, we are restricted in listing items that might best reflect these five domains. This is because, although we used measures that are in the public domain, some of the scales are copyrighted by the journals in which they were published, so they cannot be reproduced in this article, or authors of the scale assert that items cannot be used in any new version(s) (e.g., Kubiak et al., 2011). Consequently, we suggest using subscales listed in the Confirmatory Factor Analysis to measure the five domains and then using factor scores that can be derived from a new factor analysis of those scales to provide assessments of each of the five factors of anger.

Conclusion

The summary of scores on many self-report measures of anger developed across five decades of research suggest value in approaching the measurement of anger in a much simpler form, suggesting five latent traits of arousal, rumination, discomfort-intolerance, regulation, and socially constituted. The result is a 5-factor model of anger that draws from a series of theoretical perspectives, including trait theory, cognitive regulation, rational-emotive behavior therapy, intrapersonal cognitive-emotional processes, and social constructionism. Current limitations around the selection of scales (publicly available, self-report) suggest caution to the extent to which these 5 factors can be seen as definitive, as other accounts of anger were not considered. However, the findings suggest a useful and parsimonious account of a popular way of measuring anger, summarizing over 50 years of research around the psychological measurement of anger.

Ethics approval

Approval was given by the Psychology Research Ethics Committee, University of Leicester, Approval Number: 26193-jm148-ls.

Open Scholarship

This article has earned the Center for Open Science badge for Open Data through Open Practices Disclosure. The data are openly accessible at https://doi.org/10.25392/leicester.data.19426706. To obtain the author's disclosure form, please contact the Editor.

Data availability statement

The data and analysis scripts used for this article can be accessed at https://doi.org/10.25392/leicester.data.19426706.

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