European Journal of Psychological Assessment

Measurement Invariance of Three Brief Measures of Rumination in Young Adults With and Without a History of Self-Injury

Kate E. Tonta, Penelope Hasking, Mark Boyes, Joel Howell, Peter McEvoy, and Glenn Kiekens

Online First Publication, September 7, 2020. http://dx.doi.org/10.1027/1015-5759/a000605

Original Article

Measurement Invariance of Three Brief Measures of Rumination in Young Adults With and Without a History of Self-Injury

Kate E. Tonta[1], Penelope Hasking[1], Mark Boyes[1], Joel Howell[1], Peter McEvoy[1,2], and Glenn Kiekens[1,3]

[1]School of Psychology, Curtin University, Bentley, Australia
[2]Centre for Clinical Interventions, Perth, WA, Australia
[3]Department of Neurosciences, Center for Public Health Psychiatry, KU Leuven, Belgium

Abstract: Rumination is central to understanding the onset and maintenance of non-suicidal self-injury. Yet, no study has evaluated whether reported differences in rumination between people with and without a history of self-injury represent genuine group differences. The present study reports an investigation into the measurement invariance of three common measures of rumination in university students with and without a history of self-injury (total N = 1,519). Results revealed configural invariance for the Ruminative Responses Scale (RRS), the Ruminative Thought Style Questionnaire (RTSQ), and the Repetitive Thinking Questionnaire (RTQ). Additionally, the RTSQ and RTQ supported metric invariance, while the RRS supported partial metric invariance. Further, the RTQ demonstrated partial scalar invariance while the RTSQ demonstrated full scalar invariance. The current findings suggest that observed differences using the RTSQ and RTQ reflect genuine differences in rumination between people with and without a history of self-injury, while researchers using the RRS are advised to account for differential item functioning.

Keywords: rumination, non-suicidal self-injury, measurement invariance

Non-suicidal self-injury (NSSI) involves deliberate and self-inflicted damage to one's own body tissue in the absence of intent to die (International Society for the Study of Self-Injury, 2018). Common NSSI behaviors include cutting, burning, scratching, and interfering with wound healing. NSSI is reported by approximately 17% of adolescents, 13% of young adults, and 5% of adults (Swannell, Martin, Page, Hasking, & St John, 2014). Approximately 20% of university students have engaged in NSSI during their lifetime, which highlights that the university context may be of particular significance (Swannell et al., 2014). Furthermore, while peak age of onset is 14 years, there is a second peak of onset of NSSI at approximately 20 years (Gandhi et al., 2018; Kiekens, Hasking, Claes, et al., 2019). The most commonly reported function of self-injury is emotion regulation (Taylor et al., 2018), and accordingly, most theoretical models of NSSI have predominantly focused on the function of self-injury as an emotion regulation behavior (Arbuthnott, Lewis, & Bailey, 2015; Hasking, Whitlock, Voon, & Rose, 2017; Nock, 2009; Selby, Franklin, Carson-Wong, & Rizvi, 2013). When considering cognitive factors that may underlie NSSI, rumination appears particularly salient. According to the Emotional Cascade Model of NSSI (Selby et al., 2013), thinking repetitively about one's negative emotional state creates cascades of emotion by repeatedly reallocating attention to negative thoughts. NSSI serves to disrupt these cascades by diverting attention away from intense negative emotions and toward NSSI-related stimuli, such as the physical sensation of pain, the sight of blood, and attending to wounds. As a result, rumination has been proposed as a key mechanism in the onset and maintenance of NSSI.

This experience of emotional cascades also implies that people with a history of self-injury will endorse elevated trait rumination (Selby et al., 2013). Rumination has been positively related to NSSI in a range of studies (e.g., Dawkins, Hasking, Boyes, Greene, & Passchier, 2019;

Nicolai, Wielgus, & Mezulis, 2016), and there is self-report and experimental evidence that elevated rumination is associated with NSSI (Selby, Connell, & Joiner, 2010; Slabbert, Hasking, & Boyes, 2018). However, rumination can be measured with a variety of measures. It is important to note that measures of rumination and repetitive negative thinking are often used interchangeably in the context of NSSI research. Although there are conceptual differences in these constructs, visual observation of items in these measures and empirical evidence indicate that these constructs have considerable overlap (Ehring & Watkins, 2008). As such, for the purpose of this research, we will explore measures of rumination and repetitive negative thinking. Three commonly used self-report measures of rumination are the Ruminative Responses Scale (RRS; Treynor, Gonzalez, & Nolen-Hoeksema, 2003), the Ruminative Thought Style Questionnaire (RTSQ; Brinker & Dozois, 2009), and the Repetitive Thinking Questionnaire (RTQ; McEvoy, Mahoney, & Moulds, 2010).

The RRS (Treynor et al., 2003) is a 10-item measure loading onto two factors (reflecting and brooding). The RRS is one of the earlier measures of rumination, and measures rumination as a depressive process of focusing internally on one's thoughts and negative emotions. The focus on depressive symptoms limits the RRS's capacity to measure repetitive thinking for other principal and comorbid disorders, leading to the development of the RTSQ (Brinker & Dozois, 2009), a 20-item measure of rumination that assesses repetitive thinking in a range of contexts, including past and future events, in a valence-neutral way. Finally, the RTQ (McEvoy, Thibodeau, & Asmundson, 2014) is a 10-item unidimensional measure that assesses trait repetitive thinking about one's negative experiences. The RTQ was designed as a transdiagnostic tool for evaluating repetitive negative thinking across a range of psychopathologies.

It is clear that these three measures are similar but not equivalent in content, and so their use should be guided by contextual factors. For example, given it is explicitly transdiagnostic in nature, the RTQ may be more generalizable to a broader array of clinical concerns (including NSSI) than the RRS, with an exclusive focus on depression. Additionally, the RTSQ measures repetitive thinking in a valence-neutral way, rather than focusing on negative emotional experiences. Researchers and clinicians working in the context of NSSI, therefore, need to make decisions about which tool is most appropriate for their purposes.

One consideration guiding this choice is the extent to which the measures perform psychometrically when administered to people with a history of NSSI and those without. Ensuring measurement invariance is necessary for drawing conclusions about genuine group differences based on differences in scores, rather than simply reflecting a difference in the way people have interpreted and responded to the items (Putnick & Bornstein, 2016). Notably, the biased attention toward negative affect which characterizes NSSI may cloud an individual's ability to retrospectively recognize cognitive processes during periods of heightened distress, and may contribute to an inability to accurately reflect on their own ruminative processes. This could lead to apparent group differences in rumination based on self-report measures, which are a function of different interpretations of the items (i.e., a psychometric artifact), rather than reflecting true group differences in ruminative processes. To date, no published research has explored the measurement invariance of these rumination measures across groups of people with and without a history of self-injury. Establishing measurement invariance across groups would increase confidence in theoretical, empirical, and clinical work that highlights the role of rumination in initiating and maintaining NSSI.

Recent work on measurement invariance of emotion regulation measures in the context of NSSI has highlighted the importance of these evaluations (Kiekens, Hasking, & Boyes, 2019). Specifically, Kiekens, Hasking, and Boyes (2019) recently observed a potential lack of invariance in the commonly used Emotion Regulation Questionnaire (Gross & John, 2003), concluding that the reported association between expressive suppression and NSSI may merely be a measurement artifact, and not a genuine relationship, which has important implications for our understanding of factors underlying NSSI, as well as intervention. Given the central role of rumination in NSSI, it is surprising that no one has investigated measurement invariance in measures of rumination between individuals with and without a history of NSSI.

The aim of this study was to test the measurement invariance of three commonly used measures of rumination across samples of people with and without a self-reported history of self-injury. The RRS, RTSQ, and RRS were subjected to a stepwise bottom-up evaluation of measurement invariance, testing configural (i.e., equal factor structure), metric (i.e., equal factor loadings), scalar (i.e., equal item intercepts), and residual error (i.e., equal residual errors) invariance. Each subsequent level of invariance required the previous levels to be at least partially supported.

Method

Participants and Procedure

Data for this study were combined from previous studies evaluating rumination in the context of emotion regulation and mental health. All studies were approved by the Curtin University Human Research Ethics Committee. In total, 1,519 undergraduate psychology students participated.

Table 1. Demographic information across the samples

	RRS (*N* = 383)		RTSQ (*N* = 735)		RTQ (*N* = 1,222)	
	n/*M*	%/*SD*	*n*/*M*	%/*SD*	*n*/*M*	%/*SD*
Female gender	288	75.20	544	73.90	916	75.00
Age	23.17	6.76	21.69	6.12	22.15	6.17
Full-time student	310	80.94	648	88.40	1,085	88.80
Lifetime history of NSSI	126	32.90	237	32.22	421	34.50
Sample means						
RRS[a]						
Brooding	2.28	0.80				
Reflecting	2.21	0.75				
RTSQ[b]						
Problem-focused thinking			3.99	1.43		
Counter-factual thinking			5.20	1.39		
Repetitive thoughts			5.25	1.36		
Anticipatory thoughts			4.93	1.29		
RTQ[c]					3.29	0.89

Note. RRS = Ruminative Response Styles; RTSQ = Ruminative Thought Styles Questionnaire; RTQ = Repetitive Thinking Questionnaire. [a]1–4 range, [b]1–7 range, [c]1–5 range.

Participants were aged between 17 and 85 years of age (M = 22.16, SD = 6.10); 23.9% were male, 75.5% female and 0.4% identified as another gender. All were given course credit in exchange for participation. Where students had participated in more than one study, duplicate responses across datasets were deleted (the first response was retained). A total of 1,222 individuals completed the RTQ, 733 completed the RTSQ, and 385 completed the RRS. See Table 1 for sample characteristics across the three measures.

Measures

Inventory of Statements About Self-Injury

The Inventory of Statements About Self-Injury (ISAS; Klonsky & Glenn, 2009) measures history of self injury (defined to participants as intentionally harming oneself without intention to suicide). Participants who indicated they have a history of NSSI (i.e., "Have you ever engaged in non-suicidal self-injury?") were presented with 12 common methods of NSSI (e.g., cutting, burning) and provided a lifetime frequency of each behavior. NSSI was operationalized as a binary variable (history of NSSI vs. no history of NSSI), and the subsequent 12 items are used for descriptive purposes. The ISAS has been widely used in research and has established test-retest reliability (4-week, r = .85; 1-year, r = .68; Glenn & Klonsky, 2011).

Ruminative Responses Scale

The Ruminative Responses Scale (RRS; Treynor et al., 2003) originally contained 22 items, but has been refined to contain 10 items loading onto two factors; reflecting (e.g., Analyze recent events to try to understand why you are depressed) and brooding (e.g., Think "What am I doing to deserve this?"). These items assess the frequency with which participants engage in particular response styles to low moods, and responses are rated from 1 (= *almost never*) to 4 (= *almost always*). The reflecting and brooding subscales demonstrated satisfactory internal consistency in previous research (α = .72 and .79, respectively; Treynor et al., 2003) and excellent internal consistency in the present sample (α = .81 and .85, respectively).

Ruminative Thought Style Questionnaire

Although exploratory factor analyses originally yielded a single factor (Brinker & Dozois, 2009), a subsequent study developed a revised 15-item version comprising four factors (Tanner, Voon, Hasking, & Martin, 2012): problem-focused thoughts (e.g., "Even if I think about a problem for hours, I still have a hard time coming to a clear understanding"); counterfactual thinking (e.g., "I tend to replay past events as I would have liked them to happen"); repetitive thoughts (e.g., "I can't stop thinking about some things"); and anticipatory thoughts (e.g., "If I have an important event coming up, I can't stop thinking about it"). Having demonstrated reliability in subsequent studies (e.g., Voon, Hasking, & Martin, 2014), the four-factor solution was utilized in the present research. Participants rate each statement from 1 (= *not at all descriptive of me*) to 7 (= *describes me very well*) (Tanner et al., 2012). Similar to previous research, the reliability of three subscales (problem-focused thoughts, counterfactual thinking, and repetitive thoughts) in the present study were excellent (α = .90–.93) while the fourth

Table 2. Model fit of baseline models

	χ^2	*df*	RMSEA [90% CI]	CFI	TLI	SRMR	NCI
RRS (*N* = 383)	130.08	34	0.086 [0.071, 0.102]	.931	.909	.045	.882
RTSQ (*N* = 735)	304.32	84	0.060 [0.053, 0.067]	.963	.953	.047	.861
RTQ (*N* = 1,222)	529.81	35	0.108 [0.100, 0.116]	.912	.887	.042	.817
RTQ – Modified (*N* = 1,222)	336.85	33	0.087 [0.079, 0.095]	.946	.926	.034	.883

Note. RTQ = Repetitive Thinking Questionnaire; RTSQ = Ruminative Thought Styles Questionnaire; RRS = Ruminative Response Styles.

subscale (anticipatory thoughts) demonstrated moderate reliability (α = .67).

Repetitive Thinking Questionnaire

The RTQ requires individuals to consider the last time they felt particularly distressed and rate how true each item was of their experience after the distressing situation. An example item is "I have thoughts or images about all my shortcomings, failings, faults, mistakes." The response rating scale was a 5-point scale from 1 (= *not true at all*) to 5 (= *very true*). This measure has demonstrated excellent internal consistency in community samples (α = .89) and has demonstrated construct validity with measures of negative affect and psychological distress (McEvoy et al., 2010, 2014). In the current sample, the internal consistency was α = .93.

Data Analysis

A multiple group confirmatory factor analysis (MGCFA) was conducted in MPlus 8 (Muthén & Muthén, 2017) to evaluate measurement invariance using maximum likelihood estimation with robust standard errors (MLR). Given that the distributions for many of the items were skewed, MLR was chosen because it is robust to non-normality and handles missing data using full information maximum likelihood (Li, 2016). Model fit was evaluated against the following: Standardized Root Mean Square Residual (SRMR) values close to 0.08 or below, Root Mean Square Error of Approximation (RMSEA) close to 0.08 or below, and a Comparative Fit Index (CFI) in the 0.90–0.95 range or higher (Brown, 2015). Given that the χ^2 statistic is sensitive to sample size, alternative fit indices must also be considered in order to determine a violation of measurement invariance (Meade, Johnson, & Braddy, 2008). Configural (equal pattern of factor loadings), full metric (equal factor loadings which implies equal pattern of factor loadings), full scalar (equal factor loadings *and* equal intercepts), and residual error (equal factor loadings, equal intercepts, *and* equal residual error variance) invariance will be supported if the configural model shows acceptable model fit and each of the subsequent models shows at least two of the following: a nonsignificant change in χ^2 from the previous model, differences in CFI less than or equal to 0.002 from the previous model, and differences in McDonald's Non-Centrality Index (NCI) from the previous model below established cut-offs on the basis of the number of items and factors (Meade et al., 2008). If a violation of full measurement invariance is detected, modification indices are consulted to examine if partial invariance can be established.

Results

Ruminative Responses Scale

The RRS was completed by 383 participants, of whom 126 (32.9%) disclosed a history of self-injury. Of those participants, the most commonly reported behavior was cutting (69.8%) followed by banging or hitting oneself (55.6%). A two-factor confirmatory model (brooding and reflection) was tested and demonstrated acceptable model fit according to the CFI and SRMR values, although the RMSEA value was above the cut-off for acceptable fit (see Table 2).

The RRS data demonstrated configural (M1) invariance (see Table 3), but full metric (M2) variance was not supported as indicated by ΔNCI and ΔCFI above the specified cut-offs and a significant change in χ^2. When factor loadings of item 15 ("Think 'Why do I have problems other people don't have?'") were freed to vary, model fit improved significantly and partial metric (M2.1) invariance was supported according to the ΔNCI and $\Delta\chi^2$ statistics. Taking into account partial metric invariance (M2.1), full scalar (M3) invariance was demonstrated according to all considered fit statistics. Full residual error (M4) invariance was not supported, as further analyses revealed higher residual error variance in item 5 ("Think 'What am I doing to deserve this?'") for the group with a history of self-injury compared to the group with no history of self-injury. Allowing these residual errors to vary in addition to the factor loadings of item 15, partial residual error (M4.1) invariance was supported (Mplus output of invariance testing can be found in the Electronic Supplementary Material, ESM 1).

There were significant latent mean differences, with individuals with a history of NSSI scoring higher than those with no history on the reflecting subscale (reflecting: unstandardized $M_{NSSI} = 0.21$, $Z = 3.81$, $p < .001$). Regardless

Table 3. Evaluation of measurement invariance in measures of rumination between groups of individuals with and without a history of self-injury

	χ^2	*df*	TLI	NCI	CFI	Model comparison	ΔNCI[a]	ΔCFI[b]	*p* MLR $\Delta\chi^2$
RRS									
M1: Configural invariance	159.90	68	.909	.8867	.931	–	–	–	–
M2: Full metric invariance	175.76	76	.912	.8776	.925	M1–M2	.0091$^-$	.006$^-$	.053$^+$
M2.1: Partial metric invariance (freeing loading of item 15)	171.63	75	.913	.8812	.928	M1–M2.1	.0055$^+$	−.003$^-$	.133$^+$
M3: Full scalar invariance[1]	178.32	83	.923	.8827	.929	M2.1–M3	−.0015$^+$	−.001$^+$	.647$^+$
M4: Full residual error invariance[1]	195.38	93	.926	.8746	.924	M3–M4	.0081$^-$	.005$^-$	.710$^+$
M4.1: Partial residual error invariance[1] (freeing error variance for item 5)	189.33	92	.929	.8804	.927	M3–M4.1	.0023$^+$	.002$^+$	.945$^+$
RTSQ									
M1: Configural invariance	404.18	168	.952	.8514	.961	–	–	–	–
M2: Full metric invariance	412.48	179	.955	.8530	.962	M1–M2	−.0016$^+$	−.001$^+$	.686$^+$
M3: Full scalar invariance	424.58	190	.958	.8523	.962	M2–M3	.0007$^+$	< .001$^+$	.356$^+$
M4: Full residual error invariance	487.11	205	.953	.8251	.954	M3–M4	.0272$^-$	.008$^-$	< .001$^-$
M4.1: Partial residual error invariance (freeing error variance for items 1 and 4)	447.00	203	.959	.8469	.960	M3–M4.1	.0054$^+$	.002$^+$	.021$^-$
RTQ									
M1: Configural invariance	563.15	70	.879	.8171	.906	–	–	–	–
RTQ – Modified									
M1: Configural invariance	371.86	66	.920	.8823	.941	–	–	–	–
M2: Full metric invariance	392.84	75	.927	.8780	.939	M1–M2	.0043$^+$	.002$^+$	.013$^-$
M3: Full scalar invariance	434.31	84	.928	.8664	.933	M2–M3	.0116$^-$	.006$^-$	< .001$^-$
M3.1: Partial scalar invariance (freeing intercepts for items 1, 3, & 6)	406.59	81	.931	.8752	.938	M2–M3.1	.0028$^+$	.001$^+$	.033$^-$
M4: Full residual error invariance[2]	428.35	91	.936	.8710	.935	M3.1–M4	.0042$^+$	.003$^-$	.016$^-$
M4.1: Partial residual error invariance[2] (freeing error variance for item 10)	420.23	90	.937	.8735	.937	M3.1–M4.1	.0017$^+$	.001$^+$	.136$^+$

Notes. [a]cut-off value for ΔNCI > .0074 (RTQ) and ΔNCI > .0080 (RTSQ and RRS); [b]cut-off value for ΔCFI > .002; $^+$invariance was supported according to the relevant fit statistic; $^-$invariance was not supported according to the relevant fit statistic. [1]Accomodating partial metric invariance as in M2.1; [2]Accomodating partial scalar invariance as in M3.1.

of whether the differential item functioning of item 5 and 15 on the brooding subscale was considered (unstandardized $M_{NSSI} = 0.35$, $Z = 4.59$, $p < .001$) or ignored (unstandardized $M_{NSSI} = 0.36$, $Z = 4.52$, $p < .001$), individuals with a history of NSSI scored higher than those with no history.

Ruminative Thought Style Questionnaire

The RTSQ was completed by 735 participants, of whom 237 (32.2%) disclosed a history of self-injury. Among these participants, the most commonly reported behavior was cutting (78.4%) followed by banging or hitting oneself (33.9%). The baseline model fit was excellent according to the CFI, SRMR, and RMSEA values (see Table 2).

Configural (M1), full metric (M2), and full scalar (M3) invariance were supported according to all considered fit statistics (Table 3). Full residual error (M4) invariance was not supported, as further analyses revealed higher residual error variance in items 1 ("I find that my mind goes over things again and again") and 4 ("I can't stop thinking about some things") for the group with no history of self-injury compared to the group with a history of self-injury. Allowing these residual errors to vary, partial residual error (M4.1) invariance was supported (Mplus output of invariance testing can be found in ESM 2).

There were significant latent mean differences for RTSQ, indicating that individuals with a history of NSSI scored higher than those with no history of self-injury on problem-focused thoughts (unstandardized $M_{NSSI} = 0.52$, $Z = 5.18$, $p < .001$), counterfactual thinking (unstandardized $M_{NSSI} = 0.56$, $Z = 5.59$, $p < .001$), and repetitive thoughts (unstandardized $M_{NSSI} = 0.57$, $Z = 6.06$, $p < .001$). There were no mean differences on the latent factor for anticipatory thoughts (unstandardized $M_{NSSI} = 0.15$, $Z = 1.71$, $p = .087$).

Repetitive Thinking Questionnaire

In the RTQ dataset, there were 1,222 participants, of whom 421 (34.5%) disclosed a history of self-injury. Of those who had self-injured, the most commonly reported behavior was cutting (64.4%) followed by banging or hitting oneself

(49.2%). The baseline model had an acceptable fit to the data according to the CFI and SRMR values; however, the model demonstrated an unsatisfactory RMSEA (Table 2). The two largest modification indices in the baseline model indicated that freeing the covariances between items 1 ("I have thoughts or images about all my shortcomings, failings, faults, mistakes") and 2 ("I have thoughts or images about events that come into my head even when I do not wish to think about them again"; modification index 101.16), and between items 8 ("I think about the situation all the time") and 9 ("I know I shouldn't think about the situation, but can't help it"; modification index 113.80) would improve model fit. After freeing these covariances, the revised model significantly improved model fit, $\Delta\chi^2(2) = 192.96$, $p < .001$ (Table 2). We then proceeded to evaluate configural, metric, and scalar invariance for this final model.[1,2]

Configural (M1) and full metric (M2) invariance were supported, but full scalar (M3) invariance was not (Table 3). Modification indices suggested differential item-functioning for items 1 ("I have thoughts or images about all my shortcomings, failings, faults, mistakes"), 3 ("I have thoughts or images that 'I won't be able to do my job/work because I feel so badly'"), and 6 ("I notice that I think about the situation"). After allowing these intercepts to vary freely, partial scalar (M3.1) invariance was supported. In a final step, residual error (M4) variances were fixed to be equal across groups. Further analyses also revealed higher residual error variance in item 10 ("I have thoughts or images about the situation and wish it could go better") for the group with no history of self-injury compared to the group with a history of self-injury. Allowing the residual error variance of item 10 to vary freely across groups, partial residual error (M4.1) invariance was supported.

There were significant latent mean differences for RTQ, indicating that individuals with a history of NSSI scored higher in repetitive negative thinking than those with no history of self-injury, regardless of whether differential item functioning was considered (unstandardized $M_{NSSI} = 0.45$, $Z = 9.52$, $p < .001$) or ignored (unstandardized $M_{NSSI} = 0.47$, $Z = 9.60$, $p < .001$).

Discussion

Rumination has been a core concept in understanding the onset and maintenance of NSSI (Selby et al., 2013). Previous research has explored group differences in rumination across samples of individuals with and without a history of self-injury, but none to date have tested the measurement variance of the self-report tools used to evaluate rumination. The results of the current study suggest that of the assessed measures the RTSQ may be the most reliable as assessing differences in rumination levels between individuals with and without a history of self-injury. However, although the RRS and RTQ did not meet full metric and full scalar invariance respectively, ignoring differential functioning did not significantly influence latent mean differences.

Upon closer inspection, there is some degree of difference between models in psychometric performance. The only measure to demonstrate full scalar invariance was the RTSQ. However, an evaluation of latent mean differences suggests that on the fourth subscale, anticipatory differences, there were no significant differences between individuals with and without a history of self-injury. This subscale contains only two items and demonstrated low internal consistency, and as such it should be used with caution. The RTQ demonstrated full metric invariance but only partial scalar invariance. Freeing the item intercepts for three items resulted in partial scalar invariance, and evaluation of latent mean differences indicated that the difference between groups is significant regardless of whether this differential item functioning was considered or not. Finally, the RRS did not demonstrate full metric invariance, suggesting that item loadings were not equivalent between groups. Although this would suggest that group comparisons may not be reliable, latent mean analysis indicated that there was a significant mean difference between groups in this sample, regardless of whether this differential item functioning was considered or not, and that those mean differences were similar in magnitude. Future research using these measures should explore if this differential item functioning is consistent across samples.

Based on these findings, it seems although all three measures may be appropriate for use in research, the RRS in particular should be used with caution given the lack of metric invariance in this sample. The choice of which measure to use should be guided by the research question, decided upon by theoretical grounds. The RRS and RTSQ are longer than the RTQ, suggesting that if brevity is of concern, the RTQ may be used. Research seeking to evaluate valence-neutral repetitive thinking may consider the use of the RTSQ, while research which is seeking to evaluate depressive-specific rumination may consider the RRS with caution. Research looking at the broader clinical process of thinking repetitively about negative affect may consider

[1] The unmodified RTQ model was also evaluated for measurement invariance, and the pattern of findings did not differ from the modified RTQ model. Extended results are available upon request.

[2] Mplus outputs of invariance testing of both the unmodified and modified RTQ can be found in the ESM 3 and ESM 4.

the use of the RTQ. The RRS should be used with caution; however, given the concerns regarding metric variance, future research using this measure should assess measurement invariance.

A number of limitations warrant consideration. The RTQ and RRS measure repetitive thinking more broadly, while the RTSQ attempts to distinguish types of repetitive thinking. A more targeted analysis of item content may be prudent to determine whether the difference in item content is responsible for differences in measurement invariance. The findings are based upon a university student sample, and so may not necessarily generalize to the general community or clinical samples. Given rumination is likely to be elevated in clinical populations, future research should consider evaluating the invariance of these measures across clinical and non-clinical samples, across a range of psychopathologies. On this note, the present research only considered group differences and did not investigate the role of rumination in NSSI. Additionally, the present research compared individuals with no history of self-injury to individuals with a lifetime history of self-injury (i.e., has self-injured at least once in their life). It is worth considering that individuals with a recent history of self-injury may differ from individuals with a lifetime history of self-injury, in terms of emotional regulation and cognitive processes (e.g., Dawkins et al., 2019). As such, future research should explore measurement invariance across recent history and lifetime history of self-injury. In addition, the sample for the RRS was notably smaller than for the other measures (N = 383), and should be replicated in a larger sample.

Bearing these limitations in mind, the present study provides evidence that current measures of rumination can be considered as robust in the context of group comparisons in people with and without a history of NSSI. The three measures evaluated in this research demonstrated different levels of invariance. The RRS failed to demonstrate full metric invariance, while the RTQ and RTSQ both supported full metric invariance. Further, the RTQ only demonstrated partial scalar invariance while the RTSQ demonstrated full scalar invariance. Future research is needed to reproduce the structure of the measures as modified in the current findings, although these findings suggest the RTSQ can be used with confidence that true group differences will be reflected in scores.

Electronic Supplementary Materials

The electronic supplementary material is available with the online version of the article at https://doi.org/10.1027/1015-5759/a000605

ESM 1. Outputs for the RRS

ESM 2. Outputs for the RTSQ

ESM 3. Outputs for the RTQ

ESM 4. Outputs for the RTQ (revised)

References

Arbuthnott, A. E., Lewis, S. P., & Bailey, H. N. (2015). Rumination and emotions in nonsuicidal self-injury and eating disorder behaviors: A preliminary test of the emotional cascade model. *Journal of Clinical Psychology, 71*, 62–71. https://doi.org/10.1002/jclp.22115

Brinker, J. K., & Dozois, D. J. (2009). Ruminative thought style and depressed mood. *Journal of Clinical Psychology, 65*, 1–19. https://doi.org/10.1002/jclp.20542

Brown, T. A. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). New York, NY: Guilford Press.

Dawkins, J. C., Hasking, P. A., Boyes, M. E., Greene, D., & Passchier, C. (2019). Applying a cognitive-emotional model to nonsuicidal self-injury. *Stress Health, 35*, 39–48. https://doi.org/10.1002/smi.2837

Ehring, T., & Watkins, E. R. (2008). Repetitive negative thinking as a transdiagnostic process. *International Journal of Cognitive Therapy, 1*, 192–205. https://doi.org/10.1521/ijct.2008.1.3.192

Gandhi, A., Luyckx, K., Baetens, I., Kiekens, G., Sleuwaegen, E., Berens, A., … Claes, L. (2018). Age of onset of non-suicidal self-injury in Dutch-speaking adolescents and emerging adults: An event history analysis of pooled data. *Comprehensive Psychiatry, 80*, 170–178. https://doi.org/10.1016/j.comppsych.2017.10.007

Glenn, C. R., & Klonsky, E. D. (2011). One-year test-retest reliability of the Inventory of Statements about Self-Injury (ISAS). *Assessment, 18*, 375–378. https://doi.org/10.1177/1073191111411669

Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology, 85*(2), 348–362. https://doi.org/10.1037/0022-3514.85.2.348

Hasking, P., Whitlock, J., Voon, D., & Rose, A. (2017). A cognitive-emotional model of NSSI: Using emotion regulation and cognitive processes to explain why people self-injure. *Cognition and Emotion, 31*, 1543–1556. https://doi.org/10.1080/02699931.2016.1241219

International Society for the Study of Self-Injury. (2018). *What is self-injury?* Retrieved from https://itriples.org/category/about-self-injury/

Kiekens, G., Hasking, P., & Boyes, M. (2019). Measurement invariance of three brief emotion regulation questionnaires in people with and without a history of non-suicidal self-injury. *European Journal of Psychological Assessment, 35*(6), 835–841. https://doi.org/10.1027/1015-5759/a000464

Kiekens, G., Hasking, P., Claes, L., Boyes, M., Mortier, P., Auerbach, R. P., … Bruffaerts, R. (2019). Prediciting the incidence of non-suicidal self-injury in college students. *European Psychiatry, 59*, 44–51. https://doi.org/10.1016/j.eurpsy.2019.04.002

Klonsky, E. D., & Glenn, C. R. (2009). Assessing the functions of non-suicidal self-injury: Psychometric properties of the Inventory of Statements About Self-injury (ISAS). *Journal of Psychopathology and Behavioural Assessment, 31*, 215–219. https://doi.org/10.1007/s10862-008-9107-z

Li, C. H. (2016). Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. *Behavior Research Methods, 48*, 936–949. https://doi.org/10.3758/s13428-015-0619-7

McEvoy, P. M., Mahoney, A. E. J., & Moulds, M. L. (2010). Are worry, rumination, and post-event processing one and the

same? Development of the Repetitive Thinking Questionnaire. *Journal of Anxiety Disorders, 24*, 509–519. https://doi.org/10.1016/j.janxdis.2010.03.008

McEvoy, P. M., Thibodeau, M., & Asmundson, G. J. G. (2014). Trait repetitive negative thinking: A brief transdiagnostic assessment. *Journal of Experimental Psychopathology, 3*, 382–398. https://doi.org/10.5127/jep.037813

Meade, A. W., Johnson, E. C., & Braddy, P. W. (2008). Power and sensitivity of alternative fit indices in tests of measurement invariance. *Journal of Applied Psychology, 93*, 568–592. https://doi.org/10.1037/0021-9010.93.3.568

Muthén, L. K., & Muthén, B. O. (2017). *Mplus user's guide*. Los Angeles, CA: Muthén & Muthén.

Nicolai, K. A., Wielgus, M. D., & Mezulis, A. (2016). Identifying risk for self-harm: Rumination and negative affectivity in the prospective prediction of nonsuicidal self-injury. *Suicide and Life-Threatening Behavior, 46*, 223–233. https://doi.org/10.1111/sltb.12186

Nock, M. K. (2009). Why do people hurt themselves? New insights into the nature and functions of self-injury. *Current Directions in Psychological Science, 18*, 78–83. https://doi.org/10.1111/j.1467-8721.2009.01613.x

Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review, 41*, 71–90. https://doi.org/10.1016/j.dr.2016.06.004

Selby, E. A., Connell, L. D., & Joiner, T. E. (2010). The pernicious blend of rumination and fearlessness in non-suicidal self-injury. *Cognitive Therapy and Research, 34*, 421–428. https://doi.org/10.1007/s10608-009-9260-z

Selby, E. A., Franklin, J., Carson-Wong, A., & Rizvi, S. L. (2013). Emotional cascades and self-injury: Investigating instability of rumination and negative emotion. *Journal of Clinical Psychology, 69*, 1213–1227. https://doi.org/10.1002/jclp.21966

Slabbert, A., Hasking, P., & Boyes, M. (2018). Riding the emotional roller coaster: The role of distress tolerance in non-suicidal self-injury. *Psychiatry Research, 269*, 309–315. https://doi.org/10.1016/j.psychres.2018.08.061

Swannell, S. V., Martin, G. E., Page, A., Hasking, P., & St John, N. J. (2014). Prevalence of nonsuicidal self-injury in nonclinical samples: Systematic review, meta-analysis and meta-regression. *Suicide Life Threat Behav, 44*, 273–303. https://doi.org/10.1111/sltb.12070

Tanner, A., Voon, D., Hasking, P., & Martin, G. (2012). Underlying structure of ruminative thinking: Factor analysis of the Ruminative Thought Style Questionnaire. *Cognitive Therapy and Research, 37*, 633–646. https://doi.org/10.1007/s10608-012-9492-1

Taylor, P. J., Jomar, K., Dhingra, K., Forrester, R., Shahmalak, U., & Dickson, J. M. (2018). A meta-analysis of the prevalence of different functions of non-suicidal self-injury. *J Affect Disord, 227*, 759–769. https://doi.org/10.1016/j.jad.2017.11.073

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research, 27*, 247–259. https://doi.org/10.1023/a:1023910315561

Voon, D., Hasking, P., & Martin, G. (2014). The roles of emotion regulation and ruminative thoughts in non-suicidal self-injury. *British Journal of Clinical Psychology, 53*, 95–113. https://doi.org/10.1111/bjc.12030

History
Received October 30, 2019
Revision received May 7, 2020
Accepted May 12, 2020
Published online September 7, 2020
EJPA Section / Category Clinical Psychology

Funding
This work has been supported by the Curtin University Faculty International Scholarship to Glenn Kiekens, and by the Australian Government Research Training Program Scholarship to Kate E. Tonta.

ORCID
Penelope Hasking
https://orcid.org/0000-0002-0172-9288

Penelope Hasking
School of Psychology and Speech Pathology
Curtin University
Bentley, WA 6845
Australia
penelope.hasking@curtin.edu.au

