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Associations between depression, anxious arousal and manifestations of psychological inflexibility

Kirsten E. Gilbert[a], Natasha A. Tonge[b], Renee J. Thompson[b,*]

[a] Department of Psychiatry, Washington University School of Medicine, Washington University in St. Louis, St. Louis, MO, United States
[b] Department of Psychological and Brain Sciences, Washington University in St. Louis, St. Louis, MO, United States

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ABSTRACT

Background and objectives: Psychological inflexibility exhibits across multiple facets of functioning, including thinking styles, personality, cognitive shifting, emotion, and physiology, with many of these manifestations showing associations with depression. As such, these facets might be part of an overarching latent construct of psychological inflexibility that explains associations with depression. We predicted that (1) five facets of inflexibility (perseverative thinking, personality rigidity, attention-shifting, negative emotional inertia, and low respiratory sinus arrhythmia reactivity) would load onto a unique latent construct of psychological inflexibility. Further, we hypothesized this latent construct of psychological inflexibility would be (2) significantly associated with higher depression; and (3) associated with depression to a greater extent than anxious arousal.
Methods: Seventy-five adult community participants completed measures assessing the five indices of inflexibility and self-report measures of depression and anxious arousal.
Results: Structural equation modeling identified a latent inflexibility construct reflected by perseverative thinking, personality rigidity, and emotional inertia, but did not include attention-shifting or RSA reactivity. The inflexibility construct was positively associated with depression and anxious arousal, but more strongly associated with depression than with anxious arousal.
Limitations: Limitations included a small sample size, cross-sectional approach, and dimensional measures of depression and anxious arousal.
Conclusions: Findings provide preliminary support that multiple facets of inflexibility may emerge from a broader overarching vulnerability for internalizing psychopathology. This overarching inflexibility construct may have stronger associations with depression than with anxious arousal.

1. Introduction

Major depressive disorder (MDD) is one the most common and debilitating mental disorders (Kessler, Peukhova, Sampson, Zaslavsky & Wittchen, 2012), partly due to great psychosocial impairment and high degree of recurrence (Burcusa & Iacono, 2007). Identifying mechanisms that contribute to its development and maintenance is imperative for reducing depression. The current study assessed whether facets of inflexibility capture a broader individual difference construct of psychological inflexibility and tested whether this construct of psychological inflexibility was associated with depression. We also examined whether psychological inflexibility was associated with depression to a greater extent than a specific form of anxiety, anxious arousal.

Psychological flexibility is defined as an individual's ability to adapt and shift in response to fluctuating environmental and internal demands; and as such, psychological inflexibility is an inability to do so (e.g., Bonanno & Diminich, 2013; Cheng, Lau, & Chan, 2014; Kashdan & Rottenberg, 2010; Rottenberg & Yoon, 2017; Stange, Alloy & Fresco, 2017). At the momentary level, psychological inflexibility exhibits as an inability to effectively modify behavior in response to an immediate stressor or changing environmental demands. This inability to adjust to environmental change may exacerbate stress, potentially contributing to onset and maintenance of psychopathology, including internalizing disorders of depression and anxiety (Kashdan & Rottenberg, 2010; Stange et al., 2017; Waugh, Thompson, & Gotlib, 2011).

Theory has speculated that training psychological flexibility may facilitate remission from depression (Waugh & Koster, 2015), and recent empirical treatments directly target psychological inflexibility in depression and various anxiety disorders (Hayes, Strosahl, & Wilson, 2012; Lynch, 2018). Although psychological inflexibility is apparent at

* Corresponding author. 1 Brookings Drive, Campus Box 1125, St. Louis, MO, 63130, United States.
E-mail address: renee.thompson@wustl.edu (R.J. Thompson).

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the moment of increased environmental demand, clinical interventions target psychological inflexibility as a trait-level characteristic. This trait-level perspective appears disparate from momentary responding, but trait psychological inflexibility is thought to result from repeated momentary experiences of being psychologically inflexible (although circularly, may also contribute to momentary responding; Hollenstein, Lichtwarck-Aschoff & Potworoski, 2013).

One clinical approach providing a model of trait psychological inflexibility is Acceptance and Commitment Therapy (ACT). ACT conceptualizes psychological inflexibility as an interaction of cognitive and language abilities that lead to an inability to change behavior in the service of longer term valued goals. These interacting trait-like abilities exhibit as six sub-processes (e.g., experiential avoidance) that, as interrelated yet independent contexts, contribute to multiple psychopathologies (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Similar to the ACT model, a recent review examining momentary psychological inflexibility by Stange et al. (2017) highlighted the association of multiple facets of psychological inflexibility with depression and speculated these facets reflect a core capacity to be psychologically inflexible. Stange and colleagues (2017)'s review demonstrated that inflexibility across cognitive, emotional, and physiological indices individually relate to depression.

Together, previous research purports that psychological inflexibility can occur in the moment or as a trait-like tendency. Both schools of thought postulate psychological inflexibility to be composed of subprocesses or facets. However, it is unknown whether these facets of psychological inflexibility stem from a core capacity to be psychologically (in)flexible. The present study provides a first empirical test of the hypothesis that various facets of inflexibility emerge from an overarching tendency to be psychologically inflexible.

We first provide a brief review of the literature linking depression and anxiety, broadly defined, with chosen facets of inflexibility, including inflexible thinking, personality, cognition, emotion and physiology (for comprehensive review, see Stange et al., 2017). These five facets of inflexibility were chosen for the following reasons. First, each represents a major domain of functioning that is supported by empirical evidence demonstrating inflexibility, as reviewed below. Specifically, inflexible thinking, physiology, and cognition have been independently associated with depression, and to a lesser extent, some forms of anxiety, across studies and reviews (Bylsma, Salomon, Taylor-Clift, Morris, & Rottenberg, 2014; De Lissnyder, Koster, Everaert, et al., 2012; Ehring & Watkins, 2008; McEvoy, Watson, Watkins, & Nathan, 2013; Stange et al., 2016). Emotion inflexibility is akin to ACT's experiential avoidance, which is a widely examined facet of inflexibility (Hayes et al., 2006; Hayes et al., 2012) and multiple clinical models purport that psychological inflexibility stems from an overcontrolled and inflexible personality (Lynch, 2018), and an overconceptualized sense of self (Hayes et al., 2012). Second, we aimed to include only 'pure,' independent, and non-overlapping constructs of inflexibility. This decision allowed us to assess theoretically independent facets of inflexibility, although resulted in excluding some well-studied forms of inflexibility, such as affective set-shifting, which includes emotional and cognitive facets of inflexibility. Lastly, we specifically chose facets that spanned different units of analysis, from momentary facets to trait-like tendencies.

1.1. Inflexible thinking (perseverative thinking)

Perseverative thinking involves repetitive thinking that is difficult to disengage from (e.g., Ehring et al., 2011). Rumination, repetitive thinking about one's negative mood (Nolen-Hoeksema, 1991), and worry, repetitive negative and uncontrollable thoughts and images (Borkovec, Robinson, Pruzinsky, & DePree, 1983), are the two most commonly studied forms of perseverative thinking in depression and anxiety. There is speculation that rumination and worry stem from an overarching factor of perseverative negative thinking (also termed repetitive negative thinking; Ehring & Watkins, 2008; Samtani & Moulds, 2017). This transdiagnostic characteristic prolongs activation of stress-related processes that contribute to depression (Brosschot, Gerin, & Thayer, 2006; Brosschot, Verkuil, & Thayer, 2010), prospectively predicts changes in depression (e.g., Raes, 2012), and is equally implicated in depressive and anxiety disorders (McEvoy et al., 2013; 2017). However some research indicates stronger associations of inflexible thinking with depression than anxiety (Olatunji, Naragon-Gainey, & Wolitzky-Taylor, 2013). Perseverative negative thinking styles may reflect one dimension of a general tendency to be psychologically inflexible that characterizes depression and certain forms of anxiety, such as worry, but not other forms, such as anxious arousal.

1.2. Inflexible personality (personality rigidity)

The earliest literature studying psychological inflexibility emerged from personality literature (Block, 1961). Block and Block (1980) argued that some personality types are characterized by flexible responding to environmental demands (i.e., ego-resiliency), while too little ego-resiliency in the context of high ego-control (i.e., the ability to restrain emotional impulses), leads to inflexible and overcontrolled personality. An overcontrolled personality predicts internalizing psychopathology (Asendorpf, Borkenau, Ostendorf, & Van Aken, 2001).

Dimensional perspectives of personality pathology identify specific individual difference traits, including personality rigidity (e.g., Crego & Widiger, 2016; Widiger & Trull, 2007; Wright & Simms, 2014), which reflects inflexibility in beliefs and values and an unwillingness to consider alternative perspectives (e.g., Simms et al., 2011). Higher personality inflexibility may narrow the scope of experience, resulting in social isolation and depression (Kashdan & Rottenberg, 2010). Indeed, clinical treatments target interpersonal and emotional loneliness to decrease personality inflexibility (Lynch, 2018).

1.3. Cognitive inflexibility (attention-shifting)

Changing mental sets is a complex cognitive process that involves overriding previously active mental sets to shift attention to newly relevant information (e.g., Miyake et al., 2000). The inability to shift attention (i.e., difficulty disengaging attention, often from negative material) is associated with depression (e.g., De Raedt & Koster, 2010; Gotlib & Joormann, 2010). Switching impairments (i.e., the cost of switching from one mental representation to another) are associated with current and prospective onset of depression (e.g., De Lissnyder, Koster, Goubert, et al., 2012; Harvey et al., 2004; Schmid & Hammar, 2013; Stange et al., 2016). These impairments may be associated with depression because of increased attentional biases towards negative stimuli (Peckham, McHgugh & Otto, 2010) or difficulty switching attention from negative thoughts due to perseverative negative thinking (e.g., De Lissnyder, Koster, Everaert, et al., 2012; Koster, De Lissnyder, Deakshan, & De Raedt, 2011). Similarly, social anxiety and trait anxiety are associated with difficulty switching attention from negative stimuli (Ansari, Derakshan, & Richards, 2008; Cek, Sanchez, & Timpano, 2016; Schofield, Johnson, Inhoff, & Coles, 2012).

1.4. Emotional inflexibility (emotional inertia)

Emotional inflexibility is a lack of emotional change across contexts. Most emotional inflexibility research examines emotional inertia, the degree to which affect can be predicted by previous levels of affect (Butler, 2011; Kuppens, Allen, & Sheeber, 2010). Negative emotional inertia is more predictive of depression than is positive emotional inertia (Houben, Van Den Noortgate, & Kuppens, 2015), and has been independently associated with depression after accounting for perseverative thinking (i.e., rumination; Brose, Schmiedek, Koval, & Kuppens, 2015; Koval, Kuppens, Allen, & Sheeber, 2012). Related, the emotion context insensitivity theory of depression (Rottenberg, Gross,

& Gotlib, 2005) posits that depression is characterized by a lack of flexible responding across negative and positive emotion (Bylsma, Morris, & Rottenberg, 2008). Although emotional inflexibility has been linked to depression, a meta-analysis demonstrated no association between negative emotional inertia and anxiety (Houben et al., 2015).

1.5. Physiological inflexibility (RSA reactivity)

Inflexible physiological responding is captured in the parasympathetic branch of the autonomic nervous system (e.g., Beauchaine, 2001; Thayer & Lane, 2000). An index of parasympathetic responding is respiratory sinus arrhythmia (RSA), or the natural variation in heart rate driven by respiration and the vagus nerve (Bernston et al., 1997). RSA acts as a 'brake' to the sympathetic nervous system during rest (resting RSA), but also withdraws in response to different environmental demands (RSA reactivity; Porges, 1995). RSA reactivity represents change in physiological responding to meet changing environmental challenges (e.g., Porges, 1995) and may reflect physiological inflexibility. Greater RSA reactivity (i.e., greater RSA withdrawal) to a sad film clip or laboratory stressor is associated with fewer depressive symptoms and higher rates of recovery from depression, while lower reactivity predicts increased symptoms (Bylsma et al., 2014; Rottenberg et al., 2005; Shannon, Beauchaine, Brenner, Neuhaus, & Gatzke-Kopp, 2007; Stange, Hamilton, Olino, Fresco & Alloy, 2017). However, the association between RSA reactivity and depression is equivocal (Yaroslavsky, Rottenberg, & Kovacs, 2013) and may depend on other contextual features. Although there is a large literature theorizing physiological inflexibility in anxiety (e.g., Friedman, 2007), some of which directly indicates poor RSA reactivity in generalized anxiety (e.g., Kircanski, Waugh, Camacho, & Gotlib, 2016), much of this work has been in resting levels (e.g., Chalmers, Quintana, Abbott, & Kemp, 2014) rather than reactivity, which makes comparison difficult.

1.6. Associations between facets of inflexibility

Although depression and anxiety have been associated with various facets of psychological inflexibility, less research has examined multiple facets simultaneously. This small literature demonstrates perseverative thinking (rumination) and emotional inflexibility (emotional inertia) to be related and exhibit transactional relations, yet both forms independently predict depressive symptoms (Brose et al., 2015; Koval et al., 2012). Similar results emerge with perseverative thinking (rumination) and cognitive inflexibility (attention-shifting): although not related to each other, both independently predicted onset of depression (Stange et al., 2016). Examining perseverative thinking (rumination) and inflexible physiology (RSA reactivity), depressed and healthy individuals exhibited similar RSA reactivity during a rumination condition (LeMoult, Yoon, & Joormann, 2016). However, within the depressed group, RSA reactivity during rumination was *attenuated* compared with cognitive distraction, indicating less physiological flexibility within the depressed individuals while thinking inflexibly (LeMoult et al., 2016). Taken together, findings demonstrate some evidence that various facets of flexibility relate; yet each also appears to be independent.

1.7. The current study

Depression is associated with the tendency to be psychologically inflexible across a variety of facets—both at the momentary and trait level—but it is unclear whether these various facets tap a general tendency to be psychologically inflexible. The current study aimed to test whether five independent facets of inflexibility—perseverative thinking, personality rigidity, poor attention shifting, negative emotional inertia, and RSA reactivity–reflect a general tendency to be psychologically inflexible. We hypothesized that psychological inflexibility is a latent construct that manifests in these distinct ways, and further, that this construct will be associated with elevated depressive symptoms.

The current study also tested whether the association between psychological inflexibility and depression is stronger than the association between psychological inflexibility and a specific form of anxiety: anxious arousal. Although anxiety is associated with self-reported psychological inflexibility (Bluett, Homan, Morrison, Levin, & Twohig, 2014; Kashdan & Rottenberg, 2010; Simon & Verboon, 2016), cognitive inflexibility, and attention inflexibility (Ansari et al., 2008; McLaughlin & Nolen-Hoeksema, 2011), anxiety is not associated with emotional inflexibility (Houben et al., 2015); further, there is little research to date examining the association between anxiety and physiological flexibility. The equivocal findings for anxiety might be due, in part, because much of this research examines anxiety broadly. That is, research does not typically differentiate different forms of anxiety, such as anxious arousal (i.e., somatic anxiety) and anxious apprehension/worry (Nitschke, Heller, Imig McDonald, & Miller, 2001). We would expect anxious apprehension/worry to be related to psychological inflexibility compared with anxious arousal because worry, like rumination, includes perseverative and uncontrollable thinking (Ehring & Watkins, 2008; Harvey, Watkins, Mansell, & Shafran, 2004; Kircanski, Thompson, Sorenson, Sherdell, & Gotlib, 2015). Thus, in efforts to demonstrate clinical specificity, we hypothesized the latent construct of psychological inflexibility would be associated with anxious arousal, but to a lesser degree than with depression.

2. Method

2.1. Participants

We recruited 86 participants from the greater St. Louis area using advertisements and university research participant registries for a study examining everyday emotional experiences. From the parent study, 75 participants (53.3% female) completed study procedures. Participants had a mean age of 38.4 years (SD = 14.0, Range = 20–71), and the racial/ethnic composition was 65.3% White, 24% Black, 6.7% Biracial, 4% Asian, and 4% Hispanic/Latino/a. Four percent completed some junior high/high school; 24% completed some college; 50.7% completed college; and 21.3% completed graduate/professional degrees. Native English speakers, those employed at least part-time, and those who did not meet criteria for current substance use disorder or psychosis, were eligible. For psychophysiological assessment, people were ineligible if they were pregnant, had heart disease, or used medications affecting cardiovascular function.

2.2. Procedures and materials

Participants provided informed consent and completed a series of randomized self-report measures and computerized tasks during one laboratory session. Cardiac measures were acquired continuously during a 5-min baseline and during the computerized tasks. Participants were financially compensated. All procedures were in accordance with the ethical standards of the institutional review board and with the 1964 Declaration of Helsinki and later amendments.

2.2.1. Self-report measures

2.2.1.1. Depression and anxious arousal. We assessed depression and anxious arousal using the 22-item anhedonic depression and 17-item anxious arousal scales from the Mood and Anxiety Symptoms Questionnaire (MASQ; Watson et al., 1995). Participants indicated the extent to which they experienced symptoms in the past week (1 = *not at all*, 5 = *extremely*). Items are summed to form composites. These scales have good convergent and discriminant validity in community samples (e.g., Nitschke, Heller, Imig, McDonald, & Miller, 2001; Watson et al., 1995), and Cronbach's alphas for depression and anxious arousal scales were 0.94 and 0.86, respectively.[1]

2.2.1.2. Inflexible thinking: perseverative thinking. We assessed inflexible thinking using the Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011). The 15-item PTQ is a summed measure assessing repetitive negative thinking independent of specific content (0 = *never,* 4 = *almost always*). An example item includes "I get stuck on certain issues and can't move on." It has strong psychometric properties in clinical and nonclinical samples (Ehring et al., 2011; Ehring, Raes, Weidacker, & Emmelkamp, 2012); Cronbach's alpha for this scale was 0.93.

2.2.1.3. Inflexible personality: personality rigidity. We assessed inflexible personality with the 10-item rigidity scale of the Computerized Adaptive Test of Personality Disorder-Static Form (CAT-PD-SF; Wright & Simms, 2014). This rigidity scale assesses inflexible personal views, morals and values and an unwillingness to consider other perspectives. Participants indicate the extent to which each item (e.g., "Do not like reading or hearing opinions that go against my way of thinking.") is true for them (1 = *very untrue of me*, 5 = *very true of me*). The CAT-PD-SF has strong psychometric properties in community and patient populations (Simms et al., 2011); Cronbach's alpha for this scale was 0.81.

2.2.2. Computerized tasks

2.2.2.1. Emotional inflexibility: emotional inertia. To assess negative emotional inertia, participants completed a modified version of the film-clip task described in Koval et al. (2015). Participants watched ten fixed-order emotional film-clips to capture a range of affective experiences (Schaefer, Nils, Sanchez, & Philippot, 2010). After each clip, participants had 30s rest and directed their attention to a neutral image. Participants rated their current negative emotion (frustration, sadness, nervousness, disgust; 0 = *not at all,* 6 = *very much*) on 21 occasions: at baseline, following each film, and following each rest. Negative affect at each occasion was calculated using the mean of the negative emotion ratings, with an approximate multilevel reliability of $\alpha = 0.78$. As in Koval et al. (2012), we then calculated the autocorrelation of negative affect (negative emotional inertia) using multi-level modeling in HLM 7.01 (Raudenbush et al., 2011), with rating periods nested within persons.

2.2.2.2. Physiological inflexibility: RSA reactivity. To measure physiological inflexibility, we acquired cardiac measures during a 5-min baseline period and during a subsequent visual tracking task (Cavanagh & Alvarez, 2005; Muhtadie, Koslov, Akinola, & Mendes, 2015; see). Participants sat quietly during baseline. The visual tracking task has been used to elicit RSA reactivity (Muhtadie et al., 2015) and consists of four blocks of four trials in which participants tracked two to five target stimuli, sequentially. Electrocardiograph (ECG) and respiration rate (RR) data were acquired using a Biopac MP150 (Biopac Systems Inc., Goleta, CA), using a modified Lead II configuration (ECG) an abdominal respiration belt (RR), with a sampling rate of 1000 Hz in Acknowledge. Heart rate variability statistics were calculated using MindWare Heart Rate Variability 3.0.22 software (Mindware Technologies Ltd., Gahanna, OH). We used MAD/MED artifact detection algorithm (Bernston, Quigley, Jang, & Boysen, 1990) and a 4 Hz time series was applied to the interbeat interval (IBI), followed by linear detrending, mean centering, tapering using a Hamming window function, and Fast Fourier transformation to derive spectral distribution. R-spikes were visually inspected and corrected. RSA was quantified within 0.12–0.4 Hz frequency. We computed RSA reactivity by subtracting mean baseline RSA (M = 6.22; SD = 1.34) from mean visual tracking task RSA (M = 5.95; SD = 1.32), which were significantly different from each other, $t(60) = 3.29$, $p < .01$.

2.2.2.3. Cognitive inflexibility: attention-shifting. Cognitive inflexibility was assessed with an attentional set-shifting task (Dreisbach & Goschke, 2004). This task involves categorization of stimuli before and after a rule change. Reactivity to this rule change, indexed by an increased response latency post switch, reflects poor attention-shifting. On each trial, two stimuli were presented simultaneously, one above the other, with one stimulus being the target color. After the pre-switch phase, a cue informed participants of the new target color. The target color in the post-switch phase was a new color, and the non-target color was the target color of the pre-switch phase. Prior to each trial, a neutral International Affective Picture System (IAPS; Center for the Study of Emotion and Attention, 1999) picture was presented (250 ms). Participants completed three blocks, each block consisted of two phases: pre-switch (40 trials) and post-switch (20 trials). For each block, participants either categorized (1) a letter of a specified target color as a consonant or a vowel or (2) a number of a specified target color as even or odd. Attention-shifting ability was computed using the interval immediately preceding the switch (Trials 36–40) and the interval immediately following the switch (Trials 41–46) for three blocks. The mean reaction time of the pre-switch interval was subtracted from the mean reaction time of the post-switch interval. Due to a programming error, only 60 participants completed the task.

2.3. Analytic overview

After examining normality, we winsorized extreme scores (< 1% of the data) to ± 2.65 *SD*s around the mean for measures of set-shifting, NA inertia, and anxious arousal. We used a negative reciprocal transformation on anxious arousal, further decreasing skew and kurtosis.

We constructed item parcels in line with suggestions in the literature (Little, Cunningham, Shahar, & Widaman, 2002; Little, Rhemtulla, Gibson, & Schoemann, 2013) to reduce unwanted error variance. To construct parcels, we first conducted an exploratory factor analysis with oblique rotation to derive item-score correlations for each of the items that composed the depression and anxious arousal scales. We then used the item-score correlations to distribute the items across four parcels for depression and anxious arousal. Finally, item scores were summed within parcels to create indicators of the respective constructs.

We used structural equation modeling (SEM) in MPlus version 7.3 (Muthén & Muthén, 2013) to test whether psychological inflexibility, (1) was reflected in each of the five facets, (2) was positively associated with depression, and (3) showed differential associations with depression and anxious arousal. We used maximum likelihood estimation, robust to standard errors (MLR), to analyze our models. An advantage of MLR is ability to handle missing data so long as > 50% of data is non-missing (Brown, 2015). In our sample, missingness was highest for emotional inertia (8%), RSA (19%), and attention shifting (20%).

We report standardized parameter estimates, and evaluated model fit using absolute and incremental fit indices: χ^2 test of model fit (Hu & Bentler, 1999); the root mean square error of approximation (RMSEA; Steiger, 1990); the standardized root mean square residual (SRMR; Hu & Bentler, 1999); the comparative fit index (CFI; Bentler, 1990); and the

[1] To assess clinical severity of depression in the current sample, five of the 75 participants met the clinical cutoff of 23 or higher, as Bredemeier et al. (2010) demonstrated this score to be a clinical cutoff on an 8-item MASQ anhedonic depression scale. This suggests that at least a subset of participants were in the clinical range. However, because elevated depressive symptoms assessed by self-report do not indicate the presence of a major depressive episode, we invited a subset of participants who reported elevated levels of depression or anxiety (i.e., worry or anxious arousal) to complete the lifetime *Structured Clinical Interview for DSM-5* (SCID; First, Williams, Karg, & Spitzer, 2015). Doctoral clinical psychology students conducted the interviews. Interrater reliability for the presence or absence of current MDD or persistent depressive disorder (Fleiss, 1971) was $\kappa = 0.80$. Raters reached consensus through discussion. Of these 13 participants, four were in current major depressive episodes and one was in a persistent depressive disorder episode, illustrating that our sample included participants with clinically significant levels of depression.

Table 1
Descriptive statistics and pearson correlations.

	1	2	3	4	5	6	7
1. Perseverative Thinking							
2. Personality Rigidity	.41**						
3. Attention Shifting	.03	-.09					
4. Emotional Inertia	.21†	-.02	-.16				
5. RSA Reactivity	.05	-.18	.11	.06			
6. Depression	.48**	.33**	.20	.23†	-.03		
7. Anxious Arousal	.29*	-.01	-.20	.28**	.00	.22†	
M	35.50	23.67	77.65	0.09	−0.24	52.12	20.60
SD	10.67	6.65	142.28	0.08	0.58	14.84	4.04
Range	15.00–57.86	10.0–41.0	−214.58–453.46	0–0.30	−1.51–1.22	30.00–86.00	17.00–36.70

Note. RSA = Respiratory Sinus Arrhythmia.
†$p < .10$, *$p < .05$, **$p < .01$.

Tucker-Lewis Index (TLI; Bentler, 1990). Hu and Bentler (1999) suggested a small non-statistically significant χ^2 test, RMSEA values ≤ 0.06, SRMR values ≤ 0.08, and CFI/TLI values ≥ 0.95 indicate good model fit. We compared model fit using χ^2 difference tests.

We estimated a measurement model to determine whether psychological inflexibility was represented by five facets. We evaluated significance of loadings onto the latent variable and eliminated poor-loading facets when necessary. Then we constructed a measurement model in which psychological inflexibility, depression, and anxious arousal were latent variables allowed to correlate. Next, we tested a structural model in which psychological inflexibility predicted depression and anxious arousal. Finally, we compared the psychological inflexibility-depression path with the inflexibility-anxious arousal path by constraining these paths to equality. If model fit worsened, we would infer that the model "preferred" the solution where the depression path is stronger than the anxious arousal path.

3. Results

Descriptive statistics and correlations are presented in Table 1. Our test of psychological inflexibility as a latent factor with the five facets demonstrated poor fit (Model 1; Table 2), thus, we tested a measurement model that included the latent factors of depression and anxious arousal and each of their indicators (i.e., four parcels of depression, and four parcels of anxious arousal, respectively; Model 2, Table 2; unconstrained model) and allowed all latent variables to correlate. Although the model fit was good (see Model 2, Table 2), the standardized loadings for attentional shifting ($\lambda = 0.03$, $p = .83$), RSA reactivity ($\lambda = 0.02$, $p = .91$), and emotional inertia ($\lambda = 0.30$, $p = .10$) did not load significantly onto psychological inflexibility. Loadings for the other three facets indicated that they represented the psychological inflexibility factor well.

Because RSA and attentional shifting displayed such small loadings, we initially constrained loadings to zero (Model 3, Table 2; constrained model) and compared fit of the unconstrained and constrained models to determine which model was preferable. Constraining loadings did not significantly change model fit, $\Delta\chi^2(2) = 0.06$, *ns*, indicating that the simplified, model was preferred. We tested a 3-indicator measurement model (Model 4, Table 2) that removed attention shifting and RSA reactivity; the model fit was good and comparable to Model 3, $\Delta\chi^2(23) = 33.46$, *ns*. All indicators loaded significantly on the latent variable, suggesting a three-indicator construct.

Next, we tested the structural model (Model 5, Table 2), in which psychological inflexibility predicted depression and anxious arousal. The fit indices suggested good model fit. Consistent with predictions, psychological inflexibility had a large positive association with depression, $\beta = 0.65$, $p < .01$, and a moderate to strong association with anxious arousal, $\beta = 0.39$, $p < .01$ (see Fig. 1). To test whether the paths with depression and anxious arousal significantly differed, we constrained these parameters to equality (Model 6, Table 2). Because the equality constraint significantly worsened model fit compared to the freely estimated model, $\Delta\chi^2(1) = 5.58$, $p < .05$, we concluded that paths significantly differed and the psychological inflexibility-depression path was significantly stronger than the psychological inflexibility-anxious arousal path.

Table 2
Structural equation model fit indices.

Model	χ^2	*Df*	RMSEA [90% CI]	SRMR	CFI	TLI
1	7.914	6	0.07 [.00 - .17]	.08	.87	.78
2	73.48	62	.05 [.00 - .09]	.08	.97	.97
3	73.54	64	.05 [.00 - .08]	.08	.98	.97
4	*40.07*	*41*	*.00 [.00 - .08]*	*.06*	*1.00*	*1.00*
5	**40.61**	**42**	**.00 [.00 - .07]**	**.06**	**1.00**	**1.00**
6	46.19	43	.03 [.00 - .09]	.09	.99	.99

Note. RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardized root mean square residual; CFI = comparative fit index; TLI = Tucker- Lewis index. Model 1: A measurement model comprised of the five facets (perseverative thinking, personality rigidity, attention shifting, emotional inertia, and RSA) loading on psychological inflexibility as a latent factor. Model 2: Latent factors of depression and anxious arousal were additionally estimated by four parcels of depression and four parcels of anxious arousal, respectively, and all three latent variables were allowed to correlate. Model 3: RSA and attentional shifting loadings were constrained to zero. Model 4: RSA and attentional shifting were removed as indicators, which left three remaining facets as indicators of psychological inflexibility: personality rigidity, emotional inertia, and perseverative thinking. Depression and anxious arousal factors remained unchanged. Model 4 is italicized as it represents the best fitting measurement model with no structural paths. Model 5: Depression and anxious arousal factors were each regressed on the psychological inflexibility factor. Model 5 is bolded because it represents the best fitting structural equation model. Model 6: Depression and anxious arousal paths were constrained to equality to test if they significantly differed from each other. Worsened fit indicated that depression and anxious arousal paths were not equivalent.

3.1. Secondary analyses

To verify that interpretations held without item parcels, we constructed Models 2 and 5 with depression and anxious arousal scores. Fit was poor for both Models 2 (CFI = 0.65; TLI = 0.44; SRMR = 0.089; RMSEA = 0.12 [0.06 - 0.19]) and 5 (CFI = 0.804, TLI = 0.509, SRMR = 0.07, RMSEA = 0.155 [0.05–0.266]), but results were largely consistent with initial findings: RSA reactivity ($\lambda = 0.015$, $p = .92$) and attention shifting ($\lambda = 0.04$, $p = .83$) did not significantly load onto psychological inflexibility. Depression was significantly predicted by psychological inflexibility ($p < .001$), but anxious arousal was now marginally significant ($p = .07$).

As a second test of findings, we created 5- and 3-indicator (emotional inertia, personality rigidity, and perseverative thinking) summed composites and examined correlations between depression and anxious

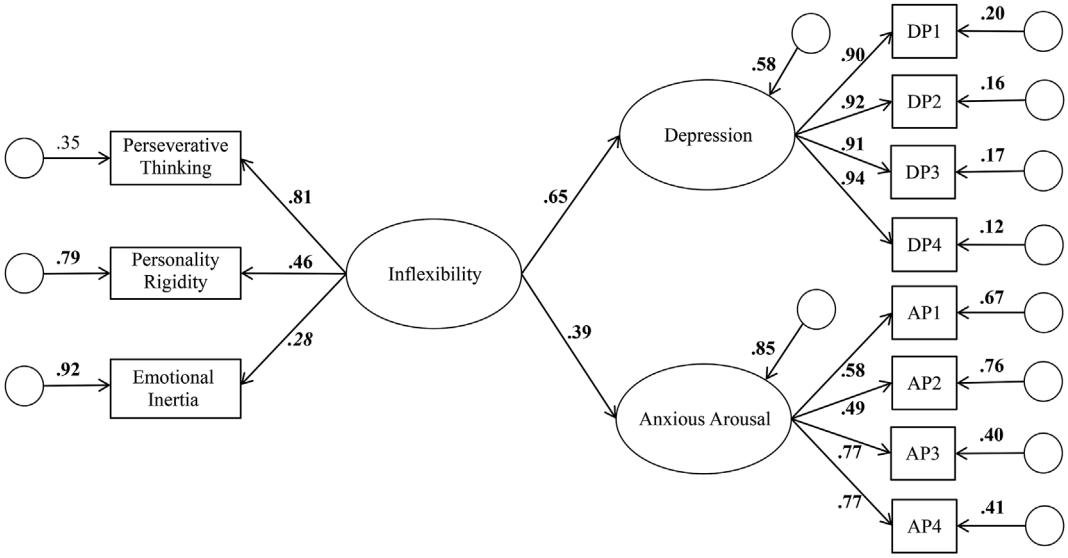

Fig. 1. Structural equation model of inflexibility predicting depression and anxious arousal (Model 4). DP = depression parcels; AP = anxious arousal parcels. All parameter estimates are standardized. Bold italic parameter estimates are significant at $p < .05$. Bold parameter estimates are significant at $p < .01$.

arousal and the two composites. Depression was significantly correlated with the 3- and 5-indicator composite ($r = 0.48$; $p < .001$ and $r = 0.48$, $p = .001$, respectively), while anxious arousal was significantly correlated with the 3-indicator ($r = 0.25$, $p = .04$), but not the 5-indicator composite ($r = 0.12$; $p = .33$). The magnitude of the correlations between the 3-indicator composite with depression versus anxious arousal were not significantly different (Fisher's z = −1.61, $p = .11$).

Finally, to determine whether a single factor of psychological inflexibility was the best model of the data, we investigated possible two-factor solutions for psychological inflexibility. We found only one converging solution: emotional inertia, personality rigidity, and perseverative thinking loaded significantly onto one factor, but RSA reactivity and attention shifting did not load on the second factor. We subsequently tested a 3-indicator model of psychological inflexibility without depression and anxious arousal as covariates and found an adequately fitting model (CFI = 0.976, TLI = 0.93, SRMR = 0.04, RMSEA = 0.07 [0–0.324]). Compared to Model 1 which utilized 5-indicators, fit for the 3-indicator model was not significantly different, $\Delta\chi^2(5) = 6.57$, *ns*, indicating it was the preferred model.

4. Discussion

Psychological inflexibility is theorized to consist of multiple facets, many of which characterize depression. The current study tested whether an overarching construct of psychological inflexibility captures the conceptual overlap of these facets and their associations with depression. Preliminary findings indicated that psychological inflexibility is best represented as a three-indicator construct of inflexible thinking, personality, and emotion.

Findings provide initial support that a larger overarching latent construct of psychological inflexibility may be composed of facets, in line with theorizing by Stange and colleagues (2017) and theory supported by clinical treatments (e.g., ACT [Hayes et al., 2006], Radically Open Dialectical Behavior Therapy; RO DBT [Lynch, 2018]). Importantly, although cognitive and personality inflexibility were assessed using self-report measures, emotional inflexibility was assessed from an experimental movie clip task. Specifically, participants repeatedly reported on their state negative emotions—from this we calculated their emotional inflexibility, indicating results are not solely due to method variance. Also of note, two facets, thinking and emotion inflexibility, occur at the momentary level. These two facets may manifest in combination as other types of inflexibility evidenced in depression, such as coping inflexibility (i.e., Bonanno & Burton, 2013; Cheng, 2001) or affective set-shifting inflexibility (e.g., Stange et al., 2017a,b). The third indicator that composed the best-fitting model was personality inflexibility; indicating psychological inflexibility should not solely be conceptualized at the moment level, but trait-level tendencies also contribute.

Contrary to predictions, cognitive (attention shifting) and physiological (RSA reactivity) inflexibility, did not load well onto the inflexibility factor. Attention shifting is consistently associated with depression (De Raedt & Koster, 2010; Gotlib & Joormann, 2010; Hertel, 1997), but it has not been associated with other forms of inflexibility within the context of depression (e.g., Stange, et al., 2016). This deficit may emerge from a separate factor associated with depression. Although RSA reactivity has been associated with other forms of inflexibility (e.g., inflexible thinking; LeMoult et al., 2016), RSA reactivity often shows strongest associations with depression in emotional contexts (e.g., Stange et al., 2017a,b), whereas the current paradigm utilized a non-emotional cognitive load. This might have also been the case for attention shifting, which is often examined in affective set-shifting (e.g., Stange et al., 2017a,b).

The lack of association between the psychological inflexibility construct and attentional shifting and RSA reactivity might also reflect a 'psychological inflexibility profile' that characterizes the current depression severity of the sample (Rottenberg & Yoon, 2017). Three of the five facets formed a latent construct in the current sample, yet a more severely depressed sample might exhibit more facets. Future research would benefit from assessing how psychological inflexibility may fluctuate based on state features, including depression severity.

As expected, our latent construct of psychological inflexibility was associated with depression and to a lesser extent anxious arousal. However, when we created a simple composite of psychological inflexibility, correlations with depression versus anxious arousal were not significantly different. Consequently, although the more rigorous statistical model suggests that psychological inflexibility more prominently characterizes depression than anxious arousal, we are unable to make a definitive conclusion. There is evidence that psychological inflexibility characterizes internalizing pathology (e.g., Bluett et al., 2014; Kashdan & Rottenberg, 2010; McEvoy et al., 2017, 2013; Simon & Verboon, 2016), but future research is needed to clarify how psychological inflexibility is associated with different forms of anxiety (i.e., worry/apprehension, anxious arousal).

Recent treatment approaches target psychological inflexibility as a mechanism of pathology, rather than targeting overt symptoms. An innovative and novel treatment, RO-DBT, targets overcontrolled and psychologically inflexible personality and was originally tested in treatment-resistant depression (Lynch, 2018; Lynch et al., 2007). Similarly, ACT directly aims to increase psychological flexibility (Hayes et al., 2006), and a recent meta-analysis demonstrated moderate efficacy of ACT for depression, however, did not find conclusive support for a broad range of anxiety disorders (Hacker, Stone, & MacBeth, 2016). These findings provide some indication that psychological inflexibility may be a more pertinent treatment target in depression, however; the meta-analysis 'clumped' various forms of anxiety.

Given this was a first examination testing an overarching construct of psychological inflexibility, several limitations should be noted. First, the current study had a small sample size. SEM is typically recommended for use with large samples (e.g., Kline, 2011); a small sample size can lead to parameter bias and difficulties obtaining converging models. Although the simplicity of our models and high internal consistency among some of our indicators allowed us to demonstrate preliminary support for a 3-indicator model of inflexibility, more complex models with larger sample sizes should be investigated. Second, some participants met criteria for a major depressive episode, but not all participants were diagnostically interviewed. Although dimensional approaches afford more power, future research should tease apart how psychological inflexibility is related to depressive and anxiety disorders. Third, the cognitive flexibility task only included one goal change during each block. Cognitive tasks with more frequent goal-switches (e.g., Ansari et al., 2008) may be stronger assessments of cognitive inflexibility. Fourth, the current study was cross-sectional. Future studies should examine inflexibility longitudinally. This work will help clarify the momentary/state versus trait questions of psychological inflexibility and the role psychological inflexibility plays as either a vulnerability factor or scar of disorder.

The current study demonstrated multiple facets of inflexibility may represent an overarching tendency to be psychologically inflexible. Findings suggest that psychological inflexibility captures resistance to change in thinking, personality, and emotion. Psychological inflexibility was strongly related to depression, and to a certain extent, anxious arousal. Continued examination of psychological inflexibility could improve understanding of how this individual difference characteristic contributes to onset and maintenance of internalizing pathology.

Compliance with ethical standards

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Declaration of interest

Kirsten Gilbert declares no conflict of interest.
Natasha Tonge declares no conflict of interest.
Renee Thompson declares no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbtep.2018.09.006.

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