The initial validation of a state version of the Cognitive Fusion Questionnaire

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Abstract

Considerable evidence supports the utility of the concepts of cognitive fusion and defusion, across diverse areas of functioning and concern. Cognitive fusion includes taking thoughts literally, and thinking being likely to dominate behaviour. Acceptance and Commitment Therapy (ACT) protocols include 'defusion' exercises, to support a distanced and more flexible relationship with thoughts. The Cognitive Fusion Questionnaire (CFQ), is a brief, psychometrically sound measure of the process. Although the CFQ has generated fusion-focussed research, it does not tend to be used in experimental settings. Instead, fusion-focussed experiments tend to use psychometrically untested measures of thought believability as a proxy for fusion. This paper reports on the initial validation of a state version of the CFQ, the State Cognitive Fusion Questionnaire (SCFQ). Three separate, predominantly student-based convenience samples, with a combined n of 379 provided preliminary evidence that the SCFQ has a theoretically consistent factor structure, shows excellent internal reliability, is stable over time, and is a valid measure of fusion. The findings also demonstrate that the SCFQ is more sensitive than the CFQ to changes in fusion, following a brief defusion exercise, making it more suitable for lab based studies.

Key words: Cognitive Fusion, State Measurement, Questionnaires, Experimental Methods, Acceptance and Commitment Therapy

1. Introduction

Acceptance and Commitment Therapy (ACT), along with a number of other empirically-supported psychotherapies (e.g., Mindfulness Based Cognitive Therapy:

Teasdale, Segal, Ridgeway, & Soulby, 2000; and Meta-Cognitive Therapy: Wells, 2000), emphasises that how we relate to cognitions (in addition to their content), can impact psycho-social functioning and the development of distress (Hayes, 2004). ACT is based on a clinical model that outlines six interrelated processes: experiential avoidance, cognitive fusion, over-attachment to a conceptualised self, ineffective action taking, lack of values clarity, and an inability to contact the present moment. Together, these processes contribute to psychological inflexibility, which plays an important role in the development and maintenance of psychopathology. The model can also be conceptualised in terms of psychological *flexibility* which contributes to healthy psychological functioning (Hayes, Strosahl, & Wilson, 2012).

In the psychological flexibility model, the relationship we have with thoughts is principally described by a continuum of experience from cognitive fusion to cognitive defusion, although because the model processes are all interrelated, the other processes can also influence cognition. Cognitive fusion has been defined as the tendency for overt and covert behaviour to be overly regulated by cognition, compared to direct contingencies (Gillanders et al., 2014). Cognitive fusion encompasses the believability of cognition, dominance of cognition over other aspects of experience, difficulty in taking alternative perspectives on thoughts, and struggling with or attempting to control thoughts (Gillanders et al., 2014). ACT interventions include 'defusion' exercises, to adopt alternative perspectives on thoughts and images, thereby reducing their dominance.

The psychological flexibility model suggests that cognitive fusion may play an important role in the development and maintenance of many forms of psychological disorder and ineffective behaviour (Hayes, Strosahl, & Wilson, 2012). There is some evidence in support of this; e.g., brief defusion exercises can reduce distress in spider fearful participants (Ritzert, Forsyth, Berghoff, Barnes-Holmes, & Nicholson, 2015). In addition, thought believability (a commonly used proxy for fusion) mediates outcomes of ACT interventions with people with psychosis (Bach, Gaudiano, Hayes, & Herbert, 2012). However, until recently, progress in research has been limited by the lack of an adequate measure of cognitive fusion.

Prior to the Cognitive Fusion Questionnaire (CFQ; Gillanders et al., 2014), measures of fusion had significant limitations (see Gillanders et al. for a detailed review). Some measures, such as the Avoidance and Fusion Questionnaire for Youth (AFQ-Y; Greco, Lambert, & Baer, 2008) and the Believability of Anxious Feelings and Thoughts Scale

(BAFT; Herzberg et al., 2012) were developed for use with a specific population or specific content. Additionally, many researchers (e.g., Zettle & Hayes, 1987) used 'believability of thoughts' as a *proxy* for cognitive fusion. This proxy measurement has been used in both intervention studies (e.g., Bach, Gaudiano, Hayes, & Herbert, 2012) and experimental studies (e.g., Mandavia et al., 2015).

The CFQ was developed to address such limitations. It is brief, psychometrically robust, and has general applicability. It has a theoretically predicted factor structure, measurement invariance across diverse samples, excellent internal consistency, strong convergent validity, temporal stability in non clinical samples and sensitivity to defusion interventions in a work stress context (Gillanders et al., 2014). Since publication it has been translated into 16 languages, and, based on its 166 citations, it has contributed to an increase in fusion research. This research has added theoretical clarity to the relationships between cognitive content and cognitive fusion as mechanisms predicting outcomes. For example, cognitive fusion has been found to mediate the relationship between threatening appraisals of cancer and anxiety, in a mixed population of cancer patients (Gillanders, Sinclair, Maclean & Jardine, 2015). Further research has also replicated the finding that reduced fusion may be responsible for the outcomes of ACT treatment. For example, reduction in CFQ predicted outcomes in a clinical effectiveness trial in psychosis (Johns et al., 2016). The CFQ has also contributed to research that confirms the theoretical structure of the psychological flexibility model. For instance, in chronic pain, Scott, McCracken and Norton (2016) used confirmatory factor analysis to demonstrate the importance to outcome of every facet of the psychological flexibility model. Research has also revealed that the CFQ is a specific predictor of unfavourable outcomes, independent of other facets of psychological flexibility, and indeed that the effects of different processes of psychological flexibility are additive, exactly as predicted by the theory. For example, in a large (n=955) cross-sectional sample of non-help seeking individuals, cognitive fusion was a significant independent predictor of depression, anxiety and stress scores, as well as being predictive of PTSD symptoms. Cognitive fusion interacted with experiential avoidance such that the correlation between experiential avoidance and depression became stronger at higher levels of fusion (Bardeen & Fergus, 2016).

The CFQ does have limitations in some contexts. In particular, the general wording of the items and instructions mean that the CFQ could be relatively insensitive to changes in

fusion over short periods of time. This could limit the utility of the CFQ in laboratory-based studies of brief defusion exercises or components. Relevant to this, despite the large number of citations described above, very few researchers have used the CFQ in experimental studies. Instead, laboratory-based studies generally utilise simple measures of thought believability, based on a 0-100 scale (e.g., Healy et al., 2008; Masuda et al., 2010; Mandavia et al., 2015; Larsson, Hooper, Osbourne, Bennett, & McHugh, 2016). Some authors have noted limitations of this form of measurement (e.g., Mandavia et al., 2015), but have not tended to acknowledge the lack of psychometric testing of this kind of measure, nor the limitations of the use of thought believability as a proxy for cognitive fusion. The CFQ is less likely to work in laboratory settings, due to the general nature of its instructions and items. To this end, a modified form of the CFQ, suitable for experimental work, could be useful. Specifically, a state version of the CFQ would address cognitive fusion as a broad construct rather than measuring thought believability alone. Additionally, the psychometric performance and validity of a state version of the CFQ could be assessed, something that would be more difficult with single-item measures of thought believability.

In summary, the original version of the CFQ has supported an increase in fusion-related research, though not in experimental studies. Instead, psychometrically untested measures of proxy variables are most commonly used in this type of study (e.g., Healy et al., 2008; Masuda et al., 2010; Mandavia et al., 2015; Larsson, Hooper, Osbourne, Bennett, & McHugh, 2016). Therefore, this paper reports on three studies outlining the development and initial validation of a state version of the CFQ—the State Cognitive Fusion Questionnaire (SCFQ). Study 1 tests the factor structure of the SCFQ using confirmatory factor analysis. It also tests the internal and test-retest reliability of the measure, and examines convergent and divergent validity. Study 2 examines changes in SCFQ scores in response to defusion and distraction interventions. Finally, Study 3 examines the differential sensitivity of the CFQ and the SCFQ in a laboratory-based defusion component study.

2. Materials and method

The first author's institution provided ethical approval, and British Psychological Society codes of ethics and conduct were adhered to. Specifically, informed consent was obtained from all participants.

2.1. Questionnaire Development

Given the excellent performance of the CFQ, the item content and structure of the SCFQ was based closely on the original, but modified to address fusion *in the present moment* rather than in general. The instructions asked participants to indicate how true each statement is for them *at this moment.* A Likert scale was used, with responses labelled: 1 – *completely untrue* to 7- *completely true*. Finally, the wording of the items was changed slightly to indicate fusion in the present moment. For example, item four of the CFQ—*I struggle with my thoughts* was changed to *I am struggling with my thoughts.* The final items and response scale can be seen in the Appendix.

2.2. Data screening and treatment of missing data

In all three studies, data for the SCFQ were examined to establish that each item had the full range of responses, which was the case. Instances of missing data were dealt with following recommendations from Tabachnick and Fidell (2013). No participants in any study had more than 10% data missing from any measure, so no participants were excluded. There were no data missing in studies 2 and 3. A non-significant Little's MCAR test for Study 1 indicated that the data were missing completely at random, $\chi^2(3940) = 3985.20$, $p = .30$ (Little, 1988). Missing data were dealt with by sample mean replacement. Data were normally distributed in all studies, as per guidance by Tabachnick and Fidell (2013) and Byrne (2010). Apart from the confirmatory factor analysis in Study 1, all analyses were carried out using SPSS Statistics version 24.0 (IBM Corp, 2016).

3. Study 1: Confirmatory factor analysis, internal reliability, test-retest reliability, convergent validity, divergent validity

3. 1. Participants

This opportunity sample ($N = 308$) consisted mainly of students at the first author's institution, some of whom completed the study as part of their undergraduate psychology course. A small number of participants were members of the public who had volunteered to be in an institutional research pool. The sample was 85% female ($n = 262$), 14% male ($n = 43$), and 1% non-binary ($n = 3$). Age ranged from 18 - 74, with a mean age of 20.05 ($SD = 5.14$). The majority of the sample identified as white British (73.40%, $n = 226$), with the remainder of the sample identifying as 'Black/Black British Caribbean/Black British African' (4.9%, $n = 15$), 'Any other white background' (4.20%, $n = 13$), 'Asian/Asian British' (3.5%, $n = 11$), and all other ethnic backgrounds (14%, $n = 43$).

3.2. Measures

1. *State Cognitive Fusion Questionnaire (SCFQ)*

The SCFQ is closely based on the CFQ, but modified to function as a state measure of cognitive fusion. As with the CFQ, higher scores on the SCFQ indicate higher levels of fusion.

2. *Cognitive Fusion Questionnaire (CFQ)*

The CFQ (Gillanders et al., 2014) measures cognitive fusion in general, rather than with particular thought content. The 7 items assess entanglement with thinking, unhelpful over-analysis, and the emotional and behavioural dominance of thinking. Items are rated on a 7-point scale from *never true* to *always true*. For each item scores range from 1 to 7, giving a total score range from 7 to 49. Higher scores indicate higher levels of fusion. The CFQ has a theory-consistent uni-dimensional factor structure and has demonstrated excellent internal reliability, (α=.88 to .93) across a range of student, occupational, and mental health samples (Gillanders et al., 2014). In the present sample α= .95. The CFQ has also demonstrated very good test-retest reliability across a 1-month period (r=.80). The validity of the measure has been demonstrated through examination of its relationship with many psychopathology, well-being, and process measures. For example, it has a predicted, large correlation (r=.62) with the Symptom Checklist-90 General Severity Scale (Derogatis, 1994), with the World Health Organisation Brief Quality of Life Scale (r=-.45; World Health Organisation, 1998), and with the Five Facets Mindfulness Questionnaire (r=-.50; Baer et al., 2008). Divergent validity has been demonstrated through a non-significant relationship with the Balanced Inventory of Desirable Responding Impression Management subscale (r=-.19; Paulhus, 1991).

3. *Brief Experiential Avoidance Questionnaire (BEAQ)*

The BEAQ (Gámez et al., 2014) assesses experiential avoidance. It consists of 15 items assessed using a 6-point scale, from *strongly disagree* to *strongly agree*. For each item, scores range from 1 to 6, giving a total score range from 15 to 90. Higher scores indicate greater experiential avoidance. The measure has good internal reliability (α=.80 to .83 (Gamez et al., 2014). In the present study α= .82. The measure has also demonstrated excellent test-retest reliability (r= .85) over a 1-week period (Carr, 2014). Across several student and patient samples Gamez et al. (2014) report that the BEAQ shows predicted correlations with related constructs such as thought suppression (r=.51; White Bear Suppression Inventory, Wegner & Zanakos, 1994) and measures of psychopathology such as

the Inventory of Depression and Anxiety Symptoms—General Depression Scale (r=.48; Watson et al., 2007).

4. *Beck Depression Inventory, 2nd edition (BDI-II)*

The BDI-II (Beck, Steer, & Brown, 1996) is a 21-item self-report questionnaire that assesses the severity of symptoms of depression over the previous two weeks. Each item is rated on a scale from 0 to 3, giving a total score range from 0 to 63. Higher scores indicate higher levels of symptomology. It has excellent psychometric properties including internal reliability (α=.92; Beck, Steer, & Brown, 1996). In the present sample α= .91. The BDI-II has also demonstrated good test-retest reliability, ranging from r=.73 to r=.96 over a mean test-retest interval of 2 weeks (Wang & Gorenstein, 2013). The same review of BDI-II psychometric performance indicates (through its relationships with other measures) that the BDI-II is a valid measure of depression. For example, it demonstrates predicted correlations (r=.47 to .66) with the Revised Hamilton Anxiety Rating Scale (Hamilton, 1959) and the Brief Symptom Inventory (r=.67; Derogatis & Melisaratos, 1983).

5. *Positive and Negative Affect Scale (PANAS)*

The PANAS (Watson, Clark, & Tellegen, 1988) is a 20-item measure of positive and negative affect. Each item is an adjective representing an emotional state. Respondents indicate the extent to which they feel each emotion on a 5-point scale (scored 1 to 5) from *very slightly or not at all* to *extremely*. Both the positive and negative scales consist of 10 items, giving each scale a total score range from 10 to 50. The present moment version of the scale was used, in which respondents are asked the extent to which they feel each emotion in the present moment. This version of the PANAS has very good internal reliability (α=.89 and .85 for the positive and negative scales respectively; Watson, Clark, & Tellegen, 1988). In the present sample α= .92 for both scales. Test-retest reliability of the present moment version of the PANAS over an 8-week period is relatively low for both the positive (r=.54) and negative (r=.45) scales (Watson, Clark, & Tellegen, 1988), as would be expected for a state scale assessing an in-the-moment experience. The validity of both PANAS scales has been demonstrated through their relationships with other measures. For example, the negative scale has a correlation of r=.51 with the Spielberger State Anxiety scale (Spielberger et al., 1983), while the positive scale has a correlation of r=-.35 with the same measure.

6. *Satisfaction With Life Scale (SWLS)*

The SWLS (Diener, Emmons, Larsen & Griffin; 1985) is a 5-item measure assessing global satisfaction with life. Items are rated on a 7-point scale from *strongly disagree* to *strongly*

agree. For each item scores range from 1 to 7, giving a total score range from 5 to 35. Higher scores represent greater satisfaction with life. The scale has good internal reliability, (α=.79 to .89; Pavot & Diener, 1993). In the present sample α= .86. The SWLS has also demonstrated very good test-retest reliability (r=.87) over a 1-month period (Pavot, Diener, Colvin, & Sandvik, 1991). The validity of the scale has been demonstrated by predicted relationships with other measures. For example, Arrindell, Meeuwesen, and Huyse (1991) reported a correlation of r=-.48 between the SWLS and the General Health Questionnaire-28 (Goldberg, 1978) and a correlation of r=-.55 with the Symptom Checklist-90 General Psychological Distress Scale (Derogatis, 1994).

7. *Balanced Inventory of Desirable Responding – Impression Management Scale (BIDR-IM)* The BIDR (Paulhus, 1991) is a 40-item measure consisting of two subscales; *Self Deceptive Enhancement* and *Impression Management*. For the present study only the 20-item *Impression Management* scale was used, to assess socially desirable responding. Items are rated on a 7-point scale from *not true* to *very true*. For each item scores range from 1 to 7. Each rating of 6 or 7 on an item contributes a point to the total score, yielding a total score range of 0 to 20. Higher scores represent higher levels of socially desirable responding. The scale has adequate to good internal reliability (α=.77 - .85; Paulhus, 1991). In the present sample α= .69. The scale has demonstrated adequate test-retest reliability (r=.65) over a 5-week period (Paulhus, 1988). The scale correlates with other measures of self and other deception, suggesting that it is a valid measure of socially desirable responding. For example, Davies, French, and Keogh (1998) report a correlation of r=.61 between the BIDR-IM and the Eysenck Personality Questionnaire-Revised Lie Scale (Eysenck & Eysenck, 1991).

3.3. Procedure

Participants provided informed consent prior to completing the questionnaires on Survey Monkey. Participants were also asked to provide information about gender, age, and ethnicity.

3.4. Analysis Plan

The factor structure of the SCFQ was assessed using confirmatory factor analysis. The open source software package 'R' (R Core Team, 2016) was used to fit the model, using the lavaan package (version 0.5-23.1097, [Rosseel, 2012]). Maximum Likelihood estimation was used to obtain fit indices and item loadings for a one factor model, given the strong

unifactorial structure of the original CFQ. CFA diagram was requested using the semPlot package (Epskam, 2014). Model fit was determined using the recommended two-index presentation of Hu and Bentler (1999), reporting the standardised root mean squared residual (SRMR), as well as the Comparative Fit Index (CFI), Tucker Lewis Index (TLI) and the root mean squared error of approximation (RMSEA). In addition, the normed chi square value (χ^2 / *df*) is also presented as recommended by Bollen (1989).

The internal reliability of the SCFQ was assessed using Cronbach's α. Test-retest reliability was assessed using Pearson's correlation between scores on the SCFQ administered four weeks apart. Convergent and divergent validity of the SCFQ were examined using Pearson's correlations with relevant measures.

3.5. Results

3.5.1. Confirmatory Factor Analysis

Fit indices can be seen in Table 1, which also contains the cut-offs recommended by Hu and Bentler (1999). The results show that the SCFQ has a unifactorial structure with excellent model fit across all fit indices. In addition, item loadings are all high (.79 – .94, Figure 1).

INSERT TABLE 1 ABOUT HERE

FIGURE 1 ABOUT HERE

3.5.2. Norms and Reliability

The mean and standard deviation for the SCFQ in this sample were 24.93 and 11.38 respectively. The measure demonstrated excellent internal reliability (Cronbach's α = .95). Test-retest reliability in a subset of the sample (n = 180) was adequate (Mean T1: 24.93 [*SD* = 11.38], Mean T2: 25.11 [*SD* = 10.48], r = .68, p < .001), and similar or superior to other state measures such as the state scale of the Spielberger State Trait Anxiety Inventory, which has a test-retest reliability of .59 over 20 days (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).

3.5.2. Validity

Table 2 shows Pearson's correlations between the SCFQ and the other study measures. In terms of convergent validity, there was a large, significant correlation between the SCFQ and the CFQ ($r = .78$, $p < .001$). There were significant, medium to large positive correlations between the SCFQ and measures of psychopathology and negative emotional experience (BDI, PANAS negative affect scale). There were significant medium-sized negative correlations between the SCFQ and satisfaction with life (SWLS), and also positive affect (PANAS positive affect scale). There was a significant relationship between the SCFQ and experiential avoidance (BEAQ). All correlations are in the direction predicted by theory. These results provide initial evidence for the convergent validity of the SCFQ. Divergent validity was assessed using the Impression Management subscale of the Balanced Inventory of Desirable Responding. The relationship between the SCFQ and the BIDR-IM was non-significant, indicating that scores on the SCFQ are not associated with presenting oneself in an overly favourable way.

INSERT TABLE 2 ABOUT HERE

4. Study 2: Using the SCFQ to measure changes in cognitive fusion in relation to brief defusion and distraction interventions

Study 2 was designed to test the SCFQ's sensitivity to detect change in fusion as a result of a defusion exercise. Brief defusion exercises have been shown to reduce the believability and unhelpful impact of negative thoughts when compared to distraction conditions, measured using visual analogue scales (e.g., Healy et al., 2008; Masuda et al., 2010; Mandavia et al., 2015). The impact of the two brief interventions was measured by the SCFQ, as well as a visual analogue believability of thoughts scale. It was predicted that the defusion exercise would result in a greater reduction in fusion and believability of thoughts than the distraction exercise.

4. 1. Participants and setting

Forty undergraduate psychology students voluntarily signed up for the study through a web-based research participant pool in the first author's institution. Participants received course credits for their participation but no other incentives. The sample comprised 26 female students (65%), 14 male students (35%), and no non-binary students. Participants' ages ranged from 18 to 28 years ($M = 21.23$, $SD = 1.93$). The ethnic composition of the sample was as follows: 87.5% ($n = 35$) identified as "White-British," and the remaining 12.5% ($n =$

5) identified as “Black/Black British-Caribbean,” “White-American,” or “Any other White Background.”

4.2. Experimental design

Participants were randomly assigned (using a random number generator) to one of two conditions: defusion or distraction. The outcome variables were cognitive fusion (as measured by the SCFQ) and believability of thoughts. Both variables were assessed pre- and post-intervention.

4.3. Measures

1. *State Cognitive Fusion Questionnaire (SCFQ)*
Described above.
2. *Believability of thoughts*
Replicating the methodology of Masuda et al. (2010), 100mm visual analogue scales were presented to participants immediately before and after the interventions to assess the believability of negative self-referential thoughts. Participants were asked “on a scale from 0 to 100, how believable is this thought?” Responses ranged from 0 (not at all believable) to 100 (very believable). The scale was marked with values at 10-point intervals on a continuous line and scored using a ruler.

4.4. Procedure

Participants were seen individually in a laboratory, and were randomly assigned to experimental condition prior to data collection. All participants were provided with an information sheet describing the study, and written informed consent was obtained. Participants then completed demographic questions and the SCFQ.

4.4.1. Thought selection and assessment

Following completion of the SCFQ, Masuda et al.’s (2010) methodology for thought selection was replicated. Participants were instructed by the researcher to verbalise a negative self-referential thought they had had repeatedly, and that was particularly believable to them (e.g., “I am stupid”). Participants were then asked to summarise the thought as one word (e.g., “stupid”). The thought selection procedure was scripted and closely adhered to for every participant. Participants were next asked to rate the believability of the word on a 0-100

visual analogue scale. If participants were unable to identify a word that they rated higher than 50 on the believability scale, they were asked to identify another negative self-referential thought that was more believable to them. Prior to commencing the study, it had been decided that participants who could not identify thoughts rated as at least 50 on the believability scale would be excluded from the study. However, all participants were able to identify such a thought.

4.4.2. Intervention

Both the defusion and distraction interventions were delivered in the form of audio recordings (via headphones), developed and recorded by the first author. Both interventions were closely scripted and matched for duration (7.5 minutes), components and sequence of components, wording, and number of prompts given.

The cognitive defusion condition was based on the 'Leaves on a stream' exercise (Hayes, Strosahl & Wilson, 2012, p. 255), which is a common component of ACT treatment protocols. Participants were given a rationale for the defusion exercise, which included the concepts of relationship to thinking and that adopting a more distanced perspective has been found to be a useful approach in a number of psychological therapies. This rationale was followed by the leaves on a stream exercise, in which participants were invited to imagine themselves sitting under a tree by the side of a stream. They were then guided to become conscious of their thoughts, and to find a way to place each thought on a leaf and watch it float by on the stream. After practising this with thoughts in general, participants were instructed to use the same approach with their negative self-referential word: to bring their word to mind, place it on a leaf, and watch it float down the stream.

In the thought distraction condition, a rationale was provided, involving distraction from negative thoughts as a common coping strategy used in a number of psychological therapies. The next phase of the distraction intervention involved describing exactly the same scene in which the participant is sitting under a tree by the side of a stream, but participants were guided on how to use this scene as a vivid and engaging distraction from other thoughts and images. There followed a practice phase with thoughts in general, before participants in this condition were instructed to use the same approach to dealing with their negative self-referential word; they were asked to bring their word to mind and then to distract themselves from it by imagining the scene.

Immediately after the intervention, participants rated the believability of their negative self-referential word again using the visual analogue scale. Finally, participants completed the SCFQ a second time. Once the study was completed, participants were debriefed about the study aims, and each participant, regardless of condition allocation, was given a written description of the defusion approach to dealing with uncomfortable thoughts, as it was predicted that this exercise would be more beneficial than the distraction exercise. All aspects of the experiment, including consent, assessment, intervention and debrief took place during one session of approximately 40 minutes.

4.5. Statistical analysis

Data for cognitive fusion and believability of thoughts were analysed separately using mixed 2 (condition) by 2 (time-point) ANOVAs. Significant intervention by time-point interaction effects were explored further using t-tests; independent t-tests were used to explore SCFQ and believability scores in terms of intervention (one for pre-intervention and one for post-intervention), and paired-samples t-tests were used to examine the effect of time-point on SCFQ and believability of thoughts scores for each intervention (defusion and distraction). Pearson's correlations were used to investigate the relationship between cognitive defusion, as measured by the SCFQ, and believability of thoughts, as measured using a visual analogue scale.

4.6. Results

4.6.1. Impact of intervention on cognitive fusion and believability of thoughts

Pre and post-intervention means and standard deviations for cognitive fusion and believability of thoughts, for both the cognitive defusion and thought distraction interventions are shown in Table 3. SCFQ scores and believability of thoughts scores varied by intervention and time-point; specifically, mean scores decreased after both interventions. However, this mean reduction was greater for the defusion intervention.

INSERT TABLE 3 ABOUT HERE

4.6.2. Cognitive fusion

Results from the mixed ANOVA revealed no significant main effect for condition, $F(1, 38) = 1.35$, $p = .25$. There was a significant within-group difference for time-point, $F(1, 38) = 22.27$, $p < .001$, in which post-intervention SCFQ scores were significantly lower than

pre-intervention SCFQ scores, indicating a reduction in fusion, pre to post intervention. There was a significant interaction between time-point and intervention, $F(1, 38) = 4.16$, $p = .048$. When the interaction was explored further, independent t-tests indicated that the difference in SCFQ scores between the two interventions for pre-intervention SCFQ scores, was not significant, $t(38) = 1.83$, $p = .08$. The difference in post-intervention SCFQ scores between the two conditions was also not significant, $t(38) = .02$, $p = .98$. Paired-samples t-tests showed a significant difference in SCFQ scores across time-point for the defusion condition, $t(19) = 3.99$, $p < .001$, and the distraction condition, $t(19) = 2.53$, $p = .02$. Given the larger change in SCFQ score in the defusion condition, these findings suggest that the significant interaction occurred because the main effect for time was more pronounced in the defusion condition.

4.6.3. Believability of thoughts

Results from the mixed ANOVA indicated that there was no significant main effect for intervention, $F(1, 38) = .05$, $p = .83$. There was a significant within-group difference for time-point, $F(1, 38) = 71.13$, $p < .001$, in which pre-intervention believability of thoughts scores were significantly higher than post-intervention believability of thoughts scores. Results indicated that there was a significant interaction between time-point and intervention, $F(1, 38) = 8.43$, $p < .01$. Further exploration of this interaction revealed no significant differences in believability of thoughts in respect of intervention for pre-intervention believability of thoughts scores, $t(38) = .73$, $p = .47$, or for post-intervention believability of thoughts scores, $t(38) = -.93$, $p = .36$. Paired-samples t-tests showed a significant difference in believability of thoughts scores across time-point for the defusion condition, $t(19) = 9.04$, $p < .001$, and the distraction condition, $t(19) = 3.55$, $p < .01$. These findings indicate that although there was a greater reduction in believability scores in the defusion condition than in the distraction condition (based on the mean scores shown in Table 3), this difference was not significant, and therefore the interaction effect was more strongly determined by the changes in believability score in both conditions, than any differences between conditions.

4.6.4. Relationships between the SCFQ and believability of thoughts measure

Given that thought believability is treated as a proxy for fusion in the ACT literature, we hypothesised that pre-intervention scores on the SCFQ and the believability of thoughts scale would be highly, positively correlated. However, this was not the case ($r = -.01$. $p =$

.96). Additionally, we hypothesised that pre to post change scores on both measures would be correlated and this hypothesis was supported (r = .62, p < .001).

5. Study 3: Comparing the CFQ and the SCFQ as measures of cognitive fusion in relation to a brief defusion intervention

The results of Study 2 indicate that the SCFQ is sensitive to changes in cognitive fusion arising from brief intervention components. However, if it is no more sensitive under these conditions than the original CFQ, there would be little point in carrying out further validation research on the measure, or using it in these kinds of experiments, given the extensive evidence of psychometric robustness already available for the CFQ. Therefore, Study 3 directly compared the ability of the SCFQ and the CFQ to detect changes in cognitive fusion related to a brief defusion exercise.

5. 1. Participants and setting

Participants (N = 39), were recruited in the same way as for Study 2. The sample comprised 28 female students (72%), 11 male students (28%), and no non-binary students. Participants' ages ranged from 18 to 25 years (M = 20.67, SD = 1.60). The ethnic composition of the sample was as follows: 89.7% (n = 35) identified as "White-British," and the remaining 10.3% (n = 4) identified as "White-American," "Black/Black British-African," or "Any other Asian Background."

5.2. Experimental design

Participants were randomly assigned to one of two conditions: fusion measured by the CFQ, or fusion measured by SCFQ. For both conditions, fusion data were collected pre and post a brief defusion exercise.

5.3. Measures

1. State Cognitive Fusion Questionnaire (SCFQ)
2. Cognitive Fusion Questionnaire (CFQ; Gillanders et al, 2014)
3. Believability of thoughts visual analogue scale
All measures described earlier.

5.4. Procedure

The procedure for this study was the same as the defusion condition of Study 2. Participants were randomly assigned to measurement condition prior to intervention. They then completed their assigned measure, undertook the defusion intervention and then repeated the measure. All participants were debriefed. In total the procedure took 40 minutes.

5.4.1. Thought selection and assessment

This aspect of the study was identical to Study 2.

5.4.2. Intervention

All participants listened to the same audio recording of the 'Leaves on a stream' defusion exercise, outlined in Study 2. This involved a rationale for why the defusion exercise might be beneficial, a chance to practice defusion with thoughts in general, and then a brief practice with their negative self-referential word.

5.5. Statistical analysis

An independent-samples t-test was conducted to compare mean CFQ pre to post difference score with mean SCFQ pre to post difference score. Similarly, an independent-samples t-test was conducted to compare the mean thought believability pre to post difference scores from the two groups.

5.6. Results

Mean and standard deviations for pre- and post-intervention CFQ, SCFQ, and believability of thoughts scores are presented in Table 4. It can be seen that there was a larger reduction in SCFQ score than CFQ score, following the defusion intervention. Pre to post difference scores were calculated by subtracting the post score from the pre score, for each participant, for the CFQ and SCFQ (see Table 4). An independent-samples t-test yielded a significant difference between pre to post difference scores for the CFQ and the SCFQ conditions, $t(37) = 3.36$, $p = .002$. This difference represents a large effect size ($d = 1.09$) and indicates that a larger change in SCFQ score occurred pre to post the brief defusion intervention, compared to change in CFQ score. Pre to post difference scores were also calculated for believability of thoughts scores in the two groups and the means for these were also compared using an independent-samples t-test. The results were non-significant ($t(37) = -.17$, $p = .87$), suggesting that the differences between the pre to post change scores for the CFQ and the SCFQ were unlikely to be a result of different group responses to the defusion

exercise. These findings therefore indicate that the SCFQ is more sensitive than the CFQ in terms of detecting changes in cognitive fusion over a short period of time, in relation to a brief defusion component.

INSERT TABLE 4 ABOUT HERE

6. Discussion

These studies indicate that the SCFQ is a psychometrically sound adaptation of the CFQ, sensitive enough to detect changes in cognitive fusion following brief defusion interventions, and significantly more sensitively than the original. Like the CFQ, it consists of items that address thinking in general as opposed to specific cognitive content, which gives it broad research utility.

With the current sample the SCFQ demonstrated excellent internal reliability and adequate test-retest reliability. Test-retest reliability tends to be modest in state measures because of their high sensitivity. In fact, the SCFQ demonstrated better test-retest reliability than the state scale of the Spielberger State Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs; 1983) and equivalent test-retest reliability to the state version of the PANAS (Watson, Clark, & Tellegen, 1988). The SCFQ also demonstrated the same unifactorial structure as the CFQ.

The SCFQ related to several relevant variables in predicted ways, included measures of psychopathology, life satisfaction, and experiential avoidance. Conversely, the SCFQ did not significantly relate to socially desirable responding, indicating divergent validity. Overall, this preliminary work suggests that the SCFQ is a valid measure of cognitive fusion.

In experimental preparations, the measure demonstrated the capacity to detect changes in fusion and outperformed the CFQ in this respect. This is important because currently the majority of studies of this type use a visual-analogue scale measuring believability of thoughts as a proxy for fusion. These types of scales have not been subjected to psychometric testing, and only address a single aspect of the broad construct of cognitive fusion. Interestingly, in Study 2, prior to intervention, there was no relationship between the SCFQ and the thought believability scale. It is possible that, at least in part, this might be due to the different response formats of the two measures. It may also be the case, however, that prior to engaging in a defusion exercise, fusion and believability are not strongly associated,

which raises questions about these two constructs, both in terms of theory and measurement. It was demonstrated however, that there was a significant relationship between pre to post change scores for the two measures, suggesting that in assessing the magnitude of changes, these two measures are related, though still not identical in what they measure. Taken together, these findings raise the possibility that the relationship between cognitive fusion and thought believability is not as straightforward as the common use of thought believability as a proxy for fusion might suggest. The development of the SCFQ will allow further investigation of this relationship.

Clearly, visual analogue thought believability scales have research utility, as the findings of several published studies (e.g., Masuda et al., 2010), and Studies 2 and 3 of this paper, can attest. However, the findings of the current studies suggest that it may not be ideal to use a measure of thought believability in experiments designed to shed light on fusion. It may be that the SCFQ can bring more theoretically consistent measurement of fusion to laboratory studies.

Experimental research conducted under laboratory conditions plays an essential role in testing models and developing interventions. In relation to ACT and its model, this work has to some extent been hindered by the lack of a psychometrically sound fusion measure, sensitive enough to detect changes in the process over short time periods. The SCFQ has the potential to allow more theoretically coherent measurement of fusion under these conditions, and thus to make a significant contribution to understanding of the role of fusion and the impact of defusion interventions. Such research could for instance begin to experiment with different types of defusion interventions to assess their relative effects. This strand of laboratory research could gather data on the essential components required of a defusion exercise. Other studies could also examine the properties of particular stimuli involved in such experiments – are certain types of content more resistant to defusion interventions than others? Are additional processes needed to enhance psychological flexibility around such content? Finally, the SCFQ could be used to assess the impact of materials such as audio exercises created for a clinical trial, prior to trial delivery.

In addition, cognitive fusion is one of six interdependent and overlapping processes, in the psychological flexibility model. Developing the CFQ has shown both the independent and combined effects of the process of fusion on a range of other variables. Development of specific state versions of measures, where possible, may allow such explorations of briefer

effects in laboratory simulations. Crucially, these kinds of experiments allow experimental manipulation of the independent variable (e.g. cues that signal a context of fusion or defusion) and the SCFQ appears to have satisfactory measurement properties to function well as a dependent variable in such experiments. It would also be of interest, given the overlapping nature of the model, to manipulate the independent variable in other ways (e.g. cues to create a valuing context, cues to create an avoidant context) and determine if such manipulations also produce effects on the SCFQ. Such work would be enhanced if other state measures of psychological flexibility processes were also available, in similarly brief and psychometrically adequate formats.

Moreover, when therapists use typical ACT intervention strategies, they rarely target a single process: The ACT classic 'Leaves on a Stream" exercise (Hayes, Strosahl & Wilson, 2012, p. 255), for example contains processes of present moment awareness, willingness, and defusion, as well as commitment to sticking with the exercise, which therapists most likely introduce using the valued context of the recipients' growth or skill development. Thus, state measures of psychological flexibility processes (such as the SCFQ) could be used to assess which processes are most targeted during which elements of a multi component intervention exercise. Again, such investigations would also be enhanced if state measures existed of the other processes.

Additionally, the SCFQ could support research addressing the relationship between ACT and Relational Frame Theory (Hayes, Barnes-Holmes, & Roche, 2001). For example, the SCFQ could be used to examine the impact on fusion of the kinds of distinction and hierarchical self-as-context interventions outlined by Luciano et al., (2011). This appears to be an active area of research, with several relevant papers being published recently (Foody, Barnes-Holmes, Barnes-Holmes, & Luciano, 2013; Foody, Barnes-Holmes, Barnes-Holmes, Rai, & Luciano, 2015; Gil-Luciano, Ruiz, Valdivia-Salas, & Suárez-Falcón, 2017; López-López, & Luciano, 2017). Again, these translational studies have typically used the proxy fusion measure of believability of thinking. Adoption of the SCFQ could make a significant contribution to this type of research by providing a psychometrically sound measure of one of the key processes involved.

Several limitations of the current research should be considered. All three studies were based on predominantly student, non-clinical samples, that included an over-representation of female participants and those identifying as being from white ethnic

backgrounds, and all participants were United Kingdom residents. Findings should be replicated with more diverse populations, including those from clinical and occupational settings.

Study 1 provided preliminary evidence of validity, but incremental validity of the SCFQ has not yet been tested, and more broadly, relationship to many important constructs is yet to be examined. Similarly, the findings of Studies 2 and 3 indicate the SCFQ may have utility in terms of measuring changes in fusion over short periods of time, but the performance of the SCFQ will need to be further tested in a range of experiments, with different study designs and populations, before it can be considered a measure with broad experimental applicability. To give just one example, currently the SCFQ has only been used to measure changes in fusion relating to the 'Leaves on a stream' defusion exercise. Many fusion-focussed experiments are based on the 'Milk milk milk' exercise, so it will be important to establish the measure's utility in relation to this and other defusion interventions.

Given the current over-reliance on psychometrically untested measures of proxy variables in fusion-focussed experimental studies, the SCFQ may significantly improve the quality of this type of research. The SCFQ is brief and easy to administer, and it is worded generally rather than in relation to one specific aspect of fusion or specific cognitive content. As such, it could have a wide range of uses. In summary, initial indications are that the SCFQ is a valid, reliable state measure of cognitive fusion, with the potential particularly to support research focussing on changes in fusion over short periods of time.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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Table 1

Model Fit Indices for a Unifactorial Confirmatory Factor Analysis

	χ^2	df	p-value	Normed χ^2	CFI	TLI	RMSEA	SRMR
SCFQ	23.47	14	.053	1.68	.996	.994	.047	.014
Criteria			ns*	<3	>.95	>.95	<.06	<.08

Table 2

Zero order correlations between the SCFQ and other study variables (N = 308).

	Measure						
	CFQ	BDI-II	PANAS Negative	PANAS Positive	SWLS	BEAQ	BIDR-IM
SCFQ	.78	.67	.52	-.39	-.55	.40	-.10

Note. All correlations significant at $p < .001$ level (2-tailed) except BIDR which is non-significant ($p = .09$)

SCFQ = State Cognitive Fusion Questionnaire; CFQ = Cognitive Fusion Questionnaire; BDI-II = Beck Depression Inventory; PANAS negative = Negative subscale of the Positive and Negative Affect Scale; PANAS positive = positive subscale of the Positive and Negative Affect Scale; SWLS = Satisfaction with Life Scale; BEAQ = Brief Experiential Avoidance Questionnaire; BIDR = Balanced Inventory of Desirable Responding - Impression Management subscale.

Table 3

Means and standard deviations of outcome variables, pre- and post-interventions.

	Cognitive Defusion (n = 20)	Thought Distraction (n = 20)	Total (n = 40)
Cognitive Fusion (SCFQ)			
Pre-intervention	25.20 (10.66)	20.05 (6.75)	22.63 (9.19)
Post-intervention	16.75 (7.27)	16.70 (7.13)	16.73 (7.11)
Believability of thoughts			
Pre-intervention	77.20 (11.59)	74.00 (15.84)	75.60 (13.80)
Post-intervention	60.70 (14.86)	65.95 (20.56)	63.33 (17.91)

Note: SCFQ=State Cognitive Fusion Questionnaire

Table 4

Means and standard deviations of CFQ, SCFQ, and believability, pre- and post-intervention.

	CFQ Condition		**SCFQ Condition**	
	CFQ (n = 19)	Believability (n = 19)	SCFQ (n = 20)	Believability (n = 20)
Pre-intervention	21.37 (7.72)	76.32 (13.23)	25.20 (10.66)	77.20 (11.60)
Post-intervention	20.42 (8.55)	59.21 (14.36)	16.75 (7.27)	60.70 (14.87)
Difference score	.95	17.11	8.45	16.50

Note: CFQ= Cognitive Fusion Questionnaire; SCFQ= State Cognitive Fusion Questionnaire; Believability= Believability of thoughts

Appendix: SCFQ

Below you will find a list of statements. Please rate how true each statement is for you at this moment, by circling a number next to it. Use the scale below to make your choice.

1	2	3	4	5	6	7
Completely untrue	**Very untrue**	**Somewhat untrue**	**Neither true nor untrue**	**Somewhat true**	**Very true**	**Completely true**

1. My thoughts are causing me distress or emotional pain	1	2	3	4	5	6	7
2. I am so caught up in my thoughts that I don't know what to do	1	2	3	4	5	6	7
3. I am over-analysing the situation to the point where it's unhelpful to me	1	2	3	4	5	6	7
4. I am struggling with my thoughts	1	2	3	4	5	6	7
5. I am upset with myself for having certain thoughts	1	2	3	4	5	6	7
6. I am very entangled in my thoughts	1	2	3	4	5	6	7
7. It's such a struggle to let go of upsetting thoughts even though I know that letting go would be helpful	1	2	3	4	5	6	7

Thank you for completing this questionnaire