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ORIGINAL ARTICLE

The Cognitive Flexibility Inventory: Instrument Development and Estimates of Reliability and Validity

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Abstract The cognitive flexibility inventory (CFI) was developed to be a brief self-report measure of the type of cognitive flexibility necessary for individuals to successfully challenge and replace maladaptive thoughts with more balanced and adaptive thinking. It was designed to measure three aspects of cognitive flexibility: (a) the tendency to perceive difficult situations as controllable; (b) the ability to perceive multiple alternative explanations for life occurrences and human behavior; and (c) the ability to generate multiple alternative solutions to difficult situations. The two studies presented in this manuscript describe the initial development of the CFI and a 7-week longitudinal study. Results from these studies indicate the CFI has a reliable two-factor structure, excellent internal consistency, and high 7-week test–retest reliability. Preliminary evidence was obtained for the CFI's convergent construct validity via the CFI's correlations with other measures of cognitive flexibility (Cognitive Flexibility Scale) and coping (Ways of Coping Checklist-Revised), respectively. Support was also demonstrated for the concurrent construct validity of the CFI via its correlation with the BDI-II. Further research is needed to investigate the reliability and validity of the CFI among clinical populations.

Keywords Cognitive flexibility · Cognitive flexibility inventory (CFI) · Coping · Cognitive behavior therapy (CBT) · Depression

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Introduction

Depression is one of the most commonly experienced psychological disorders throughout the world (Young et al. 2001). Depression ranked as the fourth most costly of all the illnesses worldwide in 1990, and by 2010 it is predicted to be ranked second (Keller and Boland 1998). According to the National Comorbidity Survey (Kessler et al. 1994), the lifetime prevalence rate of depression is 17% in the United States. Further, approximately 1 in 10 adult Americans are diagnosed with depression each year. Based on estimates provided by the National Institute of Mental Health (NIMH 1999), this indicates that more than 19 million Americans experience major depression each year.

Cognitive behavioral therapy (CBT) is the most empirically tested and supported psychotherapy for depression currently available (Young et al. 2001). A fundamental principle of CBT is that depression is most effectively treated with interventions geared toward breaking down automatic maladaptive cognitions and replacing them with more realistic, adaptive cognitions (Young et al. 2001). Depressed individuals are taught to disconfirm their maladaptive cognitions (e.g., automatic negative thoughts) by recognizing the faulty reasoning in which the cognitions are based. As depressive cognitions are changed, it is expected that the characteristic mood and behaviors of depression will also change. More precisely, as cognitions become more adaptive, it is expected that depressed mood will be alleviated and that the overall level of functioning will increase (Hollon et al. 1996).

Although the exact mechanisms through which CBT brings about a positive change in depression remains an area of much research and debate (DeRubeis et al. 1990; Hayes and Strauss 1998), preliminary research has supported the connection between increases in cognitive

flexibility and the reduction of depressive symptomatology (Dennis and Vander Wal 2009b; Fresco et al. 2007a, b; Teasdale et al. 2001). According to cognitive behavioral theories of depression (Young et al. 2001) depressed individuals are characterized by extreme rigidity in their thinking. They tend to have dichotomous, all-or-nothing thinking styles. It has been suggested that such rigidity actually promotes the acceptance of maladaptive beliefs, and in turn, causes these beliefs to become more automatic, thus maintaining the depressed state (Moore 1996; Teasdale et al. 1995).

Defining Cognitive Flexibility

The construct of cognitive flexibility has been well researched. A keyword search on the PsycINFO database using the term *cognitive flexibility* produced over eight hundred results. Currently, however, there is no consensus within the literature about precisely how to define or measure this construct. Generally speaking, the ability to switch cognitive sets to adapt to changing environmental stimuli appears to be the core component for most operational definitions of cognitive flexibility. Consequently, it is the specific way proficiency with switching cognitive sets is assessed that differentiates among the various measures of cognitive flexibility. The instruments used to measure cognitive flexibility are quite diverse. Included among them are numerous performance-based measures such as the Stroop Color and Word Test (Golden 1975), Trail Making Test Part B (TMT; Reitan and Wolfson 1993), Wisconsin Card Sorting Test (WCST; Berg 1948), and a limited number of self-report measures such as the Alternate Uses Test (Wilson et al. 1975), Attributional Style Questionnaire (ASQ; Peterson et al. 1982) and Cognitive Flexibility Scale (CFS; Martin and Rubin 1995).

As mentioned above, it has been theorized that rigid cognitive styles characteristic of depression may reinforce the depressed state by creating a bias toward the automatic acceptance of maladaptive beliefs (Moore 1996; Teasdale et al. 1995). Consequently, teaching depressed individuals to become more cognitively flexible and balanced in their thinking via instruction using automatic thought challenging techniques may decrease the rigidity that is thought to reinforce the depressed state. In other words, increasing an individual's cognitive flexibility may be a mechanism of change through which CBT brings about a positive change in depression. It does not appear that any existing measures of cognitive flexibility have been specifically developed to measure the type of cognitive flexibility that is targeted by many cognitive behavioral interventions. How much existing measures of cognitive flexibility actually tap into this aspect of cognitive flexibility is unclear.

Significant practical limitations also reduce the clinical utility of many established measures of cognitive flexibility. The majority of these measures are time consuming to administer and score, prone to practice effects, and/or require interactive relationships between test administrator and test taker (e.g., Alternate Uses Test, Stroop Color and Word Test, ASQ, TMT, WCST). These limitations often make it impractical to utilize these measures repeatedly in the measurement of treatment outcomes, which would be necessary to investigate whether they can measure the shifts in cognitive flexibility displayed by individuals becoming proficient with cognitive behavioral thought challenging techniques. Additionally, many of the performance-based measures of cognitive flexibility such as the WCST, TMT, and Stroop Color and Word Test define cognitive flexibility according to a behavioral response—the extent to which an individual displays perseverative responding on tasks requiring the changing of mental sets in response to concrete novel stimuli. The degree of similarity between this type of cognitive flexibility and the flexibility in abstract thinking required to challenge and restructure maladaptive thoughts is uncertain. Perhaps the cognitive flexibility measured by set shifting tasks is more trait like and/or indicative of organic brain abnormalities, while the cognitive flexibility required to restructure maladaptive thoughts is more state like and reactive to affective states.

Self-report measures are often more practical for use within treatment outcome literature given their brevity and ease of adminstration and scoring. However, it does not appear that any existing self-report measures of cognitive flexibility/rigidity have been specifically developed to measure the type of cognitive flexibility underlying proficiency with thought challenging techniques utilized in cognitive behavioral treatments for depression and other psychopathology. For example, the CFS, which is a 12-item self-report measure of cognitive flexibility, was developed to measure aspects of cognitive flexibility considered to be necessary for effective communication, or what the authors refer to as *communication competence* (Martin and Rubin 1995). Each item on the questionnaire consists of a statement dealing with beliefs and feelings about behavior. Respondents indicate their agreement or disagreement with each item by using a 6-point Likert scale with response options ranging from *Strongly Disagree* (1) to *Strongly Agree* (6). Test constructors reported evidence of adequate internal consistency for the questionnaire across two studies ($\alpha = .76$–$.77$) and high test–retest reliability for 1 week (.83; Martin and Rubin 1995).

Three areas of cognitive flexibility are assessed on the CFS: awareness of communication alternatives (e.g., "I can communicate an idea in many different ways"), willingness to adapt to the situation (e.g., "I am willing to listen

and consider alternatives for handling a problem"), and self-efficacy in being flexible (e.g., "I can find workable solutions to seemingly unsolvable problem"). Cognitive flexibility in these areas is considered to be an essential component of interpersonal communication competence and has been shown to be associated with communication assertiveness and responsiveness (Martin and Anderson 1998). Based on the theory underlying the CFS, individuals competent in their interpersonal communication are more likely to be successful in achieving their personal goals without interfering with long-term relational goals or the goals of other individuals. It appears reasonable to predict that such individuals might be less susceptible to depression; however, it remains unclear whether this might be because their proficiency and flexibility with social communication, as measured by the CFS, would be similar to the type of cognitive flexibility needed to successfully challenge and replace maladaptive cognitions with more balanced thinking.

The ASQ, which is another self-report measure utilized to measure cognitive flexibility, was originally developed as a measure of attributional style, or the tendency to attribute certain causal explanations to good and bad events (ASQ; Peterson et al. 1982). It contains 48 items and respondents are instructed to "vividly imagine" experiencing 12 hypothetical situations (6 positive and 6 negative). Half of the situations are achievement related and half are related to interpersonal events. For each situation, respondents are asked to write down what they feel is the major cause for that situation. Respondents then use a 7-point Likert scale (1–7) to answer three questions about the cause and one question about the situation. Test constructers (Peterson et al. 1982) report adequate internal consistency for the ASQ ($\alpha = .72$–$.75$) and adequate test–retest reliability for 5 weeks (.67). Research by Teasdale et al. (2001) has defined cognitive rigidity on the ASQ as extreme scores on the Likert scale (responding with a 1 or 7). Research by Fresco et al. (2007a, b), however, has defined cognitive flexibility on the ASQ according to how cognitively rigid or flexible individuals are in attributing causes to good and bad events.

Given the ASQ's 48-items and inclusion of items with open-ended response options, it is similar to other performance-based measures of cognitive flexibility in that it is time consuming, requiring an estimated 15–20 min to administer, score, and interpret (Dennis and Vander Wal 2009b). As with existing measures of cognitive flexibility, it is possible that the ASQ does assess the type of cognitive flexibility targeted by many cognitive behavioral thought-challenging interventions. However, the use of the ASQ would be less practical than briefer self-report measures for the repeated and frequent use within treatment outcome research, which would be necessary to more directly investigate this question. Nonetheless, research is needed to address this issue and to explore whether the ASQ, along with other existing measures of cognitive flexibility, can assess the type of flexible thinking necessary to successfully challenge and restructure maladaptive cognitions.

The purpose of the present research was to develop the cognitive flexibility inventory (CFI). The CFI was developed to be a brief self-report measure that could be administered repeatedly throughout a research investigation or therapeutic intervention in order to monitor the levels of cognitive flexibility evidenced by individuals engaged in cognitive behavioral thought challenging interventions. More specifically, the CFI was developed to measure aspects of cognitive flexibility that enable individuals to think adaptively rather than maladaptively when encountering stressful life events. Three aspects of cognitive flexibility were hypothesized to be necessary for this: (a) the tendency to perceive difficult situations as controllable; (b) the ability to perceive multiple alternative explanations for life occurrences and human behavior; and (c) the ability to generate multiple alternative solutions to difficult situations. Individuals possessing cognitive flexibility in these areas may be more likely to react adaptively in response to encountering difficult life experiences, while cognitively inflexible individuals who lack these skills may be more susceptible to experiencing pathological reactions in response to these experiences.[1]

The constructs of cognitive flexibility the CFS was developed to measure—awareness of communication alternatives, willingness to adapt to the situation, and self-efficacy in being flexible—influenced the development of the CFI. Regarding the former construct, rather than limiting the CFI's focus to the assessment of an awareness of communication alternatives, the goal was to assess a more general awareness of an individual's perceived ability to generate alternative explanations for life events and alternative solutions to difficult situations. It was hypothesized that perceiving only one possible explanation and/or adaptive solution to a difficult situation would make individuals more susceptible to increases in maladaptive thinking/behavior should that one explanation or solution prove faulty or unsuccessful. Whereas the CFS includes items explicitly assessing an individual's willingness to adapt to a situation (e.g., "I am willing to listen and consider alternatives for handling a problem."), the CFI does not, as it was anticipated that the type of cognitive flexibility required to challenge maladaptive cognitions would promote more balanced thinking, which in turn, would be expected to influence more

[1] The potential differences in the coping strategies utilized by cognitively flexible versus inflexible individuals on the CFI in response to life event stress were investigated in research conducted by the present authors (Dennis and Vander Wal 2009b). A manuscript summarizing this research is currently being prepared for publication.

adaptive responding to an ever-changing environment. Unlike the CFS, which appears to assess perceived self-efficacy of both communication competence (e.g., "I can communicate an idea in many different ways.") and problem solving ability (e.g., "I can find workable solutions to seemingly unsolvable problems."), the aim of the CFI's assessment of self-efficacy focused exclusively on the latter. It was hypothesized that individuals lacking hope/confidence about their abilities to resolve their problems would be less likely to consider alternative explanations and/or solutions for difficult situations and more likely to ruminate on this perceive inability to problem solve.

Despite the fact that the CFS was developed to measure the three aspects of cognitive flexibility described above, it does not appear that the CFS was developed to have a multiple factor structure, as an assessment of the CFS' factor structure has not been reported in the literature. Research conducted by the present authors has failed to support a multiple factor structure for the CFS (Dennis and Vander Wal 2009a, b). A major goal in developing the CFI was to create a measure with multiple subscales that reliably and validly measured distinct aspects of cognitive flexibility (*a*, *b*, and *c*) that might have distinct relationships with other psychological constructs such as coping and depression.

Another significant difference between the CFS and CFI is that the CFS includes items that measure both one's attitudes (e.g., "I am willing to listen and consider alternatives for handling a problem.") and behaviors (e.g., "I avoid new and unusual situations."), while the CFI was developed exclusively to measure the former. In support of this, past research has indicated that the relationship between life event stress and depression was best explained by an individual's attitude toward his/her ability to solve problems, rather than his/her actual ability to solve problems (Schur 1999).

The present research describes the development of the CFI. Two studies are presented. The first study describes the development of the CFI's concept map, test map, item map, and content validity analysis. In the second study, a 7-week longitudinal study was conducted and bivariate correlations were utilized to determine the CFI's relationship to more established measures of cognitive flexibility and measures of coping and depressive symptomatology. The goal of this study was to evaluate the CFI's factor structure, internal consistency, test–retest reliability, convergent construct, and concurrent criterion validity.

Method

Institutional review board approval was obtained for the research presented. The first study was conducted to develop items for the CFI. The second study was a 7-week longitudinal study to obtain a preliminary assessment of the CFI's factor structure, reliability, and validity.

Study 1: CFI Item Development & Item Reduction

The goal of this study was to develop items for the CFI that measured three aspects of cognitive flexibility: (a) the tendency to perceive difficult situations as controllable; (b) the ability to perceive multiple alternative explanations for life occurrences and human behavior; and (c) the ability to generate multiple alternative solutions to difficult situations. The instrument development procedures followed are those recommended by Crocker and Algina (2006).

Concept Map

The CFI was developed to measure the type of cognitive flexibility necessary to successfully challenge and restructure maladaptive beliefs with more balanced and adaptive thinking. A broad review was conducted of the research with existing measures of cognitive flexibility and the cognitive behavioral treatment outcome literature to determine ideas for the CFI's concept map. As mentioned above, the aspects of cognitive flexibility measured by the CFS were appealing and significantly influenced the development of the CFI's concept map. The authors theorized that three aspects of cognitive flexibility appeared necessary to demonstrate proficiency with cognitive behavioral thought challenging techniques. First, individuals must perceive that successful resolutions to difficult life situations are possible (see cognitive flexibility aspect *a* above). If they do not, they would be expected to occupy their time coping with negative emotional states and/or ruminating about their helpless states rather than thinking about potential constructive ways to resolve problematic life situations. Second, individuals capable of approaching problems from multiple perspectives (see cognitive flexibility aspect *b* above) would be anticipated to have a better appreciation of factors that lead to the development and maintenance of those problems. Finally, it was considered necessary for individuals to believe that difficult situations could be resolved in more than one way (see cognitive flexibility aspect *c* above). It was anticipated that individuals capable of generating alternative approaches to problem resolution would be more likely to identify and ultimately test more adaptive solutions.

Test Map

The goal in developing the structure for the CFI was to create a brief self-report measure that could be administered repeatedly throughout a research investigation or

therapeutic intervention in order to monitor the shifts in cognitive flexibility that an individual may evidence over time. In accord with the recommendations from Comrey (1988) for the scale length for self-report measures, the target goal was to develop a finalized CFI composed of between 11 and 20 items.

Item Map

Similar to CFS items, CFI items were formatted as declarative statements dealing with beliefs and feelings about behavior for which respondents could indicate their agreement or disagreement. In order to maximize the CFI's ability to reliably distinguish between the levels of cognitive flexibility/rigidity possessed by individuals, a 7-point Likert scale was selected as the response format for the CFI. This provided individuals with a response continuum on which to indicate their agreement or disagreement with the CFI items. Response options ranged from *strongly disagree* (1) to *strongly agree* (7). The scoring procedures specified for the CFI require reverse scoring of select items and then summing the numerical response values to obtain a total score. Higher scores were intended to be indicative of greater cognitive flexibility, which was predicted to be associated with greater cognitive adaptability when encountering stressful situations. Lower scores were intended to be indicative of greater cognitive rigidity, which was predicted to be associated with less cognitive adaptability when encountering stressful situations.

Item Generation

The goal in developing the CFI items was to include items that measured all three types of cognitive flexibility (*a*, *b*, and *c*) that were theorized to be necessary for proficiency with cognitive behavioral thought challenging techniques. The research team responsible for creating the initial CFI item pool consisted of a doctoral level, clinical psychology research supervisor and three clinical psychology doctoral students. All four members of the research team described above independently developed 30 potential CFI items—10 items for each of the three aspects of cognitive flexibility (*a*, *b*, and *c*). The resulting item pool consisted of 120 CFI items—40 items to measure each of the three aspects of cognitive flexibility. Approximately 30% of this initial item pool consisted of items that required reverse coding when being scored.

Content Validity Analysis

Next, a content validity analysis was conducted. Each of the 120 CFI items from the initial item pool was read out loud in random order. Members of the research team independently recorded which of the three aspects of cognitive flexibility (*a*, *b*, or *c*) that they believed the item measured. No communication between team members was permitted at this time. All 120 items were read out loud a second time and now each research team member verbally indicated the aspect of cognitive flexibility they believed that item to be measuring.

Cognitive flexibility inventory items for which interrater reliability was not 100% and items considered to be confusing or awkwardly worded were eliminated from the initial item pool. Items determined to be too similar were also eliminated. At the conclusion of the content validity analysis, 50 CFI items were retained from the initial 120-item pool and this 50-item CFI became the initial version of the CFI. An analysis of the readability statistics of the 50-item CFI was conducted using *Microsoft Office* 2004. The *Flesh-Kincaid* grade level for the CFI was 5.5, indicating that the CFI items require respondents to possess close to a sixth grade reading ability.

Study 2: Item Reduction, Reliability & Validity

A 7-week longitudinal study pilot study (Dennis and Vander Wal 2009b) was conducted with the CFI to obtain a preliminary assessment of the 50-item CFI's factor structure, internal consistency, concurrent construct validity, and convergent and discriminant construct validity. Psychometric data on the CFI was obtained to determine if there was sufficient variation in responses to CFI items to justify further testing of the CFI in future research. An additional goal was to assess the temporal stability of the CFI and its two-factor structure.

Method

Participants and Procedure One hundred and ninety-six undergraduates (mean age = 20.20 ± 1.05 years, 75% female) from a private Midwestern university participated in a group questionnaire session during the fall semester of the 2005–2006 academic year. The majority of participants were Caucasian (81%), female (75%), and in their junior or senior years of college (73%). Students earned course extra credit for their participation. They were recruited via the university's online experiment recruitment website. During the group questionnaire session, participants completed a demographics questionnaire, the 50-item CFI, ASQ, Beck Depression Inventory—Second Edition (BDI-II; Beck et al. 1996); CFS, and Ways of Coping Checklist-Revised (WCCL-R; Folkman and Lazarus 1985). A validity check was included at the end of the questionnaire packets to assess the integrity of the responses. The questionnaire session required approximately 35 minutes to complete.

All 196 students who participated in the first group questionnaire session (Time 1) were invited to return for a second group questionnaire session (Time 2) 7 weeks later. They earned additional course extra credit for their participation in this second questionnaire session. One hundred and fifty-two of these participants (mean age = 20.36 ± .96 years, 74% female) returned for the second questionnaire session. This was a return rate of 78%. The majority of participants were Caucasian (81%), female (75%), and in their junior or senior years of college (78%). Participants completed the same measures at Time 2 that they did at Time 1. They were assigned unique identifying codes to ensure that their responses remained confidential but could be matched across testing sessions.

Measures *50-Item CFI* The 50 CFI items retained after the content validity analysis described above were administered. A detailed description of this 50-item CFI has been provided above.

Attributional Style Questionnaire (ASQ) A description of the ASQ has been provided above. In the current research, cognitive flexibility was measured on the ASQ as measured by Teasdale et al. (2001), such that extreme scores on the ASQ's Likert scale (responding with a 1 or 7) were indicative of cognitive rigidity.[2] More extreme responding was considered indicative of less cognitive flexibility.

Beck Depression Inventory-Second Edition (BDI-II; Beck et al. 1996) The BDI-II is a 21-item self-report questionnaire designed to measure cognitive, somatic, and behavioral aspects of depression. Respondents are instructed to choose one statement from the four listed beneath each item that best describes the way they have been feeling during the past 2 weeks, including that day. Each item is scored from 0 to 3, with higher scores indicating more serious depressive symptoms; the range of scores is 0–63. Test constructors reported evidence of excellent internal consistency for the BDI-II ($\alpha = .92$) as well as high 1-week test–retest reliability ($r = .93$) when used with a sample of college students (Beck et al. 1996).

Cognitive Flexibility Scale (CFS) Higher scores on the CFS are indicative of greater cognitive flexibility. A detailed description of the CFS has been provided above.

Ways of Coping Checklist-Revised (WCCL-R; Folkman and Lazarus 1985) The WCCL-R is a self-report measure of coping derived from Lazarus' transactional model of stress. It contains 67 items that describe a broad range of cognitive and behavioral strategies people use to manage internal and/or external demands in specific stressful encounters. Respondents use a 4-point Likert scale (0 = *does not apply and/or not used*; 1 = *used somewhat*; 2 = *used quite a bit*; 3 = *used a great deal*) to indicate how often each item was or was not used in a specific stressful encounter. A factor analysis of the 67 WCCL-R items yielded eight factors: Problem-Focused Coping (PFC; $\alpha = .88$); Wishful Thinking (WT; $\alpha = .86$); Detachment (DT; $\alpha = .74$); Seeking Social Support (SSS; $\alpha = .82$); Focusing on the Positive (FOP; $\alpha = .70$); Self-Blame (SB; $\alpha = .76$); Tension Reduction (TR; $\alpha = .59$); and Keep to Self (KTS; $\alpha = .64$).[3]

Results

Time 1 Data Analysis An exploratory factor analysis (EFA) was conducted with the 50 CFI items using *SPSS* (*Version 13*) to determine the factor structure of the CFI. A *Principal Axes* extraction method was utilized because this type of extraction does not require multivariate normality. An oblique rotation was utilized, as it was anticipated that the hypothesized factors of the CFI would be correlated. A *Promax* rotation with Kaiser normalization was specified. Cattell's (1966) scree test was used to determine the number of factors that best described the CFI and determined that a two-factor solution best described the CFI. This two-factor solution accounted for 39% of the total variance in the CFI items. For comparison purposes, the factor solution of CFS was also tested via Cattell's scree test. Results indicated that a one-factor solution best described the CFS.

The following categories described by Comrey and Lee (1992) were used to interpret EFA CFI factor loadings: ≥.71 is *excellent*; .63–.70 is *very good*; .55–.62 is *good*; .45–.54 is *fair*; and ≤.44 is *poor*. Fourteen CFI items had *poor* factor loadings on the two factors specified by the scree plot and were eliminated from further analyses. Thirty-six CFI items had *fair* to *excellent* factor loadings (range = .47–.85, mean = .64) on either the first or second factor. Nine of these items had unacceptable cross loadings between the two factors and were eliminated from further analyses. A statistical summary of the results from the EFA conducted with the CFI is provided in Appendix Table 1. Fifteen of the remaining 27 CFI items with acceptable factor loadings had *fair* to *excellent* factor loadings

[2] The ASQ could not be utilized as a measure of cognitive flexibility/explanatory flexibility utilizing scoring guidelines by Fresco et al. (2007a, b), as the open-ended responses of participants on the ASQ, which are necessary for such scoring, had not been recorded.

[3] For a more detailed description of the WCCL-R subscales, see Folkman and Lazarus (1985). The internal consistency reliability for the TR and KTS subscales was low, likely due to the fact that each subscale was composed of only three items. Despite this, these subscales were included in the present analyses to maximize the ability to detect preliminary evidence supporting distinct relationships between aspects of cognitive flexibility and particular coping styles.

(range = .47–.83, mean = .64) on the first factor specified by the scree plot and 12 items had *fair* to *excellent* factor loadings (range = .51–.85, mean = .62) on the second factor specified by the scree plot.

Time 2 Data Analysis A second EFA was conducted on the 50-item CFI at Time 2 to determine the extent to which the factor structure obtained at Time 1 would replicate. Although the same sample was used at Time 1 and Time 2, and thereby increased the chances of obtaining the same factor solution, a failure to demonstrate the same factor solution across time points would bring the factor solution into question. Using the same procedures described above, a similar two-factor solution was achieved. A statistical summary of the results from the EFA is provided in Appendix Table 1.

Results from the Time 2 EFA conducted with the CFI were compared to the results from the EFA conducted at Time 1. Only CFI items with acceptable factor loadings on the *same two factors* at both time points were retained for the final version of the CFI. Thirteen of fifteen CFI items that had acceptable factor loadings on the *Alternatives* subscale at Time 1 also had acceptable factor loadings on this subscale at Time 2 (range = .47–.83, mean = .66). All thirteen of the CFI items loading on the *Alternatives* subscale at both Time 1 and Time 2 had been originally developed to assess cognitive flexibility aspects *b* and *c* (see above). This first factor was named the *Alternatives* scale. Seven of the twelve CFI items that had acceptable factor loadings on the *Control* subscale at Time 1 also had acceptable factor loadings on this subscale at Time 2 (range = .52–.78, mean = .66). Five of the seven CFI items loading on the *Control* subscale at both Time 1 and Time 2 had been originally developed to assess cognitive flexibility aspect *a* (see above). This second factor was named the *Control* scale. The final version of the CFI at Time 2 was therefore composed of 20 items—13 items on the *Alternatives* subscale and seven items on the *Control* subscale (see "Appendix 2").

Psychometric Properties of the 20-Item CFI The finalized version of the CFI was composed of 20 CFI items with acceptable factor loadings at both Time 1 and Time 2. This 20-item CFI will subsequently be referred to as the CFI. The psychometric properties of the CFI and its two subscales were then investigated. Alpha levels, as indexed by Chronbach's alpha, for the *Alternatives* subscale (Time 1 = .91; Time 2 = .91), *Control* subscale (Time 1 = .86; Time 2 = .84), and CFI (Time 1 = .90; Time 2 = .91) ranged from good to excellent. For comparison purposes, the alpha levels for the CFS and ASQ were .79 and .87 at Time 1 and .78 and .70 at Time 2, respectively. The mean total scores for the CFI were 102.98 (SD = 13.91) at Time 1 and 105.38 (SD = 13.84) at Time 2. The mean total scores for the *Alternatives* subscale were 67.59 (SD = 9.41) at Time 1 and 69.41 (SD = 9.40) at Time 2. The mean total scores for the *Control* subscale were 35.36 (SD = 7.02) at Time 1 and 35.92 (SD = 6.77) at Time 2. Bivariate correlations were conducted and indicated the following. The CFI was significantly correlated with the *Alternatives* subscale at Time 1 ($r = .89$, $p < .001$) and Time 2 ($r = .90$, $p < .001$) and the *Control* subscale at Time 1 ($r = .79$, $p < .001$) and Time 2 ($r = .80$, $p < .001$). The *Alternatives* and *Control* subscales were significantly correlated at Time 1 ($r = .41$, $p < .001$) and Time 2 ($r = .45$, $p < .001$). Bivariate correlations conducted across Time 1 and Time 2 indicated high 7-week test–retest reliability for the CFI ($r = .81$; $p < .001$), *Alternatives* subscale ($r = .75$; $p < .001$), and *Control* subscale ($r = .77$; $p < .001$). For comparison purposes, the 7-week test–retest reliability was .73 for the CFS and .72 for the ASQ.

Evidence for convergent construct validity of the CFI was obtained via the CFS' significant correlations with the CFI at Time 1 ($r = .73$, $p < .001$) and Time 2 ($r = .75$, $p < .001$), the *Alternatives* subscale at Time 1 ($r = .58$, $p < .001$) and Time 2 ($r = .62$, $p < .001$), and *Control* subscale at Time 1 ($r = .65$, $p < .001$) and Time 2 ($r = .66$, $p < .001$). These correlations indicated that greater cognitive flexibility on the CFI and its subscales was associated with greater cognitive flexibility on the CFS. The ASQ's significant correlations with the CFI at Time 1 ($r = .26$, $p < .001$) and Time 2 ($r = .18$, $p < .05$), the *Alternatives* subscale at Time 1 ($r = .19$, $p < .05$), and the *Control* subscale at Time 1 ($r = .26$, $p < .001$) and Time 2 ($r = .17$, $p < .05$) were contrary to predictions. These correlations indicated that greater cognitive flexibility on the CFI and its subscales was associated with less cognitive flexibility on the ASQ. The correlation between the ASQ and *Alternatives* subscale at Time 2 ($r = .14$, $p > .05$) was not significant. For purposes of comparison, the correlation between the CFS and ASQ at Time 1 ($r = .33$, $p < .001$) and Time 2 ($r = .28$, $p < .001$) indicated a similar unanticipated association between greater cognitive flexibility on the CFS and less cognitive flexibilty on the ASQ.

Further evidence for the convergent construct validity of the CFI was obtained via examining its correlations with the various subscales of the WCCL-R. A consideration of the larger nomothetical network suggests that cognitive flexibility, as measured by the CFI, should be positively correlated to adaptive forms of coping and inversely correlated with maladaptive forms of coping. Correlations were in the expected directions with significant positive associations evidenced between the CFI and WCCL-R coping subscales considered to be adaptive at Time 1 and

Time 2[4]: Problem-Focused Coping ($r = .48$ and $.49$, $p < .001$), Seeking Social Support ($r = .32$ and $.32$, $p < .001$), and Focusing on the Positive ($r = .39$ and $.32$, $p < .001$), and significant inverse correlations evidenced between the CFI and WCCL-R coping subscales considered to be maladaptive at Time 1 and Time 2: Keep to Self ($r = -.33$ and $-.34$, $p < .001$), Wishful Thinking ($r = -.15$ and $-.24$, $p < .05$), and Detachment ($r = -.23$ and $-.30$, $p < .001$). The correlation between the CFI and Self-Blame was significant at Time 2 ($r = -.20$, $p < .05$) but not Time 1 ($r = -.03$, $p > .05$). The correlation between the CFI and WCCL-R coping subscale Tension Reduction was not significant at Time 1 ($r = .00$, $p > .05$) or Time 2 ($.07$, $p > .05$).

Evidence for the convergent construct validity of the CFI's subscales was also obtained. The CFI's *Alternatives* subscale had significant correlations in the predicted direction at Time 1 and Time 2 with Problem-Focused Coping ($r = .51$ and $.49$, $p < .001$), Seeking Social Support ($r = .37$ and $.39$, $p < .001$), Focusing on the Positive ($r = .38$ and $.35$, $p < .001$), Detachment ($r = -.17$ and $-.20$, $p < .05$), and Keep to Self ($r = -.20$ and $-.28$, $p < .05$), but not Wishful Thinking ($r = -.05$ and $-.09$, $p > .05$), Self-Blame ($r = .11$ and $-.07$, $p > .05$), or Tension Reduction ($r = .09$ and $.07$, $p > .05$). The CFI's *Control* subscale had significant correlations in the predicted direction at Time 1 and Time 2 with Problem-Focused Coping ($r = .26$ and $.33$, $p < .001$), Focusing on the Positive ($r = .24$ and $.22$, $p < .01$), Detachment ($r = -.23$ and $-.32$, $p < .01$), and Keep to Self ($r = -.40$ and $-.31$, $p < .001$), but not Tension Reduction ($r = -.11$ and $.05$, $p > .05$). Unlike the CFI's *Alternatives* subscale, the *Control* subscale had significant correlations in the predicted direction at Time 1 and Time 2 with the WCCL-R subscales Self-Blame ($r = -.22$ and $-.30$, $p < .01$) and Wishful Thinking ($r = -.35$ and $-.35$ $p < .001$), but not Seeking Social Support ($r = .13$ and $.10$, $p > .05$).

Support for the concurrent criterion validity of the CFI was obtained via its significant inverse correlations with the BDI-II at Time 1 ($r = -.39$, $p < .001$) and Time 2 ($r = -.35$, $p < .001$). As hypothesized, greater cognitive rigidity on the CFI was associated with increasing depressive symptomatology on the BDI-II. The correlations between the BDI-II and the CFI's *Alternatives* subscale at Time 1 ($r = -.19, p < .01$) and Time 2 ($r = -.20$, $p < .01$) and the CFI's *Control* subscale at Time 1 ($r = -.50, p < .001$) and Time 2 ($r = -.44, p < .001$) provided further support for the concurrent criterion validity of these subscales. For purposes of comparison, the BDI-II was significantly correlated with the CFS at Time 1 ($r = -.42$, $p < .001$) and Time 2 ($r = -.34$, $p < .001$), but not the ASQ at either Time 1 ($r = -.06$, $p > .05$) or Time 2 ($r = -.02$, $p > .05$).

[4] The first correlation reported refers to the Time 1 correlation and the second correlation reported refers to the Time 2 correlation.

Discussion

The CFI was developed to have a three-factor solution; however, results from the EFAs conducted with the 50-item CFI at Time 1 and Time 2 indicated that a two-factor solution best described the CFI. The ability to perceive multiple alternative explanations for life occurrences and human behavior, and the ability to generate multiple alternative solutions to difficult situations were not distinct constructs as anticipated. Rather, the second factor resulting from the EFA, subsequently named the *Alternatives* subscale, was composed of 13 CFI items designed to measure both aspects of cognitive flexibility without distinguishing between the two. The first factor, subsequently named the *Control* subscale, was composed of 7 CFI items designed to measure the tendency to perceive difficult situations as controllable. EFA results suggest the CFI and its subscales have good to excellent internal consistency reliability.

Evidence was obtained for the concurrent criterion validity of the CFI and its two subscales. As predicted, lower cognitive flexibility on the CFI was associated with greater depressive symptomatology on the BDI-II. Evidence was also obtained for the convergent construct validity of the CFI and its two subscales. The CFI was developed to measure the type of cognitive flexibility that promotes more adaptive functioning/coping in response to encountering difficult life experiences and the rigid thinking styles that tend to be characteristic of depressed individuals. In support of the former, scores indicative of higher cognitive flexibility on the CFI were significantly associated with an increased tendency to utilize coping strategies considered to be adaptive—problem focused coping, focusing on the positive, seeking social support—and the decreased tendency to utilize coping strategies considered to be maladaptive—keeping to self, wishful thinking, and detachment. Support was also obtained for the convergent construct validity of the CFI's *Alternatives* and *Control* subscales, as greater cognitive flexibility on both subscales was associated with an increased tendency to utilize coping strategies considered to be adaptive and the decreased tendency to utilize coping strategies considered to be maladaptive.

It is noteworthy that the *Alternatives* and *Control* subscales had different relationships with WCCL-R coping subscales. For example, although greater cognitive flexibility was significantly associated with an increased tendency to utilize problem focused coping and focusing on the positive, and the decreased tendency to utilize keeping

to self and detachment, greater flexibility on the *Control* subscale but not the *Alternatives* subscale was significantly associated with an decreased tendency to utilize self-blame and wishful thinking. Additionally, greater cognitive flexibility on the *Alternatives* subscale but not the *Control* subscale was significantly associated with the increased tendency to utilize seeking social support as a coping strategy. Perhaps individuals who perceive difficult situations as controllable, and therefore malleable, are more motivated to address difficult situations via more constructive cognition (e.g., problem solving) rather than less constructive cognition such as wishful thinking or ruminative self-blame, which both can be considered types of cognitive avoidance. Additionally, such individuals may not reliably seek social support when faced with difficult situations, as they may at times feel confident enough to address these difficult situations without additional support. Other potential explanations for these findings are possible and need to be explored. Nonetheless, the finding that the CFI's two subscales appear to measure aspects of cognitive flexibility that differentially affect an individual's reaction to experiencing difficult life events provides preliminary support for the clinical utility of the two-factor structure of the CFI.

Evidence of the convergent construct validity of the CFI was evidenced by the significant correlations between the CFI, the *Alternatives* and *Control* subscales, and the CFS. Positive correlations were expected as the CFS is an established measure of cognitive flexibility. Significant shared variance between the CFI and CFS was anticipated, as the constructs the CFS was developed to measure influenced the development of the CFI. More specifically, there may have been some conceptual overlap between the assessment of awareness of communication alternatives and willingness to adapt to the situation on the CFS and the assessment of perceived ability to generate alternative explanations and solutions on the CFI. In addition, there may have been some overlap in self-efficacy of both communication competence and problem-solving ability, as measured by the CFS, and the ability to perceive difficult situations as controllable, as measured by the CFI. However, the moderate magnitude of the correlations between the CFI and CFS reflects that these aforementioned aspects of cognitive flexibility are significantly different.

One argument in favor of utilizing the CFI over the CFS is that higher internal consistency was evidenced for the CFI versus the CFS in the present research.[5] A second argument for utilizing the CFI over the CFS is that the CFI has a reliable two-factor structure, while the CFS has only a one-factor structure. The CFI would therefore be expected to have greater clinical utility than the CFS, as its two-factor structure increases its sensitivity relative to the CFS with regard to discovering potential associations between distinct aspects of cognitive flexibility measured by the CFI's *Alternatives* and *Control* subscales and other constructs. In support of this, results discussed above indicated that the CFI's *Alternatives* and *Control* subscales had significant differences with regard to their associations with WCCL-R coping subscales and the BDI-II.

Contrary to predictions, the correlations between the ASQ and the CFI indicated that greater cognitive flexibility on the CFI and CFS was associated with greater cognitive rigidity on the ASQ. It is important to note that the ASQ shared only minimal variance with the CFI (3–7%) and CFS (8–11%), and unlike the CFI and CFS, was not significantly correlated with the BDI-II. This indicates that the ASQ measures a largely unique construct not measured by the CFI or CFS. Both the CFI and CFS were developed via data collected from nonclinical samples, while the ASQ was established as a measure of cognitive flexibility by Teasdale et al. (2001) using a study with a clinical sample of participants recently diagnosed with Major Depressive Disorder, in partial remission, who were being treated with antidepressants. This significant difference in research samples may account for the unanticipated association between greater cognitive flexibility on the CFI and CFS and greater cognitive rigidity on the ASQ. Aspects of cognitive flexibility may be differentially affected in nonclinical populations versus clinically depressed or recently clinical depressed populations. Possessing certain aspects of cognitive flexibility, such as those measured by the CFI and CFS, may predispose individuals without a history of depression and/or who are not taking antidepressants to use the entire range of a 7-point Likert scale, including extreme scores, which were used by Teasdale et al. (2001) to measure cognitive rigidity. This would imply that the ASQ, as used by Teasdale et al. (2001), may lack the specificity to detect associations between aspects of cognitive flexibility and depressive symptomatology in nonclinical populations. Failure to find significant correlations between the ASQ and the BDI-II in the present research provides support for this explanation. More research is needed to explore this hypothesis further.

[5] It is expected that increasing the number of items on a measure will increase the measure's internal consistency. The *Spearman-Brown Prophecy formula* (Crocker and Algina 2006) was therefore used to predict the internal consistency of the CFS if it had the same number of items as the 20-item CFI, while retaining its current psychometric properties. Results indicated that the internal consistency of the CFS would increase from .79 to .86 at Time 1 and from .78 to .85 at Time 2 if it had 20 items like the CFI.

General Discussion

Basic Properties of the CFI

One hundred and twenty items were initially developed for the CFI with the goal of measuring three aspects of cognitive flexibility: (a) the tendency to perceive difficult situations as controllable; (b) the ability to perceive multiple alternative explanations for life occurrences and human behavior; and (c) the ability to generate multiple alternative solutions to difficult situations. A content validity analysis reduced this initial item pool to 50 items. Results from a 7-week longitudinal study with an undergraduate population indicated that the CFI has a reliable two-factor structure. More specifically, the results indicated that the 20 CFI items loading on two factors at Time 1 reliably loaded on the same two factors at Time 2. The CFI's first factor was termed the *Alternatives* subscale because it was composed of 13 items, all of which were originally developed to measure aspects *b* and *c* of cognitive flexibility (see above). The CFI's second factor was termed the *Control* subscale because it was composed of seven items, most of which were originally developed to measure aspect *a* of cognitive flexibility (see above). Results also indicated that the CFI and its subscales have high 7-week test–retest reliability and good to excellent internal consistency. Furthermore, evidence was obtained for the convergent construct validity of the CFI and its two subscales via their associations with other measures of cognitive flexibility, depressive symptomatology, and coping.

Clinical Utility of the CFI

The CFI was developed to measure aspects of cognitive flexibility that enable individuals to think adaptively rather than maladaptively when encountering stressful life events. The clinical utility of the CFI and its *Alternatives* and *Control* subscales appears promising. The present research has indicated that individuals with lower CFI scores (indicative of greater cognitive rigidity) are more likely to utilize coping styles considered to be maladaptive, while individuals with higher CFI scores (indicative of greater cognitive flexibility) are more likely to utilize coping styles considered to be adaptive. Perhaps cognitively flexible individuals tend to make more effective appraisals of stressful life situations, and therefore, are more likely to select appropriate strategies to enable them to effectively cope with these situations. Further research is needed to investigate the potential impact of cognitive flexibility on coping.[6] Additional preliminary support for the clinical utility of the CFI was obtained via its correlations with the BDI-II, which indicated that greater cognitive rigidity on the CFI was associated with increased depressive symptomatology on the BDI-II. Further research is needed to investigate the role that level of cognitive flexibility may have in the development and maintenance of depression and other forms psychopathology.

The brief administration time of the 20-item version of the CFI (approximately 5–7 min) makes the CFI much more practical than performance-based measures of cognitive flexibility for use in research and during therapeutic interventions, for which it was designed. Although the CFI and the CFS share approximately 56% of their variance, the CFI has a two-factor structure that the CFS lacks. This two-factor structure increases the clinical utility of the CFI relative to the CFS in that it increases the CFI's sensitivity relative to the CFS with regard to discovering potential associations between distinct aspects of cognitive flexibility measured by the CFI's *Alternatives* and *Control* subscales and other constructs. Additionally, the present research has indicated that the CFI has significantly stronger internal consistency compared to the CFS.

Directions for Future Research

The present research provides preliminary evidence for the reliability and validity of the CFI and its *Alternatives* and *Control* subscales; however, this evidence was obtained via research conducted with a relatively small sample of undergraduate students from a Midwestern university. Future research is needed to reassess the reliability and validity of the CFI and its two-factor structure using larger, more diverse samples in order to determine the generalizability of the present findings. Data from clinical samples will be needed to determine whether the CFI is predictive of an increased susceptibility or resilience to depression and other psychopathology. As described above, the CFI was developed to be a brief self-report measure that could be administered repeatedly throughout a research investigation or therapeutic intervention. The extent to which changes in scores on the CFI reflect clinically monitored shifts in cognitive flexibility that an individual may evidence over time has yet to be determined. Further, research is needed to assess the degree to which scores on the CFI correspond to the level of proficiency demonstrated with cognitive behavioral thought challenging techniques.

[6] The relationship between cognitive flexibility and coping style is unclear at present. The present authors recently completed research investigating cognitive flexibility (as measured by the CFI) and coping styles as potential mediators and/or moderators of the relationship between life event stress and depressive symptomatology (Dennis and Vander Wal 2009b). A manuscript summarizing this research is currently being prepared for publication.

Finally, the CFI is a largely face valid measure of cognitive flexibility. Research is needed to evaluate potential response biases such as socially desirable responding that may be pulled for when individuals complete the CFI. Additionally, research is needed to evaluate the presence of practice effects that individuals may display when completing the CFI repeatedly over time.

An extensive body of research has utilized performance-based instruments to measure cognitive flexibility as it relates to depression. Findings over the last 30 years consistently demonstrate that depressed individuals display significantly greater cognitive rigidity on neuropsychological tests relative to nonclinical control groups (Austin et al. 1992; Grant et al. 2001; Ilonen et al. 2000; Kindermann et al. 2000; Merriam et al. 1999). At present, it is unclear how the type of cognitive flexibility measured by neuropsychological tests compares to the type measured by self-report measures. Research investigating this question is needed.[7] The present research has also demonstrated significant associations between cognitive flexibility, as measured by the CFI, and the tendency to utilize certain coping styles. The exact relationship between cognitive flexibility and coping is unclear at present. Future research is also needed to investigate this question.

Conclusion

The present research indicated that the CFI has a reliable two-factor structure, good to excellent internal consistency, and high 7-week test–retest reliability. Additionally, preliminary support was obtained for the convergent construct and concurrent criterion validity of the CFI and its *Alternatives* and *Control* subscales via their correlations with other measures of cognitive flexibility, depressive symptomatology, and coping. Further research is needed to investigate the reliability and validity of the CFI and its subscales with more diverse populations and clinical populations to determine the generalizability of the present findings. Additionally, it is necessary to administer the CFI in treatment outcome research investigating cognitive behavioral treatments for depression and other psychopathology in order to determine if the CFI can reliably and validly assess the aspects of cognitive flexibility it was designed to assess—the type of cognitive flexibility necessary to successfully challenge and replace maladaptive thoughts with more rational and balanced thinking.

[7] The present authors have recently completed research investigating this question (Dennis and Vander Wal 2009a). A manuscript summarizing this research is currently being prepared for publication.

Appendix 1

See Table 1.

Table 1 Longitudinal study: factor loadings and cross loadings for 20 CFI items retained after Time 1 and Time 2 exploratory factor analyses

	Time 1 factor loadings		Time 2 factor loadings	
	Alternatives scale	Control scale	Alternatives scale	Control scale
CFI item				
29	.83	.30	.84	.34
18	.81	.37	.70	.29
16	.78	.28	.71	.33
28	.77	.27	.80	.39
20	.76	.31	.70	.22
6	.71	.31	.74	.38
31	.63	.33	.76	.41
47	.54	.36	.48	.36
14	.53	.21	.45	.22
2	.52	.42	.60	.39
12	.47	.33	.60	.27
8	.47	.20	.60	.32
40	.34	.85	.27	.76
43	.33	.85	.39	.71
36	.37	.74	.38	.78
30	.30	.70	.31	.52
26	.16	.55	.23	.60
50	.41	.55	.34	.60
19	.16	.53	.27	.63

Extraction method for the exploratory factor analysis is principal axes. Rotation method is Promax with Kaiser normalization

Appendix 2

20-Item Cognitive Flexibility Inventory (CFI)

Please use the scale below to indicate the extent to which you agree or disagree with the following statements.

Strongly disagree	Disagree	Somewhat agree	Neutral	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7

1. I am good at "sizing up" situations.—(47)[8]
2. I have a hard time making decisions when faced with difficult situations.—(19)

[8] Numbers in parentheses indicate the original CFI item number prior to the construction of the finalized 20-time CFI.

3. I consider multiple options before making a decision.—(29)
4. When I encounter difficult situations, I feel like I am losing control.—(40)
5. I like to look at difficult situations from many different angles.—(20)
6. I seek additional information not immediately available before attributing causes to behavior.—(14)
7. When encountering difficult situations, I become so stressed that I can not think of a way to resolve the situation.—(43)
8. I try to think about things from another person's point of view.—(8)
9. I find it troublesome that there are so many different ways to deal with difficult situations.—(26)
10. I am good at putting myself in others' shoes.—(12)
11. When I encounter difficult situations, I just don't know what to do.—(36)
12. It is important to look at difficult situations from many angles.—(41)
13. When in difficult situations, I consider multiple options before deciding how to behave.—(18)
14. I often look at a situation from different viewpoints.—(28)
15. I am capable of overcoming the difficulties in life that I face.—(50)
16. I consider all the available facts and information when attributing causes to behavior.—(31)
17. I feel I have no power to change things in difficult situations.—(30)
18. When I encounter difficult situations, I stop and try to think of several ways to resolve it.—(16)
19. I can think of more than one way to resolve a difficult situation I'm confronted with.—(2)
20. I consider multiple options before responding to difficult situations.—(6)

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