Running head: PSYCHOMETRIC PROPERTIES OF THE CAS-1

Measuring the Cognitive Attentional Syndrome associated with Emotional Distress: Psychometric properties of the CAS-1

Authors:
Henrik Nordahl[1,2], Adrian Wells[3,4]

Author Affiliations:
1) Department of Psychology, Norwegian University of Science and Technology, Trondheim, Norway.
2) St. Olavs Hospital, Division of Psychiatry, Trondheim University Hospital, Trondheim, Norway
3) The University of Manchester, Division of Clinical and Health Psychology, School of Health Sciences, Faculty of Biology, Medicine and Health, Manchester Academic Health Science Centre, Manchester, UK
4) Greater Manchester Mental Health NHS Foundation Trust, Prestwich, UK

Corresponding Author:
Henrik Nordahl, Department of Psychology, University Outpatient Clinic, NTNU, Dragvoll, 7491 Trondheim
E-mail: henrik.nordahl@ntnu.no
Phone: +47 95168246
Fax: +47 73 59 76 94

Abstract

The Self-Regulatory Executive Function model is the basis of metacognitive therapy and proposes that psychological disorders are caused by maladaptive beliefs about thinking (metacognitive beliefs) and a perseverative negative thinking style associated with them, named the cognitive attentional syndrome (CAS). The CAS-1 was devised and has been used as a clinical tool for assessment and monitoring of the cognitive attentional syndrome and underlying positive- and negative metacognitive beliefs during the course of treatment. The aim of this study is to assess the psychometric properties of the CAS-1. Seven-hundred and seventy-three participants completed a battery of self-report questionnaires at the cross-sectional level, and 431 individuals also completed the same measures 6- and 12 weeks later. Confirmatory factor analysis supported the proposed three-factor solution of the measure, and the factors demonstrated good internal consistency (α ranging from .77 to .89), convergent validity, incremental validity, stability and discriminative validity were satisfactory. Our findings support the continued use of the CAS-1 in clinical and research settings.

Keywords: psychometric properties; CAS-1; metacognitive beliefs; cognitive attentional syndrome

1. Introduction

Metacognitive therapy for psychological disorders (Wells, 2009) is based on the Self-regulatory Executive Function (S-REF) model (Wells & Matthews, 1994; 1996), which considers inflexible and recurrent styles of thinking in response to negative thoughts, feelings and beliefs as the proximal cause of disorder. This negative and perseverative thinking style is termed the cognitive attentional syndrome (CAS; Wells & Matthews, 1994). The CAS consists of worry/rumination, threat monitoring and unhelpful coping strategies, and is considered a transdiagnostic feature of psychopathology (Wells & Matthews, 1994; Wells, 2009).

The CAS is hypothesised to develop due to maladaptive metacognitions which include beliefs about thinking (i.e. metacognitive beliefs) (Wells, 2009). For example, holding the belief that worrying keeps one safe (positive metacognitive belief) disposes the person to worrying in response to a negative thought about potential danger. Furthermore, holding the belief that worrying is uncontrollable (negative metacognitive belief) leads to a persistence of worrying because the person invests reduced effort or uses unhelpful strategies to interrupt the process.

In line with the metacognitive model (Wells & Matthews, 1994), maladaptive metacognitive beliefs are positively associated with a wide range of psychological and behavioural problems (Sun, Zhu, & So, 2017; Gkika, Wittkowski, & Wells, 2017; Sellers, Varese, Wells, & Morrison, 2016). Furthermore, Metacognitive therapy (MCT; Wells, 2009) which was developed to directly modify the CAS and its underlying metacognitive beliefs appears to be an effective treatment for major depressive disorder and a range of anxiety disorders (Normann & Morina, 2018; Rochat, Manolov, & Billieux, 2018). Assessing and monitoring the CAS and underlying metacognitive beliefs is an integral part of conducting

MCT (Wells, 2009), and consequently there is a need for validated measures of this construct.

Different components of the CAS can be assessed with a variety of measures, for example the Ruminative Response Scale (RRS; Nolen-Hoeksema & Morrow, 1991) which assess tendency to ruminate, and the Penn-State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) which assesses tendency to worry. However, these measures of thinking styles are at the trait rather than at the state level, and they do not assess metacognitive beliefs. The gold standard measure of metacognitive beliefs is the Metacognitions Questionnaire (Cartwright-Hatton & Wells, 1997) and the 30 item shortened version of this instrument is most commonly used (MCQ-30; Wells & Cartwright-Hatton, 2004). The MCQ-30 has good psychometric properties (e.g., Spada, Mohiyeddini, & Wells, 2008; Nordahl, Hjemdal, Hagen, Nordahl, & Wells, 2019) but it is not intended to measure metacognitive strategies and thinking styles (i.e. the CAS) and it is also a trait measure. Thus, for clinical purposes the CAS-1 was developed to measure primary metacognitive beliefs and thinking/coping styles simultaneously and at a state-level (i.e. in the past week). The benefits of such a measure are that it provides a time-efficient way to assess key components of the metacognitive approach in clinical work.

The CAS-1 (Wells, 2009) is a 16-item self-report measure that assesses four dimensions; worry/rumination, threat monitoring, coping behaviours, and metacognitive beliefs. The first two items reflect the amount of time spent worrying or ‘dwelling’ on problems and focusing attention on threat. The next six items capture the frequency of unhelpful strategies used to cope with negative thoughts or feelings (e.g., “Tried not to think about things”), and the final eight items assess positive and negative metacognitive beliefs about the CAS (e.g., “Worrying helps me cope”; “I cannot control my thoughts”).

In line with its intended use, several clinical studies have used the CAS-1 to assess and monitor metacognitive strategies and beliefs during treatment. For example, Hutton, Morrison, Wardle and Wells (2014) used the measure in a case-series of individuals with schizophrenia treated with MCT. Other studies have used it in the context of MCT for Social anxiety disorder (Nordahl & Wells, 2018), and a randomised trial of MCT versus mindfulness meditation (Capobianco, Reeves, Morrison, & Wells, 2018). Hoffart, Johnson, Nordahl, and Wells (2018) used it to explore within-person relationships and mechanisms of change in treatment of patients with treatment resistant anxiety. Together, these studies indicate that the CAS-1 is sensitive to treatment effects and its dimensions might predict outcomes.

Although developed primarily for treatment settings, several studies have also used the measure in non-clinical research. For the CAS-1 total score, good internal consistency has been reported in a large non-clinical sample (α = .86; Fergus, Bardeen, & Orcutt, 2012), in a large community sample (α = .85; Kowalski & Dragan, 2019), in a clinical sample of patients with either a primary mood or anxiety disorder (α = .78; Fergus, Valentiner, McGratch, Gier-Lonsway, & Jencius, 2013), and in a sample of patients with psychosis (α = .85; Sellers, Wells, Parker, & Morrison, 2018). Sellers et al (2018) divided the CAS-1 items into metacognitive strategies and beliefs, and reported that these subscales had acceptable internal consistency (α = .70 for strategies, α = .81 for beliefs). Hoffart et al. (2018) divided the items into metacognitive strategies and negative- and positive beliefs, and reported that these subscales had good internal consistency in a sample of treatment-resistant anxiety patients (α = .84 for strategies, α = .86 for negative beliefs, α = .87 for positive beliefs). The CAS-1 total score has also demonstrated convergent, concurrent, incremental, predictive and discriminative validity (Fergus et al., 2012; 2013; Fergus & Scullin, 2017; Kowalski & Dragan, 2019; Sellers et al., 2018).

In sum, preliminary evidence supports the continued use of the CAS-1 in clinical and research setting, but as noted by Hoffart et al. (2018), Fergus et al. (2013) and Sellers et al. (2018), further evaluation of the psychometric properties and in particular the factor structure of the CAS-1 is needed.

One study by Kowalski and Dragan (2019) set out to evaluate the factor structure in a large community sample. In this study, confirmatory factor analyses were used to test a 2-, 3-, 4-, and 5-factor model of the measure. The authors reported that the 2-factor model, consisting of separable strategy and metacognitive beliefs factors provided the best fit to the data. The two-factor solution was reported to be a better fit than a three-factor solution where the metacognitive beliefs were divided in positive- and negative beliefs. The study by Kowalski and Dragan (2019) makes a valuable contribution in exploring the psychometric properties of the measure, nevertheless there are several important questions about the psychometric properties of the CAS unanswered. For example, data on the convergent, incremental and discriminative validity of individual factors remains to be explored as does their stability over time.

Taken together, previous studies have either used dimensions from the CAS-1 to measure aspects of the CAS or endorsement of metacognitive beliefs, or computed a total score as a marker of the CAS based on the assumption that the CAS is fundamentally a single construct represented by both metacognitive beliefs and metacognitive strategies. However, the metacognitive model distinguishes between components of the CAS and metacognitive therapy uses techniques that modify strategies and negative and positive beliefs. We therefore set out to test a three-factor model of the CAS-1, to report on its psychometric performance, and specifically assess its discriminative validity in a large convenience sample. We tested if the three-factor model of the CAS-1 (CAS strategies, positive beliefs, and negative beliefs) provides a good fit to the data in a test of construct validity, and if these subscales showed

acceptable internal consistency, positive inter-correlations, convergent and incremental validity, stability over time, and discriminative validity.

2. Methods

2.1 Participants and procedure

Participants were invited to take part in a longitudinal survey of mental health through advertisement on social media. They were recruited at convenience using an online survey program, and voluntary organizations for mental health in Norway distributed information about the survey to their social media followers. The survey consisted of a battery of self-report questionnaires delivered at four time points, approximately 6 weeks apart. The present study was planned to be based on data from the first three time points, as the CAS-1 was not administered at the fourth time point. Participants that completed the survey at all time points were invited to participate in a lottery to win a personal computer. The study was approved by the Regional Committees for Medical and Health Research Ethics (ref.nr. 2017/906/REK midt). Informed consent was obtained from all individual participants included in the study.

At time 1, seven-hundred and seventy three (773) participants were recruited. In the total sample, five-hundred and eighty-two (75.3%) were female, and the mean age was 34.16 (*SD* = 13.01). In terms of civil status the sample consisted of 234 (30.3%) singles, 121 (15.7%) in a relationship, 373 (48.3%) cohabitant/married, 36 (4.7%) divorced/separated, and 4 (0.5%) widowed. Five (0.1%) participants did not report their civil status. In terms of occupational status, 263 (34.0%) reported they were students, 329 (42.6%) reported they were working, 23 (3.0%) reported they were unemployed, 33 (4.3%) reported they were retired, and 122 (15.8%) reported they were on short- or long term sick leave. Three (0.4%)

did not report their occupational status. Three-hundred and five (39.5%) had completed higher education; at least three years at a university or equivalent.

Of the original sample, 342 (44.2%) of the participants did not complete the survey at time 2 and/or time 3, and were therefore not eligible to be used for assessing test-retest reliability of the CAS-1. This left us with a subsample of four-hundred and thirty-one participants that completed the survey at all three time points. In this re-test sample, three-hundred and twenty-four (75.2%) were female, and the mean age was 34.64 (*SD* = 12.37). In terms of civil status the sample consisted of 132 (30.6%) singles, 67 (15.5%) in a relationship, 209 (48.5%) cohabitant/married, 22 (5.1%) divorced/separated, and 1 (0.2%) widowed. In terms of occupational status, 146 (33.9%) reported they were students, 194 (45.0%) reported they were working, 10 (2.3%) reported they were unemployed, 13 (3.0%) reported they were retired, and 68 (15.8%) reported they were on short- or long term sick leave. One-hundred and ninety-eight (45.9%) had completed higher education; at least three years at a university or equivalent. Furthermore, we compared the completers (n = 431) with the 342 participants that dropped out of the study after T1 to check if completers differed from non-completers, but found no differences in age (p = .512), gender (p = .540), civil status (p = .952) or occupational status (p = .111).

2.2 Measures

The CAS-1 (Wells, 2009) is a 16-item self-report tool based on the metacognitive model of psychological disorders which was developed to assess dimensions of the cognitive attentional syndrome; strategies and metacognitive beliefs in clinical practice. It consists of four scales, and these scales provide a means of monitoring changes in worry/rumination, threat monitoring, unhelpful coping behaviours and metacognitive beliefs. Items 1, 2, and 3A to 3F measure CAS-strategies and are scored on a scale from 0 (none of the time) to 8 (all of

the time). Items measuring metacognitive beliefs are scored on a scale from 0 (I do not believe this at all) to 100 (I'm completely convinced this is true). Item 4A ("Worrying too much could harm me"), 4B ("Strong emotions are dangerous"), 4C ("I cannot control my thoughts"), and 4D ("Some thoughts could make me lose my mind") measure negative metacognitive beliefs, while item 4E ("Worrying helps me cope"), 4F ("Focusing on possible threat can keep me safe"), 4G ("It is important to control my thoughts"), and 4H ("Analyzing my problems will help me find answers") measure positive metacognitive beliefs. The CAS-1 total scale has shown good internal consistency in previous studies (Kowalski & Dragan, 2019; Fergus et al., 2012; 2013; Sellers et al., 2018).

Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987; Fresco et al., 2001) is a 24-item self-report scale assessing social anxiety severity. The respondent is asked to rate the degree of fear and avoidance in different social situations during the past week. Each item is rated on a 4-point scale, indicating degree of fear (0 = none, 1 = mild, 2 = moderate, 3 = severe) and avoidance (0 = never, 1 = occasionally, 2 = often, 3 = usually) separately. The instrument has shown excellent internal consistency (α = .96; Dos Santos, Loureiro, Crippa, & de Lima Osório, 2013). In the current study the internal consistency was excellent (α = .98).

Self-Beliefs Related to Social Anxiety Scale (SBSA; Wong & Moulds, 2009) is a 15-item self-report scale which was developed to assess the strength of social phobic beliefs based on the Clark and Wells (1995) model of social phobia. Responses are required on an 11-point Likert scale ranging from 0 (do not agree at all) to 100 (strongly agree). Higher scores reflect stronger endorsements of the beliefs in question. The measure has shown good internal consistency (α = .94) (Wong, Moulds, & Rapee, 2014). In the current study, the Cronbach's alpha was .96 for the total scale.

The Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams, 2001) is a 9-item self-report tool, based on the nine criteria for diagnosing depression in DSM-IV. Each item is scored on a scale from 0 (not at all) to 3 (nearly every day). Total scores range from 0 to 27, higher scores indicate higher levels of depression symptoms. Evidence supports the PHQ-9 as a valid instrument for measuring depression (Kroenke, Spitzer, Williams, & Löwe, 2010) and the established cut-off score for clinical 'caseness' is a score of 10 or above (Manea, Gilbody, & McMillan, 2015). In this study, the internal consistency was excellent (α = .92).

Generalized Anxiety Disorder-7 (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006) is a 7-item self-report tool assessing severity of generalized anxiety disorder symptoms. The respondent is asked to indicate how often during the past two weeks he or she has been bothered by the listed problems (e.g. "Feeling nervous, anxious or on the edge", "Trouble relaxing") on a 4-point scale from 0 (not at all) to 4 (nearly every day). Total scores range from 0 to 28, higher scores indicate higher levels of generalized anxiety symptoms, and the established cut-off score for clinical 'case-ness' is a score of 10 or above (Löve et al., 2008). The instrument has shown excellent internal consistency (α = .92) and good test-retest reliability (r = .83; Spitzer et al., 2006). In the current study the internal consistency was excellent (α = .90).

2.3 Overview of statistical procedures

IBM SPSS AMOS version 25 was used to run confirmatory factor analysis (CFA) to assess the goodness of fit of the three-factor structure of the CAS-1 and offer a test of construct validity. The three factors are: 1. CAS-strategies (e.g. worry, threat monitoring, coping strategies); 2. Positive;- and 3. Negative metacognitive beliefs. Additionally, we also tested two alternative models (a 1-factor solution, and a 2-factor consisting of strategies and

beliefs) as a means to explore if the hypothesised 3-factor model provided the better fit to the data. To accommodate that the CAS and metacognitions are measured in different ways, the CAS-1 was standardised so that all items reflected a scale score of 0-8.

For purposes of CFA it is recommended that several fit indices are used to assess model fit and should consist of the following: chi-square and degrees of freedom (DF); an absolute fit index (e.g., root mean square error of approximation [RMSEA], standardized root mean residual [SRMR]); one incremental fit index (e.g., Tucker-Lewis index [TLI] and comparative fit index [CFI]; a goodness of fit index (e.g., TLI and CFI); and a badness of fit index (e.g., SRMR and RMSEA) (Hair, Black, Babin, & Anderson, 2014). We used each of these indices to assess model fit allowing for a comprehensive analysis of fit and to reduce the risk of selection bias of fit indices that indicate a better fit. For an acceptable model fit, the CFI and TLI should be higher than .90 (Garver & Mentzer, 1999), and the SRMR and RMSEA score is recommended to be below .08 and .09 (Hu & Bentler, 1999). Moreover, the chi-square is recommended to be non-significant, but this is a very stringent criteria to use as the chi-square statistic is very sensitive to sample sizes and models with larger numbers of observed variables (Hair et al., 2014).

IBM SPSS Statistics version 25 was used to calculate means and SDs, internal consistency (Cronbach's alphas) and bivariate correlations to assess convergent validity and test-rest reliability. We used hierarchical linear regression analysis to test the incremental validity of the CAS-1 for social anxiety symptoms, whilst a hierarchical logistic regression was run to test discriminative validity based on the cut-off for caseness on the PHQ-9 and GAD-7. In these models, the metacognitive predictors were entered in the causal order as specified by the metacognitive model (Wells, 2009) with maintenance factors entered last. Thus, positive metacognitive beliefs entered the model first, negative metacognitive beliefs second, and strategies on the last step.

Incremental validity of the CAS-1 was tested in the cross-sectional data where social anxiety (LSAS) was used as the dependent variable. In a secondary analysis, we ran the same model but also controlled for negative social Self-beliefs which has been established as an important factor underlying social anxiety in cognitive models (e.g., Clark & Wells, 1995) to provide a stringent test of incremental validity of the factors by removing overlap with cognition.

Discriminant validity of the CAS-1 was tested in the cross-sectional data using two hierarchical logistic regressions; one for generalized anxiety and one for depression. In both models, participants were dived in two groups based on established cut-off scores for clinical 'caseness' on the PHQ-9 and the GAD-7, and group membership was used as the dependent variable. A score of 10 or above is considered the optimal cuff-off on both measures (Manea et al., 2015; Löve et al., 2008). Positive metacognitive beliefs were entered in step 1, Negative metacognitive beliefs were entered in step 2, and the Strategies were entered in step 3. In a secondary analysis, we reran the same model but controlled gender and age before entering the metacognitive factors.

3. Results

3.1 Factorial structure of the CAS-1

The hypothesized three factor measurement model (strategies, positive- and negative metacognitive beliefs) showed the following fit indices: $\chi^2(101) = 876.64$, $p < .01$, CFI = .87, TLI = .84, SRMR = .06, RMSEA = .10 (90% CI = .097-.109). Furthermore, we inspected modification indices and M.I. > 40 (as in the study by Kowalski and Dragan (2019)) were deemed suitable for introducing inter-correlation between item errors within the same factor to maximize the fit of the model while avoiding overfitting the model. Thus, three of the error

terms within the CAS-factor were allowed to be correlated. This model is shown in figure 1 and showed the following fit indices $\chi^2(98) = 417.451$, $p < .01$, CFI = .95, TLI = .93, SRMR = .04, RMSEA = .07 (90% CI = .060-.074).

Insert figure 1 about here

3.2 Descriptive data and internal consistency for the three-factor structure of the CAS-1

Means with SDs and Cronbach's alphas for the CAS-1 subscales are presented in table 1.

Insert table 1 about here

3.3 Convergent validity

Convergent validity of the CAS-1 was tested by correlating the subscales with related concepts: the GAD-7, PHQ-9 and LSAS. The mean score in the T1 sample (N = 773) was 7.60 (*SD* = 5.31) on the GAD-7, 9.43 (*SD* = 6.98) on the PHQ-9, and 45.69 (*SD* = 31.48) on the LSAS. A significant large positive relationship was found between the cognitive attentional syndrome (CAS) strategies and the symptom measures. A significant moderate relationship was found between negative metacognitive beliefs and symptom domains, and a significant but weak positive relationship was found between positive metacognitive beliefs and symptoms. Furthermore, the CAS-1 factors showed moderate significant and positive inter-correlations. The bivariate correlations are shown in table 2.

Insert table 2 about here

3.4 Incremental validity

Incremental validity of the CAS-1 was tested by running a hierarchical regression analysis where social anxiety (LSAS) was used as the dependent variable and we controlled for gender and age. Each step of the regression was significant. Gender and age accounted for 2.1% of the variance in step 1. Positive metacognitive beliefs accounted for an additional 16.6% of the variance in step 2, negative metacognitive beliefs accounted for an additional 11.2% of the variance in step 3, and the strategies accounted for an additional 19.3% of the variance in step 4. The regression models are presented in table 3.

In a secondary analysis of incremental validity of the CAS-1 factors, we also controlled for self-beliefs related to social anxiety (SBSA) in step 2 before entering the metacognitive factors in steps 3 to 5. The mean score in the T1 sample (N = 773) was 59.40 (*SD* = 40.30) on the SBSA. Each step of the regression was significant. Social self-beliefs accounted for a substantial part of the variance in step 2 (48.8%). Moreover, positive metacognitive beliefs accounted for an additional 0.8% of the variance in step 3, negative metacognitive beliefs accounted for an additional 1.6% of the variance in step 4, and the strategies accounted for an additional 6.2% of the variance in step 5.

Insert table 3 about here

3.5 Test-retest reliability

In order to test the stability of the CAS-1 subscales over a period of time, bivariate correlations were used between individual subscales from t1 to t2 (6 weeks apart) and from t1 to t3 (3 months apart). Over 6 weeks, the test-retest correlations were as follows (n = 431): Strategies = .81; NEG = .75; and POS = .77, and over 3 months (n = 431), the test-retest correlations were: Strategies = .78; NEG = .75; and POS = .78. As a comparison, we explored

the stability of symptom measures over the same time intervals. The correlations over 6 weeks were (n = 431): depression (PHQ-9) = .83; generalised anxiety (GAD-7) = .79; social anxiety (LSAS) = .93; and over 12 weeks: depression = .81; generalised anxiety = .76; social anxiety = .93.

3.6 Discriminative validity

Discriminative validity was tested using two hierarchical logistic regressions, one for generalized anxiety and one for depression, where group membership (below versus above the cut-off for 'case-ness' on the GAD-7 and the PHQ-9) were used as the dependent.

For anxiety, 519 (67.1%) of the participants scored below the cut-off (mean score = 4.46, std. = 2.58), while 254 of the participants scored above the cut-off (mean score = 14.06, std. = 3.23). Positive metacognitive beliefs (odds ratio = 1.009), negative metacognitive beliefs (odds ratio = 1.011), and strategies (odds ratio = 1.165) were all significant predictors of group membership at the .01 level and higher scores were associated with belonging to the above-cut-off group. In these steps, the number of correctly classified cases increased to 70.6%, 78.0%, and 84.3%, respectively. In our secondary analysis we controlled for gender and age (step 1), these variables were non-significant as predictors of group membership when the metacognitive factors were entered, and did not add to the number of correctly classified cases.

For depression, 450 (58.2%) of the participants scored below the cut-off (mean score = 4.46, std. = 2.63), while 323 of the participants scored above the cut-off (mean score = 16.44, std. = 4.86). Positive metacognitive beliefs (odds ratio = 1.007), negative metacognitive beliefs (odds ratio = 1.010), and strategies (odds ratio = 1.150) were all significant predictors of group membership at the .01 level and higher scores were associated with belonging to the above-cut-off group. In these steps, the number of correctly classified

cases increased to 63.8%, 74.1%, and 80.4%, respectively. In our secondary analysis we also controlled for gender and age, these variables were non-significant as predictors of group membership when the metacognitive factors were accounted for, and did not add to the number of correctly classified cases.

4. Discussion

The main aim of the study was to test the fit of a three-factor model of the CAS-1 consisting of metacognitive strategies, positive, and negative metacognitive beliefs in a large convenience sample, and to explore subscale reliability and validity.

Convenience sampling was used to recruit participants for the present study, and participants were invited to participate through advertisement on social media that were distributed by voluntary organizations for mental health in Norway. This fact may explain why our sample on average reported elevated emotional distress symptoms. For example, in the general population, the mean score on the GAD-7 and on the PHQ-9 have been reported to be around 3 points (Löve et al., 2008; Kocalevent, Hinz, & Brähler, 2013). In comparison, our sample had a mean score of approximately 7 points on the GAD-7 and approximately 9 points on the PHQ-9. Furthermore, our sample scored on average approximately 46 points on the LSAS and 59 points on the SBSA, which indicate elevated social anxiety levels (Rytwinski et al., 2009; Wong et al., 2014). Taken together, these findings indicate that our analyses are conducted in a sample with elevated psychopathology symptoms but where the diagnostic status is unknown.

The fit and structure of the proposed three-factor model was tested using CFA. The recommended fit indices on the CFI, TLI, RMSEA and SRMR were achieved. However, the chi-square was found to be significant which indicates a poor fitting model, but the chi-

square statistic is very sensitive to sample sizes and models with larger numbers of observed variables (Hair et al., 2014). Thus, the fit indices indicated that the suggested three-factor structure had an acceptable fit to the data. As expected, the three factors were significantly and positively correlated with each other, and negative metacognitive beliefs were more strongly associated with the CAS strategies than positive metacognitive beliefs.

In the final three-factor model, three inter-correlations between item error terms were added to improve the model fit. The first correlation was added between item 4e ("Worrying helps me cope"), and item 4f ("Focusing on possible threat can keep me safe"), the second correlation was added between item 3c ("tried not to think about things") and 3d ("tried to control my emotions"), and the final correlation was added between 3d and 3f ("controlled my symptoms"). High correlation between items could reflect sub-factors not modelled, for example item 3c, 3d and 3f might tap a latent "internal control" factor, but we did not explore this further in the present study. Moreover, some of the factor loading of the individual items (e.g. 3e "Used alcohol/drugs") were low. One explanation for this observation is low variation in our data for this particular item. Overall model fit could likely be improved by deleting such items. However, the primary aim of the present study was not to alter the measure but to evaluate the structural relations between the three-factor solution which is most in line with the metacognitive model (Wells, 2009). Moreover, conceptually there is good reason for separating positive beliefs about worry and threat monitoring, and items such as 3e ("Used alcohol/drugs") might load higher on the CAS factor in some clinical samples where alcohol/drug use is common and may have clinical utility in individual cases.

The internal consistencies were found to be acceptable to good for the CAS-1 factors, indicating acceptable reliability. This is in line with previous studies that have reported acceptable to good internal consistency for the CAS-1 total scale (Fergus et al., 2012; 2013; Fergus & Scullin, 2017; Kowalski & Dragan, 2019; Sellers et al., 2018), and with the study

by Hoffart et al. (2018) that reported good internal consistency for the same three-factor structure as explored here.

Convergent validity was tested by correlating the CAS-1 factors with symptoms of anxiety and depression, and significant positive relationships were found between the variables. The factor measuring strategies showed the strongest association with symptoms, followed by negative- and then positive metacognitive beliefs. This finding is in line with theory where the CAS is the proximal cause of emotional distress and is a maintaining factor whilst the metacognitions are underlying factors contributing more to vulnerability, with negative beliefs seen as the strongest of the two belief domains. Previous studies have reported positive correlations between the CAS-1 total score and anxiety- and depression (Fergus et al., 2012; 2013; Sellers et al., 2018), but the present study adds to these findings as it shows that different aspects measured with the CAS-1 relate to emotional distress with varying strengths.

Incremental validity was tested by running hierarchical linear regression analysis for social anxiety when controlling gender and age in the cross-sectional data. The three CAS-1 factors each accounted for a substantial amount of the variance in their specified step. This finding adds preliminary support to the notion that metacognitive strategies and beliefs (positive and negative) are related but distinct predictive components. Moreover, when also controlling for social self-beliefs before entering the metacognitive factors in our follow-up analysis, each of the three CAS-1 factors explained additional variance in social anxiety on their specified step. This finding expands on previous studies that have demonstrated incremental validity of the CAS-1 total score. Fergus et al. (2013) demonstrated that the CAS-1 total scale had incremental validity as it made a unique contribution to symptoms after controlling for “psychological inflexibility”, Fergus and Scullin (2017) demonstrated incremental validity of the CAS-1 total score as it accounted for unique variance in sleep

difficulties after controlling for demographic variables, physical health and negative affect. Kowalski and Dragan (2019) demonstrated the CAS-1 total score explained variance in quality of life after controlling for generic metacognitive beliefs and rumination.

The CAS-1 subscales showed some stability over the re-test intervals (6 weeks and 3 months) which indicates that the CAS-1 assesses relatively stable attributes, which would not be ideal for a state measure. However, the stability over the time interval in the current study for the CAS-1 factors parallels that seen in the symptom measures. One must take into consideration the short-term observational nature of the present study, and therefore one would not expect high variation in metacognitive strategies and beliefs nor symptoms over the re-test intervals. Data from other studies have suggested that the measure is sensitive to treatment effects (Capobianco et al., 2018; Hoffart et al., 2018; Hutton et al., 2014; Nordahl & Wells, 2018).

We found that the CAS-1 factors may have discriminative validity as they all were significant predictors of group membership in terms of scoring below/above clinically meaningful cut-off points for both generalized anxiety and depression symptoms. In both models, metacognitive strategies demonstrated the strongest discriminative ability. This finding is in line with the metacognitive model which conceptualises metacognitive strategies as the most proximal cause of disorder (Wells & Matthews, 1994; Wells, 2009). Our findings is also in line with the recent study by Kowalski and Dragan (2019) that demonstrated discriminative validity for a composite variable consisting of metacognitive strategies and beliefs (including the CAS-1 items). Moreover, our results add to those of Kowalski and Dragan (2019) by demonstrating discriminative validity of the CAS-1 factors.

There are several implications of our findings. The CAS-1 can be meaningfully divided into three subscales which assess metacognitive strategies, positive, and negative metacognitive beliefs. As these factors appear to have acceptable reliability and validity, it is

recommended they continue to be used in clinical and research settings to monitor and assess change in conceptually important metacognitive dimensions. The CAS-1 can be used when there is a need for a brief measure that takes both metacognitive strategies and beliefs into consideration. A recent study by Hoffart et al. (2018) is an example of how the CAS-1 could be used to examine metacognitive mechanisms of change during treatment.

The present study has several limitations that should be acknowledged. Our participants were a convenience sample, and we found a strong indication for elevated psychopathology symptoms in the sample compared to population based samples. However, we have no information on the participants' diagnostic status. There was also a substantial loss of participants from time 1 to the subsequent time points. In addition, the sample consisted of mostly female participants potential gender differences in latent models were not taken into consideration. These limitations may compromise the generalizability of our findings. Stability was tested over relatively long time intervals compared to how the CAS-1 originally was intended to be used, for example as part of weekly treatment sessions, suggesting scores are stable, but data form other studies demonstrates that the instrument is sensitive to change and therefore useful clinically (Hutton et al., 2014; Capobianco et al., 2018; Nordahl & Wells, 2018; Hoffart et al., 2018). Whilst research should evaluate the psychometric properties of the CAS in other (e.g. clinical) samples, the present study provides preliminary evidence for the CAS-1 as a valid measure to assess relationships between metacognitive strategies, beliefs and symptoms and thereby evaluate important within- and between person effects in clinical- and research settings.

Conflict of interest:

On behalf of both authors, the corresponding author states that there is no conflict of interest.

References

Capobianco, L., Reeves, D., Morrison, A. P., & Wells, A. (2018). Group Metacognitive Therapy vs. Mindfulness Meditation Therapy in a Transdiagnostic Patient Sample: A Randomised Feasibility Trial. *Psychiatry Research*, *259*, 554-561. https://doi.org/10.1016/j.psychres.2017.11.045

Cartwright-Hatton, S., & Wells, A. (1997). Beliefs about worry and intrusions: The Meta-Cognitions Questionnaire and its correlates. *Journal of Anxiety Disorders, 11*, 279-296. doi:10.1016/S0887-6185(97)00011-X

Clark, D. M., & Wells, A. (1995). A cognitive model of social phobia. In R. G. Heimberg, M. R. Liebowitz, D. A. Hope & F. Schneier, R. (Eds.), *Social Phobia: Diagnosis, Assessment, and Treatment* (pp. 69-93). New York: The Guilford Press.

Fergus, T. A., Bardeen, J. R., & Orcutt, H. K. (2012). Attentional control moderates the relationship between activation of the cognitive attentional syndrome and symptoms of psychopathology. *Personality and Individual Differences*, *53*, 213-217. https://doi.org/10.1016/j.paid.2012.03.017

Fergus, T. A., & Scullin, M. K. (2017). The cognitive attentional syndrome is associated with sleep difficulties in a community sample. *Behavioral Sleep Medicine*, *15*, 410-420. https://doi.org/10.1080/15402002.2016.1141771

Fergus, T. A., Valentiner, D. P., McGrath, P. B., Gier-Lonsway, S., & Jencius, S. (2013). The cognitive attentional syndrome: examining relations with mood and anxiety symptoms and distinctiveness from psychological inflexibility in a clinical sample. *Psychiatry Research*, *210*, 215-219. https://doi.org/10.1016/j.psychres.2013.04.020

Fresco, D. M., Coles, M. E., Heimberg, R. G., Liebowitz, M. R., Hami, S., Stein, M. B., & Goetz, D. (2001). The Liebowitz Social Anxiety Scale: a comparison of the

psychometric properties of self-report and clinician-administered formats. *Psychological Medicine*, *31*, 1025-1035. https://doi.org/10.1017/S0033291701004056

Garver, M. S., & Mentzer, J. T. (1999). Logistics research methods: employing structural equation modeling to test for construct validity. *Journal of Business Logistics*, *20*, 33-57.

Gkika, S., Wittkowski, A., & Wells, A. (2017). Social cognition and metacognition in social anxiety: A systematic review. *Clinical Psychology & Psychotherapy, 25*, 10-30. doi:10.1002/cpp.2127

Gregory, B., Wong, Q. J., Marker, C. D., & Peters, L. (2018). Maladaptive Self-Beliefs During Cognitive Behavioural Therapy for Social Anxiety Disorder: A Test of Temporal Precedence. *Cognitive Therapy and Research, 42*, 261-272. https://doi.org/10.1007/s10608-017-9882-5

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). In J. F. Hair, Jr., W. C. Black, B. J. Babin, & R. E. Anderson (Eds.), *Multivariate data analysis* (Pearson new international seventh ed.). Harlow, Essex: Pearson.

Hoffart, A., Johnson, S. U., Nordahl, H. M., & Wells, A. (2018). Mechanisms of change in metacognitive and cognitive behavioral therapy for treatment-resistant anxiety: The role of metacognitive beliefs and coping strategies. *Journal of Experimental Psychopathology*, *9*, 1-10. https://doi.org/10.1177/2043808718787414

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*, 1-55. https://doi.org/10.1080/10705519909540118

Hutton, P., Morrison, A. P., Wardle, M., & Wells, A. (2014). Metacognitive therapy in treatment-resistant psychosis: a multiple-baseline study. *Behavioural and Cognitive Psychotherapy*, *42*, 166-185. https://doi.org/10.1017/S1352465812001026

Kocalevent, R. D., Hinz, A., & Brähler, E. (2013). Standardization of the depression screener patient health questionnaire (PHQ-9) in the general population. *General Hospital Psychiatry, 35*, 551-555. https://doi.org/10.1016/j.genhosppsych.2013.04.006

Kowalski, J., & Dragan, M. (2019). Cognitive-attentional syndrome – The psychometric properties of the CAS-1 and multi-measure CAS-based clinical diagnosis. *Comprehensive Psychiatry, 91*, 13-21. https://doi.org/10.1016/j.comppsych.2019.02.007

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of General Internal Medicine*, *16*, 606-613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Kroenke, K., Spitzer, R. L., Williams, J. B., & Löwe, B. (2010). The patient health questionnaire somatic, anxiety, and depressive symptom scales: a systematic review. *General Hospital Psychiatry*, *32*, 345-359. https://doi.org/10.1016/j.genhosppsych.2010.03.006

Liebowitz, M. R. (1987). Social Phobia. In D. F. Klein (Ed.), *Anxiety.* New York, NY: Karger.

Löwe, B., Decker, O., Müller, S., Brähler, E., Schellberg, D., Herzog, W., & Herzberg, P. Y. (2008). Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. *Medical Care*, *46*, 266-274. doi:10.1097/MLR.0b013e318160d093

Manea, L., Gilbody, S., & McMillan, D. (2015). A diagnostic meta-analysis of the Patient Health Questionnaire-9 (PHQ-9) algorithm scoring method as a screen for depression.

General Hospital Psychiatry, *37*, 67-75. https://doi.org/10.1016/j.genhosppsych.2014.09.009

Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the penn state worry questionnaire. *Behaviour Research and Therapy*, *28*, 487-495. https://doi.org/10.1016/0005-7967(90)90135-6

Nolen-Hoeksema, S., & Morrow, J. (1991). A prospective study of depression and posttraumatic stress symptoms after a natural disaster: the 1989 Loma Prieta Earthquake. *Journal of Personality and Social Psychology*, *61*, 115-121. http://dx.doi.org/10.1037/0022-3514.61.1.115

Nordahl H., Hjemdal O., Hagen R., Nordahl H. M., and Wells, A. (2019). What Lies Beneath Trait-Anxiety? Testing the Self-Regulatory Executive Function Model of Vulnerability. *Front. Psychol.* 10:122. doi:10.3389/fpsyg.2019.00122

Nordahl, H., & Wells, A. (2018). Metacognitive Therapy for Social Anxiety Disorder: An A-B Replication Series Across Social Anxiety Subtypes. *Frontiers in Psychology,* 9:540. https://doi.org/10.3389/fpsyg.2018.00540

Normann, N., & Morina, N. (2018). The Efficacy of Metacognitive Therapy: A Systematic Review and Meta-Analysis. *Frontiers in Psychology*, 9:2211. doi:10.3389/fpsyg.2018.02211

Rochat, L., Manolov, R., & Billieux, J. (2018). Efficacy of metacognitive therapy in improving mental health: A meta-analysis of single-case studies. *Journal of Clinical Psychology*, *74*, 896-915. https://doi.org/10.1002/jclp.22567

Rytwinski, N. K., Fresco, D. M., Heimberg, R. G., Coles, M. E., Liebowitz, M. R., Cissell, S., . . . Hofmann, S. G. (2009). Screening for social anxiety disorder with the self-report version of the Liebowitz Social Anxiety Scale. *Depression and Anxiety, 26*, 34-38. doi:10.1002/da.20503

Sica, C., Steketee, G., Ghisi, M., Chiri, L. R., & Franceschini, S. (2007). Metacognitive beliefs and strategies predict worry, obsessive–compulsive symptoms and coping styles: A preliminary prospective study on an Italian non-clinical sample. *Clinical Psychology & Psychotherapy*, *14*, 258-268. https://doi.org/10.1002/cpp.520

Spada, M. M., Mohiyeddini, C., & Wells, A. (2008). Measuring metacognitions associated with emotional distress: Factor structure and predictive validity of the metacognitions questionnaire 30. *Personality and Individual Differences*, *45*, 238-242. http://dx.doi.org/10.1016/j.paid.2008.04.005

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of Internal Medicine*, *166*, 1092-1097. doi:10.1001/archinte.166.10.1092

Sellers, R., Varese, F., Wells, A., & Morrison, A. P. (2017). A meta-analysis of metacognitive beliefs as implicated in the self-regulatory executive function model in clinical psychosis. *Schizophrenia Research*, *179*, 75-84. https://doi.org/10.1016/j.schres.2016.09.032

Sellers, R., Wells, A., Parker, S., & Morrison, A. P. (2018). Do people with psychosis engage in unhelpful metacognitive coping strategies? A test of the validity of the Cognitive Attentional Syndrome (CAS) in a clinical sample. *Psychiatry Research*, *259*, 243-250. https://doi.org/10.1016/j.psychres.2017.10.032

Sun, X., Zhu, C., & So, S. H. W. (2017). Dysfunctional metacognition across psychopathologies: A meta-analytic review. *European Psychiatry, 45*, 139-153. https://doi.org/10.1016/j.eurpsy.2017.05.029

Wells, A. (2009). *Metacognitive Therapy for Anxiety and Depression*. New York: Guilford press.

Wells, A., & Cartwright-Hatton, S. (2004). A short form of the metacognitions questionnaire: properties of the MCQ-30. *Behaviour Research and Therapy*, *42*, 385-396. doi:10.1016/S0005-7967(03)00147-5

Wells, A., & Matthews, G. (1994). *Attention and Emotion: A clinical perspective*. Hove UK: Erlbaum.

Wells, A. & Matthews, G. (1996). Modelling cognition in emotional disorder: The S-REF model. *Behaviour Research and Therapy, 34*, 881-888. doi:10.1016/S0005-7967(96)00050-2

Wong, Q. J., & Moulds, M. L. (2011). A new measure of the maladaptive self-beliefs in social anxiety: Psychometric properties in a non-clinical sample. *Journal of Psychopathology and Behavioral Assessment*, *33*, 273-284. https://doi.org/10.1007/s10862-010-9208-3

Wong, Q. J., Moulds, M. L., & Rapee, R. M. (2014). Validation of the self-beliefs related to social anxiety scale: a replication and extension. *Assessment*, *21*, 300-311. https://doi.org/10.1177/1073191113485120

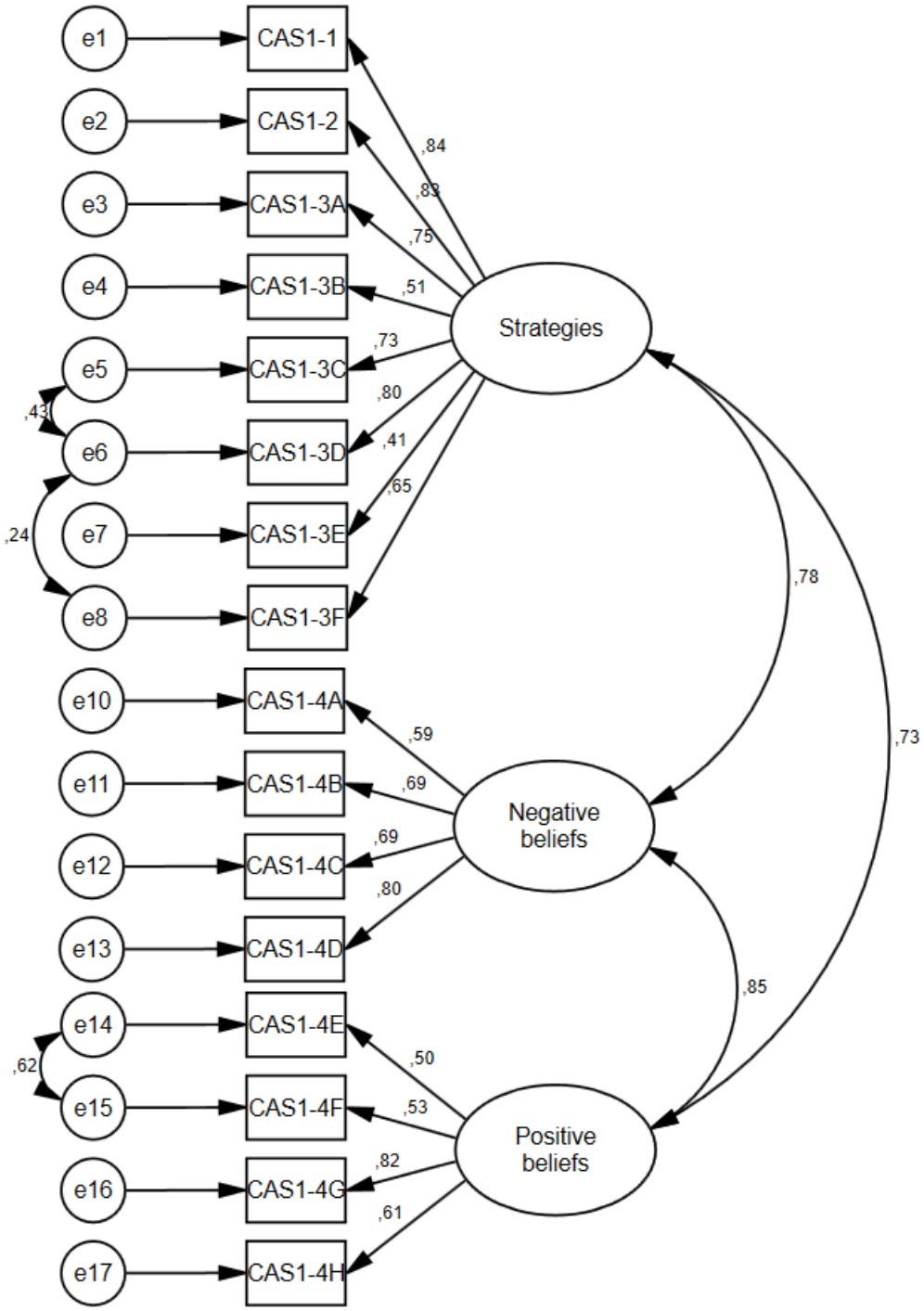

Figure 1: The model for three-factor confirmatory factor analysis (N = 773). Ovals represent the CAS-1 subscales (Strategies, negative metacognitive beliefs, positive metacognitive beliefs). Boxes represent CAS-1 items. Circles: errors. Double headed curved arrows: correlations. Straight arrows from subscales to items: regression weights.

Table 1: Descriptive data and Cronbach's alphas for the CAS-1 subscales (N = 773).

CAS-1 subscale	**Mean (*SD*)**	**Range**	**Cronbach's alpha**
Strategies	21.10 (13.76)	0 – 64	.89
Negative beliefs	146.98 (100.21)	0 – 400	.78
Positive beliefs	130.89 (90.17)	0 – 400	.77

Note: SD = standard deviation.

Table 2: Bivariate correlations between the CAS-1 subscales, generalized anxiety- (GAD-7) depression (PHQ-9), and social anxiety (LSAS) symptoms (N = 773).

	2.	**3.**	**4.**	**5.**	**6.**
1. Strategies	.64*	.56*	.79*	.73*	.70*
2. Negative beliefs		.58*	.58*	.56*	.52*
3. Positive beliefs			.43*	.39*	.41*
4. GAD-7				.84*	.70*
5. PHQ-9					.74*
6. LSAS					

Note: GAD = Generalized Disorder Scale, PHQ= Patient Health Questionnaire, LSAS = Liebowitz Social Anxiety Scale, *p<.01

Table 3: Statistics for each step of the regressions and betas on the final step with LSAS as the dependent variable and gender/age, social self-beliefs, positive metacognitive beliefs, negative metacognitive beliefs, and the cognitive attentional syndrome as predictors (N = 773).

Step		**F change**	**R^2 change**	**β**	**t**
1		7.755	.021**		
	Gender			.13	3.465**
	Age			-.05	-1.354
2		148.436	.166**		
	Gender			.12	3.663**
	Age			-.04	-1.179
	Positive beliefs			.41	12.183**
3		116.416	.112**		
	Gender			.13	4.166**
	Age			-.01	-.432
	Positive beliefs			.17	4.429**
	Negative beliefs			.41	10.790**
4		274.700	.193**		
	Gender			.04	1.408
	Age			.00	-.009
	Positive beliefs			-.01	-.206
	Negative beliefs			.13	3.491**
	Strategies			.61	16.574**

Note: *p<.05, **p<.01.