Development and initial validation of a short form of the diabetes acceptance and Action Scale

Development and initial validation of a short form of the Diabetes Acceptance and Action Scale: The DAAS-Revised (DAAS-R)

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Abstract

Background: Diabetes is a condition that requires substantial behavioural management and psychological adjustment. Acceptance and Commitment Therapy (ACT) has shown promise as an effective intervention for people with diabetes. Measures of acceptance in diabetes have been developed, though they are long, which discourages their use in routine clinical work and increases item burden in research studies. In addition, different scales have been developed for children and adults, making it difficult to compare diabetes acceptance across the lifespan. This study aimed to develop a short form of the Diabetes Acceptance and Action Scale that would be suitable for administration across all ages.

Method: People with diabetes were recruited via social media, support organisations and charities as well as clinical services. They completed an online survey measuring demographic and clinical data, the Diabetes Acceptance & Action Scale, Problems in Diabetes Short Form, Self-Care Inventory Revised, Brief Experiential Avoidance Questionnaire, Cognitive Fusion Questionnaire and Engaged Living Scale.

Results: Five hundred and thirty-one participants with diabetes responded to the online survey. The sample was 78% British, and 67% female. Seventy percent of the sample had Type 1 diabetes and 30% had Type 2. The scale was successfully reduced to a nine item, one factor scale, with excellent model fit. Cronbach's α was .9 and the scale correlated very highly with the original DAAS (r = .92, p <.0001). Initial convergent validity was established through moderate to strong correlations with diabetes related distress (r = -.76, p<.0001) and diabetes self-care (r = .33, p <.0001). Initial concurrent validity was established through strong correlations with Experiential Avoidance (r = -.64, p <.0001), Cognitive Fusion (r = -.65, p <.0001) and Engaged Living (r = .58, p <.0001).

Conclusion: The DAAS-R is a brief scale, with equivalent psychometric properties to the original 42-item scale. Its brevity should give it greater utility in both clinical and research settings.

Keywords: Diabetes, Acceptance & Commitment Therapy, Measurement, Scale Development, Factor Analysis, Test Theory

Introduction

The prevalence of diabetes is said to be 422 million people worldwide, which has doubled since 1980 (WHO, 2014). Every seven seconds a person dies from diabetes, and diabetes related healthcare cost has been indicated to be as much as US $612 billion (International Diabetes Federation, 2015). With the expected continued increase in diagnoses, healthcare costs are also expected to rise, making it vital to research interventions which can improve diabetes self-management. Self-management requires people to take regular blood checks, manage and monitor a healthy diet and engage in regular exercise.

There is an extensive literature describing psychosocial barriers to self-management in diabetes. Factors identified as barriers include difficulty changing habits, negative perceptions of self-management behaviours, and social circumstances (Booth, Lowis, Dean, Hunter, & McKinley, 2013). Further barriers include cultural beliefs about the cause of diabetes, subjective norms and cultural standards and a number of studies have found ethnic and cultural differences in how people perceive and respond to the need for diabetes self-management (e.g. Majeed-Ariss, Jackson, Knapp & Cheater, 2015; Mogre, Johnson, Tzelepis & Paul, 2019;). In addition, a number of other social and economic factors have been found to operate as barriers to successful self-management such as low income (Keen, Guo & Murillo, 2018; Vest et al., 2013), mental ill health (Mulligan et al., 2017) and rural versus urban living (Ross, Benavides-Vaello, Schuman & Haberman, 2015).

As well as economic, cultural and social factors, a number of interpersonal and psychological factors have been identified as barriers to self-management, for example: causing familial conflict, worries around appropriate diet, emotional struggles to take charge of daily burden of self-management, fears of self-injecting, feelings of failure due to not managing to control blood glucose levels, fitting diabetes into daily life, peer influences such as fear of friends having negative reactions to diabetes, anxiety in social situations, and concerns with fitting in (Borus & Laffel, 2011; Karlsson, Arman, & Wikblad, 2008).

A number of these identified psychosocial barriers involve unpleasant thoughts and feelings, social circumstances and following personal or cultural rules for behaviour. People typically respond to such unwanted thoughts and feelings by attempting to control or avoid them and the situations that lead to them. Personal or socially reinforced rules can also serve as strong influences on action, even if following them is known to have maladaptive consequences (e.g. Torneke, Luciano & Valdivia Salas, 2008). Acceptance and Commitment Therapy (ACT) is an approach which is said to promote adaptive behaviour change even in the presence of unwanted thoughts, feelings or sensations, and ineffective rules associated with diabetes and self-management (Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007).

Acceptance and Commitment Therapy (ACT) is a form of Cognitive Behavioural Therapy (CBT). The emphasis of ACT lies in the ability to notice thoughts, sensations and emotions without needing to act upon them. Unhooking from these internal events allows a person greater choice over their behaviour. This skill is called psychological flexibility. Psychological flexibility has been described as the ability to be open, present-focused, and aware, and to change or persist in behaviour when doing so serves one's values and goals (Hayes, Strosahl & Wilson, 2012). Psychological flexibility is cultivated through the development of six core processes which are promoted in ACT (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). These processes are acceptance, cognitive defusion, contact with the present moment, self as context, committed action and values.

There is growing research into the effectiveness of ACT in diabetes. A treatment conceptualisation has highlighted the benefits of ACT in diabetes management in adolescents with type 1 diabetes (Hadlandsmyth, White, Nesin, and Greco, 2013). Additionally, in a cross sectional study, psychological flexibility has been found to be positively associated with adherence and quality of life and negatively associated with diabetes related worry in adolescents with type 1 diabetes (Di Battista, Hart, Greco, & Gloizer, 2009). Acceptance and Commitment Therapy has also been found to be effective for type 2 diabetes (Hoseini, Rezaei, & Azadi, 2014). Acceptance and Commitment Therapy has also been shown to be a feasible and effective intervention to improve self-management in diabetes (Gregg *et al.*, 2007) . Gregg, Callaghan, Hayes and Glen-Lawson (2007) conducted a randomised control trial where ACT was found to be superior to education alone at 3-month follow-up on diabetes self-care. More participants in the ACT group were found to be classified as in good HbA1c control. Psychological flexibility was also found to mediate the effect of ACT on

HbA1c in this study. The efficacy of ACT in adolescent samples has not been extensively investigated and whilst results in adults are promising, the effectiveness of ACT needs to be determined at longer follow up.

It is also important to find which aspects of treatment are effective and to test hypotheses regarding the mediators of intervention. In order to do this, measures need to be reliable and valid. This has been highlighted as being a limitation to ACT studies previously (Öst, 2008). Mediation studies can then add to the accumulating evidence base supporting the hypothesis that ACT influences health outcomes via its postulated mechanism. Condition specific psychological flexibility measures are also useful for clinical practice, to determine whether intervention is in fact influencing the intended treatment target.

Four diabetes specific measures of psychological flexibility have been developed. The Illness Identity Questionnaire (IIQ) has been validated with adolescents and emerging adults with type 1 diabetes. A confirmatory factor analysis has shown adequate fit for a four-factor model that has shown high reliability and the four subscales correlated with psychological and diabetes specific functioning (Oris et al., 2016). Secondly the Acceptance and Action Diabetes Questionnaire (AADQ) has been validated in adults with type 2 diabetes (Gregg et al., 2007). In a further refinement, a six-item version of the AADQ showed good reliability and validity in adults with type 1 and type 2 diabetes, though has not yet been validated for use across the lifespan (Schmitt et al., 2014). The third measure is the Diabetes Acceptance Scale (DAS; Schmitt et al., 2016) which was originally a 28 item self-report scale that has four subscales. It showed good psychometric properties in adults with type 1 and type 2 diabetes and correlated well with the AADQ. Higher scores on the DAS were also correlated with fewer depressive symptoms, better self-management, better glycaemic control and lower diabetes distress. This has been revised to a 20-item scale (Schmitt et al., 2018) and has retained good internal reliability (α=0.96). Finally, the Diabetes Acceptance and Action Scale (DAAS; Greco & Hart, 2005) is a 42-item measure which measures diabetes acceptance. It was first developed to be used with adolescents with type 1 diabetes. In a preliminary study it indicated good reliability and correlated with quality of life (Ciarrochi & Bilich, 2006). A limitation to all of these validation studies are that they have not been assessed for correlations with other measures of psychological flexibility.

The AADQ and DAS were designed for use with adults and the DAAS and IIQ have been designed for use with young people with type 1 diabetes. It would be helpful to develop a *brief* valid and reliable measure that could be used in young people *and* adults with type 1 *or* type 2 diabetes. In addition, the three measures which have undergone psychometric testing (AADQ, DAS and IIQ) have not been assessed for correlations with other general psychological flexibility measures. The aim of this study was therefore to develop and validate a brief self-report measure of diabetes specific psychological flexibility across the lifespan.

Method

Design & Analysis:

A cross sectional design was used with convenience and snow ball sampling, data were gathered in an anonymous online survey. Ethical approval was provided by the University of Edinburgh School of Health in Social Science Ethics Review Committee and included informed consent, right to withdraw, right to confidentiality and to data security. Planned analyses included sample descriptive statistics, exploratory and confirmatory factor analyses, internal consistency (Cronbach's α) and correlational analyses to test validity. The study was planned to be sufficiently powered to be able to conduct exploratory and confirmatory factor analyses, as well as to detect correlational analyses of $r = .3$ or greater at an alpha of less than .05. For correlational analyses with these parameters, Cohen (1992) recommends a sample size of at least 84. Best practice for sample size calculation for factor analyses remains disputed. Some authors recommend minimum sample sizes of 200, 300 or even 500 (Comrey & Lee, 1992), whilst others favour a participant to item ratio. Rules of thumb for such ratios vary between 5:1 (Gorsuch, 1983) to 10:1 (Everitt, 1975). These rules of thumb would suggest a sample size of between 210 and 420 as adequate for exploratory factor analysis with the 42-item DAAS. Wolf, Harrington, Clark and Miller (2013) report a Monte Carlo study which shows that for a CFA with one to three factors, with more than 6 indictors per factor, and loadings of .5 and above, between 50 and 200 participants is adequate. The study therefore aimed to recruit around 200 participants. Analyses were performed using SPSS version 24 (IBM, 2016) and R version 3.4.2 (R Core Team, 2017).

Inclusion:

Participants were eligible to take part if they had received a clinician confirmed diagnosis of either Type 1 or Type 2 diabetes. Diagnoses were self-reported by participants and not verified, due to online recruitment. Participants needed to be 16 years or older at the time of taking part.

Recruitment:

The survey link was distributed widely using social media, links with diabetes related charities and diabetes services in Scotland. Recruitment began in December 2015 and ended in September 2016.

Measures:

The Diabetes Acceptance and Action Scale (DAAS: Greco & Hart, 2005) is a 42-item measure of acceptance aimed at adolescents with type 1 diabetes. It is scored on a five-point Likert scale from never true to always true, with approximately half the items being reverse scored. Higher scores mean greater acceptance and ability to take adaptive action even when faced with diabetes related challenges. In the original validation study, it had good internal reliability (α = .84). It was also found to have statistically significant correlations with diabetes related quality of life (r =0.36), Diabetes related worry (r = -0.41), social anxiety (r = -0.36), and adherence to medical regime (r = 0.30) (Greco & Hart, 2005). For the current study, 11 of the 42 items were slightly amended to make them more appropriate for a wider age range than teens, less specific to Type 1 diabetes, and to make them more suitable for an international population. For example, the original item, "I do worse in school when I think about my diabetes" was altered to become, "I do worse in school, college or work when I think about my diabetes"; the original item "I play video games or use the internet to take my mind off my health" was changed to "I watch TV, play video games, use the internet, or do other things to take my mind off my health" and the original item "It's OK to feel mad or upset about having diabetes", was rewritten to become "It's OK to feel angry or upset about having diabetes".

The Problem Areas in Diabetes Short-Form (PAID-5: McGuire, et al., 2010) is a 5 item measure of diabetes related distress. Items are scored on a 5-point Likert scale from 0-4 (not a problem - serious problem), with higher scores indicating greater diabetes related emotional distress. It has good reliability with a sample of adults with both type 1 and 2 diabetes (α =

0.83 - 0.86). The short-form correlated highly with the original 20 item measure (r = 0.92, p<0.001)

The Self Care Inventory Revised (SCI-R: Weinger, Butler, Welch, & La Greca, 2005) is a 15-item measure which reflects how well participants followed recommendations for self-care during the past month. Items are scored on a 5-point Likert scale from 1-5 (never-always), with higher scores indicating better self-care behaviours. It has good reliability with a sample of adults with both type 1 and 2 diabetes (α= 0.87). It correlates highly with the Summary of Diabetes Self-Care Activities (SDSCA) (r= 0.63, p < 0.0001).

The Brief Experiential Avoidance Questionnaire (BEAQ: Gámez et al., 2014) is a 15-item measure of experiential avoidance. Items are scored on a 6-point Likert scale from 1-6 (strongly disagree-strongly agree), with higher scores showing more experiential avoidance. It shows good reliability (α=0.80-0.89) with a sample of adults and correlates highly (r=0.57-0.65) with other measures of psychological flexibility (Gámez et al., 2014).

The Cognitive Fusion Questionnaire (CFQ: Gillanders et al., 2014) is a 7-item measure of cognitive fusion. Items are scored on 7-point Likert scale from 1-7 (never true-always true), with higher scores indicating higher entanglement with thinking and dominance of cognition over behaviour. It has good reliability (α=0.88-0.93), and correlates highly (r=0.57-0.87) with other measures of psychological flexibility (Gillanders et al., 2014).

The engaged living scale (ELS) is a 16-item measure of valued living. It is scored on a 5-point Likert scale from 'completely disagree' to 'completely agree' with higher scores indicating greater levels of valued living. It has good reliability in a non-clinical and a chronic pain sample (α=.87), and correlates highly (r= 0.43-0.51) with other psychological flexibility measures (Trompetter et al., 2013).

Results

The survey front page had 3272 visits, 21 participants were screened out by the screening questions relating to diabetes and age, 795 people began the survey, 264 exited the survey before finishing, and 531 participants completed the survey, representing 66.8% of those that began the survey, or 16.2% of all participants that visited the survey homepage.

Demographic Characteristics

Demographic characteristics of the sample can be seen in Table 1.

- Insert Table One here -

The sample had a mean time since diagnosis of diabetes of 16.4 years (SD = 15.1), with a minimum of 6 months and a maximum of 77 years. The majority of the sample were resident in the UK, with small numbers of participants from other high GDP countries and very few from low and middle income countries.

Table 2 shows the means and standard deviations of the study measures.

- Insert Table 2 here -

All measures had good to excellent internal consistency in the study sample, and in relation to cognitive fusion, scored similarly to the normative community samples reported in the initial validation studies. In contrast, the current sample scored lower for valued living, higher for experiential avoidance and reported greater diabetes related problems, poorer diabetes self-care and were substantially less accepting of their diabetes than the normative samples used in the construction of those measures.

Scale reduction

To reduce the scale in an empirically driven way, an iterative series of steps using exploratory factor analysis, and correlational analysis of the resultant scales with the other study measures was used. This process went back and forth comparing the factor structure, pattern of correlations and internal consistency of different versions of the scale, until a psychometrically sound, theoretically coherent and pragmatically useful set of items emerged as a final scale.

Given the total sample of 531 participants, a random number generator was used to split the sample into two samples, of 302 and 229 respectively, so that both exploratory and confirmatory factor analyses could be performed, without using the same participants. Correlational analyses were performed using the full sample. Sub samples did not significantly differ on any study variable. Sample A was used for exploratory factor analyses

(EFA). Initial communalities were used to exclude any items less than .35, resulting in the removal of three items (5, 22 and 24). Parallel Analysis and Velicer's Minimum Average Partial (MAP) test were used to determine the number of factors to extract in the EFA, using the syntax and recommendations from O'Conner (2000). Both the Parallel Analysis and the MAP test agreed that 4 factors should be extracted. Principle axis factoring was therefore used to extract four factors from the 39 remaining items of the DAAS data. The KMO was .94 and Bartlett's test was significant ($\chi_{741} = 10951.68$, $p < .001$) indicating a suitable degree of factorability. Given that factors were expected to be correlated, the oblique rotation method Promax was used to create clearer factors, as recommended by Russell (2002). Factor four only contained 4 items, each with substantial cross loadings on factor one. In addition, factor three had eight items, and four of these also showed cross loadings above .3 with factors one and two. The analysis was therefore rerun, using a forced three-factor solution.

To reduce items and create strong factors, items were successively removed based on increasingly stringent factor loadings (first all items loading below .5 were removed (15 items), and then .6 (1 items), and then .7 (2 items)). Each time a set of items were removed the subscales and total scales were recalculated and the pattern of correlations with other study measures was checked to determine the concurrent and convergent validity of the revised scales. The pattern of correlations between the DAAS revised scales and the other measures showed that the four items loading onto factor three (item 3, 12, 23 and 29) did not correlate strongly with any other study measure. Furthermore, despite reflecting accepting responses, these items showed patterns of correlation that were weak and theoretically inconsistent. A two factor solution was therefore forced, and items retained if they loaded onto either factor at .7 or above and did not cross load at greater than .2 on the other scale.

The 4 items that then loaded onto factor two were near identical (Items 6, 18, 27 & 39; all describing doing things to try and 'forget' about having diabetes). In research and clinical use, these repetitive items may be frustrating to respondents and so rather than retain near identical items, the two items with the highest inter-item correlation with the factor one items were chosen (item 18 & 39) and the others removed from the final scale.

The EFA was re-run as a one-factor scale, with the items of factor one that loaded greater than .7 on the factor, and items 18 & 39 from the previous iteration, factor two. The KMO

was .92 and Bartlett's test was significant ($\chi_{36} = 1676.4$, $p < .001$). The final scale explained 55% of the variance, with item loadings between .49 and .87 (mean item loading .73). The resultant 9 item scale had a Cronbach's α of .9. Table three shows the initial three factor solution with all items, and the final one factor solution in the far right column. It is of note that although items 18 and 39 showed less strong loadings to the factor than the other items, correlational analysis showed that without these items the total scale score was weakened in its pattern of association with other measures, and they were therefore retained.

- Insert Table 3 here -

Confirmatory Factor Analysis

The Lavaan package (Rosseel, 2012) was used in R to test the model fit of the one factor, 9 item solution, using sub sample B (n = 229). Maximum Likelihood Estimation was used. The initial CFA did not reach criteria for good enough fit. Modification indices suggested correlated residual terms, reflecting shared error variance, could improve model fit. These were added one at a time, starting with the correlated residuals between items 18 and 39 (the two former factor two items), until fit indices showed good model fit. This resulted in three correlated error terms. Figure 1 shows the confirmatory model.

- Insert Figure 1 here –

Table 4 shows the model fit statistics, alongside the criteria for good fit as recommended by Hu & Bentler (1999). In line with recommendations from Hu & Bentler (1999) a two fit index method of determining model fit was used, with both absolute and iterative fit indices reported.

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Table 4 shows that six of seven fit indices meet the criterion for good fit, and also that the model meets Hu and Bentler's (1999) two fit index criterion.

Because one of the study's aims was to create a measure that would be applicable to both older and younger people, and to people with Type 1 and Type 2 diabetes, multigroup

confirmatory factor analysis was used to test the hypotheses that the models would be invariant across age or type. The guidelines and interpretation rules described by Hirschfeld and von Brachel (2014) were followed. The analysis first specified a configural model, testing only the factor structure as equivalent between groups, whilst allowing factor loadings, intercepts, means and residuals to vary between groups. Each subsequent line then introduces equality constraints on factor loadings, intercepts, item means, and residuals and compares the model fit with the previous step. In order to maximise group size for these analyses, the multigroup CFA was conducted using the whole sample (n = 531).

The middle panel of table four shows that the model fit of the baseline model was acceptable for both younger (25 years and less) and older (26 years and more) participants. The tests for metric, for scalar and for strict invariance did yield a significant change in Chi Square, however, due to the sensitivity of this test statistic to sample size, Hirschfeld and von Brachel (2014) also recommend examining the change in CFI to determine if the constrained model is a worse fit. Hirschfeld and von Brachel (2014) state that CFI changes of .01 or less indicate equivalent models. The CFI change for each additional equality constraint is less than .01. Finally, the values for CFI, remain above the criteria for 'good' fit at each step. The RMSEA, whilst not meeting the recommended cut offs to be described as 'good', were within the 'acceptable' range. The combination of these parameters was interpreted as demonstrating metric, scalar and strict measurement invariance, across ages.

The analysis of invariance across Type One and Type Two diabetes showed a clearer pattern, with the change in Chi Square and the change in CFI agreeing that imposing equality constraints did not lead to worse model fit. This was interpreted as the DAAS-R showing configural, metric, scalar, and strict invariance, between Type One and Type Two Diabetes.

In summary, the CFA confirms the adequacy of the one factor, 9-item measurement model and the strength of loadings of items to the construct. The measure demonstrated strict invariance across older and younger participants, and those with Type One and Type Two diabetes. The final scale was named the Diabetes Acceptance and Action Scale – Revised (DAAS-R). Higher scores indicate less avoidant responding and greater ability to act towards important activities, in response to diabetes and its challenges.

Convergent validity

The total score on the DAAS-R was calculated for all participants, and used in a correlational analysis with the other standardised measures, to test the convergent and concurrent validity of the revised measure. Results can be seen in Table 5.

- Insert Table 5 here –

Table 5 shows that the DAAS-R correlates very highly with the original DAAS, supportive of the study's primary aim to create an equivalent, short-form scale. Greater acceptance as measured by the DAAS-R was strongly negatively correlated with diabetes related distress. The DAAS-R was also moderately correlated with engaging in appropriate self-management behaviours, showing initial convergent validity. The DAAS-R was also strongly negatively corelated with measures of experiential avoidance, and cognitive fusion, and valued living, indicating initial support for the scale's concurrent validity.

Discussion

The primary aim of this study was to reduce the number of items of the original DAAS-R to make a short form that retains the psychometric properties of the original, but is considerably briefer. An iterative process of exploratory factor analyses, correlational analyses and examination of Cronbach's α were used to examine the factor structure, convergent and concurrent validity and internal consistency of successive iterations of the scale. Decisions were made to remove items primarily on empirical grounds (increasingly stringent factor loadings, pattern of correlations), but also on pragmatic grounds such as the redundancy of near identical items. The resultant scale is brief, and is quick to administer and score. This will be likely to make it more useable in both clinical and research settings, reducing respondent burden. The pattern of reliability analysis and the convergent and concurrent validity analyses shows that the short form has retained the good psychometric properties of the original scale. The factor structure was replicated in a sub sample of the main sample, independent of the sample used for exploratory factor analysis. Although arguably, sample A was slightly underpowered for the full EFA of 42 items, the solution converged successfully. The CFA of the final 9 item scale was well powered to test a simple scale with multiple indicators.

The EFA and correlational analyses showed some unusual aspects that deserve some further discussion. Firstly, the items that loaded to factor three (interpreted as 'acceptance') were

only weakly associated with other measures (both in terms of concurrent and convergent validity). Furthermore, some of these correlations (not reported) were in opposite directions than theoretically predicted (albeit weak). For instance, these 'acceptance' items were positively correlated with cognitive fusion. These items were largely of the form 'It is OK for me to feel angry or upset about having diabetes'. One possible explanation for the weak and theoretically inconsistent correlation is that it is simply a spurious association that is statistically significant due to the large sample size. An alternative hypothesis is that these items reflect well-rehearsed, coping self-statements that participants may have used frequently, and as such have a quality of rigidity akin to cognitive fusion. Future research could examine the use of coping self-statements in people with diabetes to determine their relationship with cognitive fusion, and their impact upon behavioural management.

In addition, the items loading to factor two of the initial EFA were likely responded to in a similar way due to their repetition of wording such as trying to 'forget' about diabetes. It is possible that the co-variance picked up in factor two simply represents a method effect (Marsh, 1986), rather than a substantive factor. The correlated residuals between these two items that was needed to improve the fit of the CFA would support this hypothesis. Similarly, items 32 and 36 both contain reference to diabetes stopping an individual from doing things, and so could also be a method effect related to the word 'stopping'. Item 37 refers to diabetes stopping the respondent from socialising with friends and Item 7 is an evaluation that life can't be good because of having diabetes. These latter two correlated errors may reflect shared variance in responding, based upon the importance of the interpersonal world of the person with diabetes and the way in which diabetes has disrupted this.

The pattern of correlations showed that diabetes acceptance, as measured by the DAAS-R, was only moderately associated with enhanced self-care activities. This could reflect a restricted range of scores on both the self-care measure and the DAAS-R, given that the sample appeared to score lower than the normative samples for both acceptance and self-care. Future clinical research work is needed to establish if increasing diabetes acceptance via interventions such as ACT would lead to improvements in self-care. The DAAS-R was

highly correlated with concurrent validity measures, such as the BMEAQ, the CFQ and the ELS. The strength and pattern of these relationships gives confidence that the revised DAAS is actually measuring the construct of psychological flexibility, as it pertains to managing diabetes.

The analyses reported here should be considered an initial validation, there are important psychometric properties of the measure that will need to be established in future research. For instance, the scale's test - retest reliability, sensitivity to acceptance based treatment and its longitudinal predictive capacity will need to be established. For the present however, the initial validation shows that clinicians and researchers should use the DAAS-R with some confidence that it is measuring in a similar manner to the original scale, and that scores can meaningfully be compared between younger and older populations, and between Type One and Type Two diabetes patients. Its brevity and simplicity will likely enhance the potential contexts in which it can be used.

Limitations

The study had a number of limitations, firstly the measurement was entirely by self-report, which can be influenced by subjective bias, desire to report doing well or doing poorly, poor insight etc. This can particularly be the case when measures reflect abstract or unusual concepts (such as diabetes acceptance or cognitive fusion). All measures have however been well validated as self-report measures and so this was not interpreted as being a significant problem. Diagnoses were supplied by participants and could not be verified independently, though again it is considered unlikely that participants would falsely complete the survey, given that there was no incentive to do so. There was no independent measure of diabetes activity, such as HbA1c. Future studies will be needed to determine if the DAAS-R can predict glycaemic control as measured by HbA1c. Further limitations include the sample being self-selected, computer literate and willing to give time to an online survey. The sample also did not appear representative of the kinds of participants seen in the studies that had validated the standardised measures (e.g. less consistent with self-care, greater problems in living with diabetes, higher diabetes related distress and less accepting of diabetes). The scale may respond differently in samples that are more well-adjusted to their diabetes and future studies will be needed to determine this. The sample was also biased towards white British adults (though age range did cover the lifespan from teens to adults), was predominantly

female and from higher GDP countries. The ability of the DAAS-R to accurately measure diabetes acceptance in diverse populations remains untested. Finally, all of the data is based on correlational analysis and patterns of covariance, detectable by factor analysis. Relationships between constructs are therefore associations and causal directions have not yet been established. Future research exploring the longitudinal pattern and the potential to influence diabetes acceptance in treatment trials is needed to establish the status of diabetes acceptance (as measured by the DAAS-R) as cause or consequence of living well with diabetes.

A further critique of the DAAS-R is that the items that were retained (on empirical grounds) appear to assess the behavioural impacts and perceived consequences of having diabetes. Many items related to thinking and feeling were not retained. Whilst this might appear problematic in a measure of diabetes acceptance, it has led to a measure that is a behaviourally operationalised perspective on acceptance and as such is consistent with the underlying framework of Contextual Behavioral Science. The pattern of correlations indicate that the DAAS-R can be successfully used to 'predict' psychological events (i.e. which participants are struggling with their diabetes) and future research will determine if the scale can detect the 'influence' of ACT interventions in diabetes.

Conclusion

The DAAS-R is a short form of the original scale with good psychometric properties in a sample comprising both teens and working age adults. It is suitable for use in clinical and research settings. A range of epidemiological, longitudinal and intervention studies addressing unanswered questions in this field is needed, and the good initial properties of the DAAS-R should facilitate this programme of research. The measure is freely available to members of the Association for Contextual Behavioral Science for download at: http://www.contextualscience.org/DAASR.

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Table 1: Demographic Characteristics

Variable	Frequency	%
Age		
16 to 25	85	16
26 to 35	116	21.8
36 to 45	104	19.6
46+	226	42.6
Gender		
Female	354	66.7
Male	177	33.3
Other	0	0
Prefer not to say	0	0
Ethnicity		
White British	415	78.2
White European	41	7.7
White American	41	7.7
White Other	13	2.4
Black British	1	.2
Black European	0	0
Black American	0	0
Black Other	0	0
Asian British	6	1.1
Asian European	0	0
Asian American	0	0
Asian Other	3	.6
Mixed British	1	.2
Mixed European	1	.2
Mixed American	2	.4
Mixed Other	5	.9
Other	0	0
Prefer not to say	2	.4
Residence		
United Kingdom	428	80.6
Rest of Europe	37	6.9
North America	52	9.8
South America	1	.2
Middle East	2	.4
Africa	3	.6
South Asia	3	.6
East Asia	0	0
Australasia	3	.6
Prefer not to say	2	.4
Type of Diabetes		
Type 1	371	70
Type 2	160	30

Table 2: Descriptive Statistics

Measure	Cronbach's α	Mean (SD)	Range	Norms Mean (SD)
Original 42 item DAAS	.92	54.73 (24.0)	11 - 129	122.6 (16.9) [a]
BMEAQ	.87	58.4 (14.6)	15 - 90	49.4 (11.1)[b]
CFQ	.96	25.1 (11.0)	0 - 42	22.3 (8.3)[c]
ELS	.96	22.1 (13.8)	0 - 64	60.8 (7.83)[d]
PAID-5	.89	12.1 (5.2)	0 - 20	6.02 (5.25)[e]
SCI-R	.79	2.6 (.6)	.15 - 4.15	5.79 (1.06) [f]

DAAS = Diabetes Acceptance & Action Scale; BMEAQ = Brief Experiential Avoidance Questionnaire; CFQ = Cognitive Fusion Questionnaire; ELS = Engaged Living Scale; PAID-SF = Problem Areas in Diabetes Short Form; SCI-R = Self Care Inventory Revised. [a] from Greco & Harte, 2005 [b] Community sample from Gamez et al. (2014), [c] Community sample from Gillanders et al. (2014), [d] Community sample from Trompetter et al. (2013), [e] from McGuire et al. (2010), [f] from Weinger et al. (2005)

Table 3: Exploratory Factor Analysis of the Original 42 Item DAAS

#	Item	Communality	F1	F2	F3	Final One Factor
1	I do things that I care about, even when I feel sad about my diabetes.	.468	-.442			
2	I watch TV, play video games, use the internet or do other things to take my mind off my health.	.473		.395		
3	It's OK to feel down or afraid about having diabetes.	.509			.709	
4	I worry a lot about my health.	.479	.334			
5	I push away negative feelings about diabetes.	.336	-	-	-	
6	I try to forget that I have diabetes.	.475		.697		
7	**My life can't be good because I have diabetes.**	.683	.757			**.745**
8	I don't do well in school, college or work when I worry about my diabetes.	.655	.562			
9	I do things that are important to me even though I have diabetes.	.531	-.653			
10	I take care of my health, even when I feel upset about having diabetes.	.532		-.437		
11	My life would be much better if I didn't have diabetes.	.546	.343			
12	It's OK for me to feel upset about having diabetes.	.614			.820	
13	I eat things that I shouldn't, so I don't feel different from my family or friends.	.387		.500		
14	Diabetes messes up my life.	.725	.565			
15	I can live a good life with diabetes.	.579	-.674			
16	I talk about my diabetes even if it makes me feel bad.	.383			.336	
17	Thoughts about diabetes can really hurt me.	.567	*.306*	*.398*		
18	**I do things to forget about my diabetes.**	.621		.773		**.503**
19	**Diabetes keeps me from working on my goals.**	.660	.818			**.757**
20	I check my glucose even when I've had a rough day.	.405		-.505		
21	I don't try out new things because I'm afraid of having a reaction or getting sick.	.461	.559			
22	It's <u>not</u> OK to think about what diabetes can do to me.	.244	-	-	-	

23	It's OK to feel scared about my health.	.546			.691	
24	I block out negative thoughts about having diabetes.	.324	-	-	-	
25	I don't take my medicine because it reminds me I have diabetes.	.410		.422		
26	I wish I could wave a magic wand to make my diabetes go away.	.448		*.285*	*.243*	
27	I do whatever I can to forget that I have diabetes.	.638		.893		
28	I stay away from people and places that remind me of my diabetes.	.491	*.339*	*.325*		
29	It's OK for me to feel angry or upset about having diabetes.	.602			.793	
30	I share my feelings about having diabetes with other people.	.480	-.345			
31	I do things that I like to do, even when I feel upset about having diabetes.	.572	-.700			
32	**I stopped doing fun things because I have diabetes.**	.618	.830			**.724**
33	**My diabetes gets in the way of living a good and meaningful life.**	.653	.786			**.800**
34	I can't be a good friend because of my diabetes.	.414	.612			
35	I do worse in school, college or work when I think about my diabetes.	.715	.602			
36	**Diabetes stops me from doing what I want to do.**	.712	.848			**.849**
37	**Diabetes stops me from socialising with my friends.**	.739	.847			**.826**
38	**Diabetes stops me from doing well in life**	.778	.936			**.872**
39	**I try hard to forget the fact that I have diabetes.**	.623		.823		**.486**
40	If I think negative thoughts about my diabetes, it will make it worse.	.617		.430		
41	My thoughts about diabetes mess up my blood sugar levels.	.611		.436		
42	Being afraid about having diabetes will make it get worse.	.570		.384		
					Cronbach's α	.90
					Mean	9.2
					(*SD*)	7.9

Note: Blank cells are loadings <.29, and are left blank for clarity. Cells with a hyphen are items removed prior to factor analysis, due to low initial communalities. Italicised items were removed after the first EFA solution, due to low loadings or substantial cross loading. Items in bold are the items of the final revised scale.

Table 4: Confirmatory Factor Analysis

	χ^2_{24}	*p*	NC	CFI	TLI	IFI	RMSEA	SRMR
DAAS-R	40.22	.02	1.68	.99	.98	.99	.05	.03
Good Fit Criteria [a]	-	>.05	≤3 [b]	≥.95	≥.95	≥.95	<.06	<.08

Measurement Invariance: Younger versus older

	$\chi^2_{(df)}$	$\Delta\chi^2$	Δ_{df}	*p*	CFI	ΔCFI	RMSEA	ΔRMSEA
Configural	$98.4_{(48)}$	-	-	<.01	.982	-	.063	-
Loadings	123.6 (56)	25.2	8	<.01	.976	<.01	.067	<.01
Intercepts	149.7 (64)	26.1	8	<.01	.970	<.01	.071	<.01
Means	150.6 (65)	.90	1	.32	.970	<.01	.070	<.01
Residuals	172.4 (73)	21.8	9	<.01	.965	<.01	.072	<.01

Measurement Invariance: Type 1 versus Type 2 diabetes

	χ^2_{df}	$\Delta\chi^2$	Δ_{df}	*p*	CFI	ΔCFI	RMSEA	ΔRMSEA
Configural	136.0 (48)	-	-	<.01	.969	-	.083	-
Loadings	151.6 (56)	15.6	8	.048	.967	<.01	.080	<.01
Intercepts	160.8 (64)	9.2	8	.33	.966	<.01	.075	<.01
Means	162.3 (65)	1.5	1	.21	.966	<.01	.075	<.01
Residuals	189.7 (73)	27.4	9	<.01	.959	<.01	.078	<.01

NC = Normed Chi Square, CFI = Comparative Fit Index, TLI = Tucker Lewis Index, IFI = Iterative Fit Index, RMSEA = Root Mean Squared Error of Approximation, SRMR = Standardised Root Mean Squared Residual, [a] Good fit criteria from Hu & Bentler (1999), [b] from Bollen (1989).

Table 5: Concurrent and Convergent Validity

	DAAS Original	DAAS-R Total
DAAS-R Total	.92	-
PAID-SF	-.78	-.76
SCI-R	-.43	-.33
BMEAQ	-.64	-.60
CFQ	-.65	-.61
ELS Total	.58	.58
ELS Values	.51	.49
ELS Fulfilment	.61	.62

All correlations are significant at $p < .0001$, $n = 531$, DAAS: Diabetes Acceptance and Action Questionnaire, DAAS-R Diabetes Acceptance and Action Questionnaire Revised, PAID-SF: Problem Areas in Diabetes Short Form, SCI-R: Self Care Inventory Revised, BMEAQ: Brief Multidimensional Experiential Avoidance Questionnaire, CFQ: Cognitive Fusion Questionnaire, ELS: Engaged Living Scale.

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Figure 1: Confirmatory Factor Analysis