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# Development of the Tinnitus Response Scales: Factor analyses, subscale reliability and validity analyses

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## Abstract

**Objective:** Patients suffering with tinnitus are often advised to accept the noise, but few studies have examined what tinnitus acceptance entails. The present project developed and tested a new instrument to assess the mindfulness-based constructs of acceptance, control, and defeat, in relation to the experience of chronic tinnitus. **Method:** Initial scale development involved an expert panel. Participants were recruited from the general population and tinnitus support organizations and complete the first version of the Tinnitus Response Scales (TRS) and measures of tinnitus coping, severity and distress, general distress, illness cognitions, and tinnitus and health characteristics. **Results:** Three interpretable TRS factors were found: acceptance, control and defeat (an Internet sample, $N = 273$) and confirmed using another sample (hard-copy sample, $N = 278$). Factors were shown to have high internal consistency and test-retest reliabilities and differed in terms of their related cognitions, behaviour, and emotional responses to tinnitus, and their tinnitus characteristics. **Conclusion:** The TRS factors provide an alternative conceptualisation of tinnitus responding. TRS is a brief psychometrically valid measure of tinnitus responding that appears to distinguish between adaptive and non-adaptive responses to tinnitus noise, and should prove useful as a clinical measure.

**Keywords:** adaptation, psychological, reproducibility of results, scales, tinnitus, validity of tests.

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## INTRODUCTION

Tinnitus is the perception of noise in the ears or head in the absence of an external acoustic source[1-3] that is often associated with hearing loss[4]. In the present project, we report on the development of the Tinnitus Response Scales (TRS) which was designed to delineate tinnitus response patterns associated with better tinnitus outcomes, using an acceptance and mindfulness psychotherapy approach[5]. Most people with chronic tinnitus adapt to the noise and are not too bothered by it[6]. However, some people do not adapt, become sensitized, and may go on to suffer from tinnitus-related distress[3,7].

The historical focus of the tinnitus distress literature has been on people's negative cognitive appraisals of tinnitus and their individual coping resources, which have been used to help explain tinnitus annoyance and the associated distress[8]. Several tinnitus coping models and their psychometrically sound scales are described in the literature. The Tinnitus Coping Style Questionnaire[2,9] and the Tinnitus Cognitions Questionnaire[10] tend to dichotomize tinnitus coping as either positive/effective or negative/maladaptive. In general, negative/maladaptive coping has been shown to be strongly correlated to worse tinnitus severity, anxiety, and depression. However, effective coping has generally not been found to be correlated with better tinnitus outcomes e.g., less severe tinnitus[9], and nor have control-type strategies[11-13]. Furthermore, the more frequent use of coping strategies is related to greater tinnitus annoyance[14] and control strategy use is related to greater sensitivity to ambient sound[15]. Taken together, these results suggest that tinnitus noise may be the 'wrong target' for tinnitus therapy. That is, attempting to control one's tinnitus requires giving attention to the noise, likely reducing the potential for habituation and tinnitus adaptation; possibly intensifying the experience and leading to greater tinnitus annoyance and distress[16].

Thus, an alternative approach is required to identify tinnitus response pattern(s) that do lead to better tinnitus outcomes. Therefore, in this project, we used acceptance and mindfulness psychotherapy models[5] to help characterize chronic tinnitus responses. We posited that people who accept their tinnitus will fully adapt to the noise; whereas people who attempt to control the noise or are defeated by it, may be unable to adapt, and may continue to experience tinnitus distress.

Few prior studies have examined mindfulness or acceptance constructs in relation to chronic tinnitus, although the Tinnitus Acceptance Questionnaire (TAQ) has recently been developed[5], and positive results (e.g., symptom reduction) have been reported in several recent acceptance-based tinnitus treatment studies[17-19]. In addition, tinnitus acceptance responses have been shown to be related to less tinnitus distress[20], although the authors used an earlier untested version of the TRS-acceptance subscale, which included slightly different items to those in the 24-item TRS proposed by the present project. Further, acceptance was shown to be associated with a lack of seeking meaning in the tinnitus experience[21]. Taken together, these results suggest that tinnitus acceptance may occur in people with less severe or distressing tinnitus or those not searching for meaning in their condition. Thus, in the present project, we expected that TRS-acceptance will be related to less severe and distressing tinnitus, and lower Illness Perception Questionnaire-consequences of illness scores, which assesses the meaning of tinnitus.

In the literature, acceptance is described as a process of allowing or letting be, rather than avoiding, fixing, changing, or eliminating unwanted experiences that cannot be changed[22]. Thus, it is a neutral response that enables the non-judgemental perception of life situations in the present moment. The construct was initially developed for use in cognitive-behavioural-therapies such as Mindfulness-Based Cognitive Therapy[22], Dialectical Behaviour Therapy[23], and Acceptance and Commitment Therapy[16].

This literature asserts that acceptance will reduce the contingency between noxious stimuli (e.g., tinnitus noise) and habitual distress. Thus, an acceptance-based approach may permit chronic tinnitus sufferers to develop skills that enable them to simply observe the tinnitus noise rather than reacting negatively to the experience. Importantly, this approach does not require the person to give up control; rather, it involves shifting attention away from aspects of life that cannot be controlled (i.e., experience of tinnitus noise) to that which can be managed (e.g., getting on with life). Acceptance theorists assert that it is this change in focus that is likely to underpin the observed reductions in symptom severity (e.g., pain, tinnitus) seen in two recent studies[17,24].

To help guide the development of the TRS, we used the Chronic Pain Acceptance Questionnaire CPAQ[25], similar to the approach used by Westin, Hayes, Andersson[5] in developing the TAQ. Both the CPAQ and TAQ have two subscales:

1. degree to which people continue to engage in life activities; and
2. the need to suppress unwanted private experiences such as tinnitus noise or tinnitus-related distress. Further, additional items were generated in line with participant responses in a series of qualitative interviews; which resulted in the development of equal numbers of items assessing the cognitive, behavioral, and emotional aspects of tinnitus acceptance responses, as well as control and defeat subscales.

In the TRS, control was defined in terms of a person's cognitive and behavioral attempts to direct attention away from the noise and/or to manage the impact of their tinnitus. That is, control will reflect a negative primary appraisal of tinnitus noise, and a positive secondary appraisal of the availability of coping resources. In contrast, defeat was defined as a cognitive and emotional response to chronic tinnitus that is characterised by resignation, giving up on life, feeling beaten by the condition, and believing the tinnitus has ruined one's life, resulting in helplessness/hopelessness and despair. Thus, defeat responses will reflect a negative primary and secondary appraisal of tinnitus[26]. In contrast, acceptance responses are characterized by neutral thoughts, emotion, and behavior or non-reactivity to tinnitus noise, such that the noise neither concerns nor bothers the person. However, it is regarded as an active state inasmuch as it requires people to actively observe their thoughts, feelings and bodily sensations as they occur[27] although definitionally, there is a lack of need for agency in these situations.

We expected that:

1. positive and negative tinnitus-related cognitions, behaviour, and emotions will be adequately described by the TRS subscales;
2. the control and defeat sub-scores will be moderately negatively correlated with the acceptance responses,
3. high defeat scores will be strongly related to worse tinnitus severity and distress, tinnitus threat cognitions (i.e., Illness Perception Questionnaire revised [IPQ-R] consequences), maladaptive coping, and general distress; whereas high control scores will be less strongly related to tinnitus threat cognitions, and tinnitus severity and distress; and acceptance will be negatively related to tinnitus threat perceptions, tinnitus severity, and distress. Finally, tinnitus characteristics will be examined in relation to the TRS subscales making no a priori assumptions.

## METHOD

### Ethics Approval

The University of New England Human Research Ethics committee assessed and evaluated all components of the present project. Ethics approval was granted, approval number HEO4/124 enabling the project to go ahead.

### Participants and procedure – Initial scale development

Four groups of volunteers were recruited to assist with initial scale development, using the content validation guidelines of Haynes, Richard, Kubany[28] and Clark, Watson[29].

The first contained relevant experts: a mindfulness researcher, clinical psychologist, and two health psychologists, one specialising in hearing and tinnitus. They were asked to review the subscale definitions, which were refined in line with their feedback.

The second group had twelve university staff with chronic tinnitus (duration: 6-months to 30-years), 6 males and 6 females, aged 45 to 63 years, were recruited via an online advertisement and asked to describe their tinnitus experiences in a short interview. Fifty-nine items were generated from the interviews, with approximately equal numbers of items evaluating cognitive, behavioral, and emotional responses in each of the three subscales.

The third group employed 12 volunteers (from the second group) and seven more (n = 19), 9 females and 10 males, aged 45 to 70 years, were asked to complete a draft version of the TRS, and then categorize items into the subscales and provide feedback on the intelligibility of items; the items were revised in line with this feedback. Resulting in a 76-item pool.

The fourth group had nine experts (i.e., tinnitus researchers, psychology, audiology & otolaryngology clinicians) evaluated the items' representativeness and readability, and sorted them using the subscale definitions of control, defeat and acceptance (provided at the end of the Introduction). Several experts suggested that the tinnitus-related behavior should be more systematically examined (e.g. noise avoidance), thus, 11 items were adapted from the All-or-Nothing subscale of the Behavioral Responses to Illness Questionnaire[30,31], resulting in an 87-item pool. The experts reached consensus as to which items belonged to which subscale in most cases, thus, all items were retained for later analysis. TRS instructions and item intelligibility were determined to be acceptable by the experts.

### Participants and procedure – Field-testing

Participants were recruited via newspaper advertisements, radio and television interviews, and notices placed in tinnitus newsletters, websites, noticeboards (e.g., British Tinnitus Association), and tinnitus and Meniere's disease chat-rooms. They were directed to the study URL for the online surveyor they could request a paper (hard-copy) version of the survey. Internet sample responses were used to explore the factor structure of the TRS, and hard-copy survey responses were used to confirm the factor structure of the TRS. To be eligible, participants had to be 18 years or older and have had their tinnitus for one month or more.

**Internet sample**

The study URL got 701 visits in the six-month data gathering period and 273 participated (39% response rate). They completed the 87-item TRS and answered several questions about their tinnitus history. Most respondents resided in the United Kingdom (51%) or Australia (42.1%). The sample was comprised of 150 males and 123 females, ranging in age from 18 to 99 years (M = 51, SD = 14.3). Their tinnitus duration ranged from one month to 55 years (M = 11.4, SD = 11.33), with most experiencing their tinnitus for more than 10 years (n = 107). Three-quarters (n = 193) of the sample had received a formal tinnitus diagnosis.

**Hard-copy sample**

Participants were 278 Australians. They were mailed an information package and survey, and returned it anonymously or they confirmed their contact details if they wished to participate in future testing. The sample included 156 males and 122 females, with ages ranging from 19 to 88 years (M = 51, SD = 14.3 years). Their tinnitus duration ranged from half a year to 80 years (M = 18.9,SD = 15.64); most had had their tinnitus for more than 10 years (n = 158). Three-quarters of the sample had received a formal tinnitus diagnosis (n = 206).

**Measures**

The 87-item prototype of theTinnitus Response Scales (TRS) was administered to both the Internet and the hard-copy samples. Respondents rated the extent to which each statement applied to them or their tinnitus, using 0 to 10 rating scales, where 0 means not at all true and 10 means perfectly true. They also described their tinnitus symptoms, diagnosis, and history, related diagnoses, medication use, current tinnitus treatments, and they used a 0 to 10 scale to rate the tinnitus loudness at its worst, the frequency and degree of bother caused by the tinnitus, tinnitus distress, and impact of the noise on daily life.

In the test-retest and validity phases of the project, the shorter 24-item TRS was administered in conjunction with the following measures:

- Tinnitus Coping Style Questionnaire TCSQ[2,9]. Respondents were asked to rate how often they used each strategy, using 7-point Likert scales. Internal consistencies for the subscales are high, with Cronbach's alphas of .90 and .89 for maladaptive and effective coping, respectively.
- Tinnitus Reaction Questionnaire[32] is a self-report measure of psychological distress that is specific to the tinnitus experience. Respondents were asked to rate statements using 5 point Likert type scales. Total tinnitus distress scores are reported here. The scale is reported to have good test-retest reliability and high internal consistency (Cronbach's alpha = .96).

Brief Assessment of Tinnitus Severity (BATS; developed in the present project). This 5-item measure of tinnitus severity was developed from an original pool of 12-items that asked participants about how much they were bothered by the tinnitus, frequency of the bother, how loud the noise was at worst and best, how much the noise impacted on their life and threatened their health and wellbeing, how distressing the tinnitus was currently and when it was first heard, and how much they were bothered by everyday sounds, using 0 to 10 point rating scales, with high scores indicating worse tinnitus severity. In the present project, the BATS had high internal consistency with Cronbach's alphas of .83 to .89 in the Internet and hard-copy samples, respectively. Other psychometric analyses of the BATS are presented in the Results section.

The Depression Anxiety and Stress Scales-21[33] was used to assessed self-rated stress, anxiety and depression. Only core features of the syndromes are included in the measure, permitting a maximal discrimination between the different symptom clusters. Respondents were asked to rate the extent to which they experienced each state over the past week using 4-point severity and frequency subscales, with high scores indicating greater stress and distress. Internal consistencies for the subscales are reported to be moderate to high with Cronbach's alphas of .81, .73, and .81, respectively[33].

Illness Perception Questionnaire-revised IPQ-R[34]. This scale was used to assess cognitive representations of tinnitus including: psychological attributions (e.g., attitude, personality, worries), timeline (i.e., acute vs. chronic, cyclical), cause (i.e., causal attributions: risk factors, immunity, accident, chance), consequences (i.e., beliefs about severity & likely impact of disorder on physical, social & psychological functioning), curability/controllability (i.e., self-efficacy beliefs about disorder, beliefs of treatment control & treatment outcome expectancies), emotional representations (i.e., emotional response to disorder), and illness coherence (i.e., understanding of disorder). In the present project, the IPQ-R was adapted by:

1. changing the word illness to tinnitus,
2. including additional items from the IPQ-R-chronic pain version (http://www.uib.no/ipq/ pdf/IPQ-R-CP.pdf) to the causal attribution subscale, and
3. including questions asking about medications, head injury/accident, loud noise, ear disease/ infection, and chronic illness. Internal consistencies for the subscales are generally high with Cronbach's alphas ranging from .79 to .89, although values for the causal attribution

subscale are variable, ranging from .23 to .86[34,35]. The scale has high reported construct and discriminant validity[36,37].

**Statistical Analysis**

TRS items were examined empirically using exploratory (EFA) and confirmatory factor analyses (CFA). Test-retest reliability and convergent and divergent validity of the subscales were also assessed, using a sub-sample of respondents. A range of tinnitus and health variables were assessed in this regard including: tinnitus coping, severity, and distress, general distress (i.e., psychological stress, anxiety, depression), illness perceptions, tinnitus parameters (e.g., loudness), and general health indices (e.g., number of chronic illnesses).

Reliability and validity of the TRS responses were assessed using responses received from 103 of the 150 people in the Internet sample who agreed to be contacted about future testing, and 41 of 50 people in the hard-copy sample who had similarly agreed, giving a total of 144 responses. Five cases with significant missing data were deleted, leaving 139 responses. Test-retest reliability was assessed by examining the TRS responses at baseline and 5 to 12-weeks later. Convergent (and divergent) validity were assessed using measures of tinnitus coping, severity and distress, general distress (i.e., stress, anxiety, and depression), illness cognitions, and self-reported tinnitus characteristics.

TRS-defeat and tinnitus distress were log and inverse transformed due to positive skewing, but this did not change the relevant results, relative to untransformed scores. Thus, the analyses are reported using untransformed data.

## RESULTS

Half the Internet (n = 273) sample described tinnitus that started gradually (n = 132) and half described a sudden onset (n = 141). Most (n = 232) described tinnitus loudness that was variable over time, and tinnitus awareness that was constant (n = 177). One-quarter (n = 67) described the tinnitus as having a pulse or beat.

**EFA - Internet Sample**

EFA was conducted on the TRS responses using the maximum likelihood function in SPSS, which provides the best match for the mathematical algorithm used in CFA. Correlational matrices showed many correlations above .3, thus, indicating suitability for factoring. The Bartlett Test of Sphericity (.94) and Kaiser-Meyer Olkin Measure of Sampling Adequacy, $\chi^2$ (3,741, n = 273) = 15,617.27, $p < .001$, indicated suitability of the items for factoring. Cattell's scree test indicated that two or four factors should be retained, Kaiser's rule suggested 10 (i.e., Eigen values over 1), and Horn's parallel analysis suggested 8 factors, whereas Velicer's MAP test indicated ten factors. Direct Oblimin rotation ($\Delta = 0$) was conducted on all solutions from 2 to 10 factors, and matrices were assessed for interpretability.

Several solutions resulted in clearly defined factors with simple structures, but some factors had insufficient items for subscale development. Items with loadings > .3 on more than one factor or less than .5 were deleted, and the analyses were re-run until a simple structure was achieved. A single factor solution explained 41.2% of the item variance, a two-factor solution failed to achieve a simple structure, and the three-factor solution explained 48.8% of the item variance. In this model, factors labeled as acceptance and defeat were highly inversely correlated (r = -.65), whereas control was moderately correlated with defeat (r = .32) and acceptance (r = -.31).

Using the above statistical criteria, 47 items were deleted and EFA was rerun using the remaining items. Eigen values indicated there were 3 factors for retention, and scree plots suggested a one or three factor s olution. A one-factor solution explained 44.5% of the item variance, but the pattern matrix for the 3-factor solution explained more variance (49.7%). Items not loading > .60 on defeat or acceptance factors were deleted, and since the control subscale had fewer items, a cut-off level of .55 was used. Items loading onto two or more factors were deleted, leaving 24 items. An EFA was re-run on the 24-item scale, and the 3-factor solution explained 55.1% of the item variance, and defeat and acceptance were highly correlated (r = -.65), and defeat and control (r = -.29), and acceptance and control (r = .34) were moderately correlated (Table 1).

**CFA – Hard-Copy Sample**

Responses from the hard-copy sample to the 24-item TRS (n = 278) were used in a CFA. Comparing the hard-copy and Internet samples, hard-copyrespondents were older (mean age: 61.7 *vs*. 50.1 years, $t$ (271) = -9.01, $p < .001$), had a longer tinnitus duration (mean: 18.9 *vs*. 11.4 years, $t$ (267) = -6.519, $p < .001$), and were less likely to recall a gradual tinnitus onset (65% *vs*. 48%, $t$ (257) = 3.373, $p = .001$), and intermittent tinnitus awareness, $t$ (272) = 2.12, $p = .035$, relative to Internet respondents. Missing values were imputed using the expectation maximization algorithm in SPSS. Univariate outliers were retained in all analyses. CFA was run with and without multivariate outliers. Since the factor solutions were unaffected by the outliers, they were retained in all analyses.

CFA was conducted on the 24-item TRS using AMOS, and tested the goodness-of-fit of the 1, 2, and 3 factor models, see Table 2. Following the recommendations of Kline[38], multiple indices were used to assess goodness-of-fit with chi-square values and chi-square divided by degrees of freedom reported for each model. Values less than 3 on the latter statistic are better indicators of acceptable fit than chi-square[39]. These statistics indicated

**Table 1.** Direct Oblimin (Δ = 0) Rotated Factor Loadings for the TRS (24-item) (n = 273 Internet Sample).

| Item | Factor 1 a = .94 | Factor 2 a = .81 | Factor 3 a = .87 |
|---|---|---|---|
| 86 Tinnitus has ruined my life | .91 | .01 | .17 |
| 64 It distresses me that tinnitus prevents me from enjoying my life | .83 | -.02 | -.05 |
| 61 Because if the tinnitus noise it is pointless trying to concentrate on anything | .77 | .14 | .09 |
| 63 I often think I cannot take the noise any longer | .73 | -.02 | -.17 |
| 6 I despair because of my tinnitus noise | .72 | .06 | -.20 |
| 12 Tinnitus will eventually threaten my mental health | .72 | -.06 | .01 |
| 74 This tinnitus noise is all too much | .70 | -.04 | -.18 |
| 49 Tinnitus is the worst thing that has happened to me | .68 | -.04 | .03 |
| 75 Tinnitus has impacted on my close relationships | .67 | -.13 | .00 |
| 15 I am worn down by my tinnitus noise | .64 | -.07 | -.20 |
| 10 I feel helpless because of my tinnitus noise | .64 | .00 | -.09 |
| 39 I feel defeated by my tinnitus noise | .64 | -.06 | -.15 |
| 44 I use a range of strategies to suppress my tinnitus noise | -.07 | -.72 | -.01 |
| 40 I purposely change the way I think about tinnitus to improve my quality of life | -.01 | -.68 | .12 |
| 31 Most days I do things to manage my tinnitus | -.02 | -.68 | -.01 |
| 50 I work to suppress my tinnitus noise | .14 | -.58 | -.15 |
| 37 I make an effort to control my thoughts in order to cope with tinnitus noise | .17 | -.58 | -.16 |
| 23 I can usually hear the tinnitus noise and it does not bother me | .01 | -.04 | .75 |
| 27 I do hear the tinnitus noise and it does not bother me | -.06 | .04 | .74 |
| 86 When I become aware of tinnitus noise my awareness soon passes | -.07 | -.03 | .68 |
| 18 I am so used to my tinnitus noise I hardly notice it | -.07 | -.02 | .68 |
| 87 I willingly accept the presence of my tinnitus noise | .03 | .01 | .67 |
| 21 I can enjoy peace and quiet and hear the tinnitus noise | .03 | .06 | .66 |
| 85 I simply let my tinnitus noise be there in the background | -.04 | .02 | .62 |

Loadings are reported from direct oblimin rotation pattern matrix. Loadings below .60 are not included except for control where .55 was the cut-off.

that a 1 and 2 factor model did not achieve an adequate fit, but the 3-factor model achieved an adequate fit on all indices. Of the standardized residual co-variances, only one value was greater than 2.58, i.e., between acceptance item TRS 86 and control item TRS 40, z = 2.65.

Chi-square difference tests were used to determine if the 3-factor model fitted the data better than the other models. Following the recommendation of Kline[38], chi-square values of the 2 and 3-factor models were subtracted from values of the 1-factor model. The three-factor model fit the data better than the other two models.

**Reliability and Validity**

Internal consistency of the 24 - item TRS subscales were high. Cronbach's alphas of .94 for defeat (12-item, M = 36.7; SD = 31.78), .81 for control (5-item, M = 21.7; SD = 13.75), and .87 for acceptance (7-item, M = 32.9; SD = 18.37), in the Internet sample. In the hard-copy sample, Cronbach's alphas were .92 for defeat, .82 for control, and .86 for acceptance.

Test-retest reliability was computed for the TRS subscales, using the Internet and hard-copy samples, see Table 3. Test-retest reliabilities of the defeat and acceptance sub-scores were very good to excellent, and those of the control subscale were adequate to good see[38], categorization of coefficients.

**Convergent and Divergent Validity**

Associations between the TRS subscales and maladjusted and effective coping (TCSQ) were examined, see Table 4. As expected the TRS subscales, defeat ($\beta$ = 0.52, $p < .001$), acceptance ($\beta$ = -0.18, $p < .01$), and ($\beta$ = 0.13, $p > .05$) had a strong relationship with maladjusted coping with TRS explaining 52% of the variance in maladjusted coping. However, the TRS subscales only explained 17% of the variance in effective coping.

Next, the validity of the TRS sub-scores was examined in relation to TRQ and BATS. As expected, all three TRS subscales were related to the BATS, explaining more than half of its variance, $R^2 = .53$, $F(3, 269) = 101.52$, $p < .001$. High defeat explained most of the variance ($\beta = 0.38$, $p < .001$),

**Table 2.** Goodness-of-fit Indices for the Confirmatory Factor Analyses on the TRS (N = 278 hard-copy sample).

| | | | | | | 90% CI RMSEA | | |
|---|---|---|---|---|---|---|---|---|
| Model | $\chi^2$ | df | $\chi^2$/df | CFI | RMSEA | LB | UB | SRMR |
| 1 | 973.73** | 252 | 3.86 | .77 | .102 | .095 | .108 | .086 |
| 2 | 700.04** | 251 | 2.79 | .86 | .080 | .073 | .087 | .069 |
| 3 | 471.38** | 249 | 1.89 | .93 | .057 | .049 | .065 | .054 |

CI: Confidence interval; RMSEA: Root-mean-square error of approximation; LB: Lower bound; UB: Upper bound; CFI: Comparative fit index; SRMR: Standardized root-mean-square residual; BIC: Bayes's information criterion. Acceptable fit was defined as $\chi^2$/df < 3, LB of the 90% CI for RMSEA < .05 and UB < .10. ** $p$ < .01 (2-tailed).

**Table 3.** Test-retest for the TRS subscales.

| Subscale | Internet sample (n = 103) | Hard-copy sample (n = 41) |
|---|---|---|
| Defeat | .82** | .90** |
| Control | .70** | .67** |
| Acceptance | .78** | .82** |

** $p$ < .01 (2-tailed).

**Table 4.** Correlations between Coping and TRS subscales (n = 103).

| Measure | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Maladjusted coping | | | | |
| 2. Effective coping | .52** | | | |
| 3. Defeat | .70** | .17* | | |
| 4. Control | .44 ** | .42** | .50** | |
| 5. Acceptance | -.59** | -.17* | -.69** | -.45** |

*$p$ = .05 (2-tailed). ** $p$ = .01 (2-tailed).

then low acceptance ($\beta$ = -0.17, $p$ < .001), and high control ($\beta$ = 0.10, $p$ < .01). However, only defeat was significantly related to tinnitus distress ($\beta$ = 0.87, $p$ = < .001; $sr^2$ = .42; $R^2$ = .78,$R^2_{adj}$ = .78, F(3,269) = 322.82, $p$ < .001), explaining 78% of its variance.

Next the validity of the TRS sub-scores was examined in relation to affective symptoms (i.e., psychological stress, anxiety, and depression), see Tables 5 and 6. As expected, defeat was associated with all the states, explaining 30% of the variance in stress, 19% of the variance in anxiety, and 40% of variance in depression; suggesting that defeat was characterized by a pattern of high stress, depression, and also possible anxiety. TRS-defeat was more strongly correlated with tinnitus distress than the above general distress measures, suggesting that the TRS may tap into tinnitus-specific distress responses, whereas the TRQ (i.e., tinnitus distress scale) may tap into more general distress responses.

Next the validity of the TRS sub-scores was examined in relation to illness representations, using the IPQ-R subscales, see Table 7. As expected, multiple regression showed that the TRS subscales were strongly related to IPQ-R consequences $R^2$ = .59, F(3,269) = 157.56, $p$ < .001,andemotional representations $R^2$ = .62, F(3,269) = 147.89, $p$ < .001,explaining 59% and 62% of their variance, respectively; although they explained little of the variance in timeline-cyclical (5%), personal control (16%), treatment control (8%), and illness coherence (8%). High defeat scores were strongly related to tinnitus threat cognitions (i.e., IPQ-R consequences) and emotional representations, and high control was less strongly related to these illness perceptions.

**Table 5.** Associations between Tinnitus Distress, Stress, Anxiety, Depression and the TRS subscales.

| | Depression | | Anxiety | | Stress | |
|---|---|---|---|---|---|---|
| Measure | R | $r^2$ | r | $r^2$ | R | $r^2$ |
| Tinnitus distress | .70** | .50 | .55** | .30 | .63** | .40 |
| Defeat | .63** | .39 | .42** | .17 | .55** | .30 |
| Control | .16** | .03 | .23** | .05 | .25** | .06 |
| Acceptance | -.37** | .13 | -.22** | .05 | -.37** | .13 |

** $p$ < .01 (2-tailed).

**Table 6.** Multiple Regression Analyses of the Association between Stress, Anxiety and Depression and the TRS subscales (N = 273).

| | Depression | | Anxiety | | Stress | |
|---|---|---|---|---|---|---|
| Measure | $R^2$ .40** | β | $R^2$ = .19** | β | $R^2$ = .30** | β |
| Defeat | | 0.69** | | 0.45** | | 0.53** |
| Acceptance | | 0.06 | | 0.11 | | 0.00 |
| Control | | -0.08 | | 0.10 | | 0.06 |

Beta values reported are standardised coefficients, controlling for associations among the TRS scales. * $p$ < .05 (2-tailed). ** $p$ < .01 (2-tailed).

Finally, the validity of the TRS was examined in relation to tinnitus parameters and clinical details, using the TRS sub-scores, BATS, and TRQ as the study outcomes, in an exploratory manner, see Table 8.

## EFA of the BATS

Using the Internet sample, an EFAshowed that the 12-item BATS had a single factor which included 5-items, explaining 57% of the item variance, see Table 9.

In planned multiple regression analyses, BATSscore was shown to be related to salient tinnitus features (i.e., constant noise, sudden onset, pulsatile, sound sensitivity), time parameters (i.e., younger age,

**Table 7.** Pearson Correlation Coefficients between IPQ-R and TRS subscales (N = 273).

| | | Defeat | Control | Acceptance |
|---|---|---|---|---|
| IPQ-R Subscales | M (SD) | r | r | r |
| Timeline (acute/chronic) | 24.19 (3.67) | .01 | -.02 | .00 |
| Timeline (cyclical) | 10.87 (4.22) | .14* | .20** | -.06 |
| Consequences | 16.22 (5.55) | .76*** | .38*** | -.47*** |
| Personal Control | 17.58 (5.22) | -.09 | .32*** | .09 |
| Treatment Control | 13.85 (3.75) | -.03 | .24*** | .04 |
| Illness Coherence | 14.25 (5.43) | -.21*** | .06 | .20*** |
| Emotional Representations | 17.22 (5.79) | .78*** | .31*** | -.61*** |

* $p < .05$ (2-tailed). ** $p < .01$. *** $p < .001$ (2-tailed).

shorter tinnitus duration), and greater treatment use. Similarly, TRQ score was related to salient tinnitus features, time parameters, and greater treatment use, whereas acceptance was related to fewer salient tinnitus features (i.e., intermittent tinnitus, less sound sensitivity), longer tinnitus duration, and fewer tinnitus treatments, see Table 10.

Tinnitus severity was shown to be moderately correlated with the TRQ (r = .43), but only slightly correlated with stress, anxiety, and depression, .12, .14, and .10, respectively.

## DISCUSSION

The Tinnitus Response Scales (TRS) describe three distinct cognitive, behavioral, and emotional response patterns termed control, defeat and acceptance. In the present project, empirical support was provided for the scale using two community samples of people with chronic tinnitus who had similar clinical and demographic profiles to those reported elsewhere[15,40,41], although their tinnitus distress was lower than that reported in prior studies[14,32]. Respondents who completed the hard-copy version of the TRS were older than the Internet respondents, and they had had their tinnitus for substantially longer than those who completed the project online.

A series of EFAs were conducted to examine the TRS subscales, which, after expert feedback, were characterized as follows: Defeat is a response to tinnitus that reflects a deficiency of agency that may lead to helplessness/hopelessness. In contrast, control responses reflect a degree of agency and attempts to manage the tinnitus or its impact, whereas acceptance is defined as a neutral response to tinnitus that is reflected in lack of need for agency, and unconcern or non-reactivity to tinnitus. Interestingly, two of the original TRS-acceptance items, if my tinnitus disappeared tomorrow I might not notice it had gone for some time, and sometimes I need to focus on the tinnitus noise before I can hear it, failed to load onto this model, suggesting that these responses were not typical of the acceptance construct. The non-fit of these particular items suggests that affected individuals were typically aware of the tinnitus, despite having developed tolerance or acceptance to it.

A CFA supported this 3-factor structure, using data from the hard-copy survey group. Thus, the model was robust across two samples that were recruited by different mechanisms, and differed in terms of their age, tinnitus duration, and other tinnitus parameters. However, the samples did not differ in terms of their TRS response patterns, although acceptance levels were higher, and control and defeat levels were lower in the hard-copy sample. Conceptually, these results are consonant with the small emerging literature related to tinnitus acceptance and the mindfulness-based treatment of tinnitus[5,17,18].

The TRS is similar to but perhaps more comprehensive than the TAQ. That is, two factors in the TRS (i.e., defeat and control) were very similar to two factors in the TAQ, whereas acceptance was not explicitly represented in the TAQ. For example, the TAQ subscale, Activity Engagement, overlaps considerably with TRS-defeat, and the TAQ subscale, Tinnitus Suppression overlapped somewhat with TRS-control. The TRS-acceptance had no analogous construct in the TAQ and it is therefore possible that the TRS has additional utility in measuring a broader range of tinnitus responses, especially since the TRS-acceptance subscale included items that tap into behavioral adaptation or habitation to tinnitus noise.

In the TRS, the acceptance and defeat sub-scores were highly inversely correlated, and in validity testing, they tended to be correlated with opposite characteristics in terms of age, tinnitus duration, cognitions, tinnitus distress and general distress; whereas the control and acceptance sub-scores were only moderately and inversely correlated with each other. These results suggest that acceptance and defeat responses may represent polar ends of a single dimension of non-agency;and that a two-factor model (i.e., defeat/acceptance vs. control), with defeat characterized by a lack of agency and acceptance characterized by a lack of need for agency[22], may better describe tinnitus responding. However, CFA did not support this two-factor solution, nor was the solution stable in the EFA. In addition, mindfulness theory suggests that acceptance is antithetical to a range of different responses that may include defeat, helplessness, and resignation, but also control, and unwillingness[16,22,23,27].

The internal consistencies of the TRS subscales were observed to be high in both samples, with Cronbach's alphas ranging from .82 to .92, indicating that the TRS is a coherent instrument. In addition, the three TRS subscales showed good to excellent test-retest reliabilityover 5 to 12 weeks. Control was found to be

**Table 8.** Multiple Regression Analyses of the Association between Tinnitus, other Clinical Details and the TRS subscales.

| | Defeat($R^2$ = .29***) | | | Acceptance($R^2$ = .19*) | | | Control ($R^2$ = .21***) | | |
|---|---|---|---|---|---|---|---|---|---|
| Predictors | B | SE | β | B | SE | β | B | SE | β |
| Pulsatile/Non-Pulsatile | -0.23 | 0.32 | -0.04 | 0.05 | 0.34 | 0.01 | -0.33 | 0.35 | -0.05 |
| Gradual/Sudden Onset | 0.08 | 0.29 | 0.02 | -0.43 | 0.30 | -0.08 | 0.32 | 0.31 | 0.06 |
| Constant/Intermittent | -1.44*** | 0.29 | -0.26 | 1.10*** | 0.31 | 0.20 | -0.28 | 0.32 | -0.05 |
| Age | -0.05*** | 0.01 | -0.25 | 0.02 | 0.01 | 0.13 | -0.01 | 0.01 | -0.03 |
| Illness/disease | 0.24 | 0.18 | 0.07 | -0.05 | 0.20 | -0.02 | 0.36[a] | 0.20 | 0.11 |
| Treatments | 0.45** | 0.15 | 0.16 | -0.44** | 0.16 | -0.16 | 0.96*** | 0.17 | 0.33 |
| Medications | 0.02 | 0.09 | 0.01 | 0.04 | 0.10 | 0.03 | -0.30** | 0.10 | -0.19 |
| Duration | -0.00*** | 0.01 | -0.20 | 0.01** | 0.00 | 0.17 | -0.01 | 0.01 | -0.07 |
| Sound Sensitivity | 0.18*** | 0.05 | 0.21 | -0.13** | 0.05 | -0.15 | 0.15** | 0.05 | 0.17 |
| Right ear loss | -0.06 | 0.17 | -0.02 | 0.27 | 0.18 | 0.09 | -0.06 | 0.19 | -0.02 |
| Left ear loss | -0.09 | 0.16 | -0.03 | 0.06 | 0.17 | 0.02 | 0.04 | 0.18 | 0.02 |

Beta values reported are standardized coefficients, controlling for associations among hearing, health and tinnitus details. [a] $p$ = .06* $p$ < .05 (2-tailed). ** $p$ < .01 (2-tailed). *** $p$ < .001 (2-tailed).

**Table 9.** Exploratory (EFA) and Confirmatory Factor Analyses (CFA) of the Brief Assessment of Tinnitus Severity (BATS).

| Items | Loading EFA | Loading CFA |
|---|---|---|
| Rating of how much you are bothered by your tinnitus | .89 | .96 |
| Rating of how often you are bothered by your tinnitus noise | .85 | .87 |
| Rating of how distressing it is for you when you hear your tinnitus noise | .78 | .77 |
| Rating of how much tinnitus noise has impacted on your life | .74 | .73 |
| Rating of the loudness of the tinnitus noise at its worst | .62 | .57 |

Internet sample: a = .83; M = 31.33; SD = 10.15; N = 273; Hard-copy sample: a = .89; M = 24.86; SD = 11.12; N = 278.

**Table 10.** Multiple Regression Analysis of the Association between Tinnitus and other Clinical Variables, Tinnitus Distress (TRQ) and Tinnitus Severity (BATS).

| | BATS | | | TRQ | | |
|---|---|---|---|---|---|---|
| | $R^2$ = .36*** | | | $R^2$ = .34*** | | |
| Predictors | B | SE | β | B | SE | β |
| Pulsatile/Non-Pulsatile | -0.49* | 0.24 | -0.10 | -0.23* | 0.11 | -0.11 |
| Gradual/Sudden Onset | 0.60** | 0.21 | 0.15 | 0.01 | 0.09 | 0.01 |
| Constant/Intermittent | -1.13*** | 0.21 | -0.27 | -0.43*** | 0.10 | -0.23 |
| Age | -0.02* | 0.01 | -0.13 | -0.02*** | 0.01 | -0.23 |
| Illness/diseases | 0.10 | 0.13 | 0.04 | 0.11a | 0.06 | 0.10 |
| Treatments | 0.42*** | 0.11 | 0.19 | 0.16*** | 0.05 | 0.16 |
| Medications | 0.07 | 0.07 | 0.06 | 0.01 | 0.03 | 0.02 |
| Duration | 0.00* | 0.01 | -0.12 | -0.00** | 0.00 | -0.16 |
| Sound Sensitivity | 0.24*** | 0.03 | 0.37 | 0.08*** | 0.02 | 0.26 |
| Right ear loss | -0.11 | 0.13 | -0.05 | -0.01 | 0.06 | -0.01 |
| Left ear loss | 0.09 | 0.12 | 0.04 | -0.07 | 0.05 | -0.07 |

Beta values reported are standardized coefficients, controlling for associations among hearing, health and tinnitus details. [a] $p$ = .06 (2-tailed). * $p$ < .05 (2-tailed). ** $p$ < .01 (2-tailed). *** $p$ < .001(2-tailed).

the least stable subscale, but this was expected since control behavior (e.g., treatment-seeking) is likely to fluctuate over time and with the availability of coping and treatment resources. Convergent and divergent validity of the TRS sub-scores was also assessed, using additional measures of tinnitus coping, severity, and distress, general distress, tinnitus cognitions, and tinnitus and general health parameters. These correlations helped to better delineate the tinnitus response patterns as detailed below.

In relation to tinnitus coping, high defeat and low acceptance scores explained much of the variance in maladjusted coping[2,9], although only high control was related to effective coping, explaining 17% of its variance. These results indicate that defeat responses overlapped considerably with maladjusted coping, whereas acceptance was related to a lack of maladapted coping, and control shared some features in common with effective coping. In the tinnitus literature, positive coping styles (e.g., effective-coping) have generally not been shown to be related to better tinnitus outcomes e.g., less severe symptoms[2,9,10,14]; suggesting that active coping efforts may not lead to improved tinnitus outcomes.

Drawing together the remaining validity data, defeat was a cognitive, behavioral and emotional response to chronic tinnitus that was more often used by young people and/or those with a recent tinnitus onset or those with constant, severe and/or distressing tinnitus.

Cognitively, defeat was related to less understanding of the tinnitus and an exaggerated perception of tinnitus threat. Behaviorally, defeat was associated with maladjusted coping and seeking out tinnitus treatments; whereas emotionally, it was associated with high stress, anxiety, and depression levels.

In contrast, control was a cognitive and behavioral response to chronic tinnitus that was more often used by people with severe rather than mild tinnitus; although it's use was unrelated to temporal parameters (e.g., tinnitus duration), suggesting that the strategy was utilized across the lifespan. Cognitive features of control included a good understanding of tinnitus, high personal- and treatment-related control, but a magnified perception of tinnitus threat. Behaviorally, control was related to effective tinnitus coping, and actively seeking out tinnitus treatments and medications; whereas emotionally, control was not related to any clinically evident psychopathology (e.g., depression).

In contrast, acceptance was a predominantly cognitive and behavioral response to tinnitus that was more often used by people with intermittent, less severe and/or longer-term tinnitus. Cognitive features of acceptance included moderate levels of personal control, few tinnitus threat perceptions and little seeking meaning in the tinnitus, consistent with the results of Davis & Morgan[21]. Behaviorally, acceptance was only slightly or not related to maladjusted coping and tinnitus treatment-seeking, and emotionally, it was consistently unrelated to any emotional response pattern, even the absence of an emotional response. These results are consistent with the aforementioned definition of 'tinnitus acceptance', as a predominantly neutral cognitive response to tinnitus noise that involves neither concern nor bother about the noise.

These findings have potentially important treatment implications: first, defeat was common in people who had a recent tinnitus onset or had little knowledge about their condition, suggesting that adequate information provision is especially important in newly-diagnosed tinnitus patients. Second, TRS-defeat and control responses were typically used by people with severe, constant and/or distressing tinnitus, and those seeking tinnitus treatments, whereas acceptance was more often used by people who had less severe and/or longer-term tinnitus, and those not seeking meaning in or treatment of their tinnitus.

Taken together, these results suggest that the way in which people will respond to tinnitus is likely to be governed by the severity, chronicity and novelty of the condition. People may respond to tinnitus noise by trying to control it, or they may feel defeated by it, but over time, they may come to accept it, with or without assistance; although this conclusion requires substantiation using a longitudinal study. In addition, the results suggest that therapies that can facilitate acceptance of tinnitus noise (e.g., Acceptance and Commitment Therapy) may be effective in reducing the potential for tinnitus distress. Thus, there is growing evidence that Acceptance and Commitment Therapy[16] and tinnitus-specific variants[17,18] may be effective in treating distressed tinnitus patients, due to a focus on acceptance (i.e., willingness to live with the noise) rather than control (i.e., commitment not to have the noise) as a means of reducing tinnitus suffering.

Finally, we examined correlates of tinnitus severity and distress, including the three TRS subscales. Tinnitus severity was strongly related to salient tinnitus features (i.e., constant noise, sudden onset, pulsative), time parameters (i.e., younger age, shorter tinnitus duration), treatment-seeking, and all three of the TRS subscales, especially high defeat and control. These results suggest that people's perceptions of tinnitus severity are most strongly influenced by recent tinnitus onset and/or salient tinnitus features; and if the tinnitus was severe, they responded by attempting to control or treat the noise, but they may have ended up feeling defeated by it, at least in the short-term. Similarly, tinnitus distress was strongly associated with a recent tinnitus onset, salient tinnitus features (i.e., severe, constant, pulsatile), treatment-seeking, and defeat responses. In fact, defeat explained more than 75% of the variance in tinnitus distress, suggesting that perceptions of tinnitus distress were mostly influenced by feelings of defeat.

Regarding the relevant literature, few prior studies have examined the above associations or they used different but analogous constructs. For example, time parameters (e.g., tinnitus duration) have previously been shown to be unrelated to tinnitus handicap[42] and low to moderate tinnitus annoyance has been shown to decrease with age, whereas moderate to severe tinnitus annoyance increases with advancing age[15]. These results are somewhat consistent with our finding that young age was related to worse tinnitus severity and tinnitus distress perceptions.

**Potential Limitations**

Further psychometric analysis of the TRS and BATS is warranted including examinations of their test sensitivity, specificity, predictive validity, and additional convergent and divergent validity. In the latter case, the acceptance subscale of the TAQ[5], Acceptance and Action Questionnaires[27], and Multidimensional Health Locus of Control Scale[43] may be used. However, preliminary reliability and validity analyses in this paper provide encouraging results for both measures. Finally, the study was cross-sectional in nature therefore precluding any causal inferences being made.

## CONCLUSION

The Tinnitus Response Scales assessed three distinct response patterns that differed in terms of their cognitive, behavioural, and emotional responses to chronic tinnitus. The defeat subscale described a strong negative emotional response to the noise; the control subscale described an active behavioural response to suppress the noise and negative tinnitus-related thoughts; and the acceptance subscale described a neutral cognitive response that was characterized by non-reactivity to the noise and possibly tinnitus tolerance and adaptation. The three response patterns were linked to different tinnitus characteristics. For example, defeat was more common in people with a recent tinnitus onset and/or distressing tinnitus symptoms (i.e., severe, constant, pulsatile), whereas control responses were more common in people with severe or threatening tinnitus; and acceptance was more common in people with intermittent or longer-term tinnitus, or tinnitus that was self-rated as less severe.

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