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2 **The Mini Alcohol Craving Experience questionnaire: Development and clinical**

3 **application**

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26   ABSTRACT

27   **Background:** Standardised alcohol craving scales are rarely used outside of research

28   environments despite recognised clinical utility. Scale length is a key barrier to more

29   widespread application. A brief measure of alcohol craving is needed to improve research and

30   treatment of Alcohol Use Disorders (AUDs). Grounded in the Elaborated Intrusion Theory of

31   Desire, the Alcohol Craving Experience (ACE) questionnaire comprises two 11-item self-

32   report scales which assess past-week frequency and maximum strength of alcohol craving.

33   This study aimed to create a brief version of the ACE while maintaining psychometric

34   integrity and clinical utility.

35   **Methods**: Patients attending a university hospital alcohol and drug out-patient service

36   for treatment of AUD completed the ACE as part of a questionnaire battery. Three patient

37   samples were utilised: 519 patients with pre-treatment and outcome data; 228 patients with

38   pre-treatment data; and 66 patients who completed the ACE at treatment sessions one and

39   two.

40   **Results:** The Frequency scale of the ACE possessed greater clinical utility and

41   predictive validity than the Strength scale. Revision of the Frequency measure produced a 5-

42   item 'Mini Alcohol Craving Experience' (MACE) questionnaire. Satisfactory validity

43   (construct, predictive, concurrent, convergent, and incremental) and reliability (internal and

44   test-retest) was maintained. A one standard deviation increase in pre-treatment MACE score

45   was associated with a 54 percent increase in the odds of patient lapse or dropout.

46   **Conclusions:** The MACE provides a brief, theoretically and psychometrically robust

47   measure of alcohol craving suitable for use with AUD populations in time-limited clinical

48   and research settings.

49   **Keywords:** Alcohol Use Disorder, Craving, Urge, Measurement, Scale development

50 INTRODUCTION

51   Craving is a robust marker of substance dependence severity and is implicated in

52 treatment relapse (Flannery et al. 2003; Law et al. 2016; Yoshimura et al. 2016). The

53 Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) recently

54 included 'craving, or a strong desire or urge to use a substance' as a diagnostic criterion for

55 Substance Use Disorders (American Psychiatric Association, 2013). Craving was defined as a

56 strong desire to consume a substance that makes it difficult to think of anything else

57 (American Psychiatric Association, 2013; Hasin et al. 2013). Craving interventions feature

58 prominently in psychological treatments, and pharmacotherapies have been developed to

59 target specific craving neuromechanisms (Addolorato et al. 2005; Haass-Koffler et al. 2014).

60 After decades of experimental, clinical, and epidemiological research, accurate measurement

61 of substance craving remains a research priority (Tiffany and Wray 2012; Kavanagh et al.

62 2013). Historically, craving has been measured by conceptually weak and often

63 unstandardised methods, limiting generalisability and clinical utility (Sayette et al. 2000;

64 Pavlick et al. 2009; Kavanagh et al. 2013). Some standardised scales have been introduced,

65 although uptake within clinical settings has been poor (Pavlick et al. 2009; Tiffany and Wray

66 2012).

67   A national survey of U.S. addiction services found 99% considered craving in

68 treatment planning, yet only 5% employed standardised self-report craving measures (Pavlick

69 et al. 2009). The majority opted for single-item or non-standard open ended questions, despite

70 well documented limitations to the reliability of these approaches (Cortina 1993; Hruschka et

71 al. 2004). This may reflect the psychometric and theoretical weaknesses in self-report craving

72 scales (Sayette et al. 2000; Kavanagh et al. 2013) and time burden imposed by scale

73 administration and analysis in busy clinical environments. Alcohol Use Disorders (AUDs) are

74 among the most prevalent Substance Use Disorders, placing a substantial burden upon global

75   mortality and disease (Connor and Hall 2015; Gowing et al. 2015; Connor et al. 2016). A

76   brief, psychometrically sound measure of alcohol craving is needed to improve assessment,

77   diagnosis, and treatment of AUDs.

78   Measures vary considerably in their definition of craving. In a recent review of

79   alcohol craving scales, based on 47 papers published between 1990 and 2012, we argued that

80   the majority contain constructs extraneous to widely applied diagnostic definitions of craving

81   (e.g. DSM-5, ICD-10; Kavanagh 2013). These often include items measuring allied

82   constructs, such as expectancies, intentions, and refusal self-efficacy (Kavanagh et al. 2013).

83   Though such constructs are important within models of substance use and craving, the

84   presence of these allied phenomena may influence accurate diagnosis of AUD and bias

85   conclusions drawn from subsequent research. For example, the inclusion of items assessing

86   self-efficacy (Bandura 1977) may artificially inflate the predictive utility of a scale, as self-

87   efficacy about drinking control reliably predicts drinking behaviour (Connor et al. 2007).

88   The presence of allied addiction constructs does not necessarily compromise the

89   validity of a craving scale. If the outcomes are interpreted in the context of a prescribed

90   definition or with regard to a theoretical model then construct validity may be maintained.

91   However, craving scales infrequently report a definition to which they adhere and are often

92   developed atheoretically (Flannery et al. 1999; Rojewski et al. 2015; McHugh et al. 2016).

93   We developed the Alcohol Craving Experience (ACE) Questionnaire to be consistent with

94   common definitions of craving while adhering to a specified theory (Statham et al. 2011).

95   However, administration of the 22-item ACE is likely to be too time consuming for practical

96   use. It is proposed that reduction of the ACE would result in a theoretically and

97   psychometrically sound measure of craving which may be easily integrated in time-limited

98   environments.

99

100   Reflecting the Elaborated Intrusion (EI) Theory of Desire (Kavanagh et al. 2005; May

101   et al. 2014b), the ACE measures three aspects of craving: the intensity of the drive to drink

102   (Intensity), the presence of associated imagery (Imagery), and intrusiveness of desire

103   cognitions (Intrusion; Statham et al. 2011). EI theory defines craving as an affectively laden

104   cognitive event, where an object or activity and its associated pleasure or relief is in focal

105   attention (Kavanagh et al. 2005). Consistent with neurobiological models of craving,

106   addictive substances are believed to recruit the same physiological mechanisms that drive

107   appetitive behaviours required for survival (Robinson and Berridge 1993). EI theory proposes

108   that biological, environmental, and affective cues trigger intrusive desire-related cognitions

109   which occupy attention and prompt elaboration. The subsequent elaboration process—in

110   particular imagery—provides momentary pleasure or relief of physical and emotional

111   discomfort (Connor et al. 2014). However, pleasure or relief from elaborative cognitions

112   quickly dissipates. Instead, awareness is drawn to any emotional or physical deprivation and

113   to potential actions to acquire the target. Further elaboration and intensification of the desire

114   ensues, unless the target is acquired or attention is captured elsewhere.

115   EI theory aligns with treatment approaches such as motivational enhancement,

116   mindfulness, acceptance-based therapies, and retraining attentional biases (Witkiewitz et al.

117   2013; May et al. 2014b; Witkiewitz et al. 2014). Recent research has directly employed EI

118   theory in the development of promising new craving management strategies and novel

119   treatment approaches (Kemps and Tiggemann 2007; Knäuper et al. 2011; Kemps and

120   Tiggemann 2013; Hsu et al. 2014; Skorka-Brown et al. 2014; Littel et al. 2016). These

121   approaches employ non-substance imagery and sensory tasks designed to compete with

122   craving-based imagery within the limited capacity of working memory. The information

123   provided by the ACE may facilitate more detailed formulation, treatment planning, and

124   monitoring of craving.

125   The ACE was originally developed in an AUD sample (Statham et al. 2011), to

126   measure the frequency (ACE-F) and peak strength (ACE-S) of alcohol craving over the

127   previous week. Exploratory and confirmatory factor analysis showed that the items in both

128   forms of the ACE cluster into three distinct factors consistent with EI theory: Intensity,

129   Imagery, and Intrusion of craving-related cognitions. The ACE has high internal reliability

130   and significantly correlates with the Obsessive Compulsive Drinking Scale (OCDS), Alcohol

131   Use Disorders Identification Test (AUDIT), as well as measures of psychological distress

132   highly comorbid with AUDs. The ACE has further been demonstrated to discriminate non-

133   clinical from clinical samples (Statham et al. 2011). May and colleagues (2014) pooled 12

134   studies using modified forms of the ACE to assess craving across a range of substances,

135   including alcohol (May et al. 2014a). The original factor structure was replicated across all

136   substances.

137   The ACE provides a theoretically grounded, psychometrically robust measure, with

138   strong rationale for more effectively targeting alcohol craving interventions, and has shown

139   its value in research settings. For clinical settings, however, the full ACE is repetitive (with

140   each item appearing in both the Strength and Frequency forms) and time consuming. A

141   shorter version of the ACE is likely to result in higher uptake, especially where repeated

142   administration is required. The aim of this study is to develop a short form of the ACE for use

143   in treatment planning and outcome assessment without compromising its theoretical

144   foundation or psychometric integrity.

145   MATERIALS AND METHODS

146   *Participants*

147   Three samples of data were drawn from patients attending a metropolitan university

148   hospital alcohol and drug out-patient service. The service comprises eight sessions of

149   Cognitive Behaviour Therapy (CBT) conducted over 12 weeks. Treatment may be

150   supplemented by pharmacotherapy (naltrexone, acamprosate, or both). The assessment

151   battery is completed in a separate consultation prior to the first treatment session and again at

152   the completion of treatment. All patients were over 18 years of age and met DSM-IV

153   (American Psychiatric Association 2000) criteria for alcohol dependence. Human ethics

154   approval was obtained (2008/125, HREC/12/QPAH/022 HREC/14/QPAH/664) and

155   participants provided informed written consent. Sample characteristics are presented in Table

156   1.

157

158   *Scale Reduction Sample.* This sample comprised 519 alcohol dependent patients

159   (Table 1). All patients were over 18 years of age and met DSM-IV(American Psychiatric

160   Association 2000) criteria for alcohol dependence. These data have been used previously in

161   the original development of the ACE (Statham et al. 2011) and in examining craving as a

162   mediator of change (Law et al. 2016), but have not been used to directly predict treatment

163   outcome.

164

165   *Validation Sample.* The validation sample comprised pre-treatment data from 228

166   consecutively treated alcohol dependent patients (Table 1). These data were employed to

167   assess the factor structure of the ACE scales and cross-sectional relationships between

168   variables.

169

170   *Test-Retest (TRT) Sample.* The ACE-F was administered to 66 patients at treatment

171   sessions one and two, in-order to assess test-retest reliability of the ACE-F. Mean time

172   between sessions was 8.40 days ($SD = 2.86$).

173

174   **Insert Table 1**

175

176
177   *Measures*

178   *The Alcohol Craving Experience (ACE) questionnaire.* The ACE comprises two 11-

179 item scales that assess the frequency (ACE-F) and peak strength (ACE-S) of desire-related

180 cognitions over the previous week. Items load onto three classes of cognition, 'Intensity'

181 (items 1-3), 'Imagery' (items 4-8), and 'Intrusion' (items 9-11). Participants respond via an

182 11-point visual analogue scale with anchors 0 (*not at all*) and 10 (*constantly/extremely*). The

183 ACE-F and ACE-S have good internal reliability and concurrent validity, and can

184 discriminate between problem and non-problem drinkers (Statham et al. 2011).

185

186   *The Obsessive Compulsive Drinking Scale (OCDS).* The OCDS is a 14-item self-

187 report measure intended to reflect drinking-related obsessive and compulsive craving and

188 behaviour (Anton et al. 1995). The OCDS has received extensive research attention and is

189 currently the most widely used measure of alcohol craving. The OCDS has acceptable test-

190 retest reliability, internal reliability, and concurrent validity (Anton et al. 1995; Kranzler et al.

191 1999; Roberts et al. 1999). The OCDS cannot be considered a 'pure' measure of craving as

192 extraneous constructs such as consumption, effort to resist drinking, functional interference

193 and distress from drinking, as well as perceived control of drinking are all assessed within the

194 scale. The first six items, comprising the Obsessions Subscale are most consistent with the

195 clinical definitions of craving. OCDS-Obsessions is intended to assess drinking obsession

196 related cognitions, for example, "How much of your time when you're not drinking is

197 occupied by ideas, thoughts, impulses, or images related to drinking?". While less

198 confounded than the full OCDS, OCDS-Obsessions does contain extraneous phenomena,

199 assessing functional interference and distress caused by obsessive cognitions. OCDS-

200   Obsessions has been demonstrated to improve prediction of drinking behaviour (Flannery et

201   al. 2003) and likelihood of relapse post treatment (Soyka et al. 2010). As OCDS-Obsessions

202   is a widely used measure of craving and considered among the better performing craving

203   scales (Kavanagh et al. 2013) it was employed as a concurrent measure of alcohol craving.

204

205   *The Alcohol Use Disorders Identification Test (AUDIT)*. The AUDIT is a 10-item,

206   self-report measure assessing recent alcohol use, symptoms of alcohol dependence, and

207   alcohol related problems (Saunders et al. 1993). The AUDIT has sound internal reliability,

208   sensitivity and specificity, and discriminant validity (Saunders et al. 1993). Higher scores

209   indicate increased risk of harmful or hazardous drinking.

210

211   *The Beck Depression Inventory - Second Edition (BDI-II)*. The BDI-II is a 21-item

212   self-report measure assessing attitudes and behaviours symptomatic of depression (Beck et al.

213   1996). The BDI-II is a well validated measure demonstrating strong test-retest and internal

214   reliability, as well as good concurrent, content, discriminant, and construct validity (Beck et

215   al. 1988; Beck et al. 1996).

216

217   *The State Anxiety Scale (S-Anxiety)*. The S-Anxiety Scale of the State Trait Anxiety

218   Inventory (STAI) comprises 20 self-report items assessing the respondent's current state of

219   anxiety (Spielberger 1983). The S-Anxiety has acceptable internal and test-retest reliability,

220   as well as content, discriminant, and construct validity (Spielberger 1983; Oei et al. 1990;

221   Barnes et al. 2002).

222

223   *Procedure*

224   *Scale Reduction.* To best maintain consistency of the measured construct, an initial

225   step involved selection of a form of the ACE for further refinement (ACE-F or ACE-S). Each

226   form was evaluated based on perceived clinical utility and predictive validity. Decisions

227   guiding subsequent item reduction were informed by the following rationale: (a) to enhance

228   construct validity, items with the greatest face validity and theoretical importance within EI

229   theory were prioritised; (b) to maximise the sensitivity and clinical utility of a reduced scale,

230   the most highly endorsed items were also prioritised for retention; (c) to enhance predictive

231   validity, the capacity of items to discriminate between patients who lapsed or withdrew from

232   treatment and those who were abstinent throughout treatment was also considered. Data

233   analyses within this step utilised the Scale Reduction Sample.

234

235   *Scale Evaluation.* Reduced models were further evaluated based on construct,

236   predictive, concurrent, and convergent validity, as well as internal and test-retest reliability.

237   Predictive validity of OCDS-Obsessions was also assessed for concurrent comparison. Data

238   analysis within this step utilised the Validation and Test-Retest samples.

239

240   *Scale Selection.* The shortest scale maintaining psychometric integrity would be

241   selected as the final reduced version.

242

243   *Data Analysis*

244   Analyses were conducted in SPSS version 22. Confirmatory factor analyses (CFA)

245   were conducted in R version 3.2.1 (R Core Team 2015), package extension *lavaan* .5-18

246   (Rosseel 2012). As the distributions of all ACE item and scale scores were significantly

247   negatively skewed, statistical procedures robust to non-normal distributions were utilised.

248   CFA Models were compared using changes in χ^2 /df ratios (smaller values indicating

249   improved fit; Carmines and McIver 1981), Comparative Fit Indices (CFI, values >.93

250   indicating good fit; Hu and Bentler 1999) , Standardised Root Mean Square Residual

251   (SRMR; Values <.07 indicating good fit; Hu and Bentler 1999), Root Mean Square Error of

252   Approximation (RMSEA; values <.07 indicating good fit; Hu and Bentler 1999), and Akaike

253   Information Criterion (AIC; smaller values indicating improved fit; Bozdogan 1987).

254

255   RESULTS

256   *Scale Reduction*

257   *Subscale-Selection.* As the ACE-S asks the respondent to report on only the most

258   severe episode of past week craving, it is influenced by contextual factors such as situational

259   cues and novel stressors. Clinical value of this method is drawn from the isolation of a

260   specific time-period where the patient may be most vulnerable to lapse. Alternatively, the

261   ACE-F assesses the perceived frequency of craving symptoms over the past week, providing

262   a more general overview of the patients craving experience. The ACE-F was subsequently

263   identified as the preferred scale for reduction, based on its perceived benefit as a measure

264   more sensitive to change in the patient's typical craving experience.

265   Using the Scale Reduction Sample, separate logistic regression analyses were

266   employed to assess the capacity of pre-treatment ACE scale scores to predict the likelihood of

267   treatment lapse relative to patients who were abstinent throughout treatment. Patients who

268   discontinued treatment without record of lapse were conservatively included within the lapse

269   group. All scale scores were standardised to facilitate the comparison of effects. AUDIT

270   scores and medication status were included as covariates, but did not significantly improve

271   upon the intercepts-only model (χ^2 (2) = 0.26, p = .877, *Nagelkerke R^2* = .001; Table 2,

272   Baseline Model). Inclusion of either the ACE-S ($\Delta\chi^2$ (1) = 18.71, Δp = <.001, *Nagelkerke*

273   *ΔR^2* = .054, Table 2, Model 1) or ACE-F ($\Delta\chi^2$ (1) = 21.68, Δp = <.001, *Nagelkerke ΔR^2* =

274 .062, Table 2, Model 2) significantly improved the predictive power of the model. As Model

275 2 appeared to explain more variance than Model 1, the ACE-F was added to Model 1 in an

276 additional step to examine if it would account for significantly more variance than the ACE-

277 S. The addition of the ACE-F to Model 1, saw the ACE-F become the dominant predictor

278 within the model, though predictive power was not significantly improved ($\Delta\chi^2$ (1) = 3.63, Δp

279 = .057, *Nagelkerke* ΔR^2 = .011, Table 2, Model 3). The ACE-F was subsequently selected for

280 further refinement.

281

282 **Insert Table 2**

283

284 *Item Importance.* Prior to item reduction, the structure and items central to the

285 theoretical foundation of the scale were considered. At least one item from each sub-scale

286 was retained to represent each factor. Items 3 and 9 (Table 3) were prioritized for retention

287 due to high semantic consistency to the Intensity and Intrusion factors respectively. Multiple

288 items of the Imagery factor would be retained to capture potential individual differences in

289 the most prevalent imagery modalities involved in alcohol craving.

290

291 *Feature Prevalence.* Medians and interquartile ranges for all ACE-F items are

292 presented in Table S1 within the online supplementary material. While all items had an

293 interquartile range of at least 4 on the 11-point scale, most also received a large proportion of

294 'not at all' responses. To identify which items were most representative of common craving

295 symptoms among patients with AUD, the endorsement rates (ERs; proportion of non-zero

296 responses to each item) were also calculated. McNemar's χ^2 was utilised to identify

297 significant differences between items in the prevalence of endorsement rates within each

298 factor. Within the Intensity factor, the endorsement rate of Item 2 (80.2%) was significantly

299   lower than Item 3 (86.1%, $p < .001$), while Items 1 (87.6%) and 3 could not be distinguished

300   ($p = .169$). Comparisons of endorsement rates of items within the Imagery factor revealed all

301   were significantly different ($p < .001$), with the exception of the most highly endorsed, items

302   4 (80.9%) and 8 (80.1%, $p = .716$). Within the Intrusion factor, item 11 was the least

303   endorsed factor (75.8%, $p < .001$) while items 9 (84.9%) and 10 (83.8%) could not be

304   differentiated ($p = .291$).

305   Separate Mann-Whitney U tests revealed that the mean rank of patients who lapsed or

306   withdrew from treatment was significantly higher for every item than those who completed

307   treatment abstinent (Table 3). Steiger's Z revealed no significant differences in the size of the

308   effects between items.

309

310   **Insert Table 3**

311

312   *Item Reduction.* To maximize sensitivity of the reduced craving measure items with

313   the highest endorsement rates were given greater priority for retention to minimise the

314   number of 'not at all' responses within the reduced scale. Based on feature prevalence and

315   consistency with the overarching factors, items 3 and 9 were retained to represent the

316   Intensity and Intrusion factors respectively. The three imagery items with the highest

317   endorsement rates (4, 5, and 8) were retained to comprise the initial Imagery factor.

318   A sequential logistic regression was employed to assess the capacity for the selected

319   items to predict alcohol lapse in the Scale Reduction Sample. Addition of the items intended

320   to comprise the reduced ACE (items: 3, 4, 5, 8, 9) to the Baseline Model (Table S2)

321   significantly improved predictive power of the model ($\Delta\chi^2$ (5) = 21.49, $\Delta p < .001$,

322   *Nagelkerke* ΔR^2 = .061, Model 4, Table S2). To assess whether the model could be improved

323   with the inclusion of additional ACE items, the remaining items were included using forward

324   entry. Sequential inclusion of items 1 ($\Delta\chi^2$ (1) = 7.61, Δp = .006, *Nagelkerke ΔR^2 = .023,*

325   Model 5, Table S2) and 10 ($\Delta\chi^2$ (1) = 9.84, Δp =.002, *Nagelkerke ΔR^2 = .027,* Model 6, Table

326   S2) would significantly improve the final model (χ^2 (9) = 39.20, *p* < .001, *Nagelkerke R^2 =*

327   .111).

328

329   *Scale Evaluation*

330   *Validity.* To assess the construct validity of the initial five-item scale, the seven-item

331   scale, and the complete ACE-F, confirmatory factor analyses were performed utilising the

332   Validation Sample. Maximum likelihood estimation with robust standard errors and a

333   Satorra-Bentler scaled test statistic were employed to reduce the effects of non-normality.

334   Model fit statistics are presented in table 4, and parameter estimates are summarised in the

335   supplementary material. For the 11 and 7 item scales, the three-factor solution provided a

336   better fit to the data than a unifactorial model (Table 4). For the five item scale, both

337   solutions showed comparable fit. The CFI, RMSEA, SRMR, and AIC fit statistics all

338   improved through reduction. No covariance between error terms was specified in any of the

339   models. These results support previous studies validating the three-factor structure of the

340   ACE (Statham et al. 2011; May et al. 2014a), though when reduced to a five-item scale, it

341   could equally reflect a global construct of craving within a single factor (Figure 1).

342

343   **Insert Table 4**

344   **Insert Figure 1**

345

346   Data from the Validation Sample indicated that all scales had significant (*p* < 0.001)

347   large positive correlations with OCDS-Obsessions, indicating an acceptable level of

348   concurrent validity (*r* = 0.60 to 0.58). Convergent validity was demonstrated by significant (*p*

349 < 0.01) small to moderate positive correlations with the AUDIT ($r = 0.22$ to 0.20) and

350 significant ($p < 0.001$) moderate correlations with measures of anxiety (S-Anxiety: $r = 0.40$

351 to 0.38) and depression (BDI: $r = 0.39$ to 0.38). The strength of the correlations did not

352 significantly differ between the three ACE versions (Steiger's $Z, p < .05$), indicating that

353 convergent and concurrent validity of the ACE was not significantly affected by scale

354 reduction.

355   Utilising the Scale Reduction Sample predictive validity of the scales administered

356 pre-treatment was assessed by logistic regressions with the outcomes 'complete treatment

357 abstinent' and 'lapsed or discontinued treatment'. When independently added to the Baseline

358 Model, the five-item ($\Delta\chi^2$ (1) = 15.17, $\Delta p < .001$, *Nagelkerke ΔR^2* = .044, Model 7, Table 5),

359 seven-item ($\Delta\chi^2$ (1) = 20.19, $\Delta p < .001$, *Nagelkerke ΔR^2* = .058, Model 8, Table 5), and 11-

360 item (Model 2, Table 2) scales all significantly improved predictive power of the model.

361 Predictive power of OCDS-Obsessions was also assessed for concurrent comparison.

362 Addition of OCDS-Obsessions significantly improved upon the Baseline Model ($\Delta\chi^2$ (1) =

363 7.78, $\Delta p = .005$, *Nagelkerke ΔR^2* = .022, Model 9, Table 5). The incremental validity of each

364 scale was assessed by systematically adding the weaker of two scales, based on *Nagelkerke's*

365 R^2, to the Baseline Model, followed by the next strongest scale in step two. The 5-item ACE-

366 F was demonstrated to significantly improve upon the predictive power of OCDS-Obsessions

367 ($\Delta\chi^2$ (1) = 7.35, $\Delta p = .007$, *Nagelkerke ΔR^2* = .044, Model 10, Table 5) and the 7-item scale

368 significantly improved upon the 5-item ($\Delta\chi^2$ (1) = 15.43, $\Delta p < .001$, *Nagelkerke ΔR^2* = .088,

369 Model 11, Table 5). The 11-item scale did not improve upon the seven-item scale ($\Delta\chi^2$ (1) =

370 1.19, $\Delta p = .173$, *Nagelkerke ΔR^2* = .064, Model 12, Table 5).

371

372   **Insert Table 5**

373

374   *Reliability.* Internal consistency was assessed using the Validation Sample.

375   Cronbach's Alpha was above .90 for all scales with only minor reductions in the reduced

376   scales ($\alpha = 0.95$ to 0.92). Test-Retest reliability utilised session one and two data from 66

377   patients. Correlations between session one and session two ACE scores indicated that test-

378   retest reliability was acceptable across all scales ($r = 0.731$ to 0.725). Steiger's *Z* revealed no

379   significant changes in scale test-retest reliability following reduction.

380

381   *Scale Selection*

382   The procedures conducted indicate that the ACE-F may be reduced to as few as five

383   items while maintaining theoretical and psychometric integrity. The five-item scale, termed

384   the Mini Alcohol Craving Experience (MACE), was chosen as the most suitable short-form

385   scale for assessment of craving in AUD populations.

386

387   DISCUSSION

388   In place of the two 11–item forms of the ACE, a brief five-item measure of craving

389   was validated (MACE). The MACE maintained high construct, predictive, concurrent, and

390   convergent validity. High internal and test-retest reliability consistent with the ACE-F was

391   also demonstrated. The MACE measures the frequency of past week craving including

392   intense urges, imagery, and intrusiveness of craving related cognitions (Kavanagh et al.

393   2005). The MACE is simple to administer and may be completed in less than 60 seconds,

394   reducing time burden on respondents, health professionals, and researchers.

395   In addition to its brevity, the MACE maintains several strengths uncommon among

396   current craving instruments, including a strong theoretical model and absence of drinking

397   constructs known to confound craving measurement (Sayette et al. 2000; Kavanagh et al.

398   2013). By retaining the items most representative of the ACE factors, and monitoring the

399   resultant model fit, the MACE preserved the construct validity of the ACE. The MACE

400   subsequently retains the capacity for unique insight into intensity and intrusiveness of patient

401   craving, as well and key elements of craving based imagery. This information may inform

402   case formulation and treatment planning.

403   Predictive validity is infrequently examined in existing craving measures. Higher

404   scores on the MACE were predictive of increased risk of lapse or dropout from treatment in

405   this alcohol dependent sample. A one standard deviation increase in MACE score was

406   associated with a 54% increase in the odds of lapse or discontinuation of treatment; relative

407   to OCDS-Obsessions, where a one standard deviation score increase was associated with a

408   10% increase in risk. The practical interpretation of this result is that for every one-point

409   increase on the MACE pre-treatment (maximum score = 50), the odds of a patient completing

410   treatment abstinent reduced by 3.1 percent. The MACE may therefore assist addiction

411   professionals to better assess risk of relapse in their patients.

412   Few craving measures assess test-retest reliability. The MACE deliberately measures

413   past week frequency of craving, under the assumption that this will have greater stability and

414   subsequently be a more reliable indicator of change than single time point assessments. The

415   correlation of session one and two MACE scores was $r = 0.73$, and is interpreted as an

416   acceptable degree of stability within the clinical context. Given the prominence of craving

417   within clinical and research settings, a measure of craving sensitive to change over time is

418   greatly needed. The MACE may enhance the validity of studies assessing the efficacy of

419   craving interventions, and improve monitoring of patients' treatment response in clinical

420   settings.

421   As this study was conducted in a hospital outpatient clinic, the samples provided

422   optimal, clinically relevant data. However, the practical nature of the research design

423   introduced some limitations. The samples predominantly comprised middle-aged men with

424 poor social or occupational functioning and moderate to severe alcohol dependence. Future

425 studies should investigate the MACE in more diverse patient populations, as craving profiles

426 may vary across problem severity, age, culture, social-occupational status. An additional

427 limitation is that follow up data of patients who dropped out were not available, and were

428 conservatively recorded as having lapsed. Assessment of test-retest reliability was also

429 impaired by the treatment setting. An increased focus on drinking and attempts to change

430 drinking behaviours is likely to have increased variance in patient craving from session one to

431 two. While this is hypothesised to have led to the underestimation of the MACE's stability

432 future research should assess participants under stable conditions with tightly controlled time

433 points. Further research is also needed to examine the performance of the MACE as a stand-

434 alone measure. As the MACE was only assessed as a sub-selection of the full ACE, the extent

435 to which the variance of the retained items is influenced by the excluded items is unknown.

436 Finally, while craving frequency presents ongoing challenges to the control of drinking, very

437 intense peak levels also constitute significant risk. Utilising both frequency and strength

438 forms of the ACE is recommended when time permits, as they offer a more comprehensive

439 assessment of the patient's experience of craving. The MACE and ACE scales, scoring

440 instructions, and normative data are included in the online supplementary material.

441   A final recommendation, which applies to the use of all craving measures, is that scale

442 administrators, researchers and clinicians alike, carefully interpret scale scores in light of the

443 definition and theory under which they are proposed. It is argued that unclear definitions, and

444 the absence of theoretical models have impaired craving measurement to date, confounding

445 the craving construct as it is widely understood (Tiffany and Wray 2012; Kavanagh et al.

446 2013). Interpreting ACE scores in the context of the Elaborated Intrusion Theory of Desire

447 (Kavanagh et al. 2005) will improve understanding of the proposed construct of craving and

448 enhance its clinical utility.

449   The Mini Alcohol Craving Experience (MACE) reflects the key theoretical elements

450 of the ACE, while maintaining the best performing items and preserving psychometric

451 integrity. Key strengths of the MACE include excellent construct validity, predictive validity,

452 and acceptable test-retest reliability. In conjunction with its brevity, these features make the

453 MACE ideal for use with AUD populations in time limited clinical and research

454 environments.

455

462

463   CONFLICTS OF INTEREST

464   There are no conflicts of interest to declare.

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468   REFERENCES

469   Abrams DB (2000) Transdisciplinary concepts and measures of craving: commentary and

470   future directions. Addiction 95**:**237-246.

471   Addolorato G, Leggio L, Abenavoli L, Gasbarrini G (2005) Neurobiochemical and clinical

472   aspects of craving in alcohol addiction: a review. Addict. Behav. 30**:**1209-1224.

473   American Psychiatric Association, (2000) Diagnostic and statistical manual of mental

474   disorders. 4th ed. TR ed., American Psychiatric Association, Washington, DC.

475   American Psychiatric Association (2013) Diagnostic and statistical manual of mental

476   disorders. 5th ed., American Psychiatric Association, Washington, D.C.

477   Anton RF, Moak DH, Latham P (1995) The Obsessive Compulsive Drinking Scale: a self-

478   rated instrument for the quantification of thoughts about alcohol and drinking

479   behavior. Alcohol. Clin. Exp. Res. 19**:**92-99.

480   Bandura A (1977) Social Learning Theory. Prentice Hall, Englewood Cliffs, NJ.

481   Barnes LLB, Harp D, Jung WS (2002) Reliability generalization of scores on the Spielberger

482   State-Trait Anxiety Inventory. Educ. Psychol. Meas. 62**:**603-618.

483   Beck AT, Steer RA, Brown GK (1996) Beck Depression Inventory-II: Manual, Psychological

484   Corp, San Antonio.

485   Beck AT, Steer RA, Carbin MG (1988) Psychometric properties of the Beck Depression

486   Inventory: twenty-five years of evaluation. Clin. Psychol. Rev. 8**:**77-100.

487   Bozdogan H (1987) Model selection and Akaike's Information Criterion (AIC): the general

488   theory and its analytical extensions. Psychometrika 52:345–370.

489   Carmines EG, McIver JP (1981) Analysing models with unobserved variables: analysis of

490   covariance structures, in *Social Measurement: Current Issues* (Bohrnstedt GW,

491   Borgatta EF eds), pp. 65–115. Sage, Beverly Hills, CA.

492   Connor JP, Gudgeon ET, Young RM, Saunders JB (2007) The relationship between alcohol

493   expectancies and drinking restraint in treatment seeking alcohol dependent patients.

494   Addict. Behav. 32:1461–1469.

495   Connor JP, Haber PS, Hall WD (2016) Alcohol use disorders. Lancet. 387**:**988-998.

496   Connor JP, Hall WD (2015) Alcohol burden in low-income and middle-income countries.

497   Lancet. 386**:**1922-1924.

498   Connor JP, Kavanagh DJ, Andrade J, May J, Feeney GFX, Gullo MJ, White AM, Fry ML,

499   Drennan J, Previte J, Tjondronegoro D (2014) Alcohol consumption in young adults:

500   the role of multisensory imagery. Addict. Behav. 39**:**721-724.

501   Cortina JM (1993) What is coefficient alpha? An examination of theory and applications. J.

502   Appl. Psychol. 78**:**98-104.

503   Flannery, BA, Volpicelli, JR, Pettinati, HM (1999) Psychometric properties of the Penn

504   Alcohol Craving Scale. Alcohol. Clin. Exp. Res., 23, 1289-1295.

505   Flannery BA, Poole SA, Gallop RJ, Volpicelli JR (2003) Alcohol craving predicts drinking

506   during treatment: an analysis of three assessment instruments. J. Stud. Alcohol

507   64**:**120-126.

508   Gowing LR, Ali RL, Allsop S, Marsden J, Turf EE, West R, Witton J (2015) Global statistics

509   on Addictive Behaviours: 2014 status report. Addiction 110**:**904-919.

510   Haass-Koffler CL, Leggio L, Kenna Ga (2014) Pharmacological approaches to reducing

511   craving in patients with Alcohol Use Disorders. CNS Drugs 28**:**343-360.

512   Hasin DS, O'Brien CP, Auriacombe M, Borges G, Bucholz K, Budney A, Compton WM,

513   Crowley T, Ling W, Petry NM, Schuckit M, Grant BF (2013) DSM-5 criteria for

514   Substance Use Disorders: recommendations and rationale. Am. J. Psychiatry 170**:**834-

515   851.

516   Hruschka DJ, Schwartz D, St.John DC, Picone-Decaro E, Jenkins RA, Carey JW (2004)

517   Reliability in coding open-ended data: lessons learned from HIV behavioral research.

518   Field Methods 16**:**307-331.

519   Hsu A, Yang J, Yilmaz YH, Haque MS, Can C, Blandford AE (2014) Persuasive technology

520   for overcoming food cravings and improving snack choices, in Proceedings of the

521   32nd annual ACM conference on Human factors in computing systems, pp 3403-

522   3412.

523   Hu L, Bentler PM (1999) Cut off criteria for fit indexes in covariance structure analysis:

524   conventional criteria versus new alternatives. Struct. Equ. Modeling 6:1–55.

525   Kavanagh DJ, Andrade J, May J (2005) Imaginary relish and exquisite torture: the Elaborated

526   Intrusion Theory of Desire. Psychol. Rev. 112**:**446-467.

527   Kavanagh DJ, Statham DJ, Feeney GFX, Young RM, May J, Andrade J, Connor JP (2013)

528   Measurement of alcohol craving. Addict. Behav. 38**:**1572-1584.

529   Kemps E, Tiggemann M (2007) Modality-specific imagery reduces cravings for food: an

530   application of the elaborated intrusion theory of desire to food craving. J. Exp.

531   Psychol. Appl. 13**:**95-104.

532   Kemps E, Tiggemann M (2013) Hand-held dynamic visual noise reduces naturally occurring

533   food cravings and craving-related consumption. Appetite 68**:**152-157.

534   Knäuper B, Pillay R, Lacaille J, McCollam A, Kelso E (2011) Replacing craving imagery

535   with alternative pleasant imagery reduces craving intensity. Appetite 57**:**173-178.

536   Kranzler HR, Mulgrew CL, Modesto-Lowe V, Burleson JA (1999) Validity of the Obsessive

537   Compulsive Drinking Scale (OCDS): does craving predict drinking behavior?

538   Alcohol. Clin. Exp. Res. 23**:**108-114.

539   Law B, Gullo MJ, Daglish M, Kavanagh DJ, Feeney GFX, Young RM, Connor JP (2016)

540   Craving mediates stress in predicting lapse during alcohol dependence treatment.

541   Alcohol. Clin. Exp. Res. 40**:**1058-1064.

542   Littel M, Hout MAVD, Engelhard IM (2016) Desensitizing addiction: using eye Movements

543   to reduce the intensity of substance-related mental imagery and craving. Front.

544   Psychiatry 7**:**1-11.

545   May J, Andrade J, Kavanagh DJ, Feeney GFX, Gullo MJ, Statham DJ, Skorka-Brown J,

546   Connolly JM, Cassimatis M, Young RM, Connor JP (2014) The Craving Experience

547   Questionnaire: a brief, theory-based measure of consummatory desire and craving.

548   Addiction 109**:**728-735.

549   May J, Kavanagh DJ, Andrade J (2014) The Elaborated Intrusion Theory of Desire: a 10-year

550   retrospective and implications for addiction treatments. Addict. Behav. 44**:**1-6.

551   McHugh, RK, Fitzmaurice, GM, Griffin, ML, Anton, RF, Weiss, RD (2016) Association

552   between a brief alcohol craving measure and drinking in the following week.

553   Addiction 111:1004–1010.

554   Oei TP, Evans L, Crook GM (1990) Utility and validity of the STAI with anxiety disorder

555   patients. Br. J. Clin. Psychol .29**:**429-432.

556   Pavlick M, Hoffmann E, Rosenberg H (2009) A nationwide survey of American alcohol and

557   drug craving assessment and treatment practices. Addict. Res. Theory 17**:**591-600.

558   R-Core Team (2015) A language and environment for statistical computing, R Foundation for

559   Statistical Computing, Vienna.

560   Roberts JS, Anton RF, Latham PK, Moak DH (1999) Factor structure and predictive validity

561   of the Obsessive Compulsive Drinking Scale. Alcohol. Clin. Exp. Res. 23**:**1484-1491.

562   Robinson TE, Berridge KC (1993) The neural basis of drug craving: an incentive-

563   sensitization theory of addiction. Brain Res. Rev. 18**:**247-291.

564   Rojewski, AM, Morean, ME, Toll, B, McKee, S, Krishnan-Sarin, S, Green, BG, Bartoshuk,

565   LM, O'Malley, SS (2015) The Yale Craving Scale: development and psychometric

566   properties. Drug Alcohol Depend. 154:158–166.

567   Rosseel Y (2012) lavaan: an R Package for Structural Equation Modeling. J. Stat. Softw.

568   48**:**1-36.

569   Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M (1993) Development of the

570   Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on

571   Early Detection of Persons with Harmful Alcohol Consumption--II. Addiction

572   88**:**791-804.

573   Sayette MA, Shiffman S, Tiffany ST, Niaura RS, Martin CS, Shadel WG (2000) The

574   measurement of drug craving. Addiction 95**:**189-210.

575   Skorka-Brown J, Andrade J, May J (2014) Playing 'Tetris' reduces the strength, frequency

576   and vividness of naturally occurring cravings. Appetite 76**:**161-165.

577   Soyka, M, Helten, C, Schmidt, P (2010) OCDS Craving scores predict 24-month outcome in

578   alcoholic outpatients. Am. J. Addictions, 19**:** 264-269.

579   Spielberger C (1983) Manual for the State-Trait Anxiety Inventory, Consulting Psychologists

580   Press, Palo Alto: California.

581   Statham DJ, Connor JP, Kavanagh DJ, Feeney GFX, Young RMD, May J, Andrade J (2011)

582   Measuring alcohol craving: development of the Alcohol Craving Experience

583   questionnaire. Addiction 106**:**1230-1238.

584   Tiffany ST, Wray JM (2012) The clinical significance of drug craving. Ann. N. Y. Acad. Sci.

585   1248**:**1-17.

586   Witkiewitz K, Bowen S, Douglas H, Hsu SH (2013) Mindfulness-based relapse prevention

587   for substance craving. Addict. Behav. 38**:**1563-1571.

588   Witkiewitz K, Bowen S, Harrop EN, Douglas H, Enkema M, Sedgwick C (2014)

589   Mindfulness-based treatment to prevent addictive behavior relapse: theoretical models

590   and hypothesized mechanisms of change. Subst. Use Misuse. 49**:**513-524.

591   Yoshimura A, Komoto Y, Higuchi S (2016) Exploration of core symptoms for the diagnosis

592   of Alcohol Dependence in the ICD-10. Alcohol. Clin. Exp. Res.

593   doi:10.1111/acer.13225

594

595   **Table 1.** Patient sample characteristics

Sample characteristics	Scale Reduction Sample	Validation Sample	TRT Sample
	$n = 519$	$n = 228$	$n = 66$
Mean Age, years (SD)	39.82 (11.59)	44.39 (10.82)	45.48 (10.03)
Sex, female	171 (32.9%)	84 (36.8%)	22 (33.3)
Married/*De-facto*	184 (35.5%%)	82 (36.0%)	25 (37.9%)
Education			
Degree	70 (13.5%)	47 (20.5%)	17 (25.8%)
Diploma/Certificate	52 (10.0%)	16 (7.1%)	6 (9.1%)
Senior Secondary (Year 12)	157 (30.3%)	71 (31.1%)	22 (33.3%)
Junior Secondary (Year 10)	190 (36.6%)	82 (36.0%)	17 (25.8%)
Primary (Year 7)	33 (6.4%)	11 (4.8%)	4 (6.1%)
Unemployed	103 (19.8%)	44 (19.3%)	15 (22.7%)
Mean Alcohol (grams) per drinking day (SD)	147.07 (88.90)	169.80 (100.93)	196.12 (119.71)
Median Baseline ACE-F (IQR)	39 (48.00)	42.00 (46.75)	43.50 (45.50)
Mean Baseline AUDIT (SD)	27.25 (8.6)	29.38 (7.01)	27.47 (10.28)
Mean Baseline OCDS-Obsessions (SD)	7.82 (4.47)	8.82 (4.36)	8.46 (4.76)
Medication Prescribed*	315 (60.7%)	25 (11.0%)	10 (15.2%)

596   *The Scale Reduction Sample records medication (naltrexone/acamprosate/both) if it is prescribed at any point during treatment. Medication is
597   only counted in the Validation and TRT samples if it was taken in the week prior to assessment. As the Validation sample assessment occurred
598   prior to commencement of behavioural treatment and TRT sample was assessed in Session 1, the majority of patients had not yet been prescribed
599   pharmacotherapy.
600

601   **Table 2.** Summary of hierarchical logistic regression models assessing predictive validity of the ACE-F and ACE-S.

	β (SE)	Lower	Odds Ratio	Upper
		95% CI for Odds Ratio	
Baseline Model				
Constant	1.18*** (.13)		3.26	
Medication	0.11 (.22)	0.73	1.12	1.71
AUDIT	-0.00 (.11)	0.81	1.00	1.23
Model 1				
Constant	1.19*** (.14)		3.28	
Medication	0.23 (.22)	0.81	1.26	1.96
AUDIT	-0.04 (.11)	0.77	0.96	1.20
ACE-S	0.46*** (.11)	1.28	1.59	1.97
Model 2				
Constant	1.21*** (.14)		3.34	
Medication	0.23 (.22)	0.81	1.26	1.95
AUDIT	-0.05 (.11)	0.76	0.95	1.18
ACE-F	0.53*** (.12)	1.34	1.69	2.14
Model 3				
Constant	1.2*** (.14)		3.32	
Medication	0.24 (.23)	1.27	1.27	1.98
AUDIT	0.05 (.11)	0.95	0.95	1.18
ACE-S	0.15 (.19)	1.17	1.17	1.70
ACE-F	0.39 (.20)	1.48	1.48	2.21

Note: * $p < .05$, ** $p < .01$, *** $p < .001$,

604

605   **Table 3.** Mean rank comparison of abstinent patients and those who lapsed or dropped out of treatment across all ACE-F items scores.

How often did these things happen over the last week?	Complete Abstinent		Lapse or Dropout		U	Z	p	r
	n	Mean Rank	*n*	Mean Rank				
1. Did you want a drink?	118	196.24	398	276.96	16135.00	-5.19	<.001	-0.23
2. Did you think about needing a drink?	118	203.00	399	275.56	16933.00	-4.67	<.001	-0.20
3. Did you have an urge to drink?	118	203.95	399	275.28	17045.00	-4.58	<.001	-0.20
4. Did you picture alcohol or drinking?	118	215.42	399	271.89	18398.50	-3.64	<.001	-0.16
5. Did you imagine what it would taste like?	118	215.79	398	271.16	18442.50	-3.59	<.001	-0.16
6. Did you imagine what it would smell like?	118	217.61	399	271.24	18656.50	-3.54	<.001	-0.16
7. Did you imagine what it would feel like in your mouth or throat?	118	214.71	399	272.10	18315.00	-3.74	<.001	-0.16
8. Did you imagine how your body would feel if you had a drink?	118	223.04	398	269.01	19298.00	-2.96	0.003	-0.13
9. When you thought about alcohol over the last week, how often were the thoughts intrusive?	117	223.46	388	261.91	19241.50	-2.51	0.012	-0.11

10. When you thought about alcohol over the last week, how often were you trying not to think about alcohol?	117	211.29	398	271.73	17818	-3.88	<.001	-0.17
11. Did you find it hard to think about anything else?	118	203.59	399	275.56	17003	-4.55	<.001	-0.20

606

607 **Table 4.** Robust fit indices for the 3-factor and unifactorial structures of the ACE scales ($n = 228$).

Scale	$\chi2$ (df)	$\chi2$ /df	p	CFI	RMSEA	SRMR	AIC
ACE-F 11							
Unifactorial	302.13 (44)	6.87	<.001	0.898	0.160	0.069	11236.7
3-Factor	158.92 (41)	3.88	<.001	0.954	0.112	0.056	11013.50
ACE-F 7							
Unifactorial	78.91 (14)	5.64	<.001	0.955	0.143	0.040	7321.29
3-Factor	35.59 (11)	3.24	<.001	0.983	0.099	0.027	7265.35
ACE-F 5							
Unifactorial	23.23 (5)	4.65	<.001	0.983	0.126	0.026	5197.70
3-Factor	23.47 (4)	5.87	<.001	0.982	0.146	0.026	5199.57

608

609

610   **Table 5.** Summary of hierarchical logistic regression models assessing predictive validity of the reduced ACE-F Scales and OBS.

611

	β (SE)	95% CI for Odds Ratio		
		Lower	Odds Ratio	Upper
Model 7				
Constant	1.19*** (.14)		3.28	
Medication	0.22 (.22)	0.8	1.25	1.93
AUDIT	-0.04 (.11)	0.78	0.96	1.19
ACE-F-5 item	0.43*** (.12)	1.23	1.54	1.93
Model 8				
Constant	1.19*** (.14)		3.3	
Medication	0.24 (.23)	0.82	1.27	1.98
AUDIT	-0.04 (.11)	0.77	0.96	1.19
ACE-F-7 item	0.50*** (.12)	1.31	1.65	2.06
Model 9				
Constant	1.18*** (.14)		3.24	
Medication	0.20 (.22)	0.79	1.23	1.9
AUDIT	-0.07 (.11)	0.75	0.93	1.16
OBS	0.31** (.11)	1.09	1.37	1.71
Model 10				
Constant	1.19*** (1.4)		3.29	
Medication	0.225 (.23)	0.8	1.25	1.95
AUDIT	-0.06 (.11)	0.76	0.95	1.18
OBS	0.10 (.14)	0.84	1.1	1.44
ACE-F-5 item	0.37** (.14)	1.11	1.45	1.9

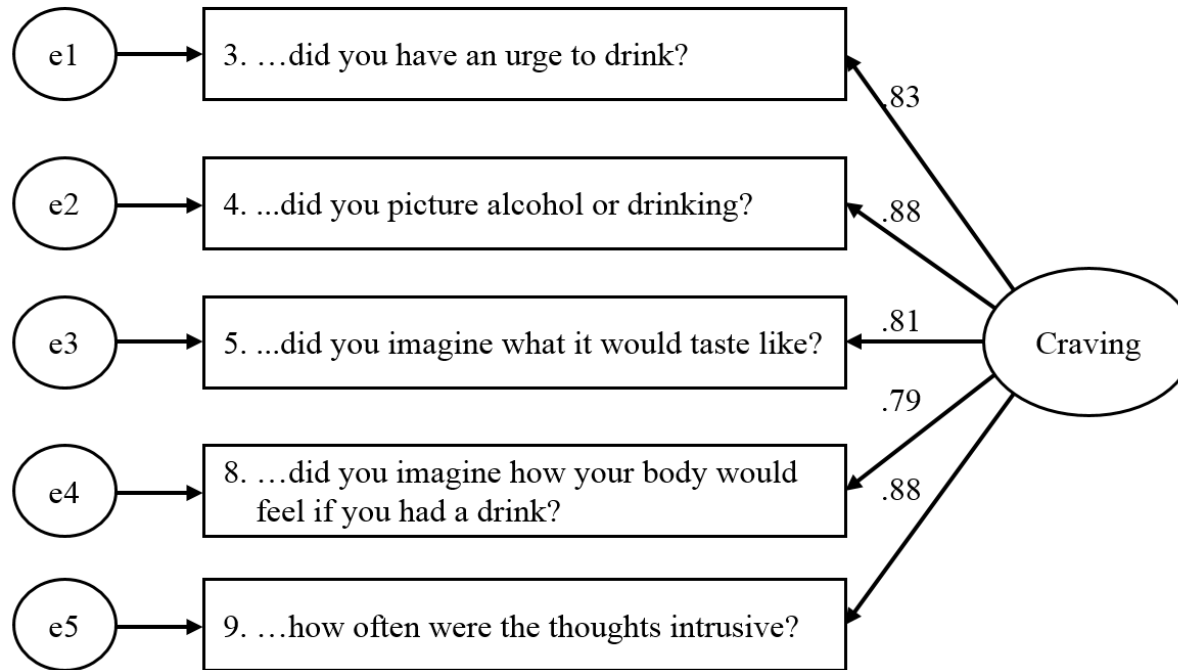|				
Model 11				
Constant	1.22 (0.14)		3.38	
Medication	0.26 (0.23)	0.83	1.29	2.02
AUDIT	-0.03 (0.11)	0.77	0.97	1.21
ACE-F-5 item	-2.21 (0.7)	0.03	0.11	0.43
ACE-F-7 item	2.67 (0.7)	3.65	14.39	56.77
Model 12				
Constant	1.22 (0.14)		3.37	
Medication	0.21 (0.23)	0.8	1.24	1.93
AUDIT	-0.06 (0.11)	0.76	0.94	1.17
ACE-F-7 item	-0.40 (0.67)	0.18	0.67	2.48
ACE-F-11 item	0.93 (0.69)	0.66	2.55	9.82

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

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613

614

How often did these things happen over the last week?

615

616 **Figure 1**. Unifactorial model of the 5-item ACE-F with standardised parameter. All paths are significant at *p* < .001.