1       **Title page**
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4       **Applicability of the Locus of Control of Behaviour scale for People with Dementia**
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7       **Ingeborg Halse [1,2,3]; Guro Hanevold Bjørkløf [1]; Knut Engedal [1,2]; Anne Marie Mork**

8       **Rokstad [1,4]; Karin Persson [1,2]; Rannveig Sakshaug Eldholm [5,6]; Geir Selbæk[1,2,3]; Maria**

9       **Lage Barca [1,2]**

10      [1] Norwegian National Advisory Unit on Ageing and Health, Vestfold Hospital Trust, Norway

11      [2] Department of Geriatric Medicine, Oslo University Hospital-Ullevål, Oslo, Norway

12      [3] Faculty of Medicine, University of Oslo, Oslo, Norway

13      [4] Faculty of Health Sciences and Social Care, Molde University College, Molde, Norway

14      [5] Department of Neuromedicine and Movement Science, Norwegian University of Science

15      and Technology (NTNU), Trondheim, Norway.

16      [6] Department of Geriatrics, St. Olavs Hospital, Trondheim, Norway

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18      **Corresponding author**: Ingeborg Halse, Norwegian National Advisory Unit on Ageing and

19      Health, Postboks 2136, 3103 Tønsberg, Norway.

20      Telephone: (+47) 22117728   Fax number: (+47) 23016161

21      E-mail: ingeborg.halse@aldringoghelse.no

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29    **Disclosure statement**: The authors report no conflict of interest.

30    **Data availability**: The data that support the findings in this manuscript are available from the

31    corresponding author (IH), upon reasonable request.

32
33

**Abstract**

*Objective:* To investigate the applicability of the LoCB for people with dementia.

*Method:* A sample of 534 participants with dementia (78.4 mean age, 58% female) were included. Assessment included the LoCB, the Montgomery–Aasberg Depression Rating Scale (MADRS), the Mini-Mental Status Examination Norwegian revised (MMSE-NR) and the Instrumental Activities of Daily Living (I-ADL). Completion percentages and internal reliability of LoCB were examined for predefined MMSE-NR groups (0-4, 5-9, 10-14, 15-19, 20-24, 25-27, and 28-30). Factors associated with completion were analysed, and a Principal component analysis (PCA) of the LoCB was performed. Sum score and component subscale scores were compared to MADRS and MMSE-NR scores.

*Results:* In total, 234 participants completed the LoCB. Completion percentages ranged from 74% (MMSE-NR 28-30) to 0% (MMSE-NR 0-9). Internal reliability was between 0.80 and 0.72 in groups with MMSE-NR>9, except in MMSE-NR 20-24 (0.52). Age, MMSE-NR and education were associated with completion. The PCA yielded three components – powerful others, internal, and luck/fate – with explained variance of 41.3%. Participants with MADRS>7 scored higher on the LoCB sum score, powerful others and internal subscale scores. No difference was found regarding the luck/fate subscale score. MMSE-NR did not affect LoCB scores.

*Conclusion:* Older age, less education, and more cognitive impairment decreased the likelihood of completion. However, psychometric test results indicate that those who completed the LoCB understood the questions, even with severe cognitive impairment. We conclude, therefore, that the LoCB is applicable for investigating control orientation among people with dementia.

**Main text**

65

66 **Introduction**

67 Until a cure is discovered for dementia, helping people cope with their disease should be a

68 major focus. One of the most common comorbid disorders to dementia is depression, with

69 prevalence rates reported between 20% and 45% (Barca, Selbæk, Engedal, & Laks, 2009;

70 Enache, Winblad, & Aarsland, 2011; Kitching, 2015). Locus of control (LoC), defined as the

71 extent to which one expects events to be a consequence of one's own behaviour as opposed to

72 being controlled by outside forces (Rotter, 1966), has repeatedly been associated with

73 depression (Benassi, Sweeney, Dufour, & Fowles, 1988; Bjørkløf, Engedal, Selbæk,

74 Kouwenhoven, & Helvik, 2013). Furthermore, recent research has shown that an external

75 LoC is also significantly related to depression among older persons (Bjørkløf et al., 2015).

76 However, little research has been done on LoC orientation among people with dementia

77 (Bjørkløf et al., 2013), and it is important not to take for granted that we know how

78 psychological constructs underlying depression should be understood in this population.

79

80 If a biopsychosocial understanding of depression is assumed (Fiske, Wetherell, & Gatz,

81 2009), psychotherapeutic interventions can help those affected by dementia and depression,

82 and we can reduce the need for psychotropic medication in this vulnerable patient group.

83 Until now, psychotherapeutic interventions have been unusual, but this appears to be

84 changing (Areán et al., 2010; Kiosses et al., 2015; Kurz et al., 2012). A systematic review and

85 meta-analysis of psychological treatments for depression and anxiety for people with

86 dementia indicate that cognitive behavioural therapy, interpersonal therapy, counselling and

87 multimodal interventions are all effective treatments (Orgeta, Qazi, Spector, & Orrell, 2015).

88 Investigations into which psychological constructs play a part in the development,

89  maintenance, and recovery from depression among people with dementia is, therefore, an

90  important supplement to this developing field and should guide therapeutic interventions.

91

92

93  In the present study, we investigated the applicability of the Norwegian version of the *Locus*

94  *of Control of Behaviour scale* (LoCB) (Craig, Franklin, & Andrews, 1984) for people with

95  dementia. This was done by examining how many participants with different degrees of

96  cognitive deficit completed the full scale, the internal reliability of the responses, and what

97  factors appeared to explain the likelihood of completion. Furthermore, we examined the

98  component structure of the LoCB, and whether LoCB scores differed according to the degree

99  of depression symptomatology and the degree of cognitive impairment.

100

101  **Method**

102  *Participants*

103  Participant data came from two projects: 273 from the follow-up part of the  project

104  "Prognosis of Alzheimer's Disease and Resource Use" (PADR), which included patients

105  referred to two memory clinics and one geriatric outpatient unit in Norway (Barca et al.,

106  2017), and 261 from "Effects and Costs of a Day Care Centre Program Designed for People

107  with Dementia" (ECOD),  a study carried out in primary healthcare (Rokstad et al., 2014).

108  Details regarding inclusion and exclusion criteria can be found in the previously published

109  papers (Barca et al., 2017; Rokstad et al., 2014). In both projects, all measures were

110  interviewer administered, and the dementia diagnosis was independently confirmed by two

111  experienced physicians after a comprehensive clinical assessment. The vast majority, 81.1%,

112  were diagnosed with Alzheimer's dementia (AD), and 8.1% with vascular dementia (VaD).

113  The remaining 1.9% had combined AD/VaD, Lewy body dementia, Parkinson's disease with

114     dementia, frontal lobe dementia or another dementia. Of a total of 534 participants, 234 had

115     complete data on the LoCB (77.3 mean age, 53.4% female) and 300 had between one and 17

116     missing-item responses on the LoCB (79.3 mean age, 62% female).

117

118     ***Ethical consideration***

119     The project has been accepted by the Regional Committee in Ethics in Medical Research in

120     South-East Norway; REK South-East case numbers 2013/1020 and 2011/531.

121

122     ***Patient consent***

123     After written and oral information about the project, the participants were asked to give

124     written informed consent. Only participants with the capacity to give consent were included.

125

126     ***Assessments***

127     The LoCB contains 17 questions with a six-point Likert-type scale ranging from zero to five

128     for each question. The score on items 1, 5, 7, 8, 13, 15 and 16 are inverted, and the total sum

129     score indicates the degree of externality. Scores vary from zero to 85, with higher scores

130     indicating an external LoC orientation (Craig et al., 1984). The scale has been translated into

131     Norwegian and back-translated (Nordtug, Krokstad, & Holen, 2011). The Norwegian version

132     has been applied in several studies in Norway (Bjørkløf et al., 2015; Bruvik, Ulstein, Ranhoff,

133     & Engedal, 2013; Dyb, Holen, Steinberg, Rodriguez, & Pynoos, 2003; Helvik et al., 2016).

134

135     The revised Norwegian version of the Mini-Mental Status Examination (MMSE-NR) was

136     used to measure global cognitive function. The scale is a well-established screening tool for

137     cognitive impairment, with 20 items measuring a wide range of cognitive functions. Scores

138     vary from zero to 30, with higher scores indicating better cognitive function (Strobel &

139     Engedal, 2008).

140

141    The Montgomery–Åsberg Depression Rating scale (MADRS) was used to measure depressive

142    symptoms. The scale measures symptoms present during the past week and consists of ten

143    items. Sum scores vary from zero to 60, with higher scores indicating more severe

144    symptomatology ((Montgomery & Asberg, 1979). The Norwegian version of the MADRS has

145    been validated for use among people with dementia, and the best cut-off indicating depression

146    was found at >7 (Knapskog, Barca, & Engedal, 2011), in contrast to a cut-off of 14 among old

147    people without dementia (Engedal et al., 2012).

148

149    The Instrumental Activities of Daily Living (I-ADL) was used to measure the ability to

150    perform the activities of daily life. The I-ADL has eight items with a possible sum score

151    between eight and 31. A higher score indicates poorer independent functioning (Lawton &

152    Brody, 1969).

153

154    *Statistical analysis*

155    The data were analysed using the Statistical Package for the Social Sciences (SPSS), version

156    21.0. Comparisons between groups with complete and incomplete LoCBs were made using

157    the independent sample t-test and the Mann–Whitney U test/Kruskal–Wallis test for normally

158    distributed and skewed continuous data, respectively. Age and LoCB sum scores were found

159    to be normally distributed by examining the histogram, Q-Q, and box-plot of each variable. A

160    chi-square test was used for categorical data. A p-value of $<0.05$ was used as the significance

161    level throughout.

162

163    First, applicability of the LoCB for people with dementia was evaluated by examining the

164    proportion of complete responses within the following seven MMSE-NR groups: 0-4, 5-9, 10-

165   14, 15-19, 20-24, 25-27, 28-30. The internal reliability of the LoCB in the seven groups was

166   then examined using Cronbach's α. Second, after dividing participants into "completers"

167   versus "non-completers", both unadjusted and adjusted logistic regression models were set up

168   to examine factors associated with completion of the LoCB. Variables with p<0.2 in the

169   unadjusted analysis were included in the adjusted analysis.

170

171   Third, a principal component analysis (PCA) on complete data sets was performed. Results

172   from the Kaiser-Meyer-Olkin measure of sampling adequacy, Bartlett's test of sphericity, and

173   the sample sizes indicated the group was large enough and appropriate for a PCA. The

174   procedure was as follows: first, an unforced PCA using varimax rotation was performed,

175   followed by gradually enforcing fewer components until reaching only one. Loadings greater

176   than or equal to 0.4 were judged to be significant. The process was repeated using oblimin

177   rotation. The number of components best fitting the data was determined by evaluating the

178   criterion of eigenvalues ≥1, examining the scree plot and performing a Monte Carlo PCA for

179   parallel analysis. Finally, LoCB sum scores and the sum scores of the LoCB subscales (as

180   found through the PCA component analysis) were examined in relation to depressive

181   symptomatology and the degree of cognitive impairment.

182

183   **Results**

184   *Participants' demographic and clinical characteristics*

185   The characteristics of participants with complete and incomplete responses on the LoCB are

186   presented in Table 1. Those in the group with complete responses were younger, had a higher

187   level of education, had a better cognitive function, and a better function in the activities of

188   daily living compared to the non-completers. No significant differences were found between

189   the groups regarding gender, marital status or level of depressive symptomatology

9

190 **[Table 1 here]**

191 *Completion percentages*

192 As seen in Table 2, the completion percentage decreased with decreasing cognitive function,

193 from 74% (MMSE-NR 28-30) to 0% (MMSE-NR 0-9). Cronbach's α in the different MMSE-

194 NR groups ranged from 0.80 to 0.52.

195 **[Table 2 here]**

196 *Logistic regression analysis*

197 The unadjusted logistic regression analyses indicated there was no association between

198 completion probability and severity of the depressive symptomatology (score on MADRS)

199 (p=0.44) or marital status (p=0.51). In the adjusted analysis, age, education, and cognitive

200 function (MMSE-NR) were significantly associated with LoCB completion. No interaction

201 effect was found between MMSE-NR and age or between MMSE-NR and education.

202 **[Table 3 here]**

203 *Principal Component Analysis*

204 The PCA with three components enforced, using both the varimax and oblimin rotation

205 methods, reached the best results. The component correlation matrix from the oblimin PCA

206 revealed low correlations between the variables, indicating that the components were not

207 related and thus showing that the varimax rotation procedure best fit the data, as shown in

208 Table 4. The three components were labelled 'powerful others', 'luck/fate', and 'internal', and

209 explained 41.3% of the variance. The Cronbach's α of the full scale was 0.69. The powerful

210 others, internal, and luck/fate subscale scores had a Cronbach's α of 0.47, 0.67, and 0.65,

211 respectively (Table 4).

212 **[Table 4 here]**

213 *LoCB scores in relation to level of depressive symptomatology and to level of cognitive*

214 *impairment*

215    Table 5 shows that participants with MADRS >7 had higher scores on the total LoCB sum

216    and on the internal and powerful others subscales compared to those with MADRS ≤ 7, but no

217    difference on the luck/fate subscale. No significant differences were found on the LoCB sum

218    or subscales when comparing participants with different MMSE-NR scores (data not shown).

219                                    **[Table 5 here]**

220

221    **Discussion**

222    The aim of the present study was to examine the applicability of the LoCB for people with

223    dementia. Among participants with an MMSE-NR sum score ≥20, more than half completed

224    the LoCB, but no participants with MMSE-NR ≤ 9 managed to complete the scale. Better

225    cognitive functioning, younger age and a higher level of education increased the likelihood of

226    completion. The internal consistency was good, with a high Cronbach's α even among those

227    with severe cognitive deficits, and the PCA revealed component structures similar to

228    populations without cognitive deficits.

229

230    Ideally, however, we would have wanted an even higher completion rate to ascertain the

231    applicability of the scale for this population. To explore potential reasons for completion of

232    the LoCB, we performed a logistic regression analysis. Lower age, better cognitive

233    functioning and higher education increased the likelihood of completion. Being younger may

234    also mean having more stamina, and less cognitive deficit increases the ability to think in

235    abstract ways. However, MMSE-NR only gives an indication of cognitive deficits regarding

236    the items in that specific test and does not give a complete picture of what the individual

237    person with dementia might struggle with. Higher education is known to postpone cognitive

238    deficits, for example, due to an increased cognitive reserve (Stern, 2012). Highly educated

11

239  people may also be more accustomed to the type of setting that the interview was performed

240  in, which can resemble an exam or a cognitively demanding meeting.

241

242  Although cognitive functioning, age, and education were indicative of higher completion

243  probability, other non-measurable factors may have been influential as well. For instance, in

244  both the ECOD and PADR studies, the LoCB was only one scale among a large test battery

245  that the participants performed. Therefore, low completion rates could also be due to fatigue.

246  Additionally, the uncommon and complicated wording may have been detrimental to

247  comprehension. In general, people with cognitive deficits benefit from concise wording,

248  whereas the items in the LoCB are phrased in a general and sometimes abstract way. Indeed,

249  other studies have reported eliminating items from the scale, in order to increase

250  comprehension and internal reliability (Bright, Kane, Marsh, & Bishop, 2013; Nordtug et al.,

251  2011). Both studies, one with the English version and one with the Norwegian, included

252  cognitively healthy participants, indicating that understanding the meaning of the LoCB items

253  could be problematic in general. Adding a cognitive disability, therefore, seems likely to

254  reduce the comprehension and thereby potentially the completion probability as well.

255

256  However, those who did complete the full scale gave valid answers despite sometimes

257  difficult wording. The internal reliability analysis of the whole scale showed a Cronbach's α

258  of 0.69. This relatively high internal reliability result remained even among those with

259  MMSE-NR scores below 20. In the group with MMSE-NR 10-14 – although applying to only

260  three participants – the Cronbach's α was 0.80. These findings alone should guide researchers

261  and practitioners to remember that a dementia diagnosis is not equal to reduced ability to

262  comprehend complex questions and state valid opinions, as also argued by Wogn-Henriksen

263  (2012).  In her qualitative study on how the person with dementia experience the disease,

264  Wogn-Henriksen (2012) found they showed considerable insight and ability to understand and

265  communicate their experiences. It is thus valuable to try to elicit more knowledge on coping

266  mechanisms in this population, using for example the LoCB. Interestingly, in the group with

267  MMSE-NR 25-27, the Cronbach´s α was 0.52, but statistical analysis did not reveal reasons

268  for this discrepancy.

269

270  In addition to examining indicators for completion and completion rates, a PCA was

271  undertaken to compare the LoCB component structure in a population with dementia with

272  populations without cognitive deficits. The LoCB was found to be multidimensional, with an

273  internal, powerful others, and luck/fate control orientation. Although this is in contrast to

274  findings by its developers (Craig et al., 1984), the defragmentation of the external LoCB is

275  consistent with both empirical and theoretical findings argued by others (Bright et al., 2013;

276  Furnham & Steele, 1993; Johansson et al., 2001; Levenson, 1973; Wallston, Wallston, &

277  DeVellis, 1978). Distinguishing between an external LoC based on powerful others versus

278  luck/fate is valuable, since believing the world to be unordered may lead to chaotic or passive

279  behaviour, whilst those believing in powerful others may still manage to effectively produce

280  wanted outcomes. The distinction is both meaningful and important when trying to understand

281  how people act.

282

283  Finally, we examined if LoCB scores were associated with depressive symptoms or the

284  degree of cognitive impairment. No differences were found regarding the latter, indicating

285  that the degree of impairment does not alter one's LoC orientation. More depressive

286  symptoms, however, were associated with a higher LoCB sum score, and internal and

287  powerful others subscale scores. This resonates with prior research on depressed older people

288  in Norway, where depression was associated with a higher LoCB sum score  (Bjørkløf et al.,

289 2015). This finding further strengthens the notion that the participants in our study who

290 completed the LoCB understood its complex questions, thereby strengthening the

291 applicability of the LoCB for people with dementia.

292

293 The present study has some limitations. The data came from two projects, posing the potential

294 risk of different data collection methods and contextual conditions. The Norwegian version of

295 the LoCB has not been validated, and we therefore only have a small number of comparable

296 results making interpretations difficult. On the other hand, the study is strengthened by the

297 inclusion of participants with dementia from a variety of healthcare services, such as

298 specialist and primary healthcare institutions, minimizing the risk of subgroup effects. The

299 dementia diagnosis was made by experienced physicians, and well-established and validated

300 scales have been used for evaluating cognition and depression. Finally, a major strength

301 regarding the LoCB analyses is the sole use of data sets with complete responses. All 17 items

302 of the original scale were analysed, and no missing items were imputed.

303

304 **Conclusion**

305 Persons with dementia who completed the LoCB scale gave valid answers, and the LoCB sum

306 scores increased with depressive symptoms, as previously shown in populations without

307 dementia. Though older age, more severe cognitive impairment, and a lower level of

308 education increase the risk of non-completion, we argue that the scale is applicable for use

309 among people with dementia and has the potential to help us better understand control

310 orientation in this population. This is valuable information for effectively preventing and

311 treating depression among people with dementia.

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14

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412        Trondheim.
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415 **Tables**

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418  **Table 1**. Demographic and clinical characteristics in groups with and without complete
419  LoCBs.

420

| Characteristics | All (n=534) | Complete LoCB (n=234) | Incomplete LoCB (n=300) | p-value |
|---|---|---|---|---|
| Age, mean (sd) (n=534) | 78.43 (8.1) | 77.3 (SD 8.2) | 79.3 (7.8) | $0.003^1$ |
| Female, n (%) (n=534) | 311 (58.2) | 125 (53.4) | 186 (62.0) | $0.057^2$ |
| Education, <10yrs, n (%) (n=524) | 263 (50.2) | 91 (39.7) | 172 (58.3) | $<0.001^2$ |
| Unmarried, n (%) (n=531) | 242 (45.6) | 102 (44.0) | 140 (46.8) | $0.570^2$ |
| LoCB, mean (sd) (n=234) | N A | 30.8 (10.5) | N A | |
| MMSE-NR, mean (sd) (n=520) | 19.8 (5.6) | 22.2 (3.7) | 17.9 (6.2) | $<0.001^3$ |
| MADRS, mean (sd) (n=483) | 4.6 (5.1) | 4.8 (5.4) | 4.5 (4.8) | $0.672^3$ |
| ADL, mean (sd) (n=417) | 21.0 (6.5) | 19.4 (6.2) | 22.2 (6.4) | $<0.001^3$ |

421  [1] Independent sample t-test   [2] Chi-square test for independence [3] Mann–Whitney test
422  NA=Not applicable

423

424  (LoCB: Locus of Control of Behaviour scale; MADRS: Montgomery–Aasberg Depression
425  Rating scale; MMSE-NR: Mini-Mental Status Examination-Norwegian Revised; I-ADL:
426  Instrumental-Activities of Daily Living scale)

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430 **Table 2**: Completion percentages and internal reliability of LoCB in relation to MMSE-NR

431 score.

| MMSE-NR | Complete LoCB % (N) | Total N | Cronbach's α |
|---|---|---|---|
| 0-4 | 0 | 16 | - |
| 5-9 | 0 | 12 | - |
| 10-14 | 14% (3) | 21 | 0.80 |
| 15-19 | 34% (63) | 185 | 0.73 |
| 20-24 | 55% (101) | 185 | 0.72 |
| 25-27 | 63% (50) | 79 | 0.52 |
| 28-30 | 74% (17) | 23 | 0.72 |
| Total | 234 | 534 | 0.69 |

432
433 (LoCB: Locus of Control of Behaviour scale; MMSE-NR: Mini-Mental Status Examination-
434 Norwegian Revised)
435
436
437

438    **Table 3**: Logistic regression predicting likelihood of LoCB completion.
439

| Variable | Unadjusted | | | Adjusted | | |
|---|---|---|---|---|---|---|
| | OR | 95% C.I. | P-value | OR | 95% C.I. | P-value |
| **Gender** | 1.42 | 1.00-2.01 | 0.046 | 1.21 | 0.73-2.02 | 0.453 |
| **Age** | 0.97 | 0.97-0.99 | 0.003 | 0.96 | 0.93-0.99 | 0.007 |
| **Education** | 2.12 | 1.49-3.01 | <0.001 | 1.59 | 1.01-2.49 | 0.044 |
| **Married** | 1.12 | 0.80-1.58 | 0.512 | | | |
| **MADRS** | 1.01 | 0.98-1.05 | 0.444 | | | |
| **MMSE-NR** | 1.22 | 1.16-1.27 | <0.001 | 1.21 | 1.14-1.29 | <0.001 |
| **I-ADL** | 0.93 | 0.91-0.96 | <0.001 | 1.01 | 0.97-1.05 | 0.732 |

440
441    (LoCB: Locus of Control of Behaviour scale; MADRS: Montgomery–Aasberg Depression
442    Rating scale; MMSE-NR: Mini-Mental Status Examination-Norwegian Revised; I-ADL:
443    Instrumental-Activities of Daily Living scale)
444

445 **Table 4**. Principal component analysis of the LoCB.
446

**Rotated Component Matrix<sup>a</sup>**

| | Component | | |
| --- | --- | --- | --- |
| | Powerful others | Internal | Luck/Fate |
| 12: When I am under stress, the tightness in my muscles is due to things outside my control. | 0.635 | | |
| 15: I understand why my problem(s) varies so much from one occasion to the next. | -0.593 | | |
| 6: My problem(s) will dominate me all my life. | 0.585 | | |
| 11: To continually manage my problems I need professional help. | 0.517 | | |
| 14: It is impossible to control my irregular breathing when I am having difficulties. | 0.506 | | |
| 10: People are victims of circumstances beyond their control. | 0.505 | | 0.428 |
| 4: I can control my problem(s) only if I have outside support. | 0.413 | | |
| 13: I believe a person can really be the master of his fate. | | 0.742 | |
| 8: Becoming a success is a matter of hard work, luck has little or nothing to do with it. | | 0.649 | |
| 16: I am confident of being able to deal successfully with future problems. | | 0.593 | |
| 5: When I make plans, I am almost certain that I can make them work. | | 0.575 | |
| 7: My mistakes and problems are my responsibility to deal with. | | 0.517 | |
| 1: I can anticipate difficulties and take action to avoid them. | | 0.439 | |
| 3: Everyone knows that luck or chance determines one's future. | | | 0.817 |
| 17: In my case maintaining control over my problem(s) is due mostly to luck. | | | 0.728 |
| 2: A great deal of what happens to me is probably just a matter of chance. | | | 0.579 |
| 9: My life is controlled by outside actions and events. | | | 0.528 |
| Eigenvalue | 3.3 | 2.2 | 1.5 |
| Explained variance | 19.3 | 13.0 | 9.0 |
| Cronbach's α | 0.47 | 0.67 | 0.65 |

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.<sup>a</sup>

<sup>a</sup> Rotation converged in 5 iterations.

447  **Table 5:** LoCB sum and subscale scores according to presence of depression.
448

| LoCB | Complete LoCB (n=234) | | |
|---|---|---|---|
| | MADRS | | |
| | ≤7 Mean (SD) | >7 Mean (SD) | P |
| Sum[1] | 28.0 | 38.5 | <0.001 |
| Powerful others[1] | 12.0 | 18.0 | <0.001 |
| Internal[1] | 7.0 | 11.0 | <0.001 |
| Luck/Fate[1] | 8.0 | 9.0 | 0.138 |

449  [1] Mann–Whitney test

450
451  (LoCB: Locus of Control of Behaviour scale; MADRS: Montgomery–Aasberg Depression
452  Rating scale)

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456