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Adherence to COVID-19 Measures:

The Critical Role of Autonomous Motivation on a Short- and Long-Term Basis

Sofie Morbée[1], Branko Vermote[1], Joachim Waterschoot[1], Lisa Dieleman[1], Bart Soenens[1], Omer Van den Bergh[2], Richard M. Ryan[3], Janne Vanhalst[1], Gert-Jan De Muynck[1], and Maarten Vansteenkiste[1]

[1] Department of Developmental, Personality and Social Psychology, Ghent University

[2] Department of Health Psychology, Catholic University Leuven

[3] Institute for Positive Psychology and Education, Australian Catholic University

Author Note

Correspondence concerning this article should be addressed to Sofie Morbée, Department of developmental, personality and social psychology, Ghent University, Henri Dunantlaan 2, 9000 Ghent, Belgium. Email: Sofie.Morbee@UGent.be.

27   **Abstract**

28   To limit the spreading of the SARS-CoV-2-virus, governments worldwide have introduced behavioral

29   measures that require considerable effort from their citizens to adhere to. Grounded in Self-

30   Determination Theory, the present research sought to examine in a study among Belgian citizens the

31   cross-sectional (total N=45975, M_{age}=50.42), week-to-week (subsample 1; N=981, M_{age}=41.32), and

32   long-term (subsample 2; N=5643, M_{age}=53.09) associations between various individual motives to

33   follow government guidelines and their self-reported adherence to these measures. Controlling for

34   COVID-specific concerns and perceived risk for infection, autonomous motivation related positively

35   to citizens' concurrent adherence (total sample), their increased week-to-week adherence during

36   the lockdown (subsample 1), and their persistent adherence during an exit phase (subsample 2).

37   Introjected regulation and external regulation were positively and negatively associated with

38   concurrent adherence, respectively, but had no long-term predictive value. The findings indicate that

39   citizens' autonomous motivation is a robust predictor of adherence, suggesting that politicians,

40   policymakers, and experts do well to adopt a communication style that ongoingly fosters

41   autonomous motivation.

42   *Keywords:* COVID-19, Motivation, Self-Determination Theory, Adherence

43   Containing the COVID-19 pandemic critically relies on the behavior of the population. Most

44   governments have therefore imposed invasive and long-lasting behavioral measures that interfered

45   with individuals' daily routines and placed substantial constraints on their autonomy. This implies a

46   huge motivational challenge for individuals to keep following the much-needed behavioral measures

47   aimed at containing the spread of the coronavirus. Recruiting citizens' motivation is therefore

48   paramount to facilitate the adoption of new behaviors and foster adherence to these health-based

49   measures (Radel et al., 2017).

50   A motivational theory that has garnered increasing interest in health care and behavior

51   change is Self-Determination Theory (SDT; Ng et al., 2012; Ntoumanis et al., 2020). Within SDT, a

52   distinction is made between fully internalized (or autonomous) and poorly internalized (or externally

53   controlled) types of motivation (Ryan & Deci, 2020). Autonomous motivation occurs when citizens

54   perceive the measures as relevant and congruent with their personal values (e.g., solidarity, health).

55   Importantly, also imposed measures (e.g., by the government) can be internalized if one can identify

56   with their necessity and meaning. However, collective measures can also be experienced as

57   pressuring demands. In that case, citizens follow the measures to avoid a sanction, that is, they

58   display external regulation. In this case, adhering to the measures is typically dependent on the

59   salience of external contingencies. A third type involves introjected regulation, which is in-between

60   autonomous and external regulation: citizens follow the measures, for instance, to avoid guilt or

61   shame or to show that they act as dutiful citizens. Such introjected motives are partially internalized,

62   that is, they are less self-alienating than in the case of external regulation but not as volitional as in

63   the case of autonomous motivation.

64   Studies in diverse life domains underscore the importance of fostering autonomous

65   motivation, demonstrating its positive effects on well-being, persistence, and performance (e.g., Ng

66   et al., 2012; Ntoumanis et al., 2020). Concerning adherence, more autonomous motivation predicts

67   greater persistence and a lower risk of drop-out among athletes (Sarrazin et al., 2002) and students

68   (Vallerand et al., 1997; Vansteenkiste et al., 2005), more consistent intake of prescribed medications

69   (Williams et al., 1998), and greater care of dental hygiene (Halvari & Halvari, 2006). In addition,

70   autonomous motivation is associated with greater transfer to different contexts (Hagger &

71   Chatzisarantis, 2016), suggesting that adherence to lockdown measures might generalize to

72   adherence to other measures during an exit phase.

73   Although many studies within SDT have demonstrated that autonomous motivation predicts

74   maintained behavior, the current manuscript is unique because of (a) the type of studied behavior,

75   (b) the broader context which may alter the predictive validity of the motives observed in other

76   studies, and (c) the design. First, much of the work within SDT has studied the dynamics involved in

77   intrinsically motivating activities or activities for which intrinsic motivation constitutes one of the

78   multiple reasons for activity engagement (e.g. sports, learning activities). Yet, following measures or

79   adhering to rules is an activity where intrinsic motivation is notably absent. Although a broad range

80   of studies focused on the internalization of "uninteresting" activities, such as paying taxes (Sheldon

81   et al., 2005) or voting (Losier & Koestner, 1999), as well as on the acceptance of "uninteresting"

82   measures, such as rules at school (e.g. Aelterman et al., 2019) and at home (Vansteenkiste et al.,

83   2014), the internalization of the COVID-19 rules may be more hindered because of their drastic and

84   intrusive nature. Indeed, some of the measures are not only inconvenient (e.g. wearing a mouth

85   mask), but even go against our natural inclinations. For example, the measure to limit social contacts

86   goes against our basic psychological need for relatedness. Also, these decisions were made top-

87   down, with little, if any input or voice by citizens. Because of their intrusive nature and their top-

88   down introduction, these measures are also strongly opposed to other autonomous motives,

89   thereby requiring a thorough rearrangement of our lifestyle. Moreover, although motives underlying

90   the exhibit of health-related behaviors have been well studied, many of these have been focused on

91   specific clinical subgroups (e.g., patients with schizophrenia [Vancampfort et al., 2013]; adult

92   outpatients [Williams et al., 1998]; obese individuals [Williams et al., 1996]). This is one of the first

93   studies in which the motivational basis of health behaviors that have broad social relevance is

94   considered. Also, while many of the health-related behaviors studied in previous research are

95 relevant to the individual (e.g., individual therapy compliance, being more physically active), in the

96 COVID-19 context, these health behaviors also have manifest interpersonal consequences (i.e., you

97 may infect or protect others). These social consequences might make it easier to internalize the

98 measures, but they might also make the measures more morally charged, bringing introjection

99 closer to autonomous motivation on the SDT-continuum. The question, therefore, is whether the

100 earlier obtained effects of introjection and autonomous motivation would by definition generalize to

101 the COVID-19 context. Moreover, external regulation may have a somewhat different effect in the

102 current context because the punishments (e.g., high fines for non-compliance with corona

103 measures) have high informational value (Mulder, 2008), signaling that adherence to the required

104 sanitary behaviors is of utmost importance to protect others. Third, the current study is unique from

105 a methodological perspective as it contains a series of studies, addressing the motivational dynamics

106 concurrently and over time, at the between- and within-person level. The majority of prior SDT-

107 studies were cross-sectional and focused on between-person differences only (see meta-analysis by

108 Ng et al., 2012).

109   Although researchers did try to explain adherence to the COVID-19 measures by using other

110 theories such as the Protection Motivation Theory (e.g., van Loenhout et al., 2021) or personality

111 theories (Krupić et al., 2021), to our knowledge, there are no published studies that consider the

112 different SDT-based types of motivation as predictors of adherence in the same systematic way as is

113 the case in the presented package of studies in our contribution. However, two SDT-based studies

114 explored the role of autonomous and controlled motivation in the prediction of adherence to one

115 specific COVID-19 measure each, that is the measure to stay at home (Legate & Weinstein, 2021)

116 and the prohibition of social gatherings during the holiday season (Guay et al., 2021). The study of

117 Legate and Weinstein (2021) showed that increases in autonomous motivation over time predicted

118 actual time spent at home, while increases in controlled motivation did not contribute. Similarly, rule

119 compliance in the study of Guay and colleagues (2021) was predicted positively by autonomous

120 motivation, while controlled-approach motivation was not a significant predictor. However,

121 adherence was negatively predicted by controlled-avoidance motivation.

122   Grounded in SDT (Ryan & Deci, 2017), the present research examined whether different

123 types of motivation would differentially predict adherence to the behavioral measures to contain

124 virus spreading, both concurrently (main sample), from week to week (subsample 1), and over time

125 when the lockdown was released and an exit phase had commenced (subsample 2). Understanding

126 which types of motivation are predictive of adherence is of critical importance because policymakers

127 can then adjust their communication strategy to promote desirable types of motivation among

128 citizens (Martela et al., 2021). In doing so, we controlled for the role of citizens' corona-related

129 concerns (in all samples) and their perceived risk of infection (in subsample 2), as concerns (Durazo

130 & Cameron, 2019) and perceived risk (Sidebottom et al., 2018) were found to predict greater

131 adherence in other health care domains. All procedures were approved by the ethics committee of

132 our faculty (№ 2020/37).

133   **Main Sample: Concurrent Associations**

134 Within a cross-sectional sample, we hypothesized that autonomous motivation would be positively

135 related to adherence, whereas external regulation was expected to yield a negative correlation.

136 Finally, we expected that introjected regulation would be positively associated with adherence, but

137 less robustly compared to autonomous motivation.

138 **Method**

139 *Procedure and Sample*

140   On February 3rd, 2020, a first infection with the SARS-CoV-2 virus was detected in Belgium.

141 As the situation escalated, on March 17th it was decided by the government to declare a lockdown

142 (e.g., avoid contact with the outside world), starting the afternoon of March 18th. Beginning March

143 19th and continuing until June 7th, 2020, an online survey was conducted among Belgian citizens.

144 Participants were recruited through a paid advertising campaign on Facebook, as well as by

145 contacting different organizations (e.g., cultural associations) and media (e.g., online newspapers).

146 After completing an online informed consent form, a total cross-sectional sample of 45975 citizens

147   (71.3% female; M_{age} = 50.42, range = 18–100 years) participated in this survey. No power calculation

148   was performed given the large sample that was collected. Of these participants, 23.2% reported

149   having one or more chronic diseases, placing them at greater risk for negative effects from COVID-

150   19. One-third (32.4%) reported not having a life partner. Finally, 38% did not attend higher

151   education, 38.9% had a bachelor's degree, and 23.1% had a master's degree.

152   ***Materials***

153   **Motivation to Adhere.** People's motivation to adhere to the corona measures was assessed

154   with an adapted version of the Behavioral Regulation in Sport Questionnaire (Lonsdale et al., 2008).

155   After the stem "Over the past week, I've adhered to these measures because", people answered to

156   items for autonomous motivation (4 items; three items measured identified regulation, e.g.,

157   "…because I find it personally relevant"; and one item measured integrated regulation, e.g.,

158   "because these are an expression of my personal values"), introjected regulation (3 items; e.g., "…I

159   would feel ashamed if I didn't"), and external regulation (3 items; e.g., "…I feel compelled to do so").

160   Items were rated on a 5-point scale ranging from 1 (*not at all true*) to 5 (*totally true*). To shorten the

161   questionnaire, it was decided on May 4 to remove the items assessing introjected regulation,

162   resulting in a subsample of 24966 people with data on this type of motivation. Internal consistencies

163   were as follows: $\alpha_{autonomous}$ = .82, $\alpha_{introjected}$ = .62, and $\alpha_{external}$ = .75.

164   **Concerns.** Three items were developed to assess people's COVID-specific concerns.

165   Following the stem "In the past week during the corona crisis…", participants were asked to indicate

166   their concerns (e.g., "I was concerned about…") regarding their health, financial situation, and how

167   the situation would evolve. Each item was rated on a scale ranging from 1 (*not at all true*) to 5

168   (*totally true*). Internal consistency was α = .56.

169   **Adherence to the Measures.** People's self-reported adherence was assessed with one item

170   for each of the four most important corona measures introduced in Belgium, that is, "to wash your

171   hands frequently", "to make only essential transfers (e.g., food stores, doctor)", "to avoid contact

172   with the outside world as much as possible", and "to maintain physical distance from others".

173 Participants were asked to indicate on a scale ranging from 1 (*I don't adhere to it at all)* to 5 (*I totally*

174 *adhere to it*) the extent to which they followed each of the four measures. Internal consistency was

175 α = .75.

Results

177 *Preliminary Analyses*

178 Bivariate Pearson-correlations indicated an ordered pattern of correlations between the

179 motivation subtypes and adherence, with the correlations becoming decreasingly positive as one

180 moves along the continuum from autonomous motivation to external regulation (Table 1).

181 Moreover, introjected regulation correlated more strongly with autonomous motivation than with

182 external regulation.

183 *Primary Analyses*

184 To identify the unique contribution of the three different types of motivation to adherence,

185 structural equation modeling (SEM) with latent variables and observed indicators was conducted,

186 using the robust MLR estimator in Mplus (Muthén & Muthén, 1998-2012). All predictors were

187 allowed to correlate, whereas the residuals were not correlated. Background characteristics,

188 autonomous motivation, introjection, external regulation, and corona-specific concerns were

189 simultaneously inserted as predictors (Figure 1). This structural model showed acceptable model fit

190 model (χ^2(221) = 20909.10, p < .001, RMSEA = 0.05, CFI = .88, SRMR = 0.06) (Hu & Bentler, 1999).

191 Results indicated that autonomous motivation was uniquely and positively related to adherence,

192 whereas the unique relation for external regulation was negative. Unique relations for introjected

193 regulation fell in between. The effect size of this model (R^2 = .39) should be interpreted as large

194 (Cohen, 1988).

Brief Discussion

196 More internalized forms of motivation related to greater adherence to the behavioral

197 measures, with autonomous motivation being the strongest positive predictor and external

198 regulation being negatively related.

199 **Subsample 1: Week-to-Week Associations**

200   The cross-sectional analyses for the total sample did not allow to investigate whether

201 variation in individuals' motivation would predict variation in adherence over time. Therefore, a

202 subsample was followed up for 10 consecutive weeks to re-address our key hypothesis at both the

203 between- and within-person levels. We expected that within- and between-person differences in

204 motivational regulation would relate to within- and between-person differences in adherence. To

205 illustrate: individuals who were higher on autonomous motivation relative to other people across

206 these 10 weeks were expected to display more overall adherence than people scoring lower on

207 autonomous motivation (i.e., between-person). In addition, individuals were expected to display

208 more adherence during weeks in which their autonomous motivation was elevated (relative to their

209 own baseline) (i.e., within-person). Further, we examined whether variations in motivational

210 subtypes predict changes in adherence during the subsequent week.

211 **Method**

212 *Procedure and Sample*

213   Of the broader sample gathered in the first week of the study (N=3284), a subsample

214 (41.63%) gave informed consent for a weekly follow-up assessment allowing for a longitudinal part

215 of the study (N = 1367; 76.8 % female; M_{age} = 39.64, range = 18–82 years). Ten data waves were

216 collected and participants could decide each week if they wanted to continue participating in the

217 survey. Of this subsample, 61.1% participated on T2, 54.7% on T3, 52.8% on T4, 47.1% on T5, 46% on

218 T6 assessment, 42.8% on T7, 35.3% on T8, 37.2% on T9, and 36.6% on T10. Participants were only

219 included in the data analysis if they participated twice or more. The final sample included 986

220 participants (76.3% female; M_{age} = 41.28, range = 18–82 years). From the final sample, 14.7%

221 reported having one or more chronic diseases. One-third (34.3%) reported not having a life partner.

222 Regarding educational status, 17.5% did not attend higher education, 37.1% had a bachelor's

223 degree, and 45.3% had a master's degree. Drop-out analyses indicated that participants who

224 participated twice or more were more likely to be older (OR = 1.03, $p \leq .001$). No differences in

225   motivation or adherence to the measures were found.

226   ***Materials***

227   The same questionnaires were used across ten weeks. The average internal consistency

228   during ten waves was α=.80 (ranging from $α_{wave1}$=.72 to $α_{wave9}$=.85) for autonomous motivation,

229   α=.70 (ranging from $α_{wave1}$=.51 to $α_{wave9\&10}$=.78) for introjected regulation, α=.82 (ranging from

230    $α_{wave1}$=.76 to $α_{wave5}$=.84) for external regulation, α=.57 (ranging from $α_{wave1}$=.52 to $α_{wave10}$=.62) for

231   concerns, and α=.67 (ranging from $α_{wave1\&3}$=.57 to $α_{wave7\&9}$=.74) for adherence.

232   **Results**

233   ***Preliminary Analyses***

234   Bivariate Pearson-correlations showed the same patterns between the regulation types and

235   adherence as in the total sample, both at between- and within-person level (Table 2).

236   ***Primary Analyses***

237   Using the MLR-estimator in the lavaan-package in R (Rosseel, 2012), multilevel modeling

238   with latent factors and observed indicators was conducted, to address the nested structure of the

239   data in which the ten waves represented the within-person level (level 1) which were nested within

240   participants, representing the between-person level (level 2). As the lavaan-package automatically

241   separates the within and between components of the level 1 variables, there was no need to center

242   the variables. The predictors were allowed to correlate, whereas the residuals were not correlated.

243   To examine whether there was significant variability in the weekly variables, we estimated intercept-

244   only models, which allow for an estimation of intraclass correlations (ICC). The ICCs indicated that for

245   each study variable, about half of the variance was situated at the within-person level (Table 2).

246   To test whether within- and between-person differences in motivational regulation related

247   to within- and between-person differences in adherence, the three regulation types were

248   simultaneously entered as predictors (both on the within- and between-person level) while

249   controlling for relevant background characteristics and corona-specific concerns. The model fit was

250   acceptable ($χ^2$(314) = 1828.59, $p < .001$, RMSEA = 0.03, CFI = .92, $SRMR_{within}$ = 0.02 – $SMR_{between}$ = .09)

251   (Hu & Bentler, 1999). The within-person associations indicated that weekly variation in autonomous

252   motivation and introjected regulation related positively to the weekly variation in adherence. On the

253   between-person level, autonomous motivation related positively to adherence, whereas external

254   regulation was negatively related (Table 3, Model 1). The effect size at the within-person level

255   (R^2=.22) should be interpreted as medium and the effect size at the between-person level (R^2=.35)

256   should be interpreted as large (Cohen, 1988).

257   To examine the predictive role of motivation over time, we conducted similar models in

258   which the regulation types on a given week (week x) predicted adherence during the subsequent

259   week (week x+1). Because it was not possible to predict adherence during the week following the

260   tenth week, these analyses were based on a truncated dataset (i.e., nine weeks). The model fit was

261   acceptable (χ^2(314) = 1616.27, $p < .001$, RMSEA = 0.03, CFI = .91, SRMR$_{within}$ = 0.02 – SMR$_{between}$ = .09)

262   (Hu & Bentler, 1999). When predicting adherence during the subsequent week, the predictive value

263   of autonomous motivation as seen in the first model remained significant, whereas introjected

264   regulation (as seen at the within-person level) and external regulation (as seen at the between-

265   person level) were no longer significant (Table 3, Model 2). The effect size at the within-person level

266   (R^2=.19) should be interpreted as medium and the effect size at the between-person level (R^2=.34)

267   should be interpreted as large (Cohen, 1988).

268   **Brief Discussion**

269   The results of this week-to-week analysis confirmed and extended the cross-sectional results

270   in various ways. First, between-person differences in autonomous motivation related positively to

271   adherence across the lockdown, whereas between-person differences in external regulation related

272   negatively to adherence. Second, regarding week-to-week variations, adherence was peaking in

273   weeks when autonomous motivation and introjected regulation peaked. Importantly, only the

274   benefits of autonomous motivation were found to last over time.

275   **Subsample 2: Long-term benefits for adherence**

276   A second subsample that was followed up over time allowed us to build on previous analyses

277 in two important ways. First, the findings reported so far applied to the lockdown phase. The

278 question can be raised whether the observed effects of autonomous motivation extend into an exit

279 phase during which individuals' self-control to comply with the measures might be increasingly

280 challenged. For example, social distance is fairly easy when nobody is out on the streets. Yet, when

281 public life gradually resumes, it may be far more effortful to remain compliant with the measures. A

282 second novel aspect is that we aim to test the role of motivation even more conservatively by taking

283 into account citizens' perceived personal and collective risk of infection. Perceived risk is related to,

284 yet distinct from, concerns (Sjöberg, 1998). Whereas the tendency to be concerned is rooted in

285 dispositional negativity and may involve disproportional concerns (Shackman et al., 2016), perceived

286 risk may reflect an appropriate assessment of the situation in the corona crisis.

287 We expected that autonomous motivation, as assessed during the lockdown phase, would

288 predict an increase in adherence during the exit phase. An opposite pattern of associations was

289 expected for external regulation. In a more conservative set of analyses, we controlled for

290 adherence and COVID-specific concerns during the lockdown, as well as for the perceived personal

291 and collective risk of infection during the exit phase.

292 **Method**

293 ***Procedure and Sample***

294 Of the total sample participating in the cross-sectional assessment during the lockdown

295 period, a subsample of 11649 (25.33%) participants was invited to complete a questionnaire during

296 the exit phase. Of this group, 5643 (48.44%) participants gave their informed consent to participate

297 and completed a second questionnaire between July 11 and August 3, 2020, at a moment when

298 government measures were gradually being relaxed. Drop-out analyses indicated that participants

299 who participated during the exit phase were more likely to be older (OR = 1.03, p<.001), whereas

300 participants who dropped out were more likely to possess a bachelor's degree (OR = .84, p<.001) or

301 to not have a higher education diploma (OR =.71, p<.001). No differences in scores on motivational

302 regulations and adherence were present. There were on average 82 days (range = 30–133 days)

303   between completing the questionnaire during the lockdown period and completing the

304   questionnaire during the exit phase. The sample that completed both questionnaires consisted of

305   70.4% women and had an average age of 53.09 years (range=18–89 years). A minority of 27%

306   reported having one or more chronic diseases. One-third (32.7%) reported not having a life partner.

307   Regarding educational level, 32.4% did not attend higher education, 40% had a bachelor's degree,

308   and 27.7% had a master's degree.

309   ***Materials***

310   　　During the lockdown phase, participants answered the previously described questionnaires

311   that assessed adherence to the measures (4 items, α=.72), autonomous motivation (4 items, α=.82),

312   introjected regulation (3 items, α=.61), external regulation (3 items, α=.75), and COVID-specific

313   concerns (3 items, α=.58). In addition, during the exit phase, the following two concepts were

314   assessed.

315   　　**Adherence to the Measures.** People's adherence was assessed with one item for each of the

316   four most important measures during the exit phase in Belgium. Two measures were the same as

317   during the lockdown, that is, "to wash your hands frequently" and "to maintain physical distance

318   from others". Two other measures differed from those during the lockdown, that is, "to wear a

319   mouth mask when required or recommended" and "to limit social contacts to the maximum number

320   of persons allowed". Participants indicated on a scale ranging from 1 (*I don't adhere to it at all)* to 5

321   (*I totally adhere to it*) the extent to which they followed each of the four measures. Internal

322   consistency was α=.72.

323   　　**Perceived Risk***.* Participants' perceived personal and collective risk of infection during the

324   exit phase was calculated by multiplying the perceived probability of infection by its perceived

325   severity (Wolff et al., 2019). Personal probability and severity were assessed with one item each,

326   that is, "What are your chances of getting infected with the coronavirus in the near future?" and "If

327   you were infected with the coronavirus, how serious do you think the consequences would be?".

328   Similarly, collective probability and severity were assessed with one item each: "How high do you

329   estimate the risk of coronavirus infection for the general population?" and "How seriously do you

330   assess the consequences of a coronavirus infection for the population in general?". Each probability

331   item was rated on a scale ranging from 1 (*very small*) to 5 (*very big*), while the severity items were

332   rated on a scale ranging from 1 (*not at all serious*) to 5 (*very serious*). Finally, the 25-point scale

333   created by multiplying the two concepts was re-scaled to a five-point scale.

334   **Results**

335   *Preliminary Analyses*

336   Bivariate Pearson-correlations (Table 6) indicated that autonomous motivation was strongly

337   and positively correlated with continuing adherence during the exit phase, while the correlations for

338   introjected and external regulation were positive and negative, respectively.

339   *Primary Analyses*

340   To identify the unique contribution of the motivational types during the lockdown period in

341   the prediction of people's adherence during the exit phase, structural equation modeling with latent

342   variables and observed indicators was performed, using the robust MLR estimator in Mplus (Muthén

343   & Muthén, 1998-2012). All predictors were allowed to correlate, whereas the residuals were not

344   correlated. Autonomous motivation, introjection, and external regulation during the lockdown

345   period were inserted simultaneously as predictors. Thereby we controlled for relevant background

346   characteristics, adherence, corona-specific concerns during the lockdown period, and perceived

347   personal and collective risk of infection during the exit phase to examine whether the initial

348   contribution of the different motivational subtypes would remain significant (Figure 2). This

349   structural model showed acceptable model fit ($\chi^2(354)=6042.24$, *p*<.001, RMSEA=0.06, CFI=.82,

350   SRMR=0.08) (Hu & Bentler, 1999). Results indicated that autonomous motivation during the

351   lockdown was uniquely and positively related to adherence during the exit phase. No significant

352   relation was found for introjected regulation or external regulation. The effect size of this model

353   (R^2=.49) should be interpreted as large (Cohen, 1988).

354   **Brief Discussion**

355   In this subsample, we examined how motivation, alongside corona-related concerns and risk

356   perceptions predicted continued adherence in the exit phase, during which the government relaxed

357   the behavioral measures. Autonomous motivation related to greater continued adherence to the

358   measures, whereas introjected and external regulation were no longer predictive.

359   **General Discussion and Conclusion**

360   In three series of analyses, we sought to examine how different motivational types for

361   following corona-related measures differentially predict individuals' adherence to these measures.

362   Finding out whether some motivational types are more critical than others in the adherence of the

363   governmentally imposed measures is of vital importance from a prevention perspective because

364   these findings can directly inform policymakers and scientists to adjust their communication pattern

365   to foster the motivation that carries the most positive predictive validity. It is also of scientific

366   interest since it puts to the test in a real-world context some fundamental SDT-assumptions (Ryan &

367   Deci, 2017).

368   **Type of Motivation Matters**

369   Although the motivation to adhere to corona-related measures was critical to contain virus

370   spreading, not all types of motivation are created equal (Vansteenkiste et al., 2006). As predicted

371   within SDT, individuals who experienced greater ownership of governmental measures showed

372   greater adherence and reported less erosion of adherence over time. The pattern of correlates for

373   introjected regulation was similar, yet, less pronounced and less consistent across time. On the other

374   hand, individuals who experienced more external pressure to stick to the measures reported being

375   less adherent. This finding suggests that being motivated via external regulation may backfire,

376   driving individuals away from what is needed (Van Petegem et al., 2015).

377   The effects of different types of motivation were not only observed at the between-person

378   level but also at the within-person level. As the situation quickly shifted on a week-to-week basis,

379   with new measures being introduced and others being relaxed, it is logical that individuals'

380   motivation underwent ups and downs. Across a 10-week period, a large portion of the variance was

381   situated at the within-person level. During weeks that autonomous motivation peaked, individuals

382   reported being more adherent. Likewise, people were more adherent in weeks they reported more

383   introjection. In contrast to introjection, autonomous motivation at one moment was able to predict

384   adherence in the subsequent week and the exit phase. Introjection did not have such lasting effects,

385   demonstrating that introjection can work temporarily, but is less effective in inducing persistent

386   adherence. The fact that autonomous motivation, the strongest predictor of adherence, waxes and

387   wanes across time highlights the importance of persistent communication to support internalization

388   (see Martela et al., 2021 for key communication guidelines).

389   A number of mechanisms may explain the persistence benefits of autonomous forms of

390   motivation. First, individuals displaying more autonomous motivation may expose themselves less to

391   situations that might seduce them to transgress the rules. To illustrate, those high in autonomous

392   motivation may simply have decided not to extend their social network when it was allowed, making

393   adherence more likely. Second, those with more internalized motives may have been less depleted

394   by their continuous adherence. Evidence suggests that volitional behavior is less depleting than

395   controlled actions (Moller et al., 2006). When people feel that they *have to* control themselves, their

396   self-control is more likely to fall apart because of its demanding nature compared to when they *want*

397   to engage in self-control because they understand its importance (Muraven, et al., 2008). Third,

398   when facing difficulty in adhering to the measures, autonomously motivated individuals may have

399   mobilized more adaptive coping mechanisms, such as seeking social support or rehearsing the

400   rationale for the imposed regulations (Smith et al., 2011). Therefore, they could perhaps more easily

401   comply with the imposed measures.

402   However, we would like to add a nuance here. Although people could identify with the self-

403   importance of adhering to the measure, for instance, to protect their own health, this identification

404   may remain relatively isolated and fails to get deeply integrated. Within Organismic Integration

405   Theory (Ryan et al., 2021), horizontal and vertical aspects of integration are distinguished.

406   Horizontally, integration implies the experience of harmony between different roles and identifies.

407   Clearly, during the first lockdown, several people experienced a lack of harmony or even conflict

408   between different roles. Parents had to take care of the children at home, engage in telework, and

409   stick to the measures. Although they may identify with the importance of each of these roles, they

410   may not necessarily be synthesized. With flexibility allowed by different companies, some parents

411   were better capable to coordinate these different roles. This example suggests that although one

412   may see the value of the measures, adhering to the measures in a consequent way also had

413   implications for other roles. In terms of vertical integration, some individuals may identify with the

414   self-importance of the measures in a more shallow way, thereby primarily seeing the benefit for

415   themselves (e.g., protecting their own health). Yet, a deep anchoring of the measures requires a

416   stronger foundation, with the measures being perceived as useful for attaining key life values, such

417   as taking care of others and contributing to the community.

418   **Limitations**

419   Our access to a large sample with multiple measurement points allowed for a detailed and

420   varied set of analyses. However, a major limitation is the use of a survey methodology, which was

421   not accompanied by behavioral observations. Studies of adherence are most compelling when they

422   can tie results to objective outcomes. In this case, outcomes such as travel tracked via GPS, or

423   observations of mask use would improve the quality of assessment. A second limitation is the non-

424   probability sampling method. Although a representative sample was less critical in this study

425   because we did not aim to report the prevalence, the observed relations might have been partially

426   influenced by a biased sample. Third, to keep the length of the questionnaire feasible, choices had to

427   be made in terms of the variables surveyed. Because it was less relevant to question amotivation in

428   the early stages of the lockdown, the decision to include this variable was taken one month after the

429   start of the survey. This resulted in a limited sample of participants who had reported on all

430   predictors simultaneously, which is why we chose not to include amotivation in our primary analyses

431   (see supplemental material for additional analyses with amotivation on a subsample of participants).

432   Similarly, it would have been interesting to split introjected regulation into its approach and

433 avoidance forms (Assor et al., 2009), as introjection approach regulation may yield somewhat more

434 beneficial effects because of its more volitional nature compared to introjection avoidance

435 regulation. Assessing both subcomponents with a more extensive set of items would have allowed

436 us to split both subtypes to examine their differential predictive validity. Finally, this study took place

437 exclusively within Belgium. Governments and cultures around the world vary in terms of regulatory

438 and communicatory practices and citizens' perceptions of trust and legitimacy. Accordingly,

439 generalizing results across nations should be done with caution.

440 **Implications**

441 The findings point to the importance of ownership around imposed measures. Accordingly,

442 fostering internalization can be a focus for health policy and messaging. A growing literature within

443 SDT is detailing strategies to foster greater internalization (e.g., Gillison et al., 2019; Martela et al.,

444 2021). For instance, it is essential to offer a solid rationale for the measures to legitimize its

445 introduction and maintenance in light of the changing situation. As the crisis lasts, politicians could

446 empathize more with the increased effort required from citizens and continue to model the required

447 behavior. Fostering corona awareness by communicating about the personal and collective risks may

448 help citizens to more fully endorse the decision to persist in their efforts. Because motivating

449 communication by the government may not suffice for those high in external regulation, health care

450 workers may need to engage in one-to-one interactions thereby making use of principles of

451 motivational interviewing (Vansteenkiste & Sheldon, 2006) to foster greater autonomous

452 motivation.

453 **Author Contributions**

454   S. Morbée, B. Vermote, J. Waterschoot and M. Vansteenkiste developed the study concept

455 and collected data. S. Morbée, L. Dieleman, J. Vanhalst, and G. J. De Muynck performed data analysis

456 and interpretation under supervision of O. Van den Bergh and M. Vansteenkiste. S. Morbée drafted

457 the manuscript, and all co-authors provided critical revisions. All authors approved the final version

458 of the manuscript for submission.

459 **Conflicts of Interest**

460   Declarations of interest: none

461 **Ethical Principles**

462   The authors have complied with the APA ethical standards in the treatment of their sample.

463 **Data Availability Statement**

464   The deidentified participant data that support the findings of this study are available from

465 the corresponding author Sofie Morbée (Sofie.Morbee@UGent.be) upon reasonable request.

466

467

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MOTIVATION AND ADHERENCE

Figure 1

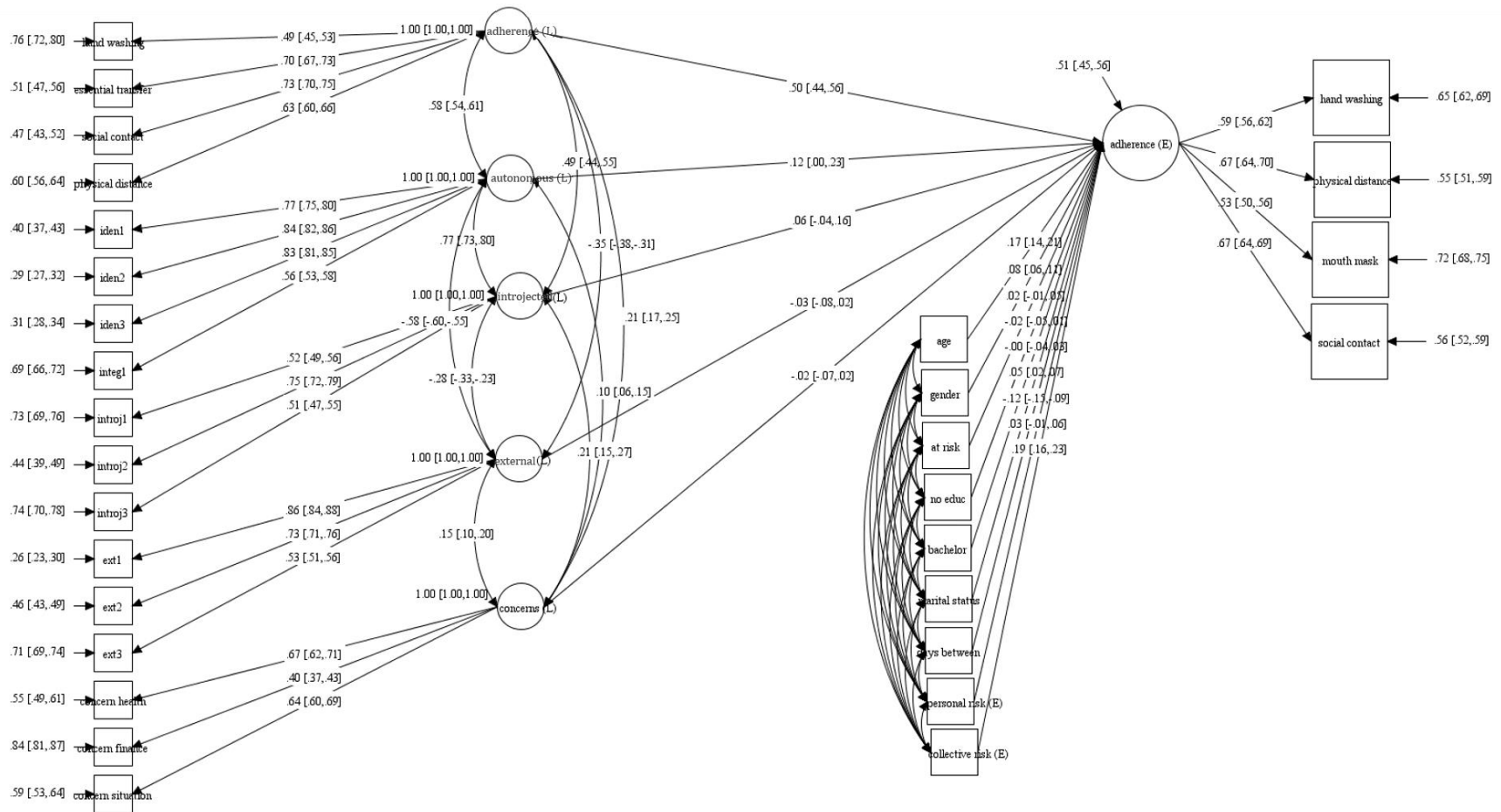*Adherence Predicted by Behavioral Regulations and Corona-Specific Concerns (Main Sample)*
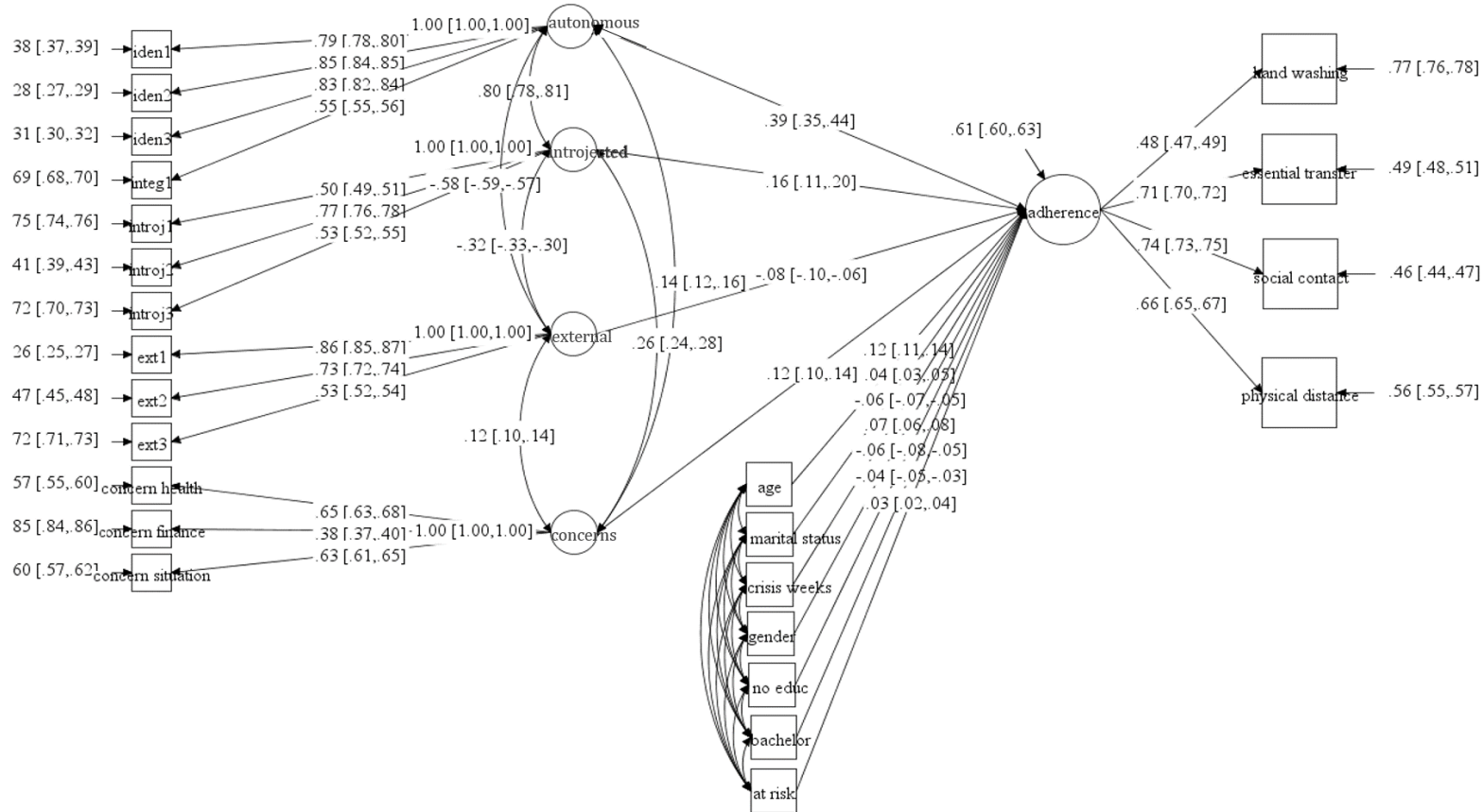
Note. Marital status = life partner vs single; gender = women vs men; no educ = no higher education vs other educational levels; bachelor = bachelor's degree vs other educational levels; at-risk = one or more COVID-related risk factors vs none.

Note. Estimates are standardized.

MOTIVATION AND ADHERENCE

Figure 2

Adherence during the Exit Phase predicted by Behavioral Regulations, Concerns, Risk Perception, and Adherence during lockdown phase (Subsample 2)

Note. Gender = women vs men; at-risk = one or more COVID-related risk factors vs none; no educ = no higher education vs other educational levels; bachelor = bachelor's degree vs other educational levels; marital status = life partner vs single; days between = days between two assessments; (L) = during lockdown phase; (E) = during exit phase. *Note.* Estimates are standardized.

MOTIVATION AND ADHERENCE

Table 1

Bivariate Pearson Correlations between the Latent Study Variables and Background Characteristics (Main Sample)

Variable	*M*	*SD*	1	2	3	4	5	6
1. Autonomous motivation	4.02	.80						
2. Introjected regulation	3.53	.88	.79[*]					
3. External regulation	2.29	.94	-.58[*]	-.31[*]				
4. Concerns	3.07	.81	.14[*]	.26[*]	.12[*]			
5. Adherence	4.42	.59	.61[*]	.55[*]	-.37[*]	.21[*]		

[*]*p*≤.001.

Table 2

Means, Standard Deviations, Intra-Class Correlations, and Within-Person and Between-Person Correlations Between the Variables of Interest (Subsample 1)

Variable	*M*	*SD*	ICC	1	2	3	4	5
1. Autonomous motivation	4.22	.68	.41 - .61		.69	-.38	.24	.42
2. Introjected regulation	3.36	.91	.47 - .62	.48		-.02	.23	.36
3. External regulation	2.36	.95	.56 - .58	-.49	.16		-.10	-.18
4. Concerns	2.88	.80	.54 - .73	-.11	.21	.37		.20
5. Adherence	4.47	.51	.33 - .61	.54	.26	-.35	.00	

Note. Between-person correlations are presented below the diagonal, within-person correlations are presented above the diagonal.

MOTIVATION AND ADHERENCE

Table 3

Results of MSEM Predicting Concurrent and Subsequent Adherence by Behavioral Regulations and

Corona-Specific Concerns (Subsample 1)

Variable	Adherence	
	Model 1 Concurrent adherence (wave x) β (*SE*)	Model 2 Subsequent adherence (wave x+1) β (*SE*)
Person-level background variables		
Age	.17 (.00)***	.16 (.00)**
Gender[1]	.01 (.02)	.02 (.03)
COVID-related risk factors[2]	.00 03)	.01 (.03)
Partner[3]	.06 (.02)	.08 (.02)
Educational level (D1)	-.04 (.03)	-.01 (.03)
Educational level (D2)	-.07 (.02)	-.05 (.02)
Person-level predictors		
Autonomous motivation	.47 (.06)***	.54 (.06)***
Introjected regulation	.05 (.02)	-.02 (.03)
External regulation	-.12 (.02)*	-.06 (.02)
Concerns	.13 (.03)**	.12 (.03)*
Within-level predictors (wave x)		
Autonomous motivation	.30 (.04)***	.32 (.05)***
Introjected regulation	.13 (.04)*	.03 (.05)
External regulation	-.06 (.01)	-.06 (.01)
Concerns	.11 (.01)**	.17 (.02)***
$R^2_{between}$	.35	.19
R^2_{within}	.22	.34

Note. D1 = No higher education versus other educational levels. D2 = Bachelor's degree versus other

educational levels.

[1] Men versus women. [2] One or more COVID-related risk factors versus none. [3] Life partner versus

single.

*p$\leq$.05, **p$\leq$.01, ***p$\leq$.001

MOTIVATION AND ADHERENCE

Table 4

Bivariate Pearson Correlations between the Variables of Interest (Subsample 2)

	Variable	*M*	*SD*	1	2	3	4	5	6	7
1.	Autonomous motivation[a]	4.15	.76							
2.	Introjected regulation[a]	3.58	.87	.77***						
3.	External regulation[a]	2.17	.92	-.57***	-.27***					
4.	Concerns[a]	3.06	.82	.12***	.22***	.13***				
5.	Personal risk perception[b]	1.90	.80	.18***	.18***	-.10***	.47***			
6.	Collective risk perception[b]	2.74	.94	.30***	.32***	-.18***	.36***	.50***		
7.	Adherence[b]	4.43	.58	.50***	.46***	-.35***	.17***	.26***	.40***	
8.	Adherence[a]	4.51	.54	.58***	.50***	-.34***	.22***	.19***	.30***	.66***

[a]During lockdown period. [b]During exit phase.

**p≤.01.

Supplemental Material

In these supplementary analyses, we want to explore whether the robust predictive power of autonomous motivation remained intact after amotivation was inserted as an additional predictor of adherence. To keep the questionnaire as short as possible and because of the limited need to measure amotivation in the early stages of the lockdown, amotivation was measured starting from the 16th of April. Because introjected regulation was removed on the 4th of May, only a small subsample of people reported on all predictors simultaneously. To maximize the number of participants who reported on amotivation, we did not include introjected regulation in these supplemental analyses. Below we have re-performed the analyses for the main sample and second subsample. Amotivation was not measured in the first (week-to-week) subsample.

Main Sample

Sample and Material

A subsample of 24011 (M_{age} = 51.09, 69.7% woman) people reported on the items of amotivation. Four items from the Environmental Amotivation Scale (Pelletier et al., 1999) were adapted to the current context. Before rating these items (e.g., "because I can no longer make the necessary sacrifices") on a 5-point scale ranging from 1 (*not at all true*) to 5 (*totally true*), participants read the following stem: "There have perhaps been moments during which you were less motivated to adhere to the measure. What are your reasons for this?". The internal consistency was sufficient (α = .78).

Results

The same analyses as for the main sample in the manuscript were conducted. Background characteristics, autonomous motivation, external regulation, amotivation, and corona-specific concerns were simultaneously inserted as predictors of adherence. This structural model showed good model fit model (χ^2(244)=13606.64, *p*<.001, RMSEA=0.05, CFI=.90, SRMR=0.06) (Hu & Bentler, 1999). Amotivation turned out to be a negative predictor of adherence (β = -.39, *p* < .001). After adding amotivation, the

positive predictive value of autonomous motivation remained significant (from β = .39, p < .001 to β = .32, p < .001) (see Figure S1).

Subsample 2

Sample and Material

A subsample of 3394 (M_{age} = 54.51, 67.5% woman) people reported on the items of amotivation. Participants answered the same questionnaires as described in the main sample. The internal consistency for amotivation was sufficient (4 items, α = .78).

Results

The same analyses as for this second subsample in the manuscript were conducted. Autonomous motivation, external regulation, and amotivation during the lockdown period were inserted simultaneously as predictors. Thereby we controlled for relevant background characteristics, adherence and corona-specific worry during the lockdown period, and perceived personal and collective risk of infection during the exit phase. This structural model showed acceptable model fit model (χ^2(383)=4171.08, p<.001, RMSEA=0.06, CFI=.85, SRMR=0.08) (Hu & Bentler, 1999). Amotivation during the lockdown turned out to have no significant value in predicting adherence during the exit phase (β = .01, p = .86). After adding amotivation, the positive predictive value of autonomous motivation remained significant (from β = .12, p < .05 to β = .17, p < .001) (see Figure S2).

Figure S1

Adherence Predicted by Behavioral Regulations and Corona-Specific Worry (Main Sample)
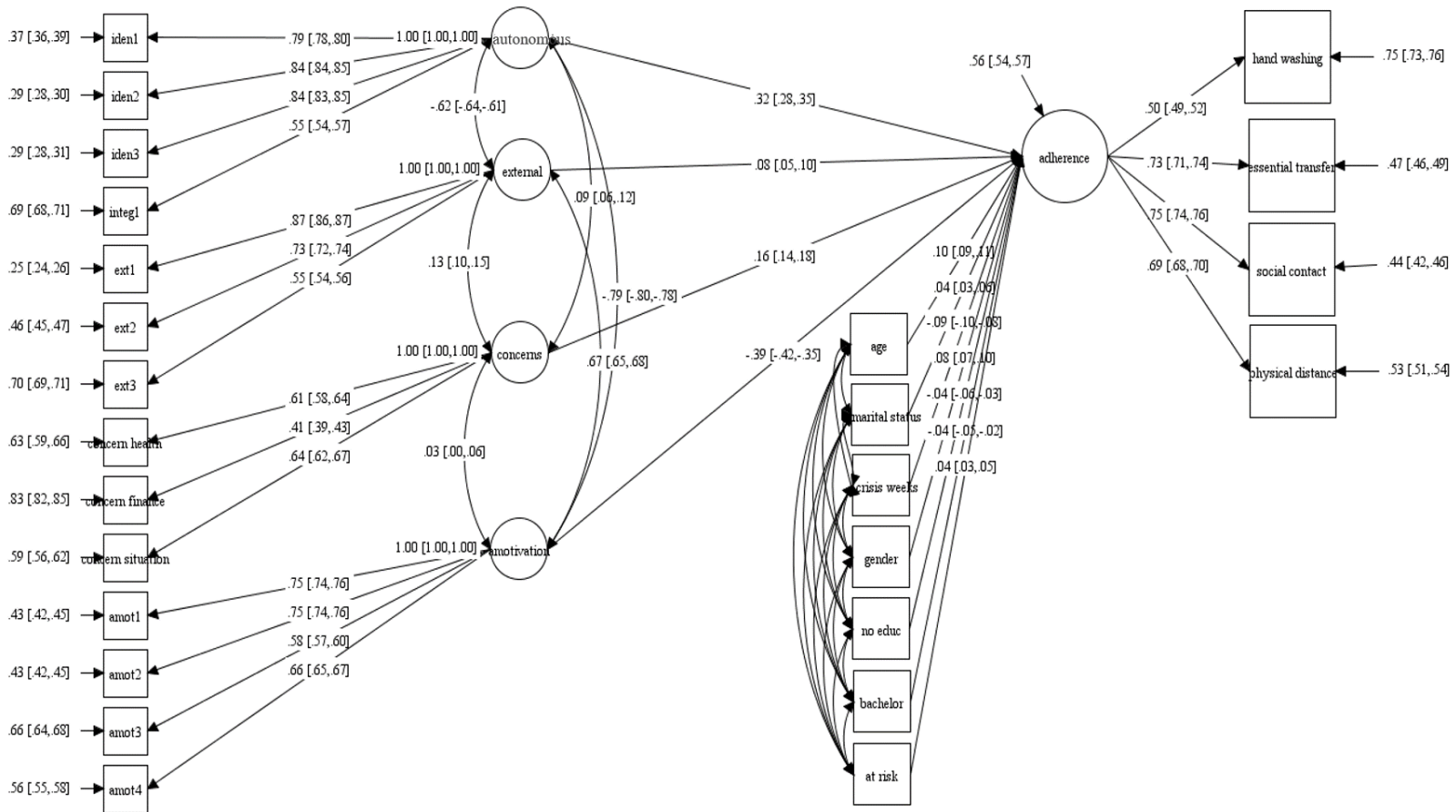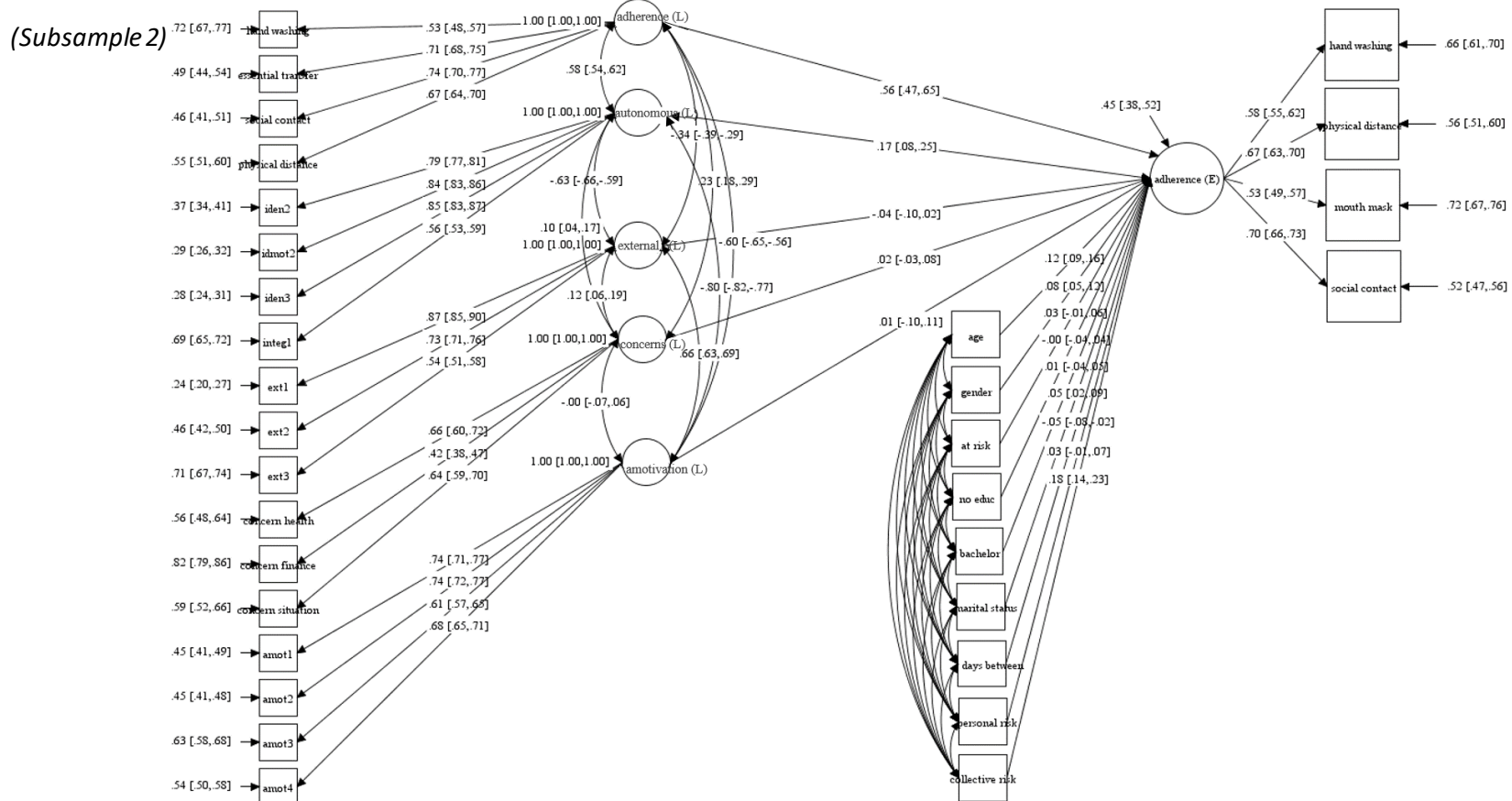

Note. Marital status = life partner vs single; gender = women vs men; no educ = no higher education vs other educational levels; bachelor = bachelor's degree vs other educational levels; at-risk = one or more COVID-related risk factors vs none.

Note. Estimates are standardized

Figure S2

Adherence during the Exit Phase predicted by Behavioral Regulations, Concerns, Risk Perception, and Adherence during lockdown phase (Subsample 2)

Note. Gender = women vs men; at-risk = one or more COVID-related risk factors vs none; no educ = no higher education vs other educational levels; bachelor = bachelor's degree vs other educational levels; marital status = life partner vs single; days between = days between two assessments; (L) = during lockdown phase; (E) = during exit phase. *Note.* Estimates are standardized.