Examining the interplay between Internet Use Disorder tendencies and well-being in relation to sofalizing during the COVID-19 pandemic

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Abstract

The present study investigated the potential links between Internet Use Disorder tendencies and well-being. A sample of 2,498 participants filled out the Compulsive Internet Use Scale (CIUS), the Satisfaction with Life Scale (SWLS, the cognitive facet of well-being) and the Sofalizing scale which comprises the Online Displacement and Social Compensation dimensions. Participants were also asked to report the extent to which changes in Internet use occurred due to COVID-19 pandemic (i.e., reductions, no changes, increases). The statistical analyses demonstrated that the aforementioned variables were robustly associated with each other. In a first mediation model, the association between higher levels of Internet Use Disorder and reduced well-being was partially mediated by the two dimensions of the Sofalizing scale, with Online Displacement exerting a negative influence on well-being and Social Compensation being positively linked with well-being. The results of the second mediation model showed that the relationship between changes in Internet use due to COVID-19 pandemic and well-being was fully mediated by CIUS scores, suggesting that increased Internet use due to the COVID-19 pandemic increased levels of Internet Use Disorder tendencies, which in turn decreased levels of well-being. The findings and their implications are further considered.

Keywords*: Internet Use Disorder, Sofalizing, Well-Being, Life Satisfaction, Internet Addiction, COVID-19 Pandemic*

Introduction

The investigation of well-being in the digital age represents a timely topic as a meta-analysis pointed out that higher Internet use is associated with lower well-being [1]. Associations between problematic Internet use or Internet Use Disorder (IUD) tendencies with lower well-being have also been reported in a meta-analysis focusing on Chinese data [2]. Currently, it remains to be understood whether IUD tendencies represent a consequence of lower well-being (potentially due to self-medication, seeking distraction) or if lower well-being is rather a consequence of overusing the Internet. To this end, a recent longitudinal study focusing on Internet Gaming Disorder, a specific form of IUD, found support for the so called 'interpersonal impairment hypothesis', suggesting that Internet Gaming Disorder tendencies resulted in lower well-being [3].

To further contribute to our understanding about the potential links between IUD tendencies and well-being, the present study will contribute to current knowledge by a) revisiting the associations between IUD tendencies and lower well-being in the context of the COVID-19 pandemic and b) investigating the interplay between IUD in relation to the emerging construct of Sofalizing [4]. As an emerging construct, Sofalizing encompasses the two following dimensions: Online Displacement and Social Compensation. Online Displacement contains items assessing individuals' preferences for online and offline social interactions. Furthermore, the Social Compensation dimension assesses tendencies to compensate needs for social interaction via the Internet.

In times of the COVID-19 pandemic and physical distancing [5], it is likely that online users may attempt to compensate for their social needs by using the Internet and specific services or applications including but not limited to online social networking sites [6]. Connecting *only* via the Internet with humans might be less fulfilling than "real" face-to-face interactions and may lead to decreased well-being (but see a study showing the positive effects of online communication [7]).

Against this backdrop, we investigated the potential mediating role of the two domains of Sofalizing (i.e., Online Displacement and Social Compensation) in the relationship between generalized IUD tendencies and well-being (operationalized via life satisfaction, a cognitive approach to well-being [8]). It was envisaged that overall, greater levels of IUD tendencies would be associated with lower levels of well-being.

Beyond this, we investigated if changes in Internet use would be linked to well-being: In detail, we expected that an increase in Internet use may lead to greater levels of IUD tendencies [9,10], which in turn might reduce well-being [2].

3

98 **Methods**

99 *Participants and procedures*

100

101   Data collection took place between August 2021 and September 2022. The study was
102 approved by the Institutional Review Board (IRB) of the University of Lübeck, the University
103 Medicine of Mainz, and the University of Berlin. Data were collected within a large
104 randomized controlled trial. The "Stepped Care Approach for Problematic Internet use
105 Treatment (SCAPIT; German: SCAVIS; www.scavis.net)" study recruited participants via
106 online activities including Instagram, Facebook, TikTok, YouTube, as well as press releases,
107 tv, radio, and newspapers. More details on the study can be found in this paper [11]. Although
108 data collection is still ongoing, for the present study data from 2,534 participants have been
109 used (N_{male} = 1,229, 48.50%; N_{female} = 1,269, 50.08%; $N_{diverse}$ = 36, 1.42%). Given the small
110 number of diverse participants, we focused the analysis on male and female participants as it
111 would be very difficult to analyze this small group of participants in a meaningful way.

112   Moreover, only participants between 16 and 67 years of age were included in the
113 analysis in line with the requirements put forward by the IRB. Hence, the final sample included
114 a total of 2,498 participants (N_{male} = 1,229, 49.20%; N_{female} = 1,269, 50.80%) with a mean age
115 of 28.59 years (SD = 13.33 years; age range: 16-67 years). To fill out the study's questionnaires
116 and provide data on the sample's online behaviors, all participants installed the smart@net-
117 application as part of the SCAPIT project. Questionnaires were filled out entirely to ensure
118 proper feedback on data as an incentive to participate.

119

120 *Measures*

121   For the present study, we focus on the analysis of measures assessing Internet Use
122 Disorder tendencies (German version of the Compulsive Internet Use Scale (CIUS); [12],
123 original [13]), Sofalizing [4], and Well-being (Satisfaction with Life Scale) [14]. The CIUS
124 consists of 14 items answered on a five-point Likert scale ranging from 0 = 'never' to 4 =
125 'very often'. Higher scores should be interpreted as higher IUD tendencies. Internal
126 consistency was excellent in the present sample (Cronbach's α = .91). The Sofalizing scale
127 was back and forth translated between English and German language by two psychologists
128 with proficiency in both German and English (translation can be found in the appendix). The
129 Sofalizing scale consists of eleven items, whereas five items answered on a five-point Likert
130 scale (0 = 'never' to 4 = 'very often') assess the facet Online Displacement (Cronbach's α =
131 .79) and six items with the same scaling the facet Social Compensation (Cronbach's α = .79).

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132 Well-being was assessed with the Satisfaction with Life scale (SWLS; [14]). In detail, this

133 measure includes five items being answered via a five-point Likert scale ranging from 1 =

134 'does not apply at all' to 5 = 'very much applies' (Cronbach's α = .84). To account for

135 changes in Internet usage patterns, a self-report item asking if participants' Internet use had

136 changed due to the COVID-19 pandemic was also included in the survey. This item was

137 answered using an 11-point Likert (originally ranging from -5 to +5) that was recoded so that

138 responses in the range of '1-5' represented a reduction in Internet use due to COVID-19,

139 responses of '6' represented no changes in Internet use, and responses in the range of '7-11'

140 represented an increase in Internet use due to COVID-19.

141

142 *Statistical analyses*

143   The planned statistical analyses included: a) reporting participants' descriptive

144 statistics in relation to all study variables (i.e., IUD, well-being, Online Displacement, Social

145 Compensation, and Changes in Internet use due to the COVID-19 pandemic); b) providing

146 gender differences comparison estimates using Welch's *t*-test and Hedges *g* effect size

147 coefficient [15]; c) estimating the degree of association between all study variables and age in

148 the total sample using adjusted *p*-values with Holm's correction method [16]; d) providing a

149 graphic visualization of the extent to which Changes in Internet use occurred across both

150 genders alongside the relationship between IUD and well-being for both genders; e)

151 estimating a mediation model testing the mediational role of Online Displacement and Social

152 Compensation in the relationship between IUD and well-being; and f) estimating a second

153 mediation model to explore the relationship between Changes in Internet use due to the

154 COVID-19 pandemic and well-being with IUD as a mediator. Both mediation models were

155 estimated based on 50,000 bootstrapped samples and bias-corrected accelerated (BCa) 95%

156 Confidence Interval (CI) to reflect current practices in mediation modeling.

157   For the present analyses R version 4.2.2. ('Innocent and Trusting') was used [17]. To

158 conduct all aforementioned analyses, the following packages were used: *psych* version 2.2.9

159 [18], *effsize* version 0.8.1 [19], *ggplot2* version 3.4.0 [20], and *ggstatsplot* version 0.9.5 [21].

160

161 **Results**

162 *Descriptive statistics*

163   Table 1 shows the descriptive statistics across all study variables (i.e., IUD, well-

164 being, Online Displacement, Social Compensation, and Changes in Internet use due to the

165 COVID-19 pandemic) for the Total Sample, Male Sample, and Female Sample while also

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166 providing inferential testing for group comparison across both genders. Of relevance, the

167 mean CIUS score was rather large (of the total sample, 44.4% fulfill screening criteria for

168 Problematic Internet Use or Internet Use Disorder (cut-off 24) and 24.7% fulfill screening

169 criteria for Internet Use Disorder (cut-off 30)). Furthermore, in terms of gender differences,

170 male and female participants did not differ significantly across the variables investigated

171 except for the Social Compensation and Changes in Internet use due to the COVID-19

172 pandemic variables, however the effect sizes for these differences were small and negligible,

173 respectively (see Table 1).

174

175 *Insert Table 1 here*

176

177   In terms of the relationship between well-being and IUD tendencies, Figure 1 shows a

178 clear negative and linear trend whereby higher levels of CIUS are associated with decreased

179 well-being levels across the total sample (see Supplementary Figure 1) and both genders. In

180 terms of patterns of Change of Internet use due to the COVID-19 pandemic, the vast majority

181 of the sample (i.e., 76.62%, $n = 1,914$, see Supplementary Figure 2) increased their Internet

182 use due to the COVID-19 pandemic while at the gender-level, the same trend was found for

183 males (i.e., 74.21%, $n = 912$) and females (i.e., 78.96%, $n = 1,002$, see Figure 2).

184

185 *Insert Figure 1 here*

186 *Insert Figure 2 here*

187

188 *Correlational analyses*

189   The correlation patterns between all study variables in addition to age are presented in

190 Table 2. Accordingly, the strongest association was found between Online Displacement and

191 Social Compensation ($r = .495$, $p < .001$), followed by Social Compensation and CIUS ($r =$

192 $.491$, $p < .001$), and CIUS and well-being ($r = -.444$, $p < .001$).

193

194 *Insert Table 2 here*

195

196 *Mediation analysis*

197   The first mediation model tested whether Online Displacement and Social

198 Compensation mediated the relationship between IUD and well-being. As shown in Figure 3,

199 higher levels of IUD tendencies significantly predicted greater levels of both Online

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200 Displacement (β_{a1} = .433, p < .0001) and Social Compensation (β_{a2} = .491, p < .0001).

201 Additionally, while Online Displacement negatively predicted well-being (β_{b1} = -.198, p <

202 .0001), Social Compensation positively predicted well-being (β_{b2} = .090, p < .0001). Taken

203 together, these variables explained about 22.5% (R^2 = .225) of the total variance in well-

204 being. The results also suggested that the total effect of IUD on well-being (path c: β_c = -.444,

205 p < .0001) and the direct effect (path c': $\beta_{c'}$ = -.402, p < .0001) were both negative and

206 statistically significant, suggesting that elevations in IUD tendencies lead to decreased well-

207 being. In terms of the indirect effects, the results suggested that total indirect effect (β = -.042,

208 Boot SE = .013, BCa 95% CI = -.067 – -.016) was significant while the specific indirect

209 effects from Online Displacement (β = -.086, Boot SE = .010, BCa 95% CI = -.107 – -.065)

210 and Social Compensation (β = .044, Boot SE = .011, BCa 95% CI = .024 – .065) were also

211 statistically significant. In conclusion, the results suggest that Online Displacement and

212 Compensation partially mediate the relationship between IUD and well-being.

213

214 *Insert Figure 3 here*

215

216 Following this, the second mediation model tested whether IUD tendencies mediated

217 the relationship between Changes in Internet use due to the COVID-19 pandemic and well-

218 being. As can be seen in Figure 4, greater levels of Changes in Internet use (towards higher

219 Internet use) due to the COVID-19 pandemic led to increased IUD tendencies (β_{a1} = .393, p <

220 .0001) while higher levels of IUD led to reduced well-being (β_{a2} = -.437, p < .0001). Overall,

221 the model accounted for about 19.7% (R^2 = .197) of the total variance in well-being.

222 Furthermore, the total effect of Changes in Internet use due to the COVID-19 pandemic on

223 well-being (path c: β_c = -.189, p < .0001) and the direct effect (path c': $\beta_{c'}$ = -.018, p = .366)

224 were both negative with only path c being statistically significant. As for the model's indirect

225 effect, the findings suggested that the total indirect effect significant (β = -.172, Boot SE = -

226 .070, BCa 95% CI = -.195 – -.150). In sum, the findings suggest that the relationship between

227 Changes in Internet use due to the COVID-19 pandemic and well-being was fully mediated

228 by IUD tendencies. Moreover, the results suggest that Online Displacement and

229 Compensation partially mediate the relationship between IUD and well-being.

230

231 **Discussion**

232 The present study revisited the investigation of the associations between IUD

233 tendencies and well-being. In line with the extant literature, negative associations were found

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234 whereby higher levels of IUD tendencies associated with lower levels of well-being. At
235 gender-level, male and females only differed in terms of Social Compensation and the extent
236 to which their Internet use changed due to COVID-19, with females typically showing greater
237 levels of Social Compensation and Changes in Internet use compared to males. However, the
238 effect sizes of these group differences were rather small.

239   As for the main mediation models tested, the first mediation model suggested that
240 although greater IUD tendencies associated with lower levels of well-being, this relationship
241 was only partially mediated by Sofalizing, which relates to one's preference for interacting
242 with others online from home rather than going out and actually meeting individuals [4]. To
243 this end and exclusively within the context of the mediation model tested, well-being was
244 positively impacted by Social Compensation but negatively impacted by Online
245 Displacement. However, based on previous research it could be hypothesized that online
246 social interactions may be less rewarding than in-person social interactions as face-to-face
247 social situations may provide a wider range of social stimuli (e.g., emotional clues, visual
248 expressions, vocal intonation, gaze, etc.) that can be highly rewarding [22]. Thus, there may
249 be an argument to support the notion that Internet use may also contribute to reduced well-
250 being, particularly in light of excessive usage [23] and doom scrolling [24] – see also a recent
251 study where lower satisfaction with the belonging motive out of Maslow's pyramid was
252 associated with higher IUD tendencies [25].

253   The second mediation model further investigated the relationship between changes in
254 Internet use due to COVID-19 and well-being. The findings obtained suggested that IUD
255 tendencies not only has a negative effect on well-being, but also fully mediates the
256 relationship between increased usage of the Internet due to COVID-19 and lower well-being
257 levels. This finding supports previous research suggesting that greater exposure and intensity
258 of Internet use may lead to the development of IUD both generalized and specific [26–28],
259 which in turn has a detrimental effect on well-being [29,30].

260   The present study comes with important limitations. Firstly, the study was solely based
261 on self-reported methodology and might include responses influenced by social desirability.
262 Beyond this, the present study is cross-sectional, thus no causal mechanisms explaining the
263 relationship between IUD tendencies and well-being can be elucidated.

264   We decided to test the predictive role of IUD on well-being because a recent study
265 showed that specific IUD (i.e., Internet Gaming Disorder) might result in lower well-being
266 [3]. This said, it is also possible that lower well-being results in higher IUD tendencies and so
267 forth. However, only properly designed longitudinal studies and experimental work might be

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268 able to disentangle the causal nature of this association. The same is true for the association

269 between IUD tendencies and increased use of the Internet due to the pandemic. Of note,

270 changes in Internet use due to the COVID-19 pandemic was assessed in the present study via

271 a simple retrospective question and might be of limited validity and reliability. Longitudinal

272 data in adolescents could show in one study that screen time as well as IUD increased when

273 comparing times before and during the pandemic [31]. We also mention that the association

274 between higher IUD tendencies and lower well-being might be due to other factors (such as

275 loneliness in the pandemic, [32]), which were not assessed. Finally, we mention that the

276 sample, although being large, is not representative. Therefore, future studies are needed to

277 confirm our results.

278

279 *Conclusions*

280   This study provides empirical evidence supporting the negative association between

281 Internet use and IUD with well-being. The findings also suggested that Sofalizing only

282 partially mediates the relationship between IUD and well-being, with Social Compensation

283 having a positive impact on well-being and Online Displacement a negative effect on well-

284 being. Furthermore, it was also found that the relationship between Changes in Internet use

285 leading to greater use of the Internet due to COVID-19 and well-being was fully mediated by

286 IUD tendencies.

287   To our knowledge, this is the first study that used the concept of Sofalizing after the

288 introduction by Tosuntas et al [4]. The findings obtained support the notion that Sofalizing is

289 of importance to one's well-being and might have relevance in IUD. As suggested for the

290 time of the COVID-19 pandemic, preventive measures might be helpful to avoid the

291 development of problematic screen time use [33]. The facet Social Compensation of

292 Sofalizing might serve as a behavior pattern with relevance to preventive and/or interventive

293 approaches. Further, reduction of online time might be at the heart of reducing IUD

294 tendencies since greater IUD tendencies associated with greater levels of Internet use.

298 **Author Contributions and Roles**

299 *Christian Montag*: Conceptualisation, Data Collection and Curation; Formal analysis;
300 Validation; Writing – Reviewing & Editing; Visualization

301

302 *Halley M. Pontes*: Data Curation; Formal analysis; Validation; Writing – Reviewing & Editing;
303 Visualization

304

305 *Christopher Kannen*: Programming of Survey Platform, Data Collection, Reviewing & Editing

306

307 *Dmitri Rozgonjuk*: Reviewing & Editing

308

309 *Dominique Brandt*: Reviewing & Editing;

310

311 *Anja Bischof*: Reviewing & Editing;

312

313 *Harriet Salbach:* Reviewing & Editing;

314

315 *Thomas Mößle:* Reviewing & Editing;

316

317 *Klaus Wölfling:* Reviewing & Editing;

318

319 *Hans-Jürgen Rumpf*: Conceptualization, Reviewing & Editing

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Tables and Figures

Table 1. Descriptive statistics of all study variables in the Total Sample (N = 2,498), Male Sample (N = 1,229), and Female Sample (N = 1,269)

Variable	Score Range	Total Sample Mean (SD)	Male Sample Mean (SD)	Female Sample Mean (SD)	Gender Differences Welch's *t*-test
Compulsive Internet Use	0-56†	23.28 (10.81)	22.80 (10.48)	23.74 (11.10)	$t(2494.4) = -2.177$, $p = .030$, $g = -.09$ (negligible)
Well-being	5-25	16.51 (4.30)	16.54 (4.14)	16.48 (4.44)	$t(2492.4) = 0.342$, $p = .732$, $g = .01$ (negligible)
Online Displacement	0-20	4.49 (3.53)	3.64 (3.54)	3.34 (3.51)	$t(2494.2) = 2.085$, $p = .037$, $g = .08$ (negligible)
Social Compensation	0-20	8.28 (3.94)	7.65 (3.91)	8.88 (3.87)	$t(2491.8) = -7.928$, $p < .001$, $g = -.32$ (small)
Changes in Internet use	1-11	8.21 (2.11)	8.11 (2.11)	8.31 (2.10)	$t(2492.6) = -2.387$, $p < .001$, $g = -.10$ (negligible)

Notes: †: Observed range for the Female Sample was 1-56. Hedges *g* statistics was used to correct for Type 1 error (see Hedges & Olkin, 1985).

Table 2. Correlations between all study variables in the total sample accounting for age (N = 2,498)

Variable	1	2	3	4	5	6
Compulsive Internet Use (1)	1	-.444***	.433***	.491***	.393***	-.362***
Well-being (2)		1	-.327***	-.205***	-.189***	.218***
Online Displacement (3)			1	.495***	.157***	-.188***
Social Compensation (4)				1	.277***	-.233***
Changes in Internet use (5)					1	-.212***
Age (6)						1

Notes: * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; *p*-values adjusted with Holm's correction method (Holm, 1979).
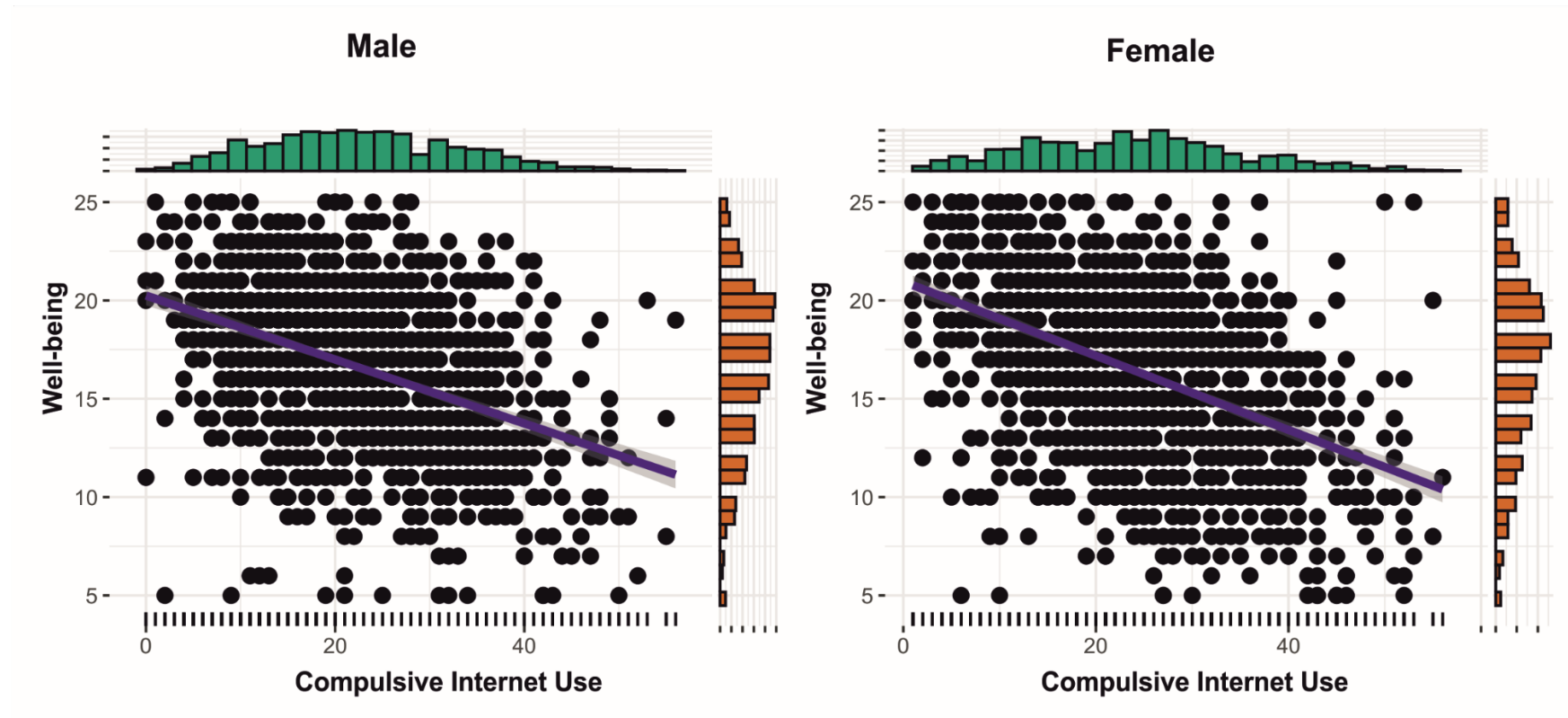
Figure 1. A graphical visualization of the relationship between Well-being and Compulsive Internet Use by gender
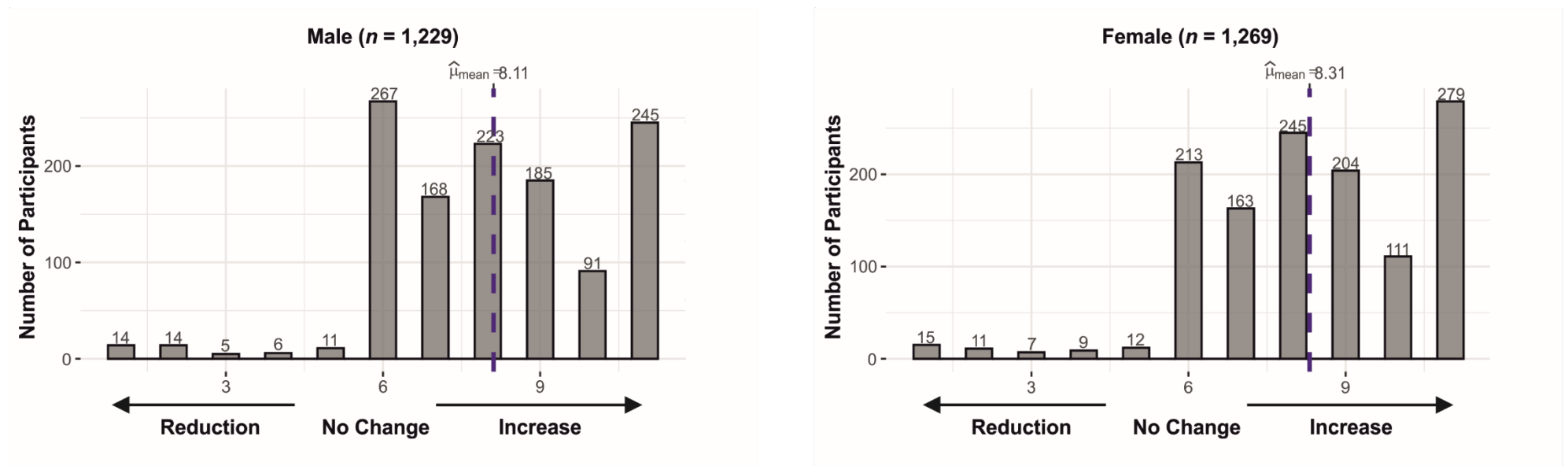
Figure 2. Changes in Internet use due to COVID-19 pandemic by gender

$R^2 = .187$

Online Displacement

$R^2 = .225$

$\beta_{a1} = .433, p < .0001$

$\beta_{b1} = -.198, p < .0001$

Compulsive Internet Use

$\beta_c = -.444, p < .0001$

$\beta_{c'} = -.402, p < .0001$

Well-being

$\beta_{a2} = .491, p < .0001$

$R^2 = .241$

Social Compensation

$\beta_{b2} = .090, p < .0001$

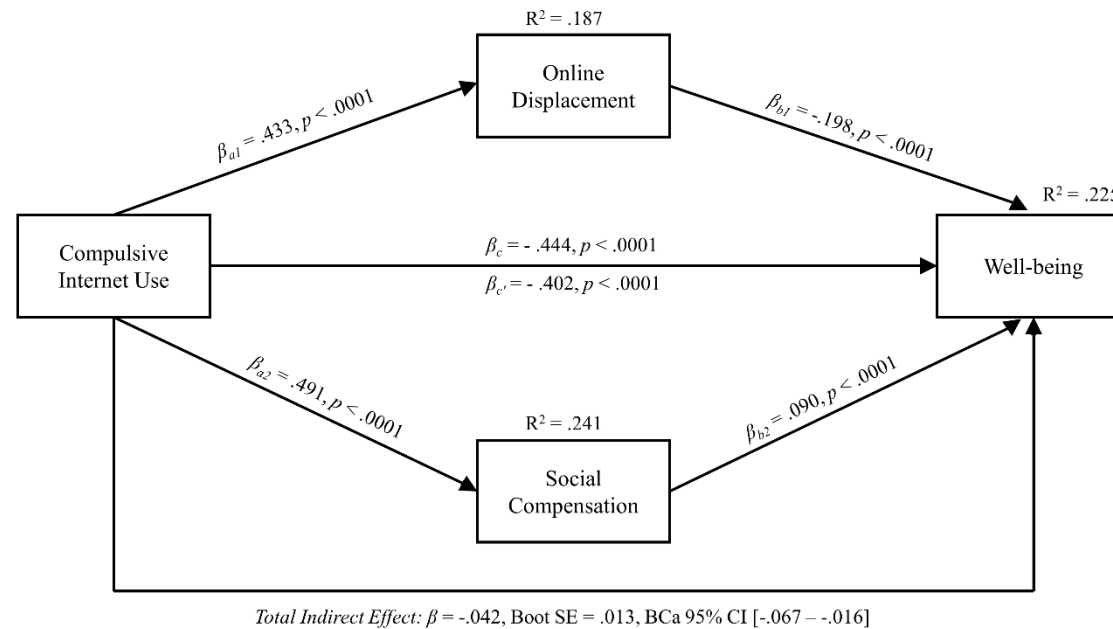*Total Indirect Effect: $\beta = -.042$, Boot SE = .013, BCa 95% CI [-.067 – -.016]*

Figure 3. Overall mediation model with standardized beta (β) coefficients and their explained variance (R^2) for the outcomes (N = 2,498). **Note**.

Mediation was performed using BCa bootstrapped 95% Confidence Intervals (CI) based on 50,000 samples; Simple arrows: statistically signifi-

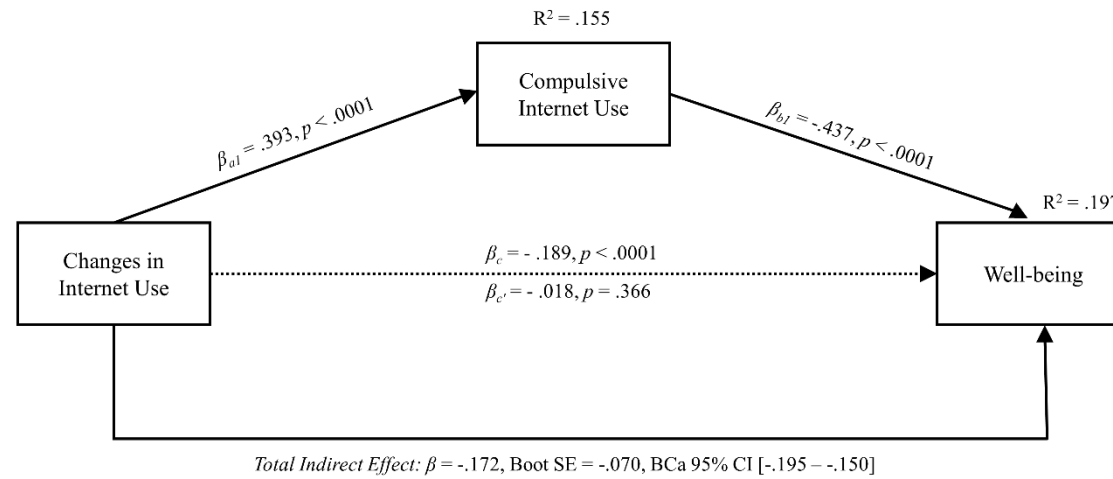cant path coefficient; Dotted arrows: non-statistically significant path coefficients.
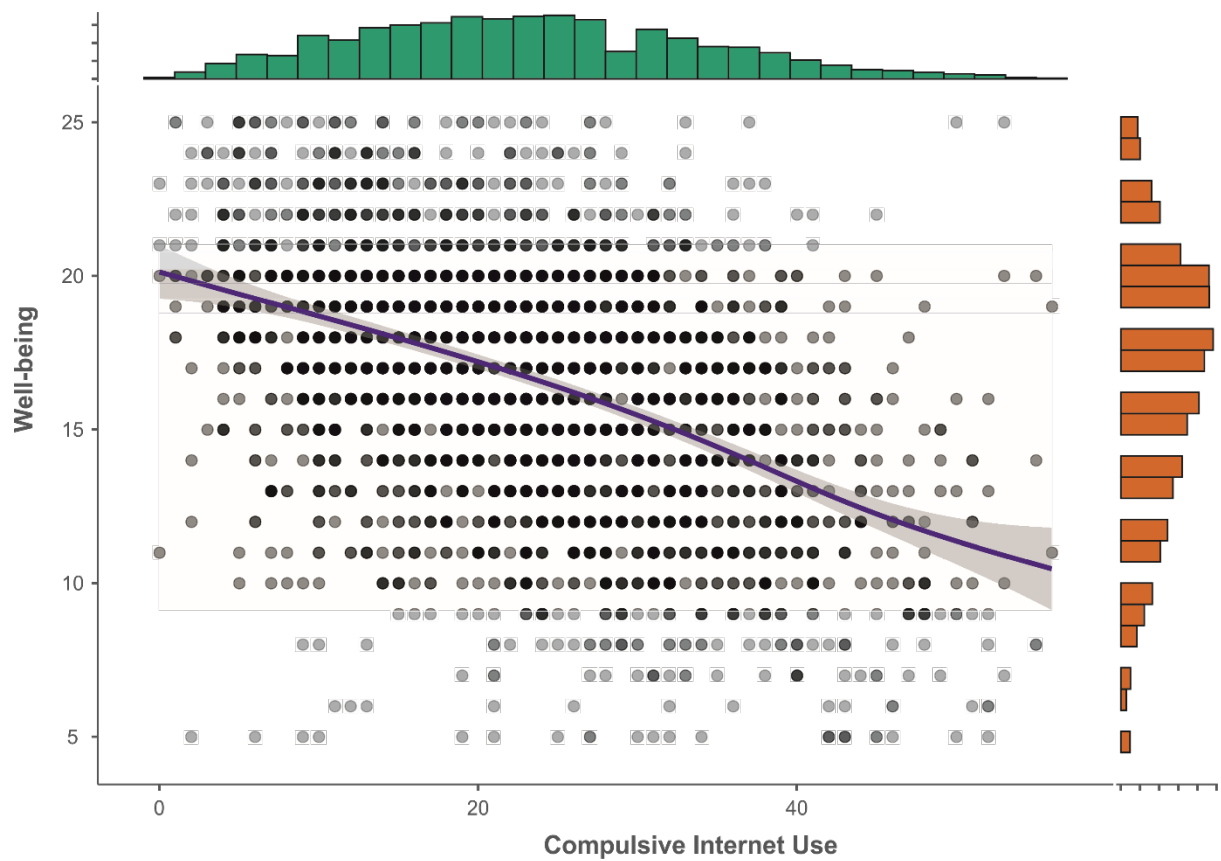
$R^2 = .155$

Compulsive
Internet Use

$\beta_{a1} = .393, p < .0001$

$\beta_{b1} = -.437, p < .0001$

$R^2 = .197$

Changes in
Internet Use

$\beta_c = -.189, p < .0001$

$\beta_{c'} = -.018, p = .366$

Well-being

Total Indirect Effect: $\beta = -.172$, Boot SE $= -.070$, BCa 95% CI [-.195 – -.150]

Figure 4. Overall mediation model with standardized beta (β) coefficients and their explained variance (R^2) for the outcomes (N = 2,498). **Note**. Mediation was performed using BCa bootstrapped 95% Confidence Intervals (CI) based on 50,000 samples; Simple arrows: statistically significant path coefficient; Dotted arrows: non-statistically significant path coefficients.
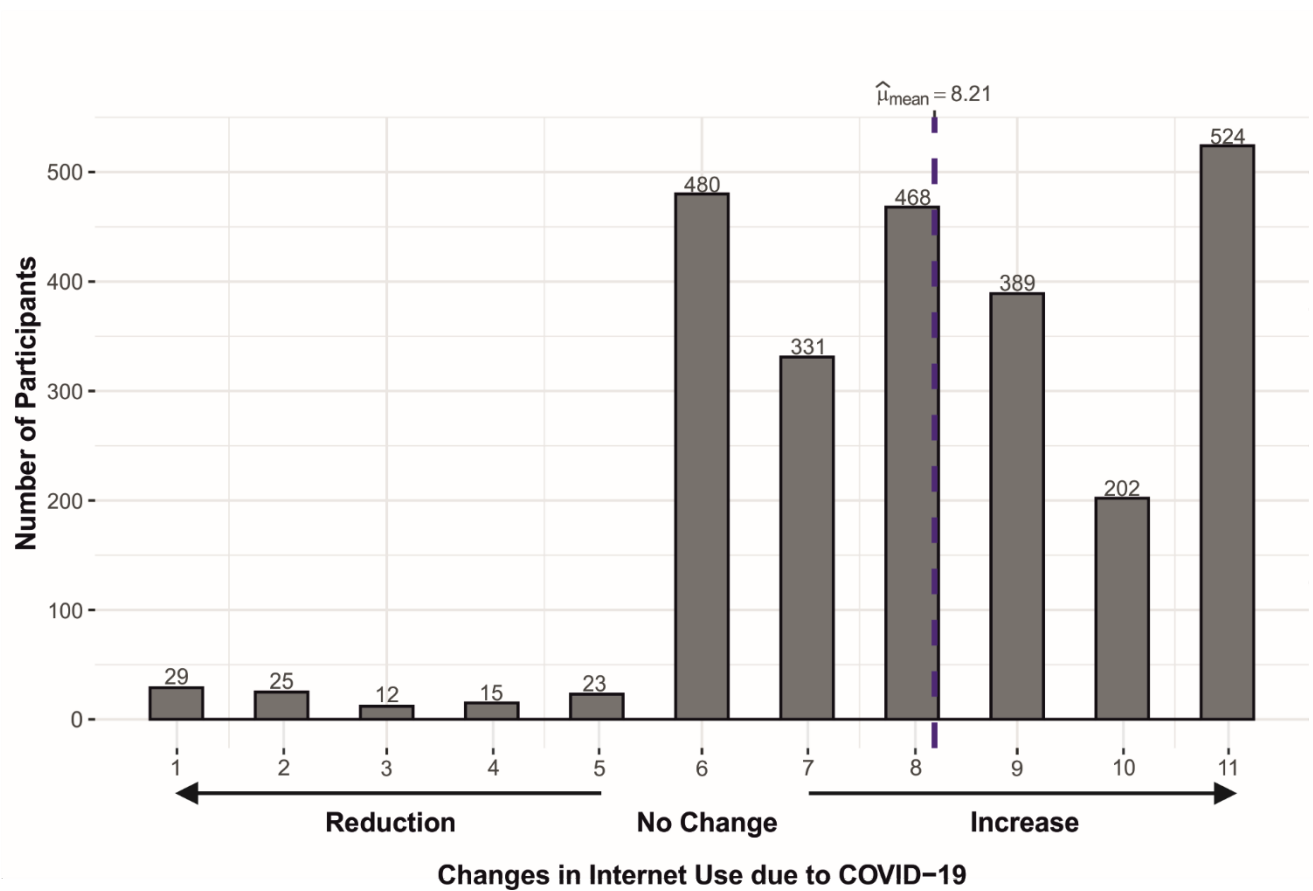
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Supplementary Information

Supplementary Figure 1. A graphical visualization of the relationship between well-being

and compulsive Internet use in the total sample (N = 2,498)

Supplementary Figure 2. Changes in Internet use due to COVID-19 pandemic in the total

sample (N = 2,498)

Supplementary Table 1. The German translation of the Sofalizing Scale

Item	Wording
1	Ich treffe mich lieber online mit meinen Freund*innen als persönlich.
2	Meine Freund*innen in Sozialen Medien zu treffen ist das gleiche, wie sie persönlich zu treffen.
3	Wenn ich mit meinen Freund*innen draußen bin, wünschte ich, ich wäre zu Hause.
4	Die meisten Dinge, die ich mit meinen Freund*innen mache, können wir auch im Online-Kontext tun.
5	Es ist einfacher, Gespräche über Soziale Medien zu führen als sich im echten Leben zu treffen.
6	Wenn ich allein bin, verbringe ich Zeit in Sozialen Medien.
7	Ich denke, dass die Gruppen, denen ich in Sozialen Medien beitrete, eine Bedeutung für mein soziales Leben haben.
8	Selbst wenn ich mich im wirklichen Leben nicht mit meiner Familie und meinen Freund*innen treffen kann, fühle ich mich ihnen aufgrund der Sozialen Medien immer noch nahe.
9	Ich habe das Gefühl, soziale Kontakte zu pflegen, während ich im Online-Kontext kommuniziere.

10	Auch wenn ich im alltäglichen Leben tatsächlich allein bin, sobald ich mich bei den Sozialen Medien einlogge, fühle ich mich nicht allein.
11	Ich gleiche meine Bedürfnisse nach Kommunikation und Zusammensein mit anderen über Soziale Medien aus.

Notes: Items 1 to 5 measure the Online Displacement dimension while items 6 to 11 measure the Social Compensation dimension.