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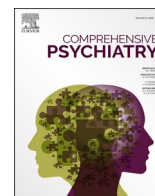
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Examining the interplay between internet use disorder tendencies and well-being in relation to sofalizing during the COVID-19 pandemic

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ABSTRACT

Aims: The present study investigated the potential links between Internet Use Disorder tendencies, well-being and the impact of COVID-19 on Internet usage patterns.

Method: A sample of 2498 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 present study comprised a survey study with cross-sectional character.

Results: 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 called Online Displacement and Social Compensation. 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.

Discussion: The findings are discussed in the context of human social needs in a time of crisis, where meeting people in-person was restricted.

1. Introduction

The investigation of well-being in the digital age represents a timely topic as a meta-analysis pointed out that higher problematic 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] and other studies focusing on specific types of Internet

use, including but not limited to gaming [3] and social media [4]. 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

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well-being [5]. In general, the study of the relationship between IUD and well-being represents a complex phenomenon because the field is hampered by the so called ‘jingle jangle fallacy’ [6]. For instance, in the context of social media (over-)use associations with loneliness, depression, anxiety, etc. have been investigated. On the other hand, absence of negative affect does not necessarily mean that a person feels well. Hence, it is also of importance to directly investigate well-being variables such as life satisfaction and perceived positive emotions in the context of technology use. The latter path has been chosen in the present study as we directly assess satisfaction with life as a proxy for subjective well-being.

The present research endeavor could also be seen in light of recent theoretical models developed to better understand IUDs. For a comprehensive framework providing insights into the development of IUD, see the Interaction of Person-Affect-Cognition-Execution model (or the I-PACE model) [7]. Among others, it has been put forward that associations between negative affect (downside of well-being) and IUDs might reflect the result of coping strategies [8]. Furthermore, recent research conducted in the context of the pandemic underline that these coping mechanisms indeed are of relevance [9]. Specifically, a longitudinal study examining Internet Gaming Disorder during the pandemic in a sample of 1778 children and adolescents reported that both children and adolescents increased their levels of disordered gaming overtime [5]. This provides support to the ‘compensatory hypothesis’ that is aligned with the I-PACE model since individual responses to the pandemic could have functioned as mediators between personal predisposing variables and disordered gaming [5]. Therefore, individuals experiencing sustained negative affect might use certain online applications to forget about their sorrows. The resulting habit formation in the realm of online use can then result in excessive online behavior (whereas IUDs can also result in sustained negative affect).

While the COVID pandemic was ongoing, many persons felt sustained negative affect such as loneliness due to governments policy including lockdowns and social distancing [10], leading individuals to overuse smartphones and social media, increasing IUD tendencies toward these technologies, subsequently lowering their well-being [11]. Not surprisingly, empirical evidence suggests that IUD tendencies were more prevalent during the pandemic [12,13]. To further understand the consequences of the pandemic and to learn the important lessons from this crisis situation, the present study aims to investigate how Internet use changed due to the pandemic and how this impacted upon users' well-being.

To further contribute to the 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 [14]. 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. The examination of this construct is crucial, as excessive screen time is posited to have adverse effects [15], primarily because it inherently diminishes the opportunity for individuals to engage in face-to-face interactions with peers. Even within the context of in-person gatherings, the presence of screens can be detrimental to the quality of social exchanges, as evidenced by research on phubbing [16]. In short, as the need to bond (being taken care of) is deeply human [17,18], it is of importance to understand how the need to interact with other persons might be fulfilled in the digital age, particularly in times of crisis, such as the COVID-19 pandemic.

In times of the COVID-19 pandemic and physical distancing [19], 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 [20]. 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 [21]).

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 [22]). 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 [10,23], which in turn might reduce well-being [2]. Please note, that we also took into account the potential effects of age and gender, because they are known to play a relevant role in understanding individual differences in IUD tendencies [24–26]. However, due to the exploratory nature of the present study, formal hypotheses were not formulated in this context.

2. Methods

2.1. Participants and procedures

Data collection took place between August 2021 and September 2022. The study was approved by the Institutional Review Board (IRB) of the University of Lübeck. Data were collected within a large randomized controlled trial. The “SCAPIT” study (Stepped Care Approach for the Treatment of IUDs) recruited participants via online activities including Instagram, Facebook, TikTok, YouTube, as well as press releases, tv, radio, and newspapers. More details on the study can be found in this paper [27]. Although data collection is still ongoing, for the present study data from 2534 participants have been used ($N_{\text{male}} = 1229$, 48.50%; $N_{\text{female}} = 1269$, 50.08%; $N_{\text{diverse}} = 36$, 1.42%). Given the small number of diverse participants, we focused the analysis on male and female participants as it would be very difficult to analyze this small group of participants in a meaningful way.

Moreover, only participants between 16 and 67 years of age were included in the analysis in line with the requirements put forward by the IRB. The data collection was part of a broader research project initially investigating how persons in work life with IUD tendencies could be supported with an online intervention to reduce IUD problems. The framing of the study clearly could have attracted participants who are sensitive to the topic of IUD and this needs to be considered when interpreting the present study's results.

The final sample included a total of 2498 participants ($N_{\text{male}} = 1229$, 49.20%; $N_{\text{female}} = 1269$, 50.80%) with a mean age of 28.59 years ($SD = 13.33$ years; age range: 16–67 years). To fill out the study's questionnaires and provide data on the sample's online behaviors, all participants installed the smart@net-application as part of the SCAPIT-study. Questionnaires were filled out entirely to ensure proper feedback on data as an incentive to participate.

2.2. Measures

For the present study, we focus on the analysis of measures assessing IUD tendencies (German version of the Compulsive Internet Use Scale (CIUS); [28], original [29]), Sofalizing [14], and Well-being (Satisfaction with Life Scale) [30]. The CIUS consists of 14 items answered on a five-point Likert scale ranging from 0 = ‘never’ to 4 = ‘very often’. Higher scores should be interpreted as higher IUD tendencies. Internal consistency was excellent in the present sample (Cronbach's $\alpha = 0.91$). The Sofalizing scale was back and forth translated between English and German language by two psychologists with proficiency in both German and English (translation can be found in Supplementary Table 1). The Sofalizing scale consists of eleven items, whereas five items answered on

a five-point Likert scale (0 = 'never' to 4 = 'very often') assess the facet Online Displacement (Cronbach's $\alpha = 0.79$) and six items with the same scaling the facet Social Compensation (Cronbach's $\alpha = 0.75$). Due to a clerical error, the last item of the Social Compensation scale was inadvertently not added to the analyses (also the reported alpha is for the five items analyzed). Well-being was assessed with the Satisfaction with Life scale (SWLS; [30]). In detail, this measure includes five items which here were answered via a five-point Likert scale ranging from 1 = 'does not apply at all' to 5 = 'very much applies' (Cronbach's $\alpha = 0.84$). The German version of the SWLS was used as in an earlier work [31]. To account for changes in Internet usage patterns, a self-report item asking if participants' Internet use had changed due to the COVID-19 pandemic was also included in the survey ("Hat sich durch die COVID-19 Pandemie Ihre Internetnutzung verändert?"; Has your Internet use changed due to the COVID-19 pandemic?). This item was answered using an 11-point Likert (originally ranging from -5 to 5; -5: weniger geworden/become less; 5 = mehr geworden/become more) that was recoded so that responses in the range of '1-5' represented a reduction in Internet use due to COVID-19, responses of '6' represented no changes in Internet use, and responses in the range of '7-11' represented an increase in Internet use due to COVID-19. This item, specifically created for the current study, utilized a -5 to +5 scale, incorporating a neutral midpoint, to obtain detailed insights into the shifts in Internet usage attributed to the pandemic. Furthermore, the format of this item facilitated its visual presentation, making it both comprehensible and visually appealing.

2.3. Statistical analyses

The planned statistical analyses included: a) reporting participants' descriptive statistics in relation to all study variables (i.e., IUD, well-being, Online Displacement, Social Compensation, and Changes in Internet use due to the COVID-19 pandemic); b) providing gender differences comparison estimates using Welch's *t*-test and Hedges *g* effect size coefficient [32]; c) estimating the degree of associations between all study variables and age in the total sample using adjusted *p*-values with Holm's correction method [33]; d) providing a graphic visualization of the extent to which Changes in Internet use occurred across both genders alongside the relationship between IUD and well-being for both genders; e) estimating a mediation model testing the mediational role of Online Displacement and Social Compensation in the relationship between IUD and well-being in one model; and f) estimating a second mediation model to explore the relationship between Changes in Internet use due to the COVID-19 pandemic and well-being with IUD as a mediator. Both mediation models were estimated based on 50,000 bootstrapped samples and bias-corrected accelerated (BCa) 95% Confidence Interval (CI) to reflect current practices in mediation modeling. Please note that the data set is of cross-sectional data and no causality can be inferred.

For the present analyses R version 4.2.2. ('Innocent and Trusting') was used [34]. To conduct all aforementioned analyses, the following packages were used: *psych* version 2.2.9 [35], *effsize* version 0.8.1 [36], *ggplot2* version 3.4.0 [37], and *ggstatsplot* version 0.9.5 [38].

3. Results

3.1. Descriptive statistics

Table 1 shows the descriptive statistics across all study variables (i.e., IUD, well-being, Online Displacement, Social Compensation, and Changes in Internet use due to the COVID-19 pandemic) for the Total Sample, Male Sample, and Female Sample while also providing inferential testing for group comparison across both genders. Of relevance, the mean CIUS score was rather large (of the total sample, 44.4% fulfill screening criteria for Problematic Internet Use or Internet Use Disorder (cut-off 24) and 24.7% fulfill screening criteria for Internet Use Disorder (cut-off 30)). Furthermore, in terms of gender differences, male and female participants did not differ significantly across the variables investigated except for the Social Compensation and Changes in Internet use due to the COVID-19 pandemic variables, however the effect sizes for these differences were small and negligible, respectively (see Table 1). Please note that the significant gender difference for the Compulsive Internet Use variable (IUD tendencies) and Online Displacement would not hold for correction procedures for multiple testing and therefore were not deemed to be relevant.

In terms of the relationship between well-being and IUD tendencies, Fig. 1 shows a clear negative and linear trend whereby higher levels of CIUS are associated with decreased well-being levels across the male and female subsamples as well as the total sample (see for the total sample also Supplementary Fig. 1) and both genders. In terms of patterns of Change of Internet use due to the COVID-19 pandemic, the vast majority of the sample (i.e., 76.62%, $n = 1914$, see Supplementary Fig. 2) increased their Internet use due to the COVID-19 pandemic while at the gender-level, the same trend was found for males (i.e., 74.21%, $n = 912$) and females (i.e., 78.96%, $n = 1002$, see Fig. 2).

3.2. Correlational analyses

The correlation patterns between all study variables in addition to age are presented in Table 2. Accordingly, the strongest association was found between Online Displacement and Social Compensation ($r = 0.495$, $p < .001$), followed by Social Compensation and CIUS ($r = 0.491$, $p < .001$), and CIUS and well-being ($r = -0.444$, $p < .001$).

3.3. Mediation analyses

The first mediation model tested whether Online Displacement and Social Compensation mediated the relationship between IUD and well-being. As shown in Fig. 3, higher levels of IUD tendencies significantly predicted greater levels of both Online Displacement ($\beta_{a1} = 0.433$, $p < .0001$) and Social Compensation ($\beta_{a2} = 0.491$, $p < .0001$). Additionally, while Online Displacement negatively predicted well-being ($\beta_{b1} = -0.198$, $p < .0001$), Social Compensation positively predicted well-being ($\beta_{b2} = 0.090$, $p < .0001$). Taken together, these variables explained about 22.5% ($R^2 = 0.225$) of the total variance in well-being. The results also suggested that the total effect of IUD on well-being (path c: $\beta_c = -0.444$, $p < .0001$) and the direct effect (path c': $\beta_{c'} = -0.402$, $p < .0001$) were both negative and statistically significant, suggesting that elevations in IUD tendencies lead to decreased well-being. In terms of

Table 1

Descriptive statistics of all study variables in the Total Sample ($N = 2498$), Male Sample ($N = 1229$), and Female Sample ($N = 1269$).

Variable	Score Range	Total Sample Mean (SD)	Male Sample Mean (SD)	Female Sample Mean (SD)	Gender Differences Welch's <i>t</i> -test
Compulsive Internet Use	0–56 [†]	23.28 (10.81)	22.80 (10.48)	23.74 (11.10)	$t(2494.4) = -2.177$, $p = .030$, $g = -0.09$ (negligible)
Well-being	5–25	16.51 (4.30)	16.54 (4.14)	16.48 (4.44)	$t(2492.4) = 0.342$, $p = .732$, $g = 0.01$ (negligible)
Online Displacement	0–20	3.49 (3.53)	3.64 (3.54)	3.34 (3.51)	$t(2494.2) = 2.085$, $p = .037$, $g = 0.08$ (negligible)
Social Compensation	0–20	8.28 (3.94)	7.65 (3.91)	8.88 (3.87)	$t(2491.8) = -7.928$, $p < .001$, $g = -0.32$ (small)
Changes in Internet use	1–11	8.21 (2.11)	8.11 (2.11)	8.31 (2.10)	$t(2492.6) = -2.387$, $p < .001$, $g = -0.10$ (negligible)

Notes: [†]: Observed range for the female sample was 1–56 (0–56 for the male and total sample). Hedges *g* statistic was used to correct for Type 1 error [32].

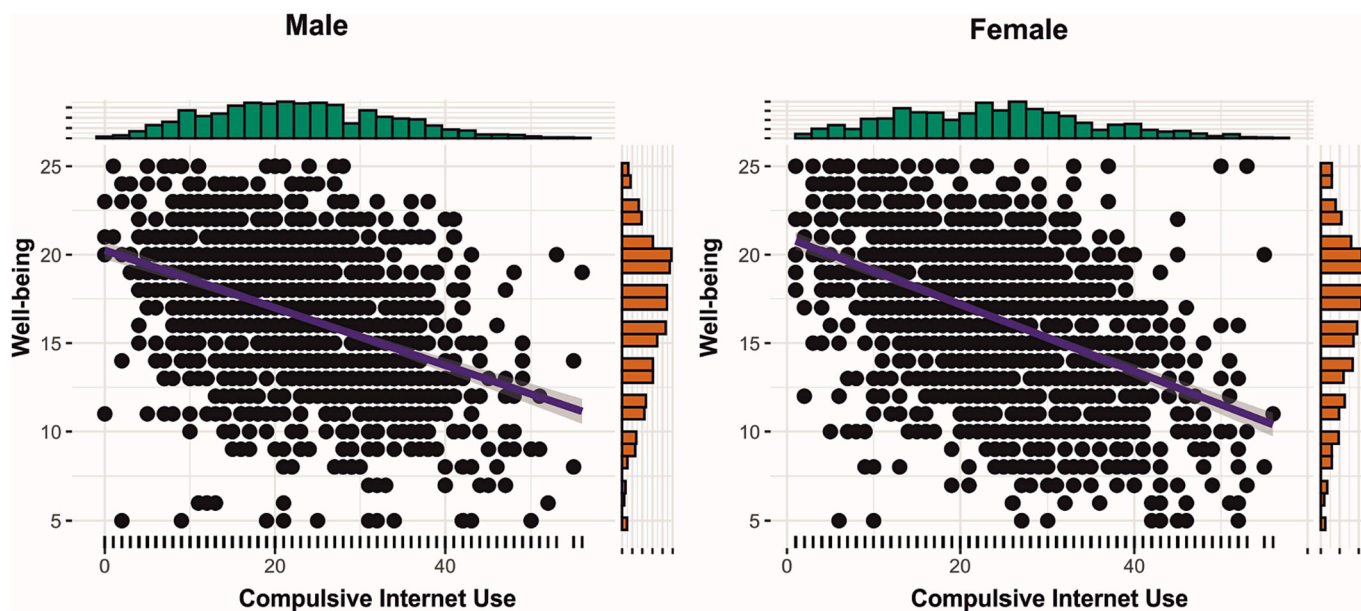


Fig. 1. A graphical visualization of the relationship between Well-being and Compulsive Internet Use by gender.

Changes in Internet Use due to COVID-19

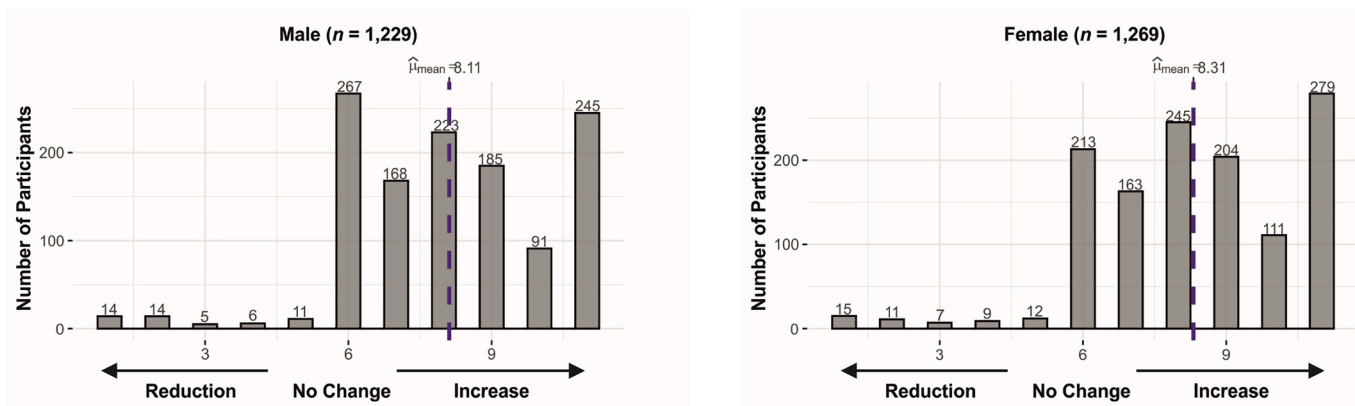


Fig. 2. Changes in Internet use due to COVID-19 pandemic by gender.

Table 2
Correlations between all study variables in the total sample accounting for age (N = 2498).

Variable	1	2	3	4	5	6
Compulsive Internet Use (1)	1	-0.444***	0.433***	0.491***	0.393***	-0.362***
Well-being (2)		1	-0.327***	-0.205***	-0.189***	0.218***
Online Displacement (3)			1	0.495***	0.157***	-0.188***
Social Compensation (4)				1	0.277***	-0.233***
Changes in Internet use (5)					1	-0.212***
Age (6)						1

Notes: * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; p -values adjusted with Holm's correction method (Holm, 1979).

the indirect effects, the results suggested that total indirect effect ($\beta = -0.042$, Boot SE = 0.013, BCa 95% CI = $-0.067 - -0.016$) was significant while the specific indirect effects from Online Displacement ($\beta = -0.086$, Boot SE = 0.010, BCa 95% CI = $-0.107 - -0.065$) and Social Compensation ($\beta = 0.044$, Boot SE = 0.011, BCa 95% CI = $0.024 - 0.065$) were also statistically significant. In conclusion, the results suggest that Online Displacement and Social Compensation partially mediate the relationship between IUD and well-being. See also further analysis

taking into account age in the mediation analysis as shown in Supplementary Table 2.

Following this, the second mediation model tested whether IUD tendencies mediated the relationship between Changes in Internet use due to the COVID-19 pandemic and well-being. As can be seen in Fig. 4, greater levels of Changes in Internet use (toward higher Internet use) due to the COVID-19 pandemic led to increased IUD tendencies ($\beta_{a1} = 0.393$, $p < .0001$) while higher levels of IUD led to reduced well-being

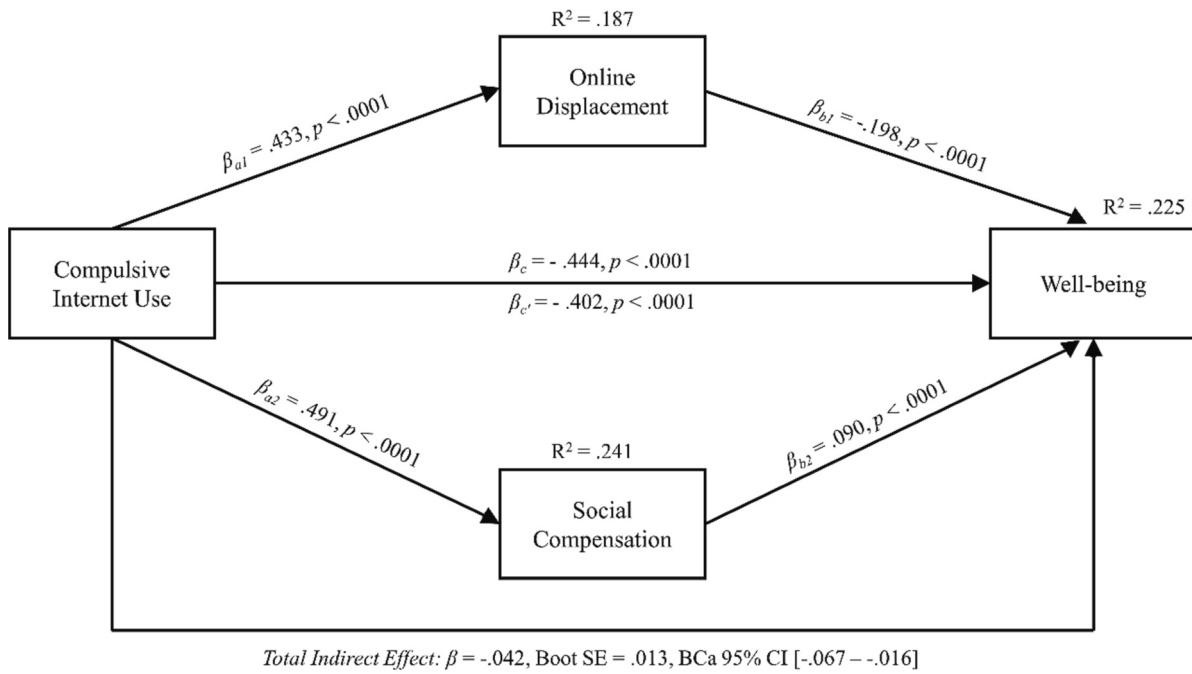


Fig. 3. Overall mediation model with standardized beta (β) coefficients and their explained variance (R^2) for the outcomes (N = 2498). **Note.** Mediation was performed using BCa bootstrapped 95% Confidence Intervals (CI) based on 50,000 samples; Simple arrows: statistically significant path coefficient. Compulsive Internet Use assesses Internet Use Disorder tendencies.

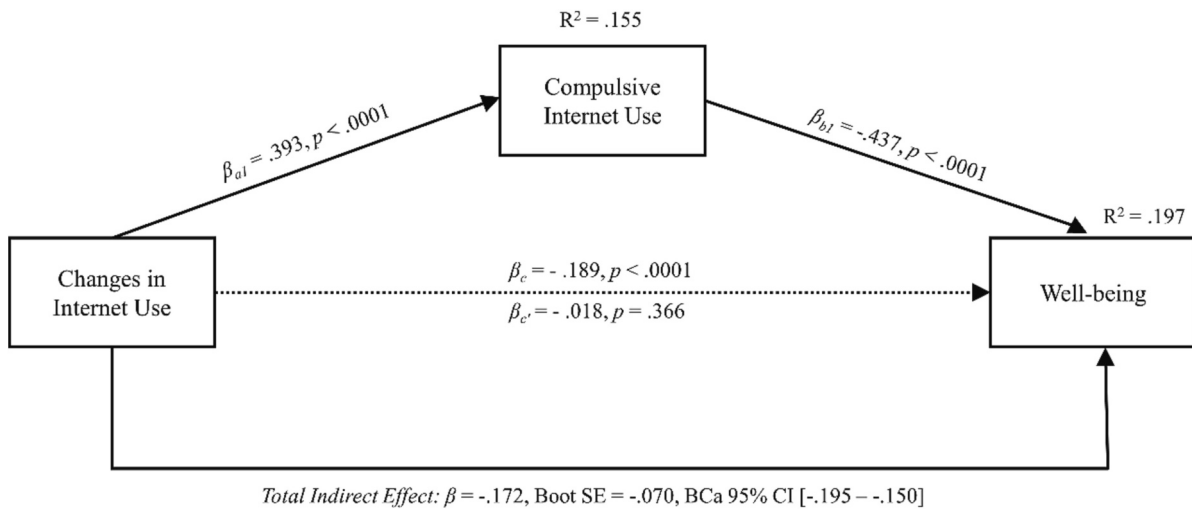


Fig. 4. Overall mediation model with standardized beta (β) coefficients and their explained variance (R^2) for the outcomes (N = 2498). **Note.** Mediation was performed using BCa bootstrapped 95% Confidence Intervals (CI) based on 50,000 samples; Simple arrows: statistically significant path coefficient; Dotted arrows: non-statistically significant path coefficients. Compulsive Internet Use assesses Internet Use Disorder tendencies.

($\beta_{a2} = -0.437, p < .0001$). Overall, the model accounted for about 19.7% ($R^2 = 0.197$) of the total variance in well-being. Furthermore, the total effect of Changes in Internet use due to the COVID-19 pandemic on well-being (path c: $\beta_c = -0.189, p < .0001$) and the direct effect (path c': $\beta_{c'} = -0.018, p = .366$) were both negative with only path c being statistically significant. As for the model's indirect effect, the findings suggested that the total indirect effect was significant ($\beta = -0.172$, Boot SE = -0.070 , BCa 95% CI = $-0.195 - -0.150$). See also further analysis taking into account age in the mediation analysis as shown in Supplementary Table 2.

In sum, the findings suggest that the relationship between Changes in Internet use due to the COVID-19 pandemic and well-being was fully mediated by IUD tendencies. Moreover, the results suggest that Online Displacement and Social Compensation partially mediate the

relationship between IUD and well-being.

4. Discussion

The present study revisited the investigation of the associations between IUD tendencies and well-being. In line with the extant literature, negative associations were found whereby higher levels of IUD tendencies associated with lower levels of well-being. At gender-level, male and females only differed in terms of Social Compensation and the extent to which their Internet use changed due to COVID-19, with females typically showing greater levels of Social Compensation and Changes in Internet use compared to males. However, the effect sizes of these group differences were rather small.

As for the main mediation models tested, the first mediation model

suggested that although greater IUD tendencies associated with lower levels of well-being, this relationship was partially mediated by Sofalizing's facets, which relates to one's preference for interacting with others online from home rather than going out and actually meeting individuals [14]. In particular, the mediator variable Online Displacement (preferring online over offline contacts) is noteworthy, as it could in particular well explain the association between higher IUD tendencies and lower well-being. Based on previous research it could be hypothesized that online social interactions may be less rewarding than in-person social interactions as face-to-face social situations may provide a wider range of social stimuli (e.g., emotional clues, visual expressions, vocal intonation, gaze, etc.) that can be highly rewarding [39]. Thus, there may be an argument to support the notion that Internet use may also contribute to reduced well-being, particularly in light of excessive usage [40] and doom scrolling [41] – see also a recent study where lower satisfaction with the belonging motive out of Maslow's pyramid was associated with higher IUD tendencies [42].

The second mediation model further investigated the relationship between changes in Internet use due to COVID-19 and well-being. The findings obtained suggested that IUD tendencies not only has a negative effect on well-being, but also fully mediates the relationship between increased usage of the Internet due to COVID-19 and lower well-being levels. This finding supports previous research suggesting that greater exposure and intensity of Internet use may lead to the development of IUD, both generalized and specific [43–45], which in turn has a detrimental effect on well-being [1,46].

The findings reported present broader implications worth considering. As the world adjusts to a post-COVID-19 period, the insights from this study highlight the need to re-evaluate individuals' relationship with technology and its impact on mental health and social well-being. Furthermore, the study's findings suggest a need for a balanced approach to internet use, where online interactions complement rather than replace face-to-face socialization.

The present study comes with important limitations. Firstly, the study was solely based on self-reported methodology and might include responses influenced by social desirability. Some recent studies have found that IUDs and objective smartphone and social media use data might not correlate with psychological variables similarly [47,48]. Beyond this, the present study is cross-sectional, thus no causal mechanisms explaining the relationship between IUD tendencies and well-being can be elucidated. Third, the item assessing changes in Internet use due to the COVID-19 pandemic is not very specific regarding the different online activities one could pursue. Moreover, it is not clear if reported changes of Internet use are of personal and/or professional nature.

We decided to test the predictive role of IUD on well-being because a recent study showed that specific IUD (i.e., Internet Gaming Disorder) might result in lower well-being [5]. This said, it is also possible that lower well-being results in higher IUD tendencies and so forth. However, only properly designed longitudinal studies and experimental work might be able to disentangle the causal nature of this association. The same is true for the association between IUD tendencies and increased use of the Internet due to the pandemic. Of note, changes in Internet use due to the COVID-19 pandemic was assessed in the present study via a simple retrospective question and might be of limited validity and reliability. Longitudinal data in adolescents could show in one study that screen time as well as IUD increased when comparing times before and during the pandemic [49]. We also mention that the association between higher IUD tendencies and lower well-being might be due to other factors (such as loneliness in the pandemic, [50]). Finally, we mention that the sample, although being large, is not representative. Therefore, future studies are needed to confirm our results.

5. Conclusions

This study provides empirical evidence supporting the negative

association between increased Internet use and IUD with reduced well-being. The findings also suggested that the two facets of Sofalizing partially mediate the relationship between IUD and well-being, with Online Displacement in particular negatively “predicting” well-being (cross sectional data). Furthermore, it was also found that the relationship between changes in Internet use leading to greater use of the Internet due to COVID-19 and well-being was fully mediated by IUD tendencies.

To our knowledge, this is the first study that used the concept of Sofalizing after the introduction by Tosuntas et al. [14]. The findings obtained support the notion that Sofalizing is of importance to one's well-being and might have relevance in IUD. As suggested for the time of the COVID-19 pandemic, preventive measures might be helpful to avoid the development of problematic screen time use [51]. The facet Online Displacement of Sofalizing might serve as a behavior pattern with relevance to preventive and/or interventive approaches. Further, reduction of online time might be at the heart of reducing IUD tendencies since greater IUD tendencies associated with greater levels of Internet use.

CRedit authorship contribution statement

Christian Montag: Writing – original draft, Formal analysis, Data curation, Conceptualization. **Halley M. Pontes:** Writing – review & editing, Validation, Formal analysis, Data curation. **Christopher Kanen:** Writing – review & editing, Software, Project administration. **Dmitri Rozgonjuk:** Writing – review & editing, Conceptualization. **Dominique Brandt:** Writing – review & editing. **Anja Bischof:** Writing – review & editing. **Harriet Salbach:** Writing – review & editing. **Thomas Möble:** Writing – review & editing. **Klaus Wölfling:** Writing – review & editing. **Hans-Jürgen Rumpf:** Writing – review & editing, Conceptualization.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.comppsy.2024.152452>.

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