

ONLINE PSYCHOLOGY BEYOND ADDICTION AND GAMING: A GLOBAL LOOK AT MENTAL HEALTH AND INTERNET-RELATED TECHNOLOGIES

EDITED BY: Elias Aboujaoude, Daria Joanna Kuss, Mike Z. Yao
and Louis W. Leung

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ONLINE PSYCHOLOGY BEYOND ADDICTION AND GAMING: A GLOBAL LOOK AT MENTAL HEALTH AND INTERNET-RELATED TECHNOLOGIES

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Editorial: Online Psychology Beyond Addiction and Gaming: A Global Look at Mental Health and Internet-Related Technologies

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Editorial on the Research Topic

Online Psychology Beyond Addiction and Gaming: A Global Look at Mental Health and Internet-Related Technologies

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The inclusion in 2018 of “Gaming Disorder” into the 11th revision of the International Classification of Diseases (World Health Organization, 2019) represented a milestone in the decades-long research investigation of the topic. It was also a stark reminder of how little attention has been paid to other highly relevant areas within online psychology. From internet-mediated impulsivity and aggression to the effects of living in a post-privacy age, important dimensions of online psychology have been relatively ignored as the field narrowly focused on gaming (Aboujaoude, 2011; Aboujaoude and Starcevic, 2016). The risk of this narrow focus is 3-fold: (i) users who may not be described as gaming “addicts” under any nosology can feel deceptively immune to online psychological harm; (ii) users can seem deceptively healthy to the mental health professionals trying to diagnose and treat them; and (iii) the limited research scope can complicate meaningful regulation of “Big Tech” by underestimating the negative impact of some of these technologies (Aboujaoude and Gega, 2021; Kuss, 2021). In this special issue, we attempt to widen the aperture beyond “traditional” gaming and the closely linked addiction framework to address crucial themes in online psychology that have received comparatively less attention.

FoMO and “phubbing” are two new additions to the popular lexicon and are the subject of studies in this special issue. FoMO refers to the social-media-fed “fear of missing out,” and has been defined as the anxious feeling “that your peers are doing, in the know about, or in possession of more or something better than you” (Barker, 2016). Phubbing represents the increasingly common practice of snubbing someone in a social setting to concentrate on one’s phone instead (Chotpitayasunondh and Douglas, 2016). The study by Li et al. explores how FoMO and smartphone addiction may mediate the impact of affect on sleep quality, showing that negative affect was associated with FoMO and smartphone addiction. Although still relatively new, phubbing has quickly spread, with seemingly universal consequences in terms of psychological distress, as suggested by the study by Blachnio et al. of users in 20 countries.

While many effects of internet-related technologies are cross-cultural, it is important to confirm “locally” and incorporate sociocultural specificities. This is particularly true when it comes to screening and diagnostic tools. Chen et al. do so in a population of Chinese fourth to sixth graders,

validating the psychometric properties of three scales that target problematic gaming but also problematic social media and smartphone “app” use. Similarly, Burkauskas et al. confirm in their study the psychometric properties of the Lithuanian version of the nine-item Problematic Internet Use Questionnaire (PIUQ-9) in a sample of Lithuania-based students.

While much research into online psychology has involved young students, “digital natives” and “Generation Z,” older adults have often been ignored. This seriously complicates any claims of “universality” when it comes to online harms and opportunities. Older adults are the target of the study by Liu et al., which compared them to college students in terms of “telepresence” and emotional responsiveness vis a vis virtual reality (VR) content. More positive attitudes toward the material were reported by older adults. This adds to the recent literature on the potential benefit from VR among older adults. Among other applications, for example, VR has been used to target mild cognitive impairment (Liao et al., 2020).

Increasingly, technology is seen as both the problem and the solution. Beyond VR being the vehicle for addictive gaming and therapeutic interventions, this is reflected in the interest in the moment-by-moment, *in situ* observation of an individual’s phenotypic details via smartphone sensing tools, which promises to improve diagnostics and tailor interventions (Huckvale et al., 2019). This idea is developed in the commentary by Lewczuk et al., which focuses on ecological momentary assessment (EMA) and ecological momentary interventions (EMI). The ideal-world-outcome could be to decrease recall bias, increase validity and deliver between-session interventions in subjects’ natural environments.

Other aspects of online life can also be seen as healthy or problematic, depending on the degree of engagement and control over the behavior. The internet has transformed age-old dating and sexual practices, for example, often in enriching ways. It has, however, also facilitated compulsive sexual behavior and risky “chemsex” [using drugs to enhance sex] (Giorgetti et al., 2017), in part *via* geolocating tools. This, according to the study by Obarska et al., has contributed to vulnerability to depression, substance use and sleep disorders among excessive users of dating apps in the group of men who have sex with men (MSM) that they studied. The results augment the literature on chemsex (Maxwell et al., 2019) by adding an important mental health dimension.

As with the healthy vs. health-compromising use of dating apps, it can be a “fine line” between the all-consuming nature of gaming in *Gaming Disorder* and among career gamers. The motivations driving professional e-sports players were examined in a study of Hungarian gamers by Banyai et al. Competition, skill development and social motivators predicted career planning for professional players.

Creative approaches are called for to help mitigate some of the negative effects of social media and other apps, including compulsive sex and disordered gaming. The current social media model rests on exploiting users’ freely supplied personal data in exchange for keeping platforms free. The acceptability of a model that would protect personal information but charge for social media use was explored in the study by Sindermann et al. Only 21.43% of study participants supported such a model, however. This would support recent survey data showing that the majority of social media users do not understand the privacy risks involved (Hitlin and Rainie, 2019).

One reason for discounting the negative impact of social media may be that we don’t know the full extent of the problem. In their paper, Marengo et al. contend that most social media research has focused on only one platform, which can underestimate the deleterious effects of social media overall. Their investigation of the usage of Facebook-owned platforms (Facebook, WhatsApp and Instagram) showed that WhatsApp had the widest reach and that personality traits differed by platform use. The study helps answer the call for the scientific exploration of this understudied but highly popular platform (Jailobaev et al., 2021).

Huge socio-political-cultural transformations have been attributed to psychological processes unfolding online and on social media. The diverse set of articles in this special issue reflects the richness of the field. Collectively, they shed an important light on some understudied facets of online psychology, although much work remains to be done to fully capture the vastness of the topic and propel it beyond gaming and addiction.

AUTHOR CONTRIBUTIONS

EA summarized the main findings from the various submissions and wrote the first draft of the editorial. DK, MY, and LL reviewed, expanded, and edited the draft. All authors contributed to the article and approved the submitted version.

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One Social Media Company to Rule Them All: Associations Between Use of Facebook-Owned Social Media Platforms, Sociodemographic Characteristics, and the Big Five Personality Traits

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Currently, 2.7 billion people use at least one of the Facebook-owned social media platforms – Facebook, WhatsApp, and Instagram. Previous research investigating individual differences between users and non-users of these platforms has typically focused on one platform. However, individuals typically use a combination of Facebook-owned platforms. Therefore, we aim (1) to identify the relative prevalence of different patterns of social media use, and (2) to evaluate potential between-group differences in the distributions of age, gender, education, and Big Five personality traits. Data collection was performed using a cross-sectional design. Specifically, we administered a survey assessing participants' demographic variables, current use of Facebook-owned platforms, and Big Five personality traits. In $N = 3003$ participants from the general population (60.67% females; mean age = 35.53 years, $SD = 13.53$), WhatsApp emerged as the most widely used application in the sample, and hence, has the strongest reach. A pattern consisting of a combined use of WhatsApp and Instagram appeared to be most prevalent among the youngest participants. Further, individuals using at least one social media platform were generally younger, more often female, and more extraverted than non-users. Small differences in Conscientiousness and Neuroticism also emerged across groups reporting different combinations of social media use. Interestingly, when examined as control variables, we found demographic characteristics partially accounted for differences in broad personality factors and facets across different patterns of social media use. Our findings are relevant to researchers carrying out their studies via social media platforms, as sample characteristics appear to be different depending on the platform used.

Keywords: Facebook, Instagram, WhatsApp, individual differences, Big Five personality traits

INTRODUCTION

Currently, about 2.7 billion individuals use at least one of the Facebook-owned platforms (Newsfeed.org, 2019). With 2.4 billion current users, Facebook still represents the platform with the largest outreach, followed by WhatsApp (1.6 billion), and Instagram (one billion), both also owned by Facebook (Statista.com, 2020). Because they provide different features to their users (Gazit et al., 2019), different Facebook-owned platforms tend to reach individuals with different demographic backgrounds. Regarding gender, Facebook and Instagram show a higher prevalence of female users compared to male users (Perrin and Anderson, 2019), while the WhatsApp audience appears to be more gender-balanced (Statista.com, 2019). Comparing the users between the platforms, Instagram is characterized by a higher prevalence of adolescent and young adult users compared to both the WhatsApp and Facebook platforms (Perrin and Anderson, 2019; Statista.com, 2019).

Personality is an important factor for many life outcomes (for an overview, see Montag and Elhai, 2019), including links to Internet use and its diverse applications (Hamburger and Ben-Artzi, 2000; Kuss et al., 2014; Montag and Reuter, 2017), and is relatively time stable (e.g., Edmonds et al., 2008). Therefore, recent studies have aimed at determining personality's role in explaining individual preferences for social media use, typically focusing on Big Five personality traits (e.g., Ljepava et al., 2013; Montag et al., 2015b; Brailovskaia and Margraf, 2016; Taber and Whittaker, 2018; Sindermann et al., 2020a). In particular, findings indicate that, compared with non-users, Facebook users report higher scores on extraversion (Ryan and Xenos, 2011; Brailovskaia and Margraf, 2016; Sindermann et al., 2020a), higher neuroticism and openness (Taber and Whittaker, 2018), and lower conscientiousness scores (Ryan and Xenos, 2011; Sindermann et al., 2020a), although the findings are not always consistent across studies. Regarding the association between the Big Five traits and preferences for Instagram and WhatsApp use, existing findings are scant. Although inconclusive, findings from existing studies appear to be in line with those of Facebook users: Instagram users have been found to show higher neuroticism (Gazit et al., 2019) compared to non-users, while WhatsApp users tend to be more extraverted and less conscientious than non-users (Montag et al., 2015b).

Although they provide important findings, the studies mentioned above have mostly only reported findings concerning the associations between personality and individual preferences for a single, specific platform. As such, they failed to investigate differences between groups characterized by different combinations of social media preferences, including those individuals using all the platforms, or none of them. In view of this limitation, in the present study we aim (to our knowledge for the first time) (1) to examine the relative prevalence of groups characterized by different combinations of use of Facebook-owned platforms (i.e., Facebook, Instagram, and WhatsApp) and (2) to investigate whether user groups differ on certain sociodemographic characteristics and Big Five personality traits.

Can we expect significant differences in the distribution of demography and personality across groups of individuals characterized by different patterns of social media use? This

question is highly relevant because more and more research is conducted based on samples recruited from these social-media platforms. Thus, it is important to understand whether online samples can be expected to differ on key individual characteristics depending on the platform used for online recruitment. Beyond that, other reasons exist to study the present research question. Currently it is highly debated how social media platforms impact society via filter bubbles and fake news. For instance, Facebook precisely studies the online behavior of each of its users. They do this to be able to present users a personalized news feed, likely to prolong online time on their platform (Montag et al., 2019). This in turn leads to more of a person's data being monetized by selling the digital profiles of users to the marketing industry (see also Matz et al., 2017). In the realm of politics, liking content of political figures or certain parties could result in radicalization, because users are not confronted with differing world views (Pariser, 2011). Beyond that, fake news is known to be spread via social media (Lazer et al., 2018). Logically, people who abstain from using social media will be less prone to fall for such false information, because they are less likely to get in touch with such news. Although the present work is not able to ultimately answer who falls for fake news (Pennycook and Rand, 2020) or who in particular is prone to the effects of the filter bubble [or echo chamber; see recent work by Sindermann et al. (2020b)], it can at least inform on who decides to use what social media platform or abstains from using them at all.

Although other popular platforms exist beyond those owned by Facebook (e.g., Snapchat, Twitter, China's WeChat, and TikTok), we decided to focus the present study on Facebook-owned platforms because of their overwhelming reach in terms of number of active users worldwide, whether taken individually or combined together.

MATERIALS AND METHODS

Procedure and Participants

Study data was collected by administering an anonymous questionnaire via an online web survey research platform (SurveyCoder by Christopher Kannen)¹, and employing a cross-sectional data collection design. As we aimed to recruit a large, demographically heterogeneous sample, the research was advertised by both national and local German-speaking media outlets (TV, radio, press, and Internet). Recruitment was performed using a convenience sampling approach. Participation in the research was voluntary. The survey included questions on demographic variables, use of Facebook-owned platforms, and personality. Participants were informed that the survey would take 20 to 45 min to complete. No monetary reward was offered to participants; however, as an incentive to participate in the present research project, participants were provided with automated, personalized feedbacks on their personality, smartphone, and social media use. All participants were required to provide informed electronic consent prior to participation. Additionally, participants below the age of 18 stated that their legal guardians

¹<https://ckannen.com/>

approved their participation. The study was approved by the local Ethics Committee of Ulm University, Ulm, Germany.

A total of $N = 3092$ German-speaking participants filled in questionnaires on the online platform. All participants reported owning a smartphone. $N = 89$ observations were removed because of missing data on either demographic variables ($N = 60$) or social media use variables ($N = 29$). Eventually, a sample of $N = 3003$ participants ($n = 1181$ males, $n = 1822$ females) remained. The mean age of the sample was 35.53 years ($SD = 13.53$) with a range from 12 to 79 years. We also collected information about education level (1, no graduation; 2, mainstreamed secondary school; 3, secondary school leaving (graduation) certificate; 4, vocational baccalaureate diploma; 5, A-level/High-school diploma; 6, university of applied sciences degree; 7, university degree). Please refer to the **Supplementary Material** for details on the distribution of educational level in the present sample (**Supplementary Table 3**).

Instruments

Use of Facebook-Owned Social Media Platforms

We asked participants to report about use of Facebook-owned social media platforms, i.e., Facebook, Instagram, and WhatsApp. More specifically, we asked participants to indicate if they currently used each platform (yes/no). A large majority ($N = 2829$, 94.21%) reported using at least one of the Facebook-owned platforms, while $N = 174$ (5.79%) reported using none. With $N = 2762$ users (91.97%), WhatsApp was the most widely used platform in the sample, followed by Facebook ($N = 1733$, 57.71%) and Instagram ($N = 1389$, 46.25%; these percentages do not add to 100%, because of non-mutually exclusive item endorsement).

Figure 1 shows a Venn diagram representing the prevalence of different patterns of social media use in the sample. Among participants reporting use of at least one of the platforms, the majority reported using WhatsApp, either alone ($N = 725$, 24.14% of participants) or in combination with both Facebook and Instagram ($N = 997$, 33.20%), Facebook ($N = 677$, 22.54% of social media users), or Instagram ($N = 363$, 12.09% of participants). Remaining groups were smaller: 38 participants (1.27%) only used Facebook, eight (0.27%) reported only using Instagram, while 21 (0.70%) reported using both Facebook and Instagram.

Big Five Inventory

In order to assess individual differences on the Big Five personality traits, we administered the German version of the Big Five Inventory (BFI, Rammstedt and Danner, 2016). The German BFI includes 45 items, including scales to assess Extraversion (8 items), Agreeableness (10 items), Conscientiousness (9 items), Neuroticism (8 items), and Openness (10 items). All items in the questionnaire are answered on a 5-point Likert-Scale ranging from 1 = “very inapplicable” to 5 = “very applicable”. Internal consistency estimates (using Cronbach’s alpha) in the final sample of $N = 3003$ participants were 0.86, 0.74, 0.83, 0.85, and 0.79 for Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness, respectively.

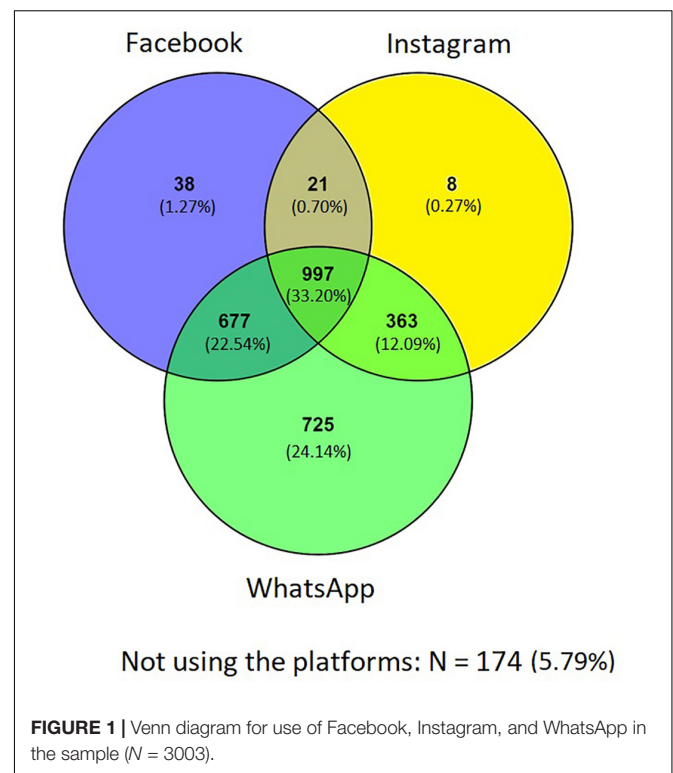


FIGURE 1 | Venn diagram for use of Facebook, Instagram, and WhatsApp in the sample ($N = 3003$).

In addition to the five broad factors, BFI items can be combined to generate scores for ten facet subscales, two for each trait: Assertiveness ($\alpha = 0.82$) and Activity ($\alpha = 0.57$) within the larger Extraversion factor; Altruism ($\alpha = 0.54$) and Compliance ($\alpha = 0.46$) within Agreeableness; Order ($\alpha = 0.65$) and Self-Discipline ($\alpha = 0.71$) within Conscientiousness; Anxiety ($\alpha = 0.76$) and Depression ($\alpha = 0.57$) within Neuroticism; and Aesthetics ($\alpha = 0.77$) and Ideas ($\alpha = 0.57$) within Openness. Due to the limited number of items for each subscale, score reliability is known to be modest (Soto and John, 2009; Rammstedt and Danner, 2016).

Data Analysis

First, we computed descriptive statistics on study variables. We computed means, standard deviations, minimums and maximums for all continuous variables (age, Big Five broad personality traits, and facets), and frequency counts for categorical variables (gender, education level). We present this information in the **Supplementary Material** (**Supplementary Tables 1–4**).

Next, we explored associations between different patterns of use of Facebook-owned social media platforms, and both demographic variables (i.e., gender, age, and education level) and personality traits. In order to pursue this aim, we created a multinomial variable grouping individuals by different patterns of social media use. Given the small sample size of participants reporting only using Facebook ($N = 38$), Instagram ($N = 8$), or both Facebook and Instagram ($N = 21$), we decided not to include these groups in the analyses examining between-group differences in demographic variables and personality traits.

However, we still report information about the distribution of study variables across all groups in the **Supplementary Material (Supplementary Tables 1–3, 5)**.

Then, one-way analysis of variance (ANOVA) with *post hoc* pairwise comparisons (Bonferroni-corrected) was used to inspect age-related differences by patterns of social media use. A Chi-Square test was used to examine differences in the distribution of demographic variables (gender, educational level) across the groups, while Z-tests with a Bonferroni correction were used to perform pairwise multiple comparisons.

Next, we used multivariate analysis of variance (MANOVA) to assess differences in Big Five traits, and their facets, according to different patterns of social media use. First, we performed the analyses by including all five broad personality traits (Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness) as dependent variables in a single MANOVA model. Then we performed the same analysis including the ten facets as dependent variables in a single MANOVA model. In both cases, between-group analyses were performed twice. First, we computed the analysis by examining only the effect of the grouping variable distinguishing between different patterns of social media use; next, we computed the analysis by also controlling for the effect of age (continuous covariate), and gender and education level (categorical factors; please note that the interaction between categorical factors were not included in the model). At each step, Wilks' criterion was used to assess the overall significance of effects. Additionally, to assess pairwise differences between groups within each personality trait, estimated marginal means for each group (both unadjusted and adjusted for other factors and covariates) were compared with Bonferroni-corrected nominal p -values ($p < 0.05$). SPSS statistics version 23 was used for all analyses.

RESULTS

Association Between Patterns of Social Media Use and Demographic Variables

Figure 2 provides a visualization of the association between different patterns of social media use and the variables of age, gender, and education levels. With regard to age, one-way ANOVA results supported the existence of strong age-related differences between groups [$F(4, 2931) = 155.067, p < 0.001, \eta^2 = 0.175$]. *Post hoc* tests (see **Figure 2A**) indicated that no significant mean age difference existed between participants reporting no social media use and those using only the WhatsApp platform, but these two groups showed higher mean age estimates compared to the remaining groups, which in turn all differed significantly from each other. Among these groups, participants reporting use of Instagram and WhatsApp, but no Facebook use, showed the lowest mean age; those reporting use of both WhatsApp and Facebook showed the highest mean age; and those using all platforms fell in between these two groups of age.

There was a significant association between gender and patterns of social media use ($\chi^2(4) = 43.78, p < 0.001$, Cramer's $\nu = 0.122$). Pairwise comparisons (**Figure 2B**) indicated that among participants using none of the platforms there was a

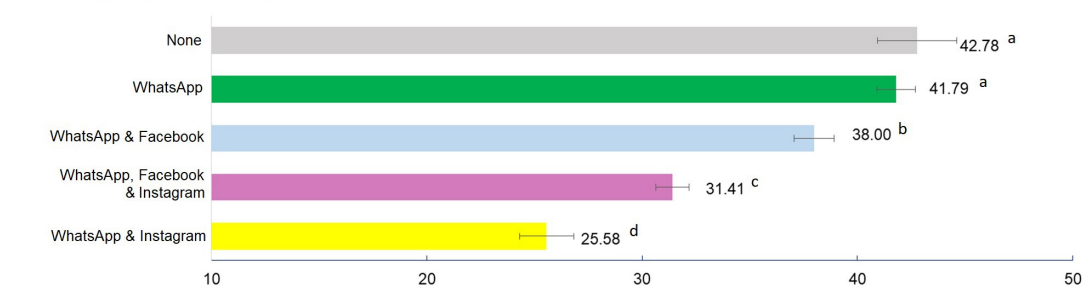
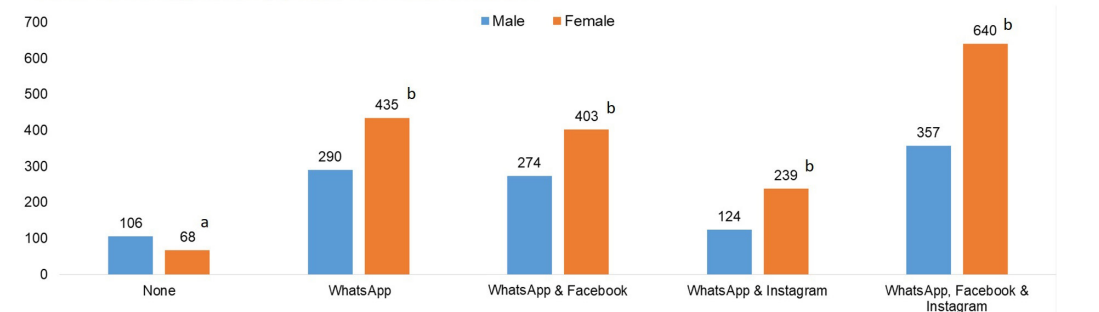
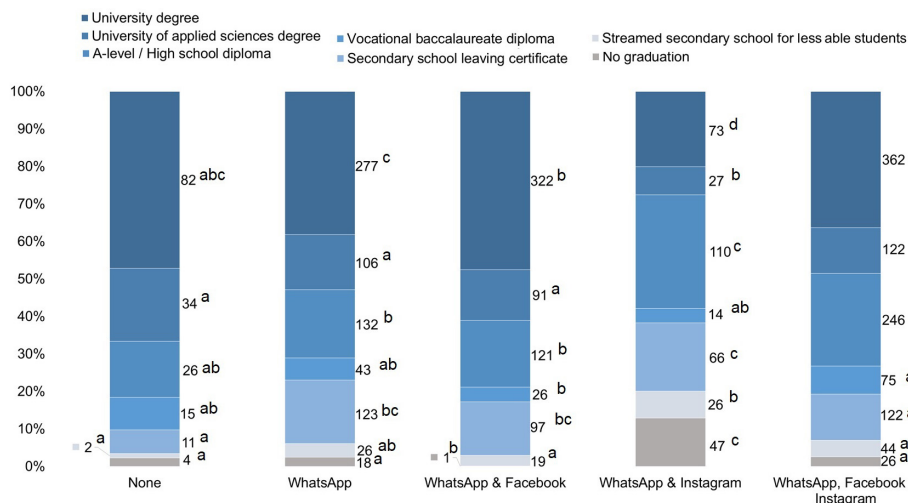
higher frequency of males than females, while the opposite was found in all other groups. No other significant contrast emerged between the groups.

Finally, we also found a significant association between education level and different patterns of social media use ($\chi^2(24) = 272.156, p < 0.001$, Cramer's $\nu = 0.152$). Pairwise comparisons of education level across patterns of social media use are shown in **Figure 2C**. We found a higher proportion of individuals holding a university degree among participants reporting using only WhatsApp, or a combination of Facebook and WhatsApp, when compared with participants reporting use of WhatsApp and Instagram. Further, holding a university degree was more prevalent among those using WhatsApp and Facebook when compared to those reporting use of WhatsApp only, and those using all platforms. Interestingly, holding a university degree appeared to be more prevalent among participants using all platforms when compared with those using a combination of only WhatsApp and Instagram (but this is likely confounded with age, because older persons are more likely to hold a higher education degree). Regarding individuals holding a university of applied sciences degree, we found a lower prevalence among those using a combination of WhatsApp and Instagram when compared with all the other groups, except for participants using all platforms. Individuals holding an A-level/high school diploma were more likely to use a combination of WhatsApp and Instagram when compared with all the other groups, except for participants reporting use of all platforms.

Participants reporting use of only WhatsApp, and those using both Facebook and WhatsApp, also showed a lower prevalence of holding an A-level/high school diploma when compared with participants reporting use of all platforms. Individuals holding a vocational baccalaureate diploma were more prevalent among those reporting use of all platforms when compared with those reporting use of WhatsApp and Facebook. Holding a secondary school leaving graduation certificate was more prevalent among participants using a combination of WhatsApp and Instagram than among those using all platforms, and those using none. This latter group also showed a lower prevalence of holding a secondary school leaving certificate than those using only WhatsApp, and those using a combination of WhatsApp and Facebook. Attending mainstreamed secondary school for lesser able students was more prevalent among participants using a combination of WhatsApp and Instagram than those using both WhatsApp and Facebook, and those using none of the platforms. Finally, individuals yet to have graduated were more prevalent among those using both WhatsApp and Instagram than among all the other groups, and showed a lower prevalence among those reporting using WhatsApp and Facebook when compared with all the other groups.

Differences in Big Five Personality Traits by Pattern of Social Media Use

Next, we explored between-group differences in Big Five personality scores by patterns of social media use. Here, we present results for broad personality traits. Because of the low score reliability found for many of the Big Five personality

A Mean age by pattern of social media use**B Distribution of gender by patten of social media use****C Education level by pattern of social media use**

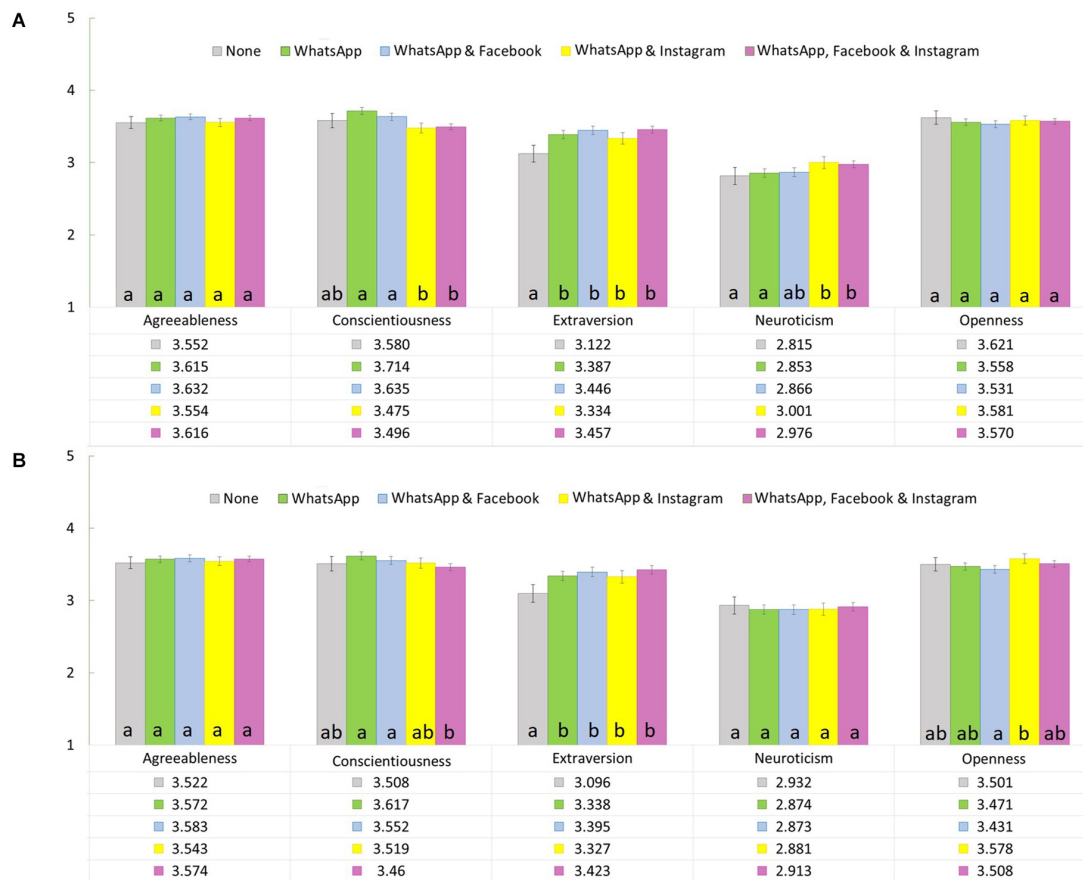
Note. Different letter markings indicate significant ($p < .05$) between-group differences. In panel (a), 95% confidence intervals are reported.

FIGURE 2 | Associations between patterns of social media use and age (Panel **A**), gender (**B**), and education level (**C**). In panel (**A**), 95% confidence interval are reported. Different letter markings indicate significant ($p < 0.05$) differences by pattern of social media use. An example: In Panel (**C**), prevalence of participants with a university degree is found to differ between the WhatsApp & Facebook group (b marking) and the WhatsApp group (c marking), while both these groups do not differ from the group reporting not using the platforms (abc marking).

facets, results concerning facet scores are presented in the **Supplementary Material (Supplementary Presentation 1)**.

In the MANOVA without control variables, platform use group membership was mildly related to Big Five broad personality traits [$Wilks' \lambda = 0.953$, $F(20, 9708.71) = 7.032$,

$p < 0.001$, $\eta^2 = 0.012$]. Significant differences emerged in Extraversion [$F(4, 2931) = 8.144$, $p < 0.001$, $\eta^2 = 0.011$], Conscientiousness [$F(4, 2931) = 14.949$, $p < 0.001$, $\eta^2 = 0.020$], and Neuroticism [$F(4, 2931) = 5.042$, $p < 0.001$, $\eta^2 = 0.007$]. In turn, there were no significant differences in Agreeableness



Note. Adjusted marginal means are estimated controlling for age, gender, and education level. Different letter markings indicating significant between-group differences ($p < 0.05$)

FIGURE 3 | Unadjusted (A) and adjusted (B) estimated marginal means and 95% confidence intervals for Big Five personality traits by pattern of social media use. Adjusted marginal means are estimated controlling for age, gender, and educational level. Different letter markings indicate significant between-group differences ($p < 0.05$).

[$F(4, 2931) = 1.764, p = 0.133, \eta^2 = 0.002$] and Openness [$F(4, 2931) = 0.972, p = 0.422, \eta^2 = 0.001$] between the groups.

Pairwise contrasts comparing estimated marginal means among groups with different patterns of platform use are shown in **Figure 3A**. Regarding Extraversion, participants reporting not using any of the platforms showed significantly lower scores than all other remaining groups using at least one of the investigated social media platforms. There were no differences in Extraversion across the remaining groups. Regarding Conscientiousness, participants using both WhatsApp and Instagram, as well as those using all the platforms (WhatsApp, Facebook, and Instagram) showed lower scores than those reporting only using WhatsApp, as well as both WhatsApp and Facebook. There were no differences on the Conscientiousness trait between participants reporting no platform use and all the other groups. With respect to Neuroticism, participants using both WhatsApp and Instagram, as well as those using all platforms (WhatsApp, Facebook, and Instagram) had higher scores than those reporting only use of WhatsApp, or no platform at all. There were no

differences between participants reporting both WhatsApp and Facebook, compared to the other groups.

When including control variables in the MANOVA, the overall relationship between different patterns of social media use and personality traits was reduced [Wilks' $\lambda = 0.972, F(20, 9682.18) = 4.200, p < 0.001, \eta^2 = 0.007$]. Among the control variables, gender showed a large effect [Wilks' $\lambda = 0.849, F(5, 2919) = 103.721, p < 0.001, \eta^2 = 0.151$]. Education level [Wilks' $\lambda = 0.952, F(30, 11678.00) = 4.802, p < 0.001, \eta^2 = 0.010$] and age [Wilks' $\lambda = 0.980, F(5, 2919.00) = 12.215, p < 0.001, \eta^2 = 0.020$] also showed significant effects. In the adjusted model, differences in social media use were still related to differences in Extraversion [$F(4, 2923) = 6.995, p < 0.001, \eta^2 = 0.009$], and Conscientiousness [$F(4, 2923) = 5.925, p < 0.001, \eta^2 = 0.008$]. However, after including control variables, there were no between-group differences on Agreeableness [$F(4, 2923) = 0.658, p = 0.621, \eta^2 < 0.001$] and Neuroticism [$F(4, 2923) = 0.508, p = 0.730, \eta^2 < 0.001$], while a new, small between-group effect emerged for the Openness trait [$F(4, 2923) = 3.508, p = 0.007$,

$\eta^2 = 0.005$]. Estimated marginal means were then subjected to pairwise comparisons. Regarding Extraversion, the overall pattern was the same found when inspecting the unadjusted contrasts (**Figure 3B**). Regarding Conscientiousness, results were similar to those observed in the unadjusted contrasts, except for the group of participants using both WhatsApp and Instagram, which no longer showed a significant mean difference between the groups using only WhatsApp, or both WhatsApp and Facebook. Regarding Openness, the group of participants using both WhatsApp and Instagram reported higher scores than participants only using WhatsApp and Facebook, while other contrasts were not significant.

DISCUSSION

The present work aimed at (1) investigating the prevalence of groups of social-media users characterized by different combinations of use of Facebook-owned social media platforms, namely Facebook, WhatsApp, and Instagram, and (2) examining differences in sociodemographic characteristics and personality traits among emerging groups. To pursue this aim, we grouped individuals based on emerging combinations of self-reported social media preferences, and evaluated the significance of between-group differences in the distributions of gender, age, education levels, and Big-Five personality traits. We believe this study to be of relevance, because most previous studies exclusively focused on one social media platform, yet many users spend their time on different social media platforms. Hence, the nature of social media use is more complex than many studies suggest.

Concerning specific platforms use prevalence, we found that 91.97% of the sample used WhatsApp, making it the most used platform (a finding that fits previous findings, Montag et al., 2015b), followed by Facebook (57.71%), and Instagram (46.25%). Instagram use was in general scarcer, reflecting also international user numbers (Statista.com, 2020). Regarding the prevalence of different combinations of social media use, our data show that the largest group of individuals was the one using all Facebook owned platforms (33.20%). Other frequent combinations of social media use resulted in a group of people only using WhatsApp (24.14%), a combination of WhatsApp and Facebook (22.54%), and a combination of WhatsApp and Instagram (12.09%). Overall, the vast majority of Facebook and Instagram users also used at least one of the other Facebook-owned social media platforms (99.42% of Instagram users; 97.81% of Facebook users), while WhatsApp users were less likely to use other Facebook-owned platforms (73.75% of WhatsApp users).

Next, we found that sociodemographic variables such as age and gender varied significantly according to the specific pattern of social media use reported by participants. In our study, age showed the strongest association with individuals' social media use, with non-users and WhatsApp users being the oldest group, and participants using both WhatsApp and Instagram being the youngest. Overall, our findings support the assumption that Instagram attracts the younger user generation. Further, our findings show that females are more strongly

represented on social media – no matter which social media combination is investigated, which is also coherent with previous findings (e.g., Andreassen, 2015). The education findings are not further discussed now, because we believe them to be strongly confounded with age. To illustrate this point, Instagram use is more often reported in groups with lower education levels, but these persons are also younger – hence are still often attending school.

From a personality psychology perspective, findings from the present study clearly highlight that social media users differ in extraversion from non-users. This is the most robust finding with respect to the Big Five, also underlining the idea that extraverts have a stronger need for social interaction, which might result in them choosing to use social media to communicate with others via this digital channel in order to fulfill their needs for bonding. Both Extraversion facets drive this effect (see **Supplementary Material, Supplementary Presentation 1**), with non-users reporting to both be less active and assertive when compared with social media users.

We also found that individuals using all social media platforms or simply WhatsApp and Instagram (hence also the younger persons; see **Figure 2A**) had the lowest conscientiousness scores. This is not surprising, as low conscientiousness is known to have a direct relationship with tendencies toward Internet Use Disorders, which in turn are strongly characterized by social media use (Montag et al., 2015a; Müller et al., 2017; Sha et al., 2019). Supplementary analyses showed this effect was especially pronounced for Conscientiousness' order facet; hence, individuals using all Facebook-owned platforms tend to be less orderly and diligent.

Finally, we found Neuroticism was significantly higher among individuals using all platforms, or just WhatsApp and Instagram, compared to those reporting using no platform, or just WhatsApp. Interestingly, the association between Neuroticism and social media use when controlling for demographic variables would suggest an underlying confounding effect.

Overall, findings from the present study highlight the role of Extraversion in explaining differences in social media use vs. non use. These findings are coherent with those reported by studies examining Big Five personality traits and use of specific social media platforms (e.g., Ryan and Xenos, 2011; Montag et al., 2015b; Brailovskaia and Margraf, 2016; Sindermann et al., 2020a). Further, going beyond previous studies, we found that the Neuroticism and Conscientiousness traits were also related to the combined use of different social media platforms, which in turn suggests that distinct links emerging from previous studies may well reflect a common underlying association between these traits and individual differences in the inclination toward social media use. Still, it is worthy to note that although the described personality associations fit well with the literature, between-group differences were generally small-sized and could be detected due to the large sample size.

Limitations

The present study has several limitations, which need to be addressed. First, our sampling strategy used to recruit

participants involved convenience sampling. Hence, limited inference can be derived from the present study regarding the actual prevalence of different patterns of social media use in the reference population. However, because of the large sample recruited, results about the association between emerging different patterns of social media use and both demographic variables, and personality traits, appear to be quite robust. An additional limit of the present study relates to its focus only on Facebook-owned platforms. Nevertheless, we believe the focus to be relevant, because these platforms are currently the most successful and important ones in terms of numbers of active users (Statista.com, 2019). Still, other platforms such as Snapchat, Twitter, or recently also Chinese platforms including WeChat (Montag et al., 2018) and TikTok, have been steadily increasing in popularity. The correlational nature of the present work represents another relevant limitation, preventing us from obtaining insight into cause-effect mechanisms or how personality relates to different types of platform usage (hence activity patterns). Finally, associations between facet levels of the Big Five and social media usage need to be handled with caution, as internal consistency was in the lower range of acceptability. Despite these shortcomings the present work is much needed, because it provides insight from a bird's eye view on who has an account on the different social media platforms owned by Facebook.

Conclusion

In sum, the present work shows social media users of Facebook's platforms to be younger, more likely female, and more extraverted compared to non-users. Our findings might be of relevance when research is carried out via social media platforms, because sample characteristics might be biased. Extending previous findings (e.g., Rife et al., 2016), we found that significant differences in the observed distributions of demographics and personality traits can be observed depending on the specific combination of social media platforms used by participants. These findings have practical implications, because biases in the distributions of demographics and personality may affect results concerning the distribution of variables of interest, as well as their associations (e.g., behaviors, Dash et al., 2019; intelligence, Jacobs

et al., 2012); abilities, Soh and Jacobs, 2013; and health, Feldman et al., 1999). Our findings might also be of relevance when aiming to understand who is at risk of falling for fake news. Logically, participants who abstain from using social media apps should receive less contact with fake news that are shared online. With respect to filter bubbles, it is highly interesting that Sindermann et al. (2020b) recently observed that low conscientious and high neurotic people have higher tendencies to also inform themselves only via the news feed on social media. Fittingly, those persons are also those who more likely end up using multiple social media applications.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the **Supplementary Material**.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethic Committee of Ulm University.

AUTHOR CONTRIBUTIONS

CM designed the present study. DM analyzed the data and wrote the "Materials and Methods" and "Results" sections. CM drafted the "Introduction" and "Discussion" sections, which were later edited and revised by DM, JE, and CS. CS checked independently all statistics. All authors worked over the manuscript and critically revised it.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2020.00936/full#supplementary-material>

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Conflict of Interest: CM mentions that he is part of a discussion circle (Digitalität und Verantwortung: <https://about.fb.com/de/news/h/gesprachskreis-digitalitaet-und-verantwortung/>) debating ethical questions linked to social media, digitalization and society/democracy at Facebook. In this context, he receives no salary for his activities. Finally, CM currently is an independent researcher on the scientific advisory board of the Nymphenburg group. For this activity he is financially compensated.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Should We Pay for Our Social Media/Messenger Applications? Preliminary Data on the Acceptance of an Alternative to the Current Prevailing Data Business Model

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In the age of surveillance capitalism, the prevailing business model underlying the use of social media applications (“apps”) foresees the exchange of personal data for the allowance to use an online service. Such a data business model comes with many potential negative side effects ranging from violation of privacy issues to election manipulation. Therefore, it is of utmost importance to think of alternatives to the current data business model. The present study investigated how strong the support would be for a monetary payment model among a sample of 210 participants. Participants were asked about their willingness to pay for social media, if in turn their data would be private and other problems concerning social media use would be tackled. Only one-fifth of participants (21.43%) supported such a model. From the Big Five personality traits, Agreeableness was positively associated with support of such a model. Finally, data are also provided on how much participants would be willing to pay for social media on a monthly basis. The present study’s findings are of a preliminary nature and will contribute to the start of an important discussion.

Keywords: data business model, surveillance capitalism, social media, big five, personality, payment model

INTRODUCTION

It has been estimated that 3.8 billion humans used social media¹ and messenger services in 2020 (We Are Social et al., 2020). The most popular platforms in the Western part of the world derive from Facebook Inc. (We Are Social et al., 2020). Facebook owns not only the Facebook platform itself, but also Instagram and the messenger application WhatsApp. In the Eastern part of the world, in particular in China, WeChat dominates the market (Montag et al., 2018; We Are Social et al., 2020).

Although different social media platforms and messenger apps exist offering various functions and content to their users, the prevailing business model to earn money is the data business

¹Of note, despite existing definitions, for the present work the term social media is used to explicitly refer to platforms such as Facebook and Instagram, whereas messenger apps/services refer to instant messenger services such as WhatsApp (Howard and Parks, 2012; Carr and Hayes, 2015).

model. In short, users can use an online service in exchange for their data being used by the platform operators. Such digital footprint data are studied and analyzed by the social media and messenger app companies by means of algorithms, and the online profiles are sold to the marketing industry in order to enable them to engage in microtargeting (Kirkpatrick, 2016; Matz et al., 2020). Microtargeting entails sending a customized promotional message to an individual. In this regard, one study estimated that advertisers pay around \$25 CPM (cost per mille; costs per 1,000 impressions) to reach an average user (but differences in the prices exist) (Papadopoulos et al., 2017). The data business model has been highly criticized because it raises ethical questions in the area of privacy and also encourages developers to design platforms which are “addictive” (Burt, 2019; Montag et al., 2019; for the addictive potential of platforms see Sha et al., 2019; Sindermann et al., 2020a,b). This is due to more time being spent on the platforms, leading to more user data being assessed, which in turn leads to better predictions of the users’ preferences through the algorithms used.

Finally, some of the elements of social media platforms, such as the newsfeed, are designed to show users what they like (based on the assumptions drawn from the digital footprints left on the platform) to make the users spending more time on the platform (Montag et al., 2019). This personalization of content has several advantages, such as the “automatic” reduction of content that users are not interested in without the need for users to filter all the information available on their own. Still, benefits to the user are not clear, resulting in attenuation of privacy concerns (Aguirre et al., 2016). Personalization can also result in problems such as filter bubbles (Sindermann et al., 2020c). Of importance, personalized content (whether personalized by algorithms or by the users themselves) may be associated with radicalization and might even undermine democracy, especially if users decide to inform themselves about the political news exclusively via social media (Sunstein, 2004; Stroud, 2010; Bozdog and van den Hoven, 2015).

In the age of surveillance capitalism (Zuboff, 2015, 2019) it is of high importance to think of alternatives to the prevailing data business model because social media blurs the boundaries between the public and the private. By being inclusive, status-disregarding, discourse-generating, and theme-comprehensive, social media as virtual communities involve the entire spectrum of necessary preconditions for a public sphere (Habermas, 1998). Platforms such as Facebook and Instagram can be considered virtual communities (Rheingold, 1993) which perform the function of a public sphere, allowing individuals to come together to share experiences and opinions, driving democracy via freedom of speech and assembly (Habermas, 1998). Therefore, social media platforms are not merely a public sphere, but can be considered the *ideal* public sphere.

Given this important role of social media, it is questionable to what extent social media companies should provide this public sphere on their own, without other provisioning and regulatory bodies’ involvement (e.g., the European Union, other governmental institutions, and NGOs). Researchers have called for stronger regulation of social media companies (Griffiths et al., 2018). Moreover, the General Data Protection Regulation

recently adopted in the European Union and the European Economic Area Regulation (EU 2016/679) is a first step in ensuring data privacy and additional measures need to be taken to give back control over users’ privacy rights. This may include replacing the data business model with a monetary payment model investigated in the present study. This would likely reduce the aforementioned negative side-effects of the data business model because in exchange for the allowance to use a social media service actual money is being paid (e.g., via a subscription model as successfully used by Netflix and Spotify; Netflix as cited in Statista, 2020; Spotify, 2020). As a consequence, companies such as Facebook would need to refrain from selling social media users’ data to the marketing industry.

Of note, several studies examining the willingness to pay for specific (personal) data exist (Carrascal et al., 2013; Egelman et al., 2013; Schreiner and Hess, 2015). For example, a study on web browsing reports that users value their online browsing history at around €7 (Carrascal et al., 2013). Another study by Schreiner and Hess (2015) reported that perceived usefulness and trust in a fictive premium version of Facebook with more privacy protection functions positively influenced how much participants were willing to pay for this fictive premium version of Facebook. However, within and across studies it is important to note that privacy behavior must be seen as a contextual phenomenon (Acquisti et al., 2013; Carrascal et al., 2013; Morando et al., 2014) dependent among others to an extent on how relevant, trustworthy, value-added, and engaging personalization is currently perceived by users (Aguirre et al., 2016).

Based on this background literature, the present study aimed to answer two specific questions: (i) what proportion of users would support such an alternative business/monetary subscription model for social media offers and messenger apps, and (ii) do specific sociodemographic and personality variables predict support for such a model (numerous studies report associations of demographics and personality with various social media use variables; Montag et al., 2015; Kuss and Griffiths, 2017; Sindermann et al., 2020a). The study is necessarily of an exploratory nature. Therefore, no hypotheses were formulated given the scarce literature on this topic.

MATERIALS AND METHODS

Procedure and Sample

The present dataset was collected via an online survey investigating several research questions dealing with the topics of smartphone use, social media use, and news consumption (programmed with the Survey Coder platform²³). The link to the study was advertised offline (e.g., on television and radio) as well as online (e.g., via social media and websites of news agencies) and participation was voluntary. Therefore, the participants in the present study form a convenience sample. As an incentive, participants of the study received anonymous feedback, for example on their scores on the Big Five of Personality in

²<https://www.surveycoder.com/>,

³<https://ckannen.com/>

comparison to the average scores of the other participants of the study. All participants provided informed consent prior to participation. The study followed the guidelines of the German Society for Online Research⁴.

After data cleaning (see **Supplementary Material**), the final sample comprised $N = 210$ participants ($n = 117$ males; $n = 91$ females; $n = 2$ “third gender”). The mean age of the sample was 35.82 years ($SD = 12.30$ years; median = 33.50 years) with a range from 18 to 73 years. Approximately half of the participants indicated university degree as their highest educational degree ($n = 108$). The other participants stated a university of applied sciences degree ($n = 22$), or some kind of school degree ($n = 80$) as their highest educational degree.

Materials

Big Five Inventory

To assess the Big Five of Personality, the German version of the Big Five Inventory (BFI) was applied (Rammstedt and Danner, 2017). It comprises 45 items answered on a five-point Likert-Scale from 1 (“very inapplicable”) to 5 (“very applicable”). The 45th item concerning disputes with others (which is unique to the German version of this instrument) was not included in the final analyses to allow for closer comparability with other studies. Despite the possibility of calculating subscale scores of each broad Big Five factor to assess sub-facets, the present work will focus on the broad Big Five factors. The internal consistencies (Cronbach’s alphas) of the five scales in the present sample were 0.82, 0.83, 0.88, 0.75, and 0.86 for Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, respectively.

Willingness to Pay for Social Media/Messenger Services

The willingness to pay for social media/messenger services was assessed in two ways. First of all, four items on the willingness to pay a monthly usage fee for social media (such as Facebook and Instagram) were assessed. These included the willingness to pay (i) “if thereby it is ensured that my data accrued there are not used for marketing purposes,” (ii) “if thereby it is ensured that my data accrued there are better protected,” (iii) “if thereby it is ensured that the social media offers are designed in a way that does not aim to prolong the time users spend online,” (iv) “if thereby it is ensured that the problem of fake news and radicalization is reduced.” Each item was answered on a five-point Likert-Scale from 1 (“strongly disagree”) to 5 (“strongly agree”). The scores in the four items were collapsed into one aggregate scale with an internal consistency (Cronbach’s alpha) of 0.89. For the results of a principal component analysis, please see **Supplementary Material**. The items are presented in English and German language in **Tables 1, 2**. The German version was used in the present study.

Additionally, participants were asked to indicate how much money (in Euros) they were willing to pay per month for a single social media service such as Facebook and Instagram. The same question was also asked about paying for a single messenger service.

TABLE 1 | Questionnaire assessing the willingness to pay for social media (WtP-SM) in English language.

I am willing to pay a monthly usage fee (money) for social media services such as Facebook or Instagram, if thereby it is ensured that my data accrued there are not used for marketing purposes.

I am willing to pay a monthly usage fee (money) for social media services such as Facebook or Instagram, if thereby it is ensured that my data accrued there are better protected.

I am willing to pay a monthly usage fee (money) for social media services such as Facebook or Instagram, if thereby it is ensured that the social media offers are designed in a way that does not aim to prolong the time users spend online.

I am willing to pay a monthly usage fee (money) for social media services such as Facebook or Instagram, if thereby it is ensured that the problem of fake news and radicalization is reduced.

The items are answered on the following response scale: “strongly disagree”, “disagree”, “neither agree nor disagree”, “agree”, “strongly agree”.

TABLE 2 | Questionnaire assessing the willingness to pay for social media (WtP-SM) in German language.

Ich bin bereit für Social Media Angebote wie beispielsweise Facebook oder Instagram pro Monat eine Nutzungsgebühr (Geld) zu bezahlen, wenn dadurch sichergestellt wird, dass meine dort anfallenden Daten nicht für Marketing-Zwecke genutzt werden.

Ich bin bereit für Social Media Angebote wie beispielsweise Facebook oder Instagram pro Monat eine Nutzungsgebühr (Geld) zu bezahlen, wenn dadurch sichergestellt wird, dass meine dort anfallenden Daten besser geschützt werden.

Ich bin bereit für Social Media Angebote wie beispielsweise Facebook oder Instagram pro Monat eine Nutzungsgebühr (Geld) zu bezahlen, wenn dadurch sichergestellt wird, dass die Social Media Angebote so gestaltet sind, dass sie nicht auf die Verlängerung der Online-Zeiten der Nutzer abzielen.

Ich bin bereit für Social Media Angebote wie beispielsweise Facebook oder Instagram pro Monat eine Nutzungsgebühr (Geld) zu bezahlen, wenn dadurch sichergestellt wird, dass das Problem der Fake News und Radikalisierung reduziert wird.

The items are answered on the following response scale: “stimme überhaupt nicht zu”, “stimme nicht zu”, “weder noch”, “stimme zu”, “stimme absolut zu”.

Statistical Analyses

First, descriptive statistics of all variables of interest were calculated. The skewness and kurtosis of all Big Five scales and the aggregate score on whether participants were willing to pay for social media (such as Facebook and Instagram) were below ± 1 , indicating a normal distribution (Miles and Shevlin, 2001). However, the skewness and kurtosis of the two items asking about how much participants would be willing to pay per month were much higher. Therefore, boxplots of these variables were inspected and some univariate outliers were identified. More specifically, scores outside the boxplot

⁴https://rat-marktforschung.de/fileadmin/user_upload/pdf/R08_RDMS.pdf

whiskers (set according to the formula by Tukey (1977): {25th-Quantile – [1.5 × (75th-Quantile – 25th-Quantile)]} and {75th-Quantile + [1.5 × (75th-Quantile – 25th-Quantile)]}) were identified as outliers.

For these participants (in total $n = 7$), the actual response was replaced by the highest score, which was still identified as non-outlier (i.e., €12.50). Of note, completely excluding the seven participants from the analyses did not markedly change the main results. However, it slightly reduced the mean values of the two items on how much participants were willing to pay. Moreover, it reduced effect sizes and increased p -values of some correlations between personality and payment variables. For example, the correlation between Agreeableness and the aggregate score on whether participants were willing to pay for social media (such as Facebook and Instagram) was $r = 0.17$ and $p = 0.016$ in the sample of 203 participants. After dealing with the outliers, the skewness and kurtosis of both variables in parts still exceeded ± 1 . Exceeding a value of ± 1 indicates a violation of the normal distribution assumption (Miles and Shevlin, 2001). This was also underlined by significant values utilizing Shapiro–Wilk tests (although this test is biased towards significance due to the sample size). Finally, the histograms clearly indicated a non-normal distribution (see **Supplementary Material**). Consequently, non-parametric analyses were used to investigate these two items, and parametric analyses for the remaining tests.

Associations of all variables of interest with age and gender were calculated. Pearson's correlations were used to calculate correlations of age with the Big Five and the aggregate score on whether participants were willing to pay for social media (such as Facebook and Instagram) (see aforementioned assumption of a normal distribution). Spearman's correlations were calculated for the associations of age with the two items asking about how much participants would be willing to pay per month (see aforementioned violation of criteria to assume a normal distribution). To examine gender differences in the Big Five and the aggregate score on whether participants were willing to pay for social media (such as Facebook and Instagram), t -tests were calculated (Welch's t -tests if equal variances could not be assumed based on a Levene's test; see aforementioned assumption of a normal distribution). Gender differences in the two items asking about how much participants would be willing to pay per month were investigated by Mann–Whitney U -tests (see aforementioned violation of criteria to assume a normal distribution).

Finally, correlations between personality and the aggregate score on whether participants were willing to pay for social media were calculated by means of Pearson's correlations corrected for age (see section “Results”). To examine the associations between personality and how much money participants would be willing to pay for social media (such as Facebook and Instagram), and messenger services per month, Spearman's correlations corrected for age were calculated. All correlations are presented for the total sample and for males and females separately. Due to the low number of participants stating “third gender” as their designated gender identity, no separate results for this group are presented.

RESULTS

Descriptive Statistics, Associations With Age, and Gender Differences

Descriptive statistics are presented in **Table 3**. Moreover, **Figure 1** shows the proportion of participants who were not willing to pay (scores 1.00–2.50), were neutral (scores 2.51–3.50), or were willing to pay (scores 3.51–5.00) according to the aggregate score.

Age correlated significantly with Openness ($r = 0.16$, $p = 0.025$), Conscientiousness ($r = 0.19$, $p = 0.007$), and Neuroticism ($r = -0.15$, $p = 0.029$), as well as with the amount of money participants were willing to pay per month for a messenger service ($r_s = -0.15$, $p = 0.027$). Gender differences were found in Extraversion and Neuroticism only. Females had higher scores than males in both scales (see **Table 3**).

Correlations Between Personality and Willingness to Pay for Social Media/Messenger Services

As can be seen in **Table 4**, the only significant associations were found between Agreeableness and the willingness to pay for social media (such as Facebook and Instagram) and the amount of money participants would be willing to pay for a messenger service. These correlations were positive and the effect sizes were rather small. The association between Agreeableness and the amount of money participants were willing to pay for social media (such as Facebook and Instagram) just failed to be statistically significant.

Investigating the same associations among males and females separately (**Table 5**) showed similar results among males. More specifically, moderate positive associations between Agreeableness and all variables on the willingness to pay for social media and messenger services were found among males only. Among females, all associations were non-significant.

When applying a very strict Bonferroni correction, none of the correlations remained significant (e.g., $0.05/15 = 0.003$; because the Big Five scales were associated with three scales/items on the willingness to pay for social media/messenger services). However, this is a strict correction procedure and it should be noted that the rather small present sample size (especially when split by gender) had an impact on statistical significance.

DISCUSSION

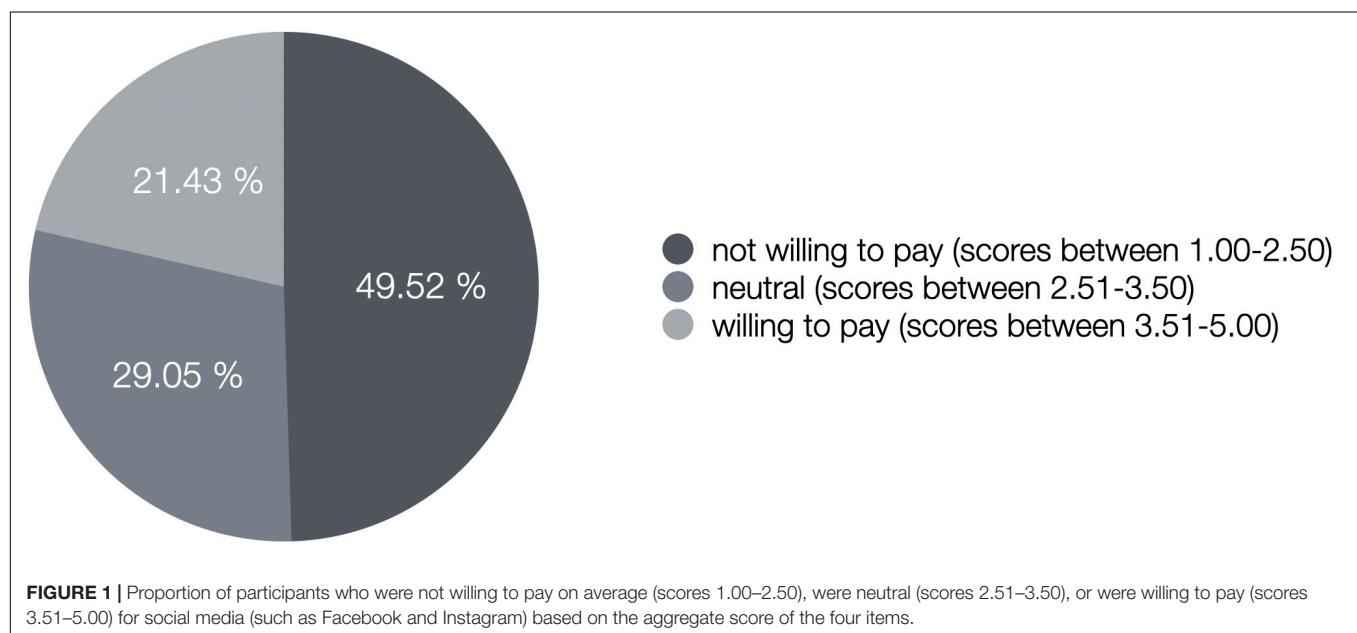
The present study examined how strong a social media user's support would be for an alternative model to the data business model which is currently being used by almost all social media companies. Beyond obtaining first insights into such support, the study also aimed to understand which socio-demographic variables and personality traits predicted support for such an alternative (i.e., paying for an online service with money).

In the present sample, approximately one-fifth of the participants (21.43%) stated they were willing to pay money (e.g., via a monthly subscription fee) for a social media online service. Of the participants, 29.05% were indecisive, whereas

TABLE 3 | Descriptive statistics of all variables of interest and differences between males and females.

	Total sample (N = 210)		Males (n = 117)	Females (n = 91)	Differences between males and females
	M (SD)	Median	M (SD)	M (SD)	
Openness	3.79 (0.64)	3.80	3.80 (0.63)	3.77 (0.66)	$t(206) = 0.30, p = 0.766, d = 0.04$
Conscientiousness	3.40 (0.66)	3.33	3.32 (0.60)	3.49 (0.73)	$t(172.91) = -1.71, p = 0.089, d = 0.24$
Extraversion	3.28 (0.84)	3.38	3.17 (0.85)	3.41 (0.82)	$t(206) = -2.08, p = 0.039, d = 0.29$
Agreeableness	3.58 (0.59)	3.67	3.55 (0.55)	3.60 (0.64)	$t(206) = -0.67, p = 0.502, d = 0.09$
Neuroticism	2.70 (0.79)	2.75	2.52 (0.76)	2.93 (0.79)	$t(206) = -3.81, p < 0.001, d = 0.53$
Willingness to pay	2.65 (1.13)	2.75	2.58 (1.12)	2.73 (1.14)	$t(206) = -0.95, p = 0.344, d = 0.13$
Amount of monthly social media fee	2.22 (2.96)	1.00	2.15 (2.95)	2.36 (3.01)	$W = 5,059.5, p = 0.520, r = -0.04$
Amount of monthly messenger fee	2.40 (2.73)	1.25	2.59 (2.84)	2.20 (2.59)	$W = 5,742.5, p = 0.320, r = 0.07$

Willingness to pay: aggregate score of four items on whether participants were willing to pay for social media (such as Facebook and Instagram); amount of monthly social media fee: how much money participants would be willing to pay for one social media service, such as Facebook and Instagram, per month; amount of monthly messenger fee: how much money participants would be willing to pay for one messenger service per month. Two participants stated "third gender" as their gender identity and are not included in this table due to the low number of individuals in this group; d = Cohen's D ; r = effect size for Mann-Whitney U-tests.



nearly half of the users stated that they were not willing to pay for such a service. This shows that paying money for social media in order to heighten privacy standards and reduce related problems such as radicalization finds no acceptance in a fairly large proportion of our investigated sample. It could be that either the majority of social media users (i) really do not care about privacy implications and just want to continue having free access to social media sites, or (ii) do not understand how their data is being used and/or exploited. Of additional interest, **Supplementary Table S3** shows the mean values of the single items asking participants about their willingness to pay in order to reduce the use of their data for marketing purposes, to ensure better data protection, to reduce prolongation of users' time spent online, and to reduce problems of fake news and radicalization. It turns out that individuals in the present sample were willing to pay most in order to reduce risks such as fake news and radicalization followed by

paying for higher data protection, decreased use of data for marketing purposes, and decreased prolongation of online time, in ascending order.

If the identified percentages on the (un)willingness to pay for social media services are replicated in large representative studies, measures need to be taken to ensure data protection on social media sites. One of the recommendations would be to create large campaigns which explain the value of privacy, and to support a monetary alternative business model. Otherwise, new alternatives must be thought of. Giving users the option to choose between a monetary payment option (to heighten privacy) and the data payment option might be such an alternative. However, adoption of such an approach will disadvantage individuals on lower incomes who may not have the financial means to pay for such subscriptions. The present research shows that the search for alternative business models to the prevailing data business models is just beginning and represents

TABLE 4 | Partial correlations between the Big Five personality traits and the items on the willingness to pay for social media and messenger services in the total sample.

	Total sample (N = 210)		
	Willingness to pay	Amount of monthly social media fee	Amount of monthly messenger fee
Openness	$r = 0.11, p = 0.098$	$r_s = 0.09, p = 0.175$	$r_s = -0.03, p = 0.616$
Conscientiousness	$r = -0.08, p = 0.280$	$r_s = -0.04, p = 0.592$	$r_s = -0.05, p = 0.477$
Extraversion	$r = -0.01, p = 0.846$	$r_s = -0.01, p = 0.907$	$r_s = -0.07, p = 0.288$
Agreeableness	$r = 0.20, p = 0.004$	$r_s = 0.13, p = 0.053$	$r_s = 0.16, p = 0.023$
Neuroticism	$r = -0.02, p = 0.805$	$r_s = -0.05, p = 0.495$	$r_s = -0.06, p = 0.409$

Willingness to pay: aggregate score of four items on whether participants were willing to pay for social media (such as Facebook and Instagram); amount of monthly social media fee: how much money participants would be willing to pay for one social media service, such as Facebook and Instagram, per month; amount of monthly messenger fee: how much money participants would be willing to pay for one messenger service per month; all correlations presented are corrected for age.

an important and timely research endeavor. New solutions are urgently needed.

A second aim of the present study was to understand if specific demographic and personality characteristics predict stronger support for a monetary payment model in the realm of social media use. Whereas age and gender played minor roles in predicting such support, higher Agreeableness was positively associated with support for a monetary payment model. Whilst among both males and females Agreeableness was positively associated with the variable *willingness to pay for social media* (association in females just failed to be significant but effect sizes are similar), Agreeableness was also positively correlated with the proposed monthly fee for the social media/messenger service only among males. However, these observations need to be replicated in other samples.

Although messenger apps such as WhatsApp can be considered part of the umbrella term social media (Kuss and Griffiths, 2017) participants were specifically asked how much money they would pay for a service such as Instagram versus WhatsApp. In line with the very large distribution of WhatsApp (currently 1.5 billion users vs. 1 billion Instagram users), participants indicated a slightly higher monthly fee they were willing to pay for messenger services compared to social media, such as Facebook and Instagram (although this might also be a function of age). In 2019, Facebook earned \$29.25 per user (at the moment of writing about €26.94; Facebook annual report as cited in Statista, 2020). Accordingly, roughly €2.50 per month would be required per user based on a subscription fee model to earn the same 2019 revenue. This number closely matches the mean provided by the participants of our sample (€2.22 for social media vs. €2.40 for a messenger service). From this perspective, the finding provides a good basis for discussions about a monetary payment model for social media/messenger services.

However, the present study's findings (despite methodological limitations analyzed below) demonstrate that monetizing a currently free service (or offering a subscription-based alternative one) in return for data privacy appears to have a weak base of support. Based on Social Exchange Theory (Thibaut and Kelley, 1959) purporting a cost-benefits analysis in driving human decisions, behaviors, and expectations, it could be hypothesized that the current perceived benefits of social media platforms and app services outweigh the potential negatives (e.g., privacy concerns and echo chambers) (Lowry

et al., 2011) and therefore users are reluctant to endorse a subscription-based model, solely on the proposition of safeguarding data privacy.

Instead, a monetized subscription-based business model offering commercial-free and data protected social exchanges could potentially find greater support if social media operators and regulators went beyond safeguarding data protection and rights of minors, into encouraging a more socially responsible social media business model. Equally with corporate social responsibility (CSR) initiatives in other industries – i.e., the food and beverage industry, which has endorsed healthier eating habits or more environmentally friendly agricultural and trading conditions (World Health Organization, 2004) – the greater promotion of user rights and representation, the reduction of poverty, social inequality, and greater access to media literacy, the prevention of sedentary lifestyles and obesity, radicalization, and the encouragement of social entrepreneurship could be just a few of the social media industry's CSR initiatives for a healthier platform ecosystem (Afridi and Joseph Rowntree Foundation, 2011; Paus-Hasebrink et al., 2019; Throuvala et al., 2020).

Governmental interventions in this direction have started to be enacted (Department for Digital Culture Media Sport, 2019) in line with mounting social pressures for greater accountability in some countries (5Rights Foundation, 2019; Information Commissioner's Office, 2019). Such measures would then render more tangible benefits to users, tapping into their basic psychological needs for autonomy, competence, and relatedness (Deci and Ryan, 1985). Additionally, an advertising-free, data protected and more socially responsible social media environment would potentially safeguard against technological burn-out (Peterka-Bonetta et al., 2019) triggered by information overload and impacting daily productivity (Duke and Montag, 2017; Rozgonjuk et al., 2020).

Higher regulation could also lead to diminished environmental/design triggers ("chasing" likes, followers), reinforcing prolonged user engagement and driving needs to control self-representation, content and relationships online (Throuvala et al., 2019a,b). Initiatives such as Instagram's trial to ban "likes" (Griffin, 2019) are steps in the right direction, but need to be followed by robust and more socially inclusive policies. If CSR benefits are appropriately channeled to end users, it is likely that an alternative

TABLE 5 | Partial correlations between the Big Five personality traits and the items on the willingness to pay for social media and messenger services among males and females.

	Males (<i>n</i> = 117)			Females (<i>n</i> = 91)		
	Willingness to pay	Amount of monthly social media fee	Amount of monthly messenger fee	Willingness to pay	Amount of monthly social media fee	Amount of monthly messenger fee
Openness	$r = 0.12, p = 0.208$	$r_s = 0.10, p = 0.281$	$r_s = -0.08, p = 0.406$	$r = 0.11, p = 0.307$	$r_s = 0.09, p = 0.386$	$r_s = 0.04, p = 0.687$
Conscientiousness	$r = -0.10, p = 0.301$	$r_s = -0.03, p = 0.721$	$r_s = -0.22, p = 0.018$	$r = -0.06, p = 0.570$	$r_s = -0.06, p = 0.583$	$r_s = 0.15, p = 0.160$
Extraversion	$r = 0.04, p = 0.639$	$r_s = 0.03, p = 0.740$	$r_s = -0.01, p = 0.912$	$r = -0.12, p = 0.268$	$r_s = -0.09, p = 0.409$	$r_s = -0.13, p = 0.221$
Agreeableness	$r = 0.21, p = 0.024$	$r_s = 0.25, p = 0.006$	$r_s = 0.26, p = 0.004$	$r = 0.20, p = 0.064$	$r_s = -0.01, p = 0.903$	$r_s = 0.07, p = 0.493$
Neuroticism	$r = -0.00, p = 0.976$	$r_s = -0.04, p = 0.632$	$r_s = 0.03, p = 0.716$	$r = -0.06, p = 0.551$	$r_s = -0.10, p = 0.368$	$r_s = -0.17, p = 0.101$

Willingness to pay: aggregate score of four items on whether participants were willing to pay for social media (such as Facebook and Instagram); amount of monthly social media fee: how much money participants would be willing to pay for one social media service, such as Facebook and Instagram, per month; amount of monthly messenger fee: how much money participants would be willing to pay for one messenger service per month. Two participants stated "third gender" as their gender identity and are not included in this table due to the low number of individuals in this group; all correlations presented are corrected for age.

monetary model offering data protection and CSR will be more convincing and widely accepted. This reflects evidence suggesting that a higher value is ascribed to more positive experiences vs. references to money, which are usually negative due to the reminder of the cost to acquire a product or service rather than the pleasure or benefit of using it (Mogilner and Aaker, 2009). Future studies may therefore examine further the feasibility of a more integrative monetary business model.

Finally, it is worth drawing attention to the privacy paradox. This paradox describes the tendency to not protect one's privacy (e.g., to disclose personal data) despite being concerned over one's privacy (Norberg et al., 2007). For example, a study by Woodruff et al. (2014) investigated associations between generic privacy attitudes and responses to several hypothetical scenarios and outcomes. The study found that individuals categorized as privacy fundamentalists (high concern), pragmatists (mixed concern), and unconcerned (no/little concern) did not differ in their likelihood to disclose data in any of the scenarios or depending on outcome. Although the present study did not directly assess privacy concerns or actual behavior, one can interpret the willingness to pay as intention for a specific privacy protective behavior, while acknowledging a potential hypothetical bias between willingness to pay and users' real intentions (Schmidt and Bijmolt, 2020). Therefore, whether individuals would ultimately actually pay for social media or messenger services remains debatable (for more information on the privacy paradox, see the review by Kokolakis, 2017).

The present study has several limitations, which need to be addressed. As mentioned, the study is not of representative nature and the sample size is rather small. This is also one of the reasons why the analyses were not run separately for the groups with different educational background (in addition to separately for gender). Another reason for this decision was that the level of education was unequally distributed in the present sample. Therefore, larger studies need to be conducted in this area. The study is viewed by the authors as a first step to start an important discussion in this area. Beyond this, the study is correlational in nature. Therefore, no causal interpretation between the variables is possible. The data were also of a self-report nature, therefore common method biases (such as social desirability) may have influenced the findings. Moreover, the results may also differ depending on geographical location, including Asia, where average earnings may be lower in comparison to Germany, and the respective sociocultural context may impact the results. In addition, many more factors putatively associated with the willingness to pay for social media services should be taken into account in future studies (Malhotra et al., 2004). For example, willingness to pay may depend upon whether individuals need to use social media platforms in the work context and upon an individual's income. Finally, the effects of an option to actively allow big technology companies to use one's data (i.e., by a "pay by sharing your data" option) should be further investigated in future studies. An additional item in a future survey would be to ask if individuals would be willing to pay to hinder third party

apps to collect data about the user of a social media platform, although such apps might be helpful to run surveys such as the present one (Kalimeri et al., 2020; but see also differences across social media user groups as reported in Marengo et al., 2020).

DATA AVAILABILITY STATEMENT

All datasets present in this study are available at the Open Science Framework: <https://osf.io/wehmj/>. Moreover the datasets are uploaded alongside this article in the **Supplementary Material (Supplementary Table S1)**.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their

electronic informed consent to participate in this study prior to participation.

AUTHOR CONTRIBUTIONS

CM and CS designed the present work. CM drafted the first version of the Introduction and Discussion. CS wrote the Methods and Results, and conducted the statistical analysis, which were independently checked by CM. DK, MT, and MG critically revised the first draft of the manuscript. All authors approved the final version of this work.

SUPPLEMENTARY MATERIAL

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Career as a Professional Gamer: Gaming Motives as Predictors of Career Plans to Become a Professional Esport Player

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Increasing numbers of young video gamers view esports (i.e., competitive video gaming) as a career opportunity, rather than just a recreational activity. Previous studies have explored the motivational differences between esports and recreational gamers and the motivational changes through career journey to become a professional esports player. The present study explored the predictors of career plans to become a professional esports player, with a specific focus on gaming motivations. Gaming time, gaming motivations, and esports-related playing experience were also examined among Hungarian gamers with competitive gaming experience ($N = 190$), such as years spent in esports, medium and frequency of participating in esports tournaments, the effort put into training before the tournaments, and the plans to become a professional esports player. Binary logistic regressions were carried out and results showed that the gaming motivations of competition, skill development, and social motivations predicted career planning as a professional esports player. Additionally, results showed that younger players were more likely to seek career opportunity as professional esports players than older players. Future studies should focus on novice esports players' psychological exposure to the hypercompetitive scene of esports, such as high expectations or the risk of becoming problematic videogame users due to their motivational changes.

Keywords: eSports, professional video gaming, mental health, gaming motivations, career planning

INTRODUCTION

Although research in videogames predominantly focuses on problematic use or addiction (Király et al., 2017; Rumpf et al., 2018; Müller et al., 2019), playing videogames is a recreational activity for most gamers, and it can even be a highly paid job for a minority of them who master their game-related skills and become professional esports players sponsored by well-known companies (e.g., Coca Cola, T-Mobile). Esports (i.e., electronic sports) refers to competitive video gaming where teams or individuals compete against each other in a videogame. It is now considered by some to be a sporting activity in which gamers can develop and train their mental skills and hand-eye coordination while playing (Hemphill, 2005; Wagner, 2006; Jonasson and Thiborg, 2010; Adamus, 2012). Esports started to gain popularity in the gaming community in the early 2000s (Bányai et al., 2019a), and today the number of esports consumers (i.e., actively participating in or watching

esport events) is 201.2 million (Newzoo, 2019). Furthermore, 1,757.5 million people have heard of esports without participating in it or viewing it (Newzoo, 2019). In the last 2 years, esport revenue (e.g., merchandise, tournament tickets, brands, media rights, sponsorship) also grew markedly. In 2017, the total revenue was \$655 million (US), while in 2019 there was a 26.7% increase from 2018 to \$1,096 million (Newzoo, 2019).

Competitive video gaming comprises organized esport tournaments with similar rules, systems, play, judging, and broadcasting like more traditional sporting events. Furthermore, professional esport players face similar training requirements as other sporting athletes (Taylor, 2012). Esports can be played via LAN (local area network) when gaming devices are connected or online, and events are supported by sponsors, while the large audience can follow the games with live sport-commentary via streaming platforms (e.g., *Twitch*, *YouTube*, *Mixer*) (Taylor, 2012; Jenny et al., 2016; Hamari and Sjöblom, 2017). Due to the popularity of esports and being considered as a sport activity, some universities provide sport scholarships for professional players (e.g., University of California-Irvine and University of California-Berkeley). Furthermore, the Olympic Council of Asia has included esports in the official program of 2022 Asian Games of China (the follow-up event to the Olympic Games) (Hallmann and Giel, 2018).

According to a recent online survey with a convenience sample of 1814 Hungarian esport players, esport as career option is most popular among adolescents and young adults aged below 24 years (eNet, 2017), and esport players are mostly males (92%) (Newzoo, 2017). The popularity to seek a career in esports among aspiring young gamers is not surprising considering the high earning potential and the respect and fame given toward the top esport players. Earnings can include cash prizes for esport tournament participation and rewards, team salaries (average around \$3,000–5,000 per month, and up to \$15,000 per month in top tiers), sponsorship money (e.g., *Astralis Counter Strike* franchise and team ownership by *Audi*), streaming (e.g., viewers' subscription fees on streaming channels of individual esport players or esport event broadcasts via platforms like *Twitch*), media rights, merchandising, and tickets (Newzoo, 2019; TheStreet, 2019).

Seeking a career in esports means that in addition to being a hobby or a sporting activity, playing videogames competitively can also be considered as an individual's job. Professional video gaming as a career has given rise to considerable debate among researchers in the field. On one hand, Caillois (2001) argued that competing as a professional gamer can negatively affect the concept of video gaming as a free activity, because it may compromise the core elements of play (i.e., free, separate, uncertain, unproductive, regulated, and fictive). Following Caillois' work (2001), Brock (2017) highlighted that esports could cause gamers to be driven by more extrinsic motivations (e.g., rewards, prize pools of tournaments) than intrinsic ones (e.g., self-development, self-concept and identity, the rewarding nature of the activity itself) (Ryan and Deci, 2000; Ryan et al., 2006). On the other hand, previous studies have shown that even professional esport players, whose job it is to compete and perform at maximum gaming level against their

opponents, describe esports as "serious leisure" (i.e., intermediate activity between work with beneficial implications and casual leisure) (Seo, 2016) and are driven by intrinsic motivations such as improving their in-game skills, and making esports part of their identity (Kim and Thomas, 2015).

Motivations that drive gamers to play videogames competitively are also important in influencing players to pursue esports as a career choice. Therefore, research is not only needed to identify the core motivations of professional esport players, but also to examine which motivations are most associated with gamers' aspiration to become professional esport players.

Previous studies have highlighted that intrinsic motivations and acquiring an esport player identity can be a detrimental part of becoming a professional. To acquire an esport player identity, Seo (2016) found in field observation and interview sessions with 10 professional esport players that aspiring gamers view playing videogames as a casual leisure activity (i.e., playing for fun), gain interpersonal relationships within the esport community, and as their skills and knowledge improve, esports gradually becomes an important aspect of their lives and their identity. Seo (2016) also found that the main characteristics of esport players who choose competitive gaming as a career were the celebration of mastering skills, pursuit of self-improvement, importance of fairness, equality, respect in the community, experiencing high self-esteem, accomplishment, and recognition.

Kim and Thomas (2015) also examined how motivations (intrinsic, extrinsic), goals, and learning style of professional esport players change during the process of becoming professionals. Following their interviews with professional esport players, their team coaches, team director, and psychological consultant, five different stages of becoming an esport player were identified. The motivational pattern of the gamers changed during each phase. For a beginner in the esports scene, the activity of gaming itself is motivating enough. Through gaining more experience as well as struggles with winning and losing, meeting more experienced opponents, and competing in videogames itself, gaming loses its fun factor. However, by developing greater competency, the enjoyment of gaming intrinsically motivates experienced esport players. Nevertheless, Kim and Thomas (2015) drew attention to the need to distinguish casual players and esport players based on the change in their motivational patterns. More specifically, competing in top tiers should be considered as work and it is usually driven by extrinsic motivation (e.g., tournament prizes, rewards, and fame) rather than intrinsic motivation.

Two recent studies investigated different aspects of gaming motivations comparing esport players with casual gamers. Martončík (2015) highlighted, that professional gamers compete in videogame playing to satisfy their life goals (i.e., intimacy, affiliation, altruism, power, achievement, and diversion). Affiliation (i.e., the need to help others, being in active interaction, and relation with others) differentiated esport players from casuals most probably because esport players tend to develop meaningful relationships with team members, and other members of the esport scene. Moreover, diversion motivation (i.e., the need for excitement, tension, and new experiences) also drives esport players more than casual players to compete

in playing videogames. Furthermore, those professionals who were leaders of the esports teams also satisfied their need for power by holding the leader position. In a more recent study, Bányai et al. (2019b) found that esports players played more (i.e., longer game times on weekdays and weekends) and scored higher in social (i.e., developing and maintaining relationships with other gamers), competition, and skill-development motives than casual gamers.

In addition, research among traditional sportsmen has shown similar results. More specifically, the motivational pattern of sport has both intrinsic and extrinsic aspects. Traditional sports athletes enjoy the competition itself, internalize the professional athlete identity, and constantly strive for self-improvement, but can also be motivated by extrinsic motivations, such as prizes or fame (Baker et al., 2009; Van De Pol and Kavussanu, 2012; Pelletier et al., 2013; Rottensteiner et al., 2015; Clancy et al., 2016; Lochbaum et al., 2016).

In summary, previous studies have reported that competition, seeking challenge, social factors, and the drive for self-development are core motivations among professional esports players. Furthermore, esports players have different motivations than casual players, and that these motivations change during their career path. Nevertheless, the findings of previous studies still raise the question as to which motivations are most important in the initial stages of becoming an esports professional. Therefore, the present study explored the predictors of career plans to become a professional esports player among gamers with competitive videogame playing experience. Drawing upon previous literature, the present study specifically focused on motives as possible predictors of career planning. The identification of relevant predictors is likely contribute to the growing body of literature on the increasingly researched area of esports by providing an insightful examination of motives associated with professional videogame playing.

MATERIALS AND METHODS

Participants and Procedure

Participants were recruited from the largest gaming community in Hungary (GameStar.hu). Data were collected using an online survey that specifically focused on competitive gaming experiences. The survey was available in Hungarian, therefore participants came from countries with Hungarian-speaking population, such as Hungary, Romania, or Slovakia. Prior to survey completion, respondents were informed about the general aims of the research and that participation was voluntary. Respondents were requested to provide informed consent by ticking a box if they were over 14 years of age and agreed to the terms. For underage participants (those below 18 years of age), parental approval was also required. As an incentive, two 60,000 HUF-worth (approximately €200) of shopping vouchers were raffled off among participants. The study was approved by the Institutional Review Board of the research team's university and was carried out in accordance with the Declaration of Helsinki (World Medical Association, 2018).

A total of 190 participants with a history of competitive gaming experience completed the survey. All respondents were male aged between 14 and 52 years ($M_{age} = 21.6$ years, $SD = 6.2$). Participants had spent an average of 12–13 years in education ($M = 12.6$ years, $SD = 3.1$). A considerable proportion of participants studied ($n = 75$; 39.5%), worked ($n = 59$; 31.1%), or studied and worked ($n = 52$; 24.7%) at the time of the data collection, while only four respondents (2.1%) were unemployed. Approximately half of the esports players in the sample were single ($n = 102$; 53.7%), 38.5% in an intimate relationship ($n = 73$), 5.8% were married ($n = 11$) and 2% did not provide information regarding their relationship status ($n = 4$).

Measures

Demographic Characteristics

Data concerning major demographic variables were collected including gender, age, the number of years spent in education, current educational study and/or work experience, and marital status.

Competitive Gaming Experience

Participants were asked to provide information about their competitive gaming activities such as the medium of the tournaments [1 = online, 2 = offline (LAN), 3 = offline and online], the number of years spent in competitive gaming as a participant of tournaments, the frequency of attendance in online and/or offline tournaments during the past year [1 = "I did not participate in such tournaments," 2 = "1–2 times," 3 = "3–5 times," 4 = "6–11 times," 5 = "a few times a month (1–3 times)," 6 = "weekly or more frequently"], the type of tournaments based on location (1 = international, 2 = national, 3 = regional, 4 = local tournaments), the effort put into training for the tournaments (1 = "I do not train myself for the tournaments, I just register when I wish to participate," 2 = "I train less than 1 h a day," 3 = "I train 1–2 h a day," 4 = "I train 2–4 h a day," 5 = "I spend more than 4 h training"), and whether the participant planned to pursue a career as a professional esports player [1 = "I do not plan," 2 = "yes, I am already planning," 3 = "yes, this is in progress (I have a team forming, being a professional esports player is within my reach)," 4 = "yes, I am already a member of a professional team/I am a professional esports player playing solo"].

Motives for Playing Online Games

The Motives for Online Gaming Questionnaire (MOGQ; Demetrovics et al., 2011) was used to assess players' motives. The 27-item MOGQ comprises seven subscales: social (four items; e.g., "... because I can get to know new people"), escape (four items; e.g., "... because it makes me forget real life"), competition (four items; e.g., "... because I like to win"), coping (four items; e.g., "... because it helps me get rid of stress"), skill development (four items; e.g., "... because it improves my skills"), fantasy (four items; e.g., "... to feel as if I was somebody else"), and recreation (three items; e.g., "... because it is entertaining"). Participants were asked to indicate why they played online games using a five-point Likert scale (ranging from 1 = "never" to 5 = "almost always/always"). Higher scores indicate stronger motivation to play online games for the respective aspect.

Statistical Analysis

Data analysis was performed using IBM SPSS version 22.0 (IBM SPSS Inc., Chicago, Illinois). Participants who reported plans to pursue a career as a professional esports player [i.e., those who selected 2 = “yes, I am already planning,” 3 = “yes, this is in progress (I have a team forming, being a professional esports player is within reach, or 4 = “yes, I am already a member of a professional team/I am a professional esports player playing solo” for the question of whether they planned to pursue a career as a professional esports player] were considered as players with plans to become a professional esports player (coded as 1 in the binary logistic regression analysis) ($n = 72$, 37.9%), while participants who had no career plans (i.e., selected 1 = “I do not plan” for the same question as above) were considered as players who had no plans to pursue a career as a professional esports player (coded as 0 in the binary logistic regression analysis) ($n = 118$, 62.1%).

Pearson correlations were carried out to explore associations between motives for playing online games. The strength of correlations is interpreted according to Evans (1996): $r = 0.00$ – 0.19 “very weak,” 0.20 – 0.39 “weak,” 0.40 – 0.59 “moderate,” and 0.60 – 0.79 “strong.” Provided that several moderate and strong correlations were found between motives, two separate binary logistic regressions were performed. In the single-predictor model, age was treated as a control variable, whereas predictor variables were added separately to the model, which resulted in a regression analysis wherein inter-correlations among predictor variables were not allowed. Therefore, associations between motives had no impact on the results. By contrast, all predictor variables were added in the analysis at the same time in the multiple-predictor model, meaning that inter-correlations between variables were allowed, and which may influence the results.

RESULTS

Descriptive Statistics

With regard to the specifics of competitive gaming experiences, the vast majority of players participated in online tournaments ($n = 184$; 96.8%), and only a small minority of players participated exclusively in offline (LAN) tournaments ($n = 6$; 3.2%) (see Table 1 for details).

On average, players spent 3–4 years in competitive gaming (ranging from 0 to 18 years). Participation in offline and online tournaments varied across players during the past year. Nearly half of the sample did not participate in offline tournaments in the past year (43.7%), while the majority of players participated in online tournaments at least 1–3 times a month ($n = 156$; 82.1%). In relation to the location of tournaments, overlapping categories were used indicating that a considerable proportion of players participated in international, national, regional, and local tournaments. The effort put into training for the tournaments varied across players. More than one-third of respondents reported they did not train for the tournaments ($n = 68$; 35.8%), while nearly half of them ($n = 92$; 48.5%) trained for at least 1 h a day preceding the tournaments. With regard to career plans, more than one-third of players had plans to become a

TABLE 1 | Descriptive statistics of competitive playing experiences among male players with a history of competitive playing activities.

	Participants (<i>N</i> = 190)
Medium of the tournaments <i>n</i> (%)	
Offline (LAN)	6 (3.2%)
Online	114 (60.0%)
Offline (LAN) and online	70 (36.8%)
Years spent in competitive playing	
<i>Mean (SD)</i>	3.5 (3.6)
Frequency of attendance in tournaments in the past year <i>n</i> (%)	
Offline tournaments	
Weekly or more frequently	12 (6.3%)
A few times a month (1–3 times)	34 (17.9%)
6–11 times	23 (12.1%)
3–5 times	15 (7.9%)
1–2 times	23 (12.1%)
No participation	83 (43.7%)
Online tournaments	
Weekly or more frequently	56 (29.5%)
A few times a month (1–3 times)	100 (52.6%)
6–11 times	19 (10.0%)
3–5 times	7 (3.7%)
1–2 times	5 (2.6%)
No participation	3 (1.6%)
Participation in tournaments based on location in the past year <i>n</i> (%)	
International	90 (47.4%)
National	78 (41.1%)
Regional	57 (30.0%)
Local	87 (45.8%)
Training for the tournaments <i>n</i> (%)	
More than 4 h a day	15 (7.9%)
2–4 h a day	29 (15.3%)
1–2 h a day	48 (25.3%)
Less than 1 h a day	30 (15.8%)
No training	68 (35.8%)
Career plans <i>n</i> (%)	
Already member of a professional team/professional esports player	3 (1.6%)
In progress to become a professional esports player (team or solo)	19 (10.0%)
Already planning a career	50 (26.3%)
No career plans	118 (62.1%)

professional esports player ($n = 69$; 36.3%), although only three players were already a member of a professional team or a solo professional esports player (1.6%).

Correlations Between Motives for Playing Online Games

Means, standard deviations, and indices of internal consistency (Cronbach's alpha) relating to the subscales of the motive dimensions alongside the associations between motives are presented in Table 2.

TABLE 2 | Zero-order correlations among motives for playing online games ($N = 190$).

	Mean (SD)	α	1.	2.	3.	4.	5.	6.	7.
1. Social	2.75 (1.05)	0.87	–						
2. Escape	2.31 (1.13)	0.90	0.21**	–					
3. Competition	3.33 (1.12)	0.88	0.27***	0.28***	–				
4. Coping	3.03 (1.08)	0.84	0.27***	0.62***	0.21**	–			
5. Skill development	3.46 (1.08)	0.90	0.51***	0.23**	0.35***	0.43***	–		
6. Fantasy	2.85 (1.21)	0.87	0.28***	0.61***	0.26***	0.61***	0.34***	–	
7. Recreation	4.34 (0.71)	0.76	0.19*	0.24**	0.18*	0.42***	0.36***	0.39***	–

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Motives for playing online games were scored on a five-point Likert scale ranging from 1 to 5.

All seven motives were positively associated. The strongest associations were observed for escape, coping, and fantasy on one hand, and between social and skill development motives on the other. The weakest associations were found between recreation and social and competition motives. Given that significant associations were found between motives (mostly weak and moderate associations with a few strong associations) which could possibly influence the results of a binary logistic regression analysis in which all variables are entered at the same time, two separate logistic regressions (i.e., a single-predictor model and a multiple-predictor model) were conducted in the following steps.

Binary Logistic Regressions

In order to explore possible predictors of career planning as a professional esports player among players with competitive gaming experience, binary logistic regression analysis was performed between players who had no plans to pursue a career as a professional esports player ($n = 118$, 62.1%) and players who had career plans ($n = 72$, 37.9%). In the first step, motives were added separately to the model while adjusting for age. Results are presented in **Table 3**.

Results of the single-predictor model showed that three motives were significant predictors of career plans: social,

skill development, and competition. This result indicates that high levels of the motivation to enhance social relationships, develop gaming-related skills, and compete with others predict career planning as a professional esports player among players with a history of competitive gaming experiences. The strongest predictor was competition, followed by skill development, and social motives. However, these motives explained only a small proportion of the total variance of players' career plans (Nagelkerke R^2 was below 0.20 for all three motives).

In the second step, a multiple-predictor model was tested in which age and motives for online playing were added to the model at the same time, allowing for intercorrelations between predictor variables. In contrast to the first regression model, the association between age and career plans was marginally significant, indicating that being younger in age was associated with a greater likelihood of planning a career as a professional esports player. The strongest predictor of career planning was again the motive of competition. Additionally, skill development also predicted career plans to be a professional esports player. The social motive just failed to reach the level of significance in this model ($p = 0.09$), while coping negatively predicted career plans. This result suggests that players with higher coping motives are less likely to have plans to become a professional

TABLE 3 | Binary logistic regression models predicting plans to pursue a career as a professional esports player ($N = 190$).

	Single-predictor model				Multiple-predictor model		
	B	SE	OR (95% CI)	Nagelkerke R^2	B	SE	OR (95% CI)
Control variable							
Age	−0.05	0.03	0.95 (0.90; 1.00)	0.03	−0.06	0.03	0.94 (0.88; 1.00) [†]
Motives for playing online games							
Social	0.45	0.15	1.57 (1.16; 2.11)**	0.09	0.34	0.20	1.40 (0.95; 2.05)
Escape	−0.10	0.14	0.91 (0.69; 1.19)	0.03	−0.05	0.21	0.95 (0.63; 1.44)
Competition	0.67	0.16	1.95 (1.44; 2.65)***	0.17	0.66	0.17	1.94 (1.38; 2.72)***
Coping	−0.19	0.15	0.82 (0.62; 1.10)	0.04	−0.51	0.25	0.60 (0.37; 0.99)*
Skill development	0.49	0.16	1.63 (1.20; 2.22)**	0.10	0.52	0.23	1.68 (1.07; 2.64)*
Fantasy	−0.06	0.13	0.94 (0.73; 1.21)	0.03	−0.15	0.21	0.86 (0.58; 1.30)
Recreation	0.02	0.21	1.02 (0.67; 1.54)	0.03	−0.17	0.29	0.85 (0.48; 1.49)

Nagelkerke R^2 of the model: 0.29

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; [†] $p = 0.05$. SE, standard error; OR, odds ratio; CI, confidence interval. In single predictor models, motives for playing online games were entered separately in the regression analysis while controlling for age. Reference category is "players who have no plans to pursue a career as a professional esports player" coded as 0 ($n = 118$, 62.1% of the total sample).

esport player than players with lower coping motives. However, it should be acknowledged that intercorrelations between motive dimensions could have influenced the results of this analysis. Furthermore, the explanatory power of motives in the total variance of career planning was again relatively low, indicating that 29% of the total variance of career planning is explained by age and motives for online playing (Nagelkerke R^2 was 0.29).

DISCUSSION

The present study explored the possible predictors of a career as a professional esport player among videogame players with competitive gaming experience. It drew on previous studies' findings, which highlighted that the motivational pattern of professional esport players included competition and self-improvement related motives, such as competing, seeking challenges, obtaining and maintaining relationships, and the willingness to develop one's own skills (Kim and Thomas, 2015; Seo, 2016). The findings of the present study highlighted that higher levels of competition, skill-development, and social motives predicted career planning to become professional esport player. Moreover, younger players were more likely to seek career opportunities as professional esport players than older players with competitive gaming experience.

According to the recent study, competition was the most powerful predictor among gaming motivations for aspiring esport players to become professionals. According to Kim and Thomas (2015), the motivation to compete can be beneficial through obtaining the esport player's identity and help to maintain the career, even if the professional esport players struggle with losing. Moreover, during the process of becoming an esport player, playing the game itself can be rewarding and can motivate the gamers intrinsically, which means competing with others in an esport game can help esport players in their early career (i.e., the enjoyment stage) and also later on when they need to cope with winning and losing (i.e., the achievement stage) (Kim and Thomas, 2015).

Skill-development also appears to play a large role in becoming a professional esport player. It is not just an intrinsic motivation that drives esport players to challenge themselves and master their skills in an esport game, but also the requirement to adapt to the changes of videogame mechanics, rules and playstyles of the opponents, and to their team-members, which is ultimately key to being (and remaining) successful. Skill-development includes the willingness to obtain deep knowledge about game mechanics, strategic thinking, and quick decision-making, as well as being motivated to keep playing and competing, and maintaining a growth mindset (Himmelstein et al., 2017). Skill-development can be meaningful for professional esport players. As Seo (2016) highlighted, during the stage of personal transformation called "*the road of trials*," esport players develop and specialize their skills and knowledge about the game itself and its mechanics, and their attitude changes from viewing esport as a leisure activity to focus on practice.

Social motivations, such as obtaining and maintaining relationships with esport team members, gaming community members, and even opponent esport players can be also beneficial for aspiring esport players who seek a career opportunity. Martončík (2015) highlighted, that esport players satisfy their affiliation life goals (i.e., the need to help others, interact with others) more than casual gamers, which means that being more sociable can be a requirement for an esport player to be successful in the esport community (e.g., developing friendly relationships, being supportive, and being a real team-member).

The coping motive, which was associated negatively with the career plan to become professional esport player, also confirms the different approach in how casual gamers and aspiring players with competitive gaming experience view their video gaming activity. Coping motivation means that videogames are played to get rid of daily stress (Demetrovics et al., 2011). However, previous studies have highlighted that esport players usually describe esport as "serious leisure" (i.e., intermediate activity between work and casual leisure) even if they enjoy the gaming itself (Kim and Thomas, 2015; Seo, 2016; Bányai et al., 2019b). This means that their aim is not to get rid of stress but to self-improve and be successful.

Limitations

Due to the voluntary participation in the current study, participants were self-selected and came from countries with Hungarian-speaking population, such as Hungary, Romania, or Slovakia. Therefore, sampling affects the generalizability and the representativeness of the results. In the present study, only male esport players were recruited. However, in the esport scene a small minority of female users are also present (8% of the competitors are female esport players) (Newzoo, 2017), and female esport players may have differed in their motivations to male esport players. Furthermore, planning to become a professional esport player was assessed utilizing a single-item question in the present study. However, according to the results of recent market research, a wide range of factors affect the career planning of an esports player besides ambition, such as the opportunity to test and master their skills, competition, self-development, the possible high income (prizes), fame, and becoming a community member (eNet, 2017; Pintér, 2018). Furthermore, experience in competitive gaming – which ranged from 0 to 18 years in the present sample – may also influence (further) career planning. Therefore, future research should focus on the influence of the different factors in esport career planning and should use more complex methods and measures to assess it.

Gaming motivations explained approximately 30% of the variance in the present study of esport career, but other factors such as social support (e.g., parental attitudes), availability of training opportunities in the region (e.g., scholarships, sport associations), cultural differences, and attitudes of the society toward esports (e.g., in South Korea esport players are widely respected as traditional sportsmen) also have a considerable explanatory power.

IMPLICATIONS AND CONCLUSION

Esport is not just gaining popularity in the gaming community, but also draws the attention from the representatives of traditional sports, big companies, and even the education sector (e.g., in the form of university scholarships). In this new era of video gaming, new professions have emerged, including professional esport players, esport managers, esport coaches, esport psychologists, esport sport commentators, and esport event organizers. Therefore, it is not surprising that esport is considered as a career option and is most popular among youth who represent the largest proportion of esport consumers (eNet, 2017). According to previous studies, which explored the identity transformation and motivational changes of esport players in order to become professionals (Kim and Thomas, 2015; Seo, 2016), it is important to stress that young gamers who enter this hypercompetitive gaming community have to deal with immense stress and expectations from team members, coaches, sponsors and the esport community itself. They have similar requirements and challenges as traditional athletes (Taylor, 2012), such as being sociable, competitive, and a willingness to invest time and practice in improving their skills. Furthermore, research suggests that esport players have similar motivational patterns to traditional sportsmen (e.g., intrinsic motivation meaning that the sport activity itself is rewarding, internalizing the professional athlete identity, and striving for self-improvement, as well as extrinsic motivation such as gaining respect and fame in the community, winning high prizes) (Baker et al., 2009; Van De Pol and Kavussanu, 2012; Pelletier et al., 2013; Rottensteiner et al., 2015; Clancy et al., 2016; Lochbaum et al., 2016).

Previous studies have shown that intrinsic motivations such as self-development and enjoying the game itself can help esport players during their professional career journey (from the very beginning to the top tier leagues) and cope with ongoing struggles (Kim and Thomas, 2015; Seo, 2016). Moreover, the findings of the present study highlighted that high levels of competition, skill development, and social motivations predicted initial career planning among esport players. These results highlight the importance of identifying specific motive patterns that can be predictive of long-term career plans among youth with a history of competitive gaming. The identification of such motive patterns (e.g., similarly high levels of social, skill development, and competition motives) constitute a reliable indicator of long-term career goals in young esport players, which can help sponsors and managers prepare for decisions about financial support or training programs that can improve the performance of professional esport teams.

Additionally, motive patterns can help coaches with a more nuanced understanding of attitudes, intentions, and behaviors that can contribute to more targeted and effective decisions about specific roles and positions within a team. In addition, the present findings highlight that the fostering of some specific motives in players may facilitate favorable attitudes toward esports as career. However, extrinsic motivations can also drive esport players' career plans (e.g., fame, rewards) and can lead professionals to pursue extrinsic rewards through

excessive videogame use. Increasing numbers of adolescents view esports as an activity from which they can make a professional living. From this perspective, novice esport players can also be affected by problematic use of videogames (Chung et al., 2019) due to the stress level of the hypercompetitive esport scene, high expectations toward them, and extrinsic motives (Bányai et al., 2019b). Moreover, the social context and individual vulnerability to problematic gaming and gaming disorder can also affect esport players, such as the level of experienced real life stress and related coping strategies (e.g., escaping/avoiding real life problems by playing video games), lower self-esteem (Kardefelt-Winther, 2014), additional mental health issues (e.g., depression, social anxiety) (Allison et al., 2006; Mehroof and Griffiths, 2010; Kneer et al., 2014; Király et al., 2018). Social features such as the quality of social support in the family, the presence or lack of meaningful relationships, and subjective wellbeing in the workplace or in education (Zhou and Li, 2009; Rehbein et al., 2010; Haagsma et al., 2012; Rehbein and Baier, 2013) could also influence novice esport players' video game usage. Consequently, future research should focus on esport players' psychological vulnerability, especially because this activity is more popular among youth who are generally in an identity transformation in their adolescence and young adulthood.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Research Ethics Committee of ELTE Eötvös Loránd University Faculty of Pedagogy and Psychology. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

FB, ÁZ, MG, and ZD contributed to the conception and design of the study. FB organized the database. ÁZ performed the statistical analysis. FB, ÁZ, and OK wrote the first draft of the manuscript. All authors contributed to manuscript revision, read and approved the submitted version.

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Mobile Internet Technologies, Ecological Momentary Assessment, and Intervention—Poison and Remedy for New Online Problematic Behaviors in ICD-11

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INTRODUCTION

Technological advancements often present new challenges to mental health and well-being while, at the same time, creating the possibility for new, effective interventions for its preservation, improvement, and recovery (1). In the current commentary, on one hand, we discuss the category of problematic behaviors for which mobile internet technologies have created an outlet. We also consider research challenges related to the conceptualization of these problems, as proposed by the World Health Organization (WHO) for the upcoming 11th revision of International Classification of Disorders (2). On the other hand, we discuss what the development of mobile and online technologies offers for solving or mitigating these problems. Specifically, we focus on ecological momentary assessment (EMA) and intervention (EMI) methodologies (3, 4) and how they can help in overcoming difficulties currently faced in problematic online behavior research, diagnosis, and therapy.

NEW ARENAS FOR PROBLEMATIC AND ADDICTIVE BEHAVIOR

High-speed internet that can be accessed cheaply, at whim, using convenient pocket-sized portable devices and through a multitude of entertaining applications have created a new environment in which gratifying behavior can be easily engaged in and repeated, leading in some cases to the development of detrimental habits. In this way, some online-mediated activities, like cybersex and pornography use, gambling, gaming, buying, social networking, video streaming, or general internet use, can become problematic and—for a subset of users—constitute a mental health problem (5–7). Although some of these behaviors were potentially problematic before the Internet era, the advent of high-speed Internet and widespread use of mobile technology has dramatically increased their

addictive potential, making them more significant mental-health threats both on a personal and societal level (8, 9).

ICD-11 AND PROBLEMATIC ONLINE BEHAVIORS

To address clinical concerns on growing societal significance of new behavioral problems related to the development of technology, WHO recently classified some of them as new diagnostic entities in the ICD-11 (2). Pathological gambling, as well as pathological gaming were described in the “Disorders due to substance use and addictive behaviors” category, while Compulsive Sexual Behavior Disorder (CSBD) was deemed a member of “Impulse Control Disorders” (2, 10), although the discussion on the addictive, compulsive, and/or impulsive roots of the disorder is still ongoing (11–13). An alike debate for some of the other problematic behavior types, e.g., gambling (14, 15), gaming (16) or buying (17, 18) is still in progress.

In our opinion, this discussion raises important questions on determinants for the classification of problematic behavior. Why are some of them classified as addiction-type disorders while others as impulse control disorders? It is worth mentioning that in the Diagnostic and Statistical Manual IV-TR (19) gambling disorder was classified as an impulse control disorder and in the 5th edition (20) as an addiction. A similar change occurred between ICD-10 (21) and ICD-11 (3) for pathological gambling. It raises further important questions: what are the main mechanisms underlying problematic gaming, gambling, or CSBD, and are they homogeneous within each unit? Recognizing these pathological behaviors as psychiatric conditions naturally require further research on their accurate conceptualization and development of effective treatments. Here, another significant question emerges: how do we examine the effectiveness of the treatment? In the case of substance use disorders, there is plenty of objective measures of abstinence such as urinal, saliva, or blood tests (22, 23). In contrast, there is no such objective and retrospective method of assessment for problematic behaviors. However, if the behavior is engaged in online, reliable tracking of activity can be made possible by using EMA.

ECOLOGICAL MOMENTARY ASSESSMENT: A WAY TO BETTER UNDERSTAND NEW PROBLEMATIC BEHAVIORS

EMA is a method delivered through mobile devices aimed to collect and record a person's activities and inner states in real time as they occur, by periodically prompting the user to fill-out short assessment questionnaires (3, 24, 25). Among the most appreciated benefits of EMA are: (a) minimization of recall bias by assessing the current, instead of retrospective data; (b) maximization of ecological validity through data collection in a real-world setting, as opposed to data collection in controlled

laboratory environments; (c) enabling to gather a large amount of quantitative data from individuals across time and different contexts (3); as well as (d) to identify the dynamic interplay between the variables, thereby helping (e) to infer causal relationships between them (26). Most recent versions of EMA running on new mobile devices equipped with sophisticated sensors and features allow for real-time geolocation, active tracking, objective inferring on stress or arousal level based on biosensors (e.g., heart rate and temperature measurements with smartwatches) and tracking of actual online behavior (e.g., on smartphone or tablet) (3, 24, 25). Recent advances in the research have transformed EMA from an initially a valuable data collection method into real-time intervention tool - EMI (5), providing not only the assessment but also the management of momentary variables (22, 27, 28). In our opinion research involving EMA may help (a) to solve the etiological debate on the correct conceptualization and behavioral phenotyping of gambling, gaming, CSBD, and not-yet classified behaviors such as problematic social media use of video bingeing. (b) It provides a more reliable and objective measure of frequency and severity, progression, or improvement of actual behaviors; and in combination with EMI (c) can offer new scientifically verified treatments.

ADDICTIVE, IMPULSIVE, AND COMPULSIVE MODELS: SOLVING THE PUZZLE

To illustrate the benefits of using EMA in advancing the debate between addictive, impulsive, and compulsive models of online problematic behaviour, we will use the example of CSBD, for which the discussion is especially lively (11). The validity of each model is based on the presence and relative importance of symptoms predicted by each of the three models (29). The presence of obsessions driving sexual behavior, as well as its relative rigidity and ritualism, can indicate its kinship to obsessive-compulsive disorders and support the validity of the compulsive model. The presence of withdrawal symptoms and tolerance lends support to the addictive model, while impulsive sexual behavior-driven mainly by pleasure-seeking with associated general impulse control deficits indicates the validity of the impulsive model (12, 13, 29, 30). Compared to a standard self-report method, EMA can be better suited to investigate these predictions and the concurrent validity of these models because: (a) it enables ecologically valid measurements of symptom feature predicted by the three models, which is especially important as addictive behavior have a highly contextual character; (b) phenomena-like obsessions, withdrawal symptoms and cravings are transient states and the adopted method of measurement should be able to reflect their fluctuation (which is hard to achieve with retrospective, aggregate measurements); (c) frequency of a targeted problematic behavior can be assessed with higher accuracy, using ecological declarative measurements or objective indicators (see the section below); (d) multiple points of measurement over time allow for directional relationships between variables to be investigated; (e) Lastly, the most valid solution to the debate on etiology may not rely on singling out the model that is the best universal descriptor of

symptoms for all subjects, but on investigating possible subtypes or profiles of the disorder that pertain to the three described models and the prevalence of these subtypes (allowed due to the possibility for gathering large amounts of data with EMA) (31). In this way, EMA can provide unique contributions to an accurate classification of gambling, gaming, CSBD, as well as problematic behavior not yet classified (e.g., problematic buying, social networking), which are harder to obtain using more traditional approaches.

FOR ONLINE PROBLEMATIC BEHAVIOR, ACCURATE BEHAVIOR TRACKING IS CRUCIAL

Self-reports are associated with numerous errors, related to faulty memory, memory bias, or social desirability bias (32). We have evidence of inaccuracies of self-reports regarding problematic behaviors like gambling (33) or gaming (34). Moreover, these biases can be the strongest for the most active/problematic users (33). This is especially important, as for online problematic behavior the frequency of the behavior is one of the main factors contributing to the severity of experienced negative symptoms (35). With respect to this, EMA delivered on smartphones offers unique advantages, as the methodology allows for more accurate tracking of frequencies of a target behavior, thoughts or moods, with higher compliance and lower data loss compared to standard paper-pencil or computer-based questionnaires or diaries (36). Additionally, in conjunction with biosensors and specific software solutions, it enables objective data collection continuously and passively, with little or no burden to participants (heart rate, temperature, location, smartphone use, or social media and online engagement gathered through data mining), which provide reliable diagnostic and predictive biomarkers of examined constructs (25, 28, 37). Future studies in online problematic behaviors may combine both subjective and objective measurements that help to accurately assess behavioral and psychological changes over time and between contexts as well as to better monitor progression, recovery, and possible relapses in problematic behavior treatment (28, 37, 38). Although objective tracking of problematic behavior in its offline form is harder, EMA can still provide more accurate assessments based on subjective indicators (36). Additionally, as (a) offline vs online forms of problematic activities can have differing features, patterns of use, as well as risk and protective factors; (b) subjects engaging in online vs offline problematic behaviors can have different characteristics; (c) similar differences can potentially appear depending on the used device [e.g., computer vs mobile mediated form of problematic behavior, see examples for problematic gambling (39–42)], EMA/EMI can be employed as a useful tool for investigating these differences.

EMI AS A PROMISING METHOD FOR ADDICTIVE BEHAVIOR INTERVENTION

A significant gap between the number of people that need or could benefit from treatment and the number of people actually

receiving it is one of the most urgent problems in therapy (43). Due to its high cost-effectiveness, EMI offers the possibility to improve access to evidence-based treatment for various populations, democratizing it (1, 5). EMI seems to be promising owing to the possibility of identifying contextual (social interaction, location) and intra-individual (craving, mood, physiological responses) precipitating factors of lapses through the employment of machine learning algorithms and data mining (44, 45). EMI has the potential to tailor the intervention to the demographic, psychological, and behavioral characteristics of a person and specific symptoms experienced (46), meta-analytic evidence shows that such adaptive features increase the effectiveness of the interventions (47). As online problematic behavior can be induced by external cues, delivering just-in-time adaptive interventions (46) can contribute to successful behavioral management in many cases. Recent research has shown that physiological information gathered with EMA can be positively used for EMI (e.g., when the stress indicators exceed a threshold value, relaxation exercises can be prompted) (48). Moreover, EMI allows for the preservation of anonymity, therefore helping to overcome the fear of social-stigmatization (49). Lastly, EMI is well suited for the group of people manifesting online problematic behavior as a barrier to entry does not exist: members of this group are used to smartphones and mobile applications.

Additionally, it is worth underlying that the discussed methodology has already proven to be useful in assessment and therapy of substance addictions and related behavior: aiding recovery from alcoholism by reducing risky drinking episodes (50), helping to limit binge drinking among young people (51), supporting smoking cessation (52), reducing marijuana cravings (53), and significantly predicting substance use relapse after treatment (54).

Despite these factors, to the best of our knowledge, and recent-meta-analytic work (55), no randomized controlled trials for interventions delivered *via* smartphones are available for online problematic behavior. Supplementing this lack in the near future is key for further advancements.

NEW ETHICAL ISSUES

Although tracking objective indicators of online behavior and offering tailored interventions are possible with mobile devices, it raises ethical issues connected to gathering, managing, and storing sensitive, personal data (56). Also, using mobile applications as the method of delivery of interventions can potentially result in increasing, not decreasing, the reliance of a person on technology (2). Researchers and commentators now point to the fact that in order to attract users and extend time online, application creators often make them, in fact, more addictive (57), which results in a dangerous possibility of exchanging one addiction to another in the process of treatment (3). Repetitive assessment of problematic behavior and associated variables can make the behavior itself more salient and increase the risk of relapse or increase craving, which has to be monitored and taken into account by researchers

and developers (58). Overall, there is an existing need to improve the evidence base behind mobile app products through careful evaluation of their safety and effectiveness before the public distribution or clinical use (59).

CONCLUSION

The development of mobile and online technologies has allowed for the proliferation of online problematic behavior, but can also be harnessed for more effective intervention and therapy, as well as effective tackling of remaining theoretical questions. Although challenges exist (e.g., ethical issues), EMA and EMI methodologies seem to have huge potential for online problematic behavior research and therapy, which is—as yet—untapped.

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Fear of Missing Out and Smartphone Addiction Mediates the Relationship Between Positive and Negative Affect and Sleep Quality Among Chinese University Students

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Background and Aims: The widespread use of social media on smartphones has led to the fear of missing out (FoMO) and smartphone addiction among a minority of adolescents and adults. However, few studies have investigated the impact of trait affect on sleep quality via FoMO and smartphone addiction. The present study examined whether FoMO (trait-FoMO and state-FoMO) and smartphone addiction mediated the relationship between positive affect (PA)/negative affect (NA) and sleep quality, and the prevalence of sleep disturbance among Chinese university students.

Methods: The sample comprised 1,164 university students and they completed a survey which included the Chinese Trait-State Fear of Missing Out Scale (T-SFoMOS-C), Mobile Phone Addiction Index (MPAI), International Positive and Negative Affect Scale Short-Form (I-PANAS-SF), and the Pittsburgh Sleep Quality Index (PSQI).

Results: The prevalence of sleep disturbance was found to be 15.98% among Chinese university students. The serial multiple mediation effects indicated that PA directly impacted on sleep quality, but the mediation effects of trait-FoMO and state-FoMO were not found. NA impacted on sleep quality via the mediation effects of trait-FoMO/state-FoMO and smartphone addiction.

Conclusion: Negative affect was positively associated with poor sleep quality, which was partially mediated by FoMO and smartphone addiction among Chinese university students. Individuals with high negative affect were more likely to have high levels of FoMO and were more prone to smartphone addiction as well as experiencing poor sleep quality. These findings provide an evidence base for emotion management, prevention of smartphone addiction, and sleep improvement.

Keywords: trait-fear of missing out, state-fear of missing out, smartphone addiction, sleep quality, positive affect, negative affect

INTRODUCTION

The phenomenon of ‘fear of missing out’ (FoMO) has become more prevalent due to social media use over past few years (1, 2). A survey from *Xinli001* (i.e., a professional psychological information and service platform in China) reported that 15.2% of respondents experienced severe FoMO (3). As “a pervasive apprehension that others might be having rewarding experiences from which one is absent” (1), FoMO is also considered as a two-dimensional construct including trait-FoMO (i.e., “a relatively stable individual characteristic”) and state-FoMO (i.e., “fear of missing out online content and interaction with others using social media”) (4).

Recent studies have identified that social media use (5–9), psychological need satisfaction (1, 10–12), and personality traits (13–17) may be considered as risk factors of FoMO. Wolniewicz et al. also reported that FoMO was most strongly associated with both problematic smartphone use and normal smartphone use (e.g., video and voice calls, text/instant messaging, email, social networking sites) relative to negative affect and fears of negative and positive evaluation (18), similar to the relationship between FoMO and other types of internet addiction (e.g., Facebook addiction, social networking site [SNS] addiction) (19–23). State-FoMO has been found to directly and indirectly impact phubbing *via* problematic Instagram use, whereas trait-FoMO has been indirectly associated with phubbing *via* state-FoMO and problematic Instagram use (24). Additionally, some studies have shown the associations between high levels of FoMO and negative outcomes, such as bad school performance, fatigue, and decreased sleep (25–28).

In March 2020, the China Internet Network Information Centre reported that the total number of Chinese internet users was 904 million, with 897 million accessing the internet *via* smartphones (99.3%) (29). Smartphone addiction has been found to be prevalent among adolescents and emerging adults in China and elsewhere in the world (30–32). The prevalence of problematic smartphone use/smartphone addiction was estimated in one study to be 21.3% among Chinese undergraduates (33).

As a form of technological addiction or one of generalized internet addictions (34–37), smartphone addiction is also described as “an inability by individuals to regulate their use of smartphones and which eventually leads to negative consequences and clinical impairment in daily life” (38). Some risk factors of smartphone addiction have been examined such as negative affect (e.g., depression, anxiety and loneliness), low Internet self-efficacy, high impulsivity, as well as narcissism (39–45). In studies of smartphone addiction, Additionally, smartphone addiction has shown demonstrable association with alcohol use disorder symptoms, specific mental health diagnoses (i.e., ADHD, anxiety, depression, and PTSD), poor scholastic performance (46), vision problems (47), driving risk (48), and musculoskeletal pain (49–52). Smartphone addiction is also associated with poor sleep quality (32, 53, 54). Most studies have also shown that smartphone addiction is often associated with social media addiction because social media use is primarily engaged in *via* smartphones (55, 56).

Negative urgency has been shown to mediate the relationship between negative emotion and smartphone addiction (57). Moreover, smartphone addiction may serve as a mediator between loneliness and sleep quality (30).

Trait affect as a key personality construct has been an important concept in applied psychology (58). The positive and negative dimensions of trait affect have been defined by several scholars (59, 60). Positive affect (PA) reflects “the extent to which a person feels enthusiastic, active, and alert”, whereas negative affect (NA) is “a general dimension of subjective distress and unpleasurable engagement that subsumes a variety of aversive mood states, including anger, contempt, disgust, guilt, fear, and nervousness” (61).

Positive affect and negative affect as ambivalent emotions have been found to be associated with high levels of FoMO when using Facebook (1). Przybylski et al. developed the Fear of Missing Out Scale (FoMOS), which is a unidimensional scale for assessing trait FoMO. Individuals experiencing lower levels of general mood reported higher levels of FoMO (1). Moreover, FoMO has been found to mediate the relationship between general mood and social media engagement, as well as basic need satisfaction/life satisfaction and social media engagement (1). Riordan et al. reported that negative affect has been associated with FoMO when using Facebook (62). Shin et al. also reported the mediating effects of affect on the associations between personality factors and internet gaming disorder (63). In addition, envy as a specific negative affect has been shown to impact on problematic smartphone use and SNS addiction *via* FoMO (64, 65). In the interaction of Person-Affect-Cognition-Execution (I-PACE) model, Brand et al. proposed that internet-related disorders (e.g., smartphone addiction, social media addiction) were the consequence of interactions between predisposing variables (e.g., neurobiological and psychological components), moderators (e.g., coping style and internet-related cognitive biases), and mediators (e.g., affective and cognitive responses to specific stimuli in combination with reduced executive functioning) (66, 67). In the early stages of behavioral addiction, negative or positive moods as internal triggers may be perceived, which result in affective (e.g., FoMO) and cognitive responses and increase attention to stimuli and urges to behave in specific ways (e.g., urge to use smartphone, play online gaming) (67, 68).

Some studies have reported that sleep disturbances are common among Chinese university students (69, 70). A recent meta-analysis examining sleep problems and internet addiction reported a significant odds ratio (OR) for sleep problems and a significant reduction in sleep duration among individuals addicted to the internet (71). Some studies have reported that sleep quality is positively associated with NA and negatively associated with PA (72, 73). Although, some scholars argue that the relationship between sleep quality and affect may be bidirectional (74–76), previous research has also shown that both positive and negative affect can mediate the impact of expressive suppression on sleep quality (73, 77). Another recent study showed that insomnia partially mediated a significant association of interpersonal stress and FoMO with

mental health (78). Moreover, the relationship between negative affect and sleep quality may also be mediated by smartphone addiction (79).

Based on the I-PACE theory and previous studies, the aim of the present study was to carry out a multiple mediation analysis examining PA/NA to sleep quality, in which trait-FoMO/state-FoMO and smartphone addiction were the mediator variables. It was hypothesized that a) PA/NA, trait-FoMO/state-FoMO, and smartphone addiction would be associated with sleep quality; b) trait-FoMO and smartphone addiction would mediate the association between PA and sleep quality; c) state-FoMO and Smartphone addiction would mediate the association between PA and sleep quality; d) trait-FoMO and smartphone addiction would mediate the association between NA and sleep quality; and e) state-FoMO and smartphone addiction would mediate the association between NA and sleep quality (Figure 1).

METHODS

Participants

A cross-sectional study was carried out from October 2019 to November 2019. The survey was completed on the Wenjuanxing platform (www.wjx.cn). The participants comprised 1,258 students (from 17 to 25 years; mean age = 20.1 years; $SD \pm 1.6$) by cluster convenience sampling from three universities in Jiangxi province and Liaoning province of China. However, 94 participants were excluded from the dataset owing to incomplete information. The final sample comprised 1,164 participants (656 females, 508 males) with a 92.5% response rate.

Measures

Pittsburgh Sleep Quality Index (PSQI)

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) (80), which assessed sleep disturbances during a 1-month time period. The PSQI was translated into Chinese by Liu et al. (81). The instrument contains 19 items assessing seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The seven component scores are summed to produce a global PSQI score, where the total score ranges from 0 to 21 points (0 to 3 points for each component), with higher scores indicating worse sleep

quality. The cut-off value for sleep disturbance is 7 (81). The Cronbach's alpha of the PSQI was 0.71 in the present study.

International Positive and Negative Affect Scale Short-Form (I-PANAS-SF)

Positive affect and negative affect were assessed using the International Positive and Negative Affect Scale Short-Form (I-PANAS-SF) (82). The I-PANAS-SF comprises 10 items originating from the Positive and Negative Affect Schedule (PANAS) (61), and was translated into Chinese by Huang, Yang and Ji (83). NA and PA have five items respectively answered on a 5-point scale from 1 ("not at all") to 5 ("extremely"). A higher NA total score indicated more negative affect or the extent to which the individual feels aversive mood states and general distress, whereas a higher PA total score indicates more positive affect or the extent to which the individual feels enthusiastic, active, and alert. The Cronbach's alpha of the I-PANAS-SF was 0.72, for PA was 0.71, and for NA was 0.81 in the present study.

Chinese Trait-State Fear of Missing Out Scale (T-SFoMOSC)

The 12-item Trait-State Fear of Missing Out Scale (T-SFoMOSC) was developed by Wegmann et al. (4) and assesses fear of missing out across two domains (i.e., trait-FoMO and state-FoMO). The first five items reflect trait-FoMO, whereas the remaining seven items are state-FoMO. Each item is rated on a 5-point Likert scale from 1 ("totally disagree") to 5 ("totally agree"). Higher total scores represent a higher level of FoMO. The Cronbach's alpha value of the trait-FoMO and state-FoMO were 0.82 and 0.81, respectively. In the present study, using the T-SFoMOSC, the Cronbach's alpha for the total scale was 0.82, 0.78 for the trait-FoMO, and 0.81 for state-FoMO.

Mobile Phone Addiction Index (MPAI)

Smartphone addiction was assessed using the Mobile Phone Addiction Index (MPAI) (84), which was translated into Chinese (85) and is used widely in Chinese contexts (86, 87). The MPAI contains 17 items assessing four domains: inability to control craving, feeling anxious and lost, withdrawal/escape, and productivity loss. Each item is responded to from 1 ("not at all") to 5 ("always"). Final scores were summed and higher total scores reflect higher levels of smartphone addiction. The Cronbach's alpha of the MPAI was 0.86 in the present study.

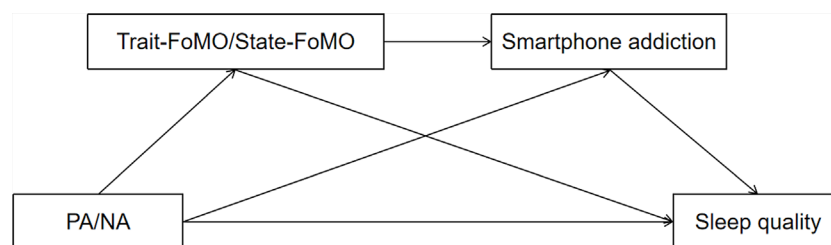


FIGURE 1 | The proposed series multiple mediation model.

Procedure

The survey was conducted in three universities [Gannan Medical University (542 participants), Jiangxi University of Science and Technology (418 participants), and Jinzhou Medical University (298 participants)] in the two provinces of China from October 2019 to November 2019. Participants received a detailed explanation of the study's purpose and completed the survey, and participants received course credits in mental health education classes. Four self-report scales including the PQSI, the I-PANAS-SF, the T-SFoMOS, and the MPAI were completed in approximately 10 min.

Statistical Analysis

SPSS 20 was used for the present study analysis. The skewness and kurtosis levels were examined for data distribution (with a skewness cut-off of 2.0 and kurtosis cut-off of 7.0) (88). Descriptive analysis of the sample's characteristics was conducted by means, standard deviations, and frequency analysis. A chi-square test was utilized for analyzing the gender difference in sleep disturbance. Pearson correlation tests were applied among all variables. The series of multiple mediation models of positive/negative affect on sleep quality *via* trait-FoMO/state-FoMO and smartphone addiction were tested using Model 6 of Hayes's PROCESS tool (89).

Ethics

The study was approved by the Ethics Committee of Gannan Medical University, and was carried out in accordance with the requisite ethical standards (e.g., the Helsinki declaration). Written informed consent was obtained from all participants.

RESULTS

Descriptive Statistics and Correlation Analyses

Descriptive statistics are displayed in **Table 1**. Data were regarded as normal distribution due to the maximum values of skewness (< 2) and kurtosis (< 7). PA was significantly positively associated with state-FoMO ($r = 0.09, p < .01$), but significantly negatively associated with smartphone addiction ($r = -0.06, p < .05$) and poor sleep quality ($r = -0.09, p < .01$). PA was not significantly associated with the total scores of FoMO ($r = 0.05, p = 0.110$) and trait-FoMO ($r = -0.02, p = 0.509$). NA was significantly positively associated with trait-FoMO

($r = 0.26, p < .01$), state-FoMO ($r = 0.16, p < .01$), smartphone addiction ($r = 0.31, p < .01$), and poor sleep quality ($r = 0.42, p < .01$). Trait-FoMO was significantly positively associated with smartphone addiction ($r = 0.33, p < .01$) and poor sleep quality ($r = 0.23, p < .01$). State-FoMO was significantly positively associated with smartphone addiction ($r = 0.42, p < .01$) and poor sleep quality ($r = 0.19, p < .01$). Smartphone addiction was also significantly positively associated with poor sleep quality ($r = 0.32, p < .01$).

The Prevalence of Sleep Disturbance

Based on 7 as the threshold value for the PQSI (81), of the 1,164 participants, 978 (84.02%) reported normal sleep quality and 186 (15.98%) reported sleep disturbance. The numbers of males (18.38%, male 506) and females (14.13%, female 658) with sleep disturbance were both 93. There was no significant difference between gender ($\chi^2 = 3.53, p = 0.06$).

Testing of the Mediation Effects From PA to Sleep Quality

The series multiple mediation effects of PA on sleep quality *via* trait-FoMO/state-FoMO and smartphone addiction were tested using Model 6 of Hayes's PROCESS tool. Gender and age were regarded as control variables in the present study. As shown in **Table 2**, the total mediation effects of PA on sleep quality *via* trait-FoMO and smartphone addiction ($\beta = -0.018, 95\%CI: -0.043, 0.006$) as well as state-FoMO and smartphone addiction ($\beta = -0.009, 95\%CI: -0.033, 0.014$) were both non-significant, whereas the direct effects of PA on sleep quality ($\beta = -0.062, 95\%CI: -0.114, -0.010$; $\beta = -0.070, 95\%CI: -0.122, -0.018$) were both significant. In the serial mediation model of trait-FoMO and smartphone addiction, the relationship between PA and poor sleep quality was not mediated by trait-FoMO ($\beta = -0.003, 95\%CI: -0.012, 0.006$) or smartphone addiction ($\beta = -0.014, 95\%CI: -0.032, 0.003$). However, in the serial mediation model of state-FoMO and smartphone addiction, the relationship between PA and poor sleep quality was mediated by smartphone addiction ($\beta = -0.024, 95\%CI: -0.042, -0.007$), but not state-FoMO ($\beta = 0.006, 95\%CI: 0.000, 0.015$).

Testing of the Mediation Effects From NA to Sleep Quality via Trait-FoMO and Smartphone Addiction

The serial multiple mediation effects of NA on sleep quality *via* trait-FoMO/state-FoMO and smartphone addiction were also

TABLE 1 | Descriptive statistics and correlation analysis of the study variables.

		<i>M</i>	<i>SD</i>	Skewness	Kurtosis	1	2	3	4	5	6	7
1.	Sleep quality	5.26	2.29	0.279	-0.051	1.00						
2.	Positive affect	14.12	3.13	-0.206	0.504	-0.09**	1.00					
3.	Negative affect	10.69	3.37	0.389	-0.176	0.42**	0.07*	1.00				
4.	FoMO	29.07	6.95	-0.160	0.151	0.25**	0.05	0.24**	1.00			
5.	Trait-FoMO	12.19	3.63	0.008	-0.170	0.23**	-0.02	0.26**	0.79**	1.00		
6.	State-FoMO	16.88	4.63	0.121	-0.007	0.19**	0.09**	0.16**	0.88**	0.41**	1.00	
7.	Smartphone addiction	42.09	10.24	0.052	-0.116	0.32**	-0.06*	0.31**	0.45**	0.33**	0.42**	1.00

** $p < .01$, * $p < .05$.

TABLE 2 | Total effect, direct effect, and mediation effects of PA/NA on sleep quality via trait-FoMO/state-FoMO and smartphone addiction.

Path (PA→trait-FoMO)	B	SE	95%CI	Path (PA→state-FoMO)	B	SE	95%CI
Total effect	-0.079	0.028	-0.134, -0.024	Total effect	-0.079	0.028	-0.134, -0.024
Direct effect	-0.062	0.026	-0.114, -0.010	Direct effect	-0.070	0.027	-0.122, -0.018
Total mediation effect	-0.018	0.012	-0.043, 0.006	Total mediation effect	-0.009	0.012	-0.033, 0.014
Ind1	-0.003	0.004	-0.012, 0.006	Ind1	0.006	0.004	0.000, 0.015
Ind2	-0.014	0.009	-0.032, 0.003	Ind2	-0.024	0.009	-0.042, -0.008
Ind3	-0.002	0.003	-0.007, 0.004	Ind3	0.008	0.004	0.000, 0.017
Path (NA→trait-FoMO)	B	SE	95%CI	Path (NA→state-FoMO)	B	SE	95%CI
Total effect	0.414	0.027	0.362, 0.466	Total effect	0.414	0.027	0.362, 0.466
Direct effect	0.336	0.028	0.282, 0.391	Direct effect	0.348	0.027	0.295, 0.402
Total mediation effect	0.078	0.012	0.055, 0.103	Total mediation effect	0.066	0.011	0.046, 0.089
Ind1	0.021	0.008	0.006, 0.037	Ind1	0.012	0.005	0.002, 0.024
Ind2	0.045	0.009	0.028, 0.063	Ind2	0.044	0.009	0.027, 0.062
Ind3	0.013	0.003	0.007, 0.019	Ind3	0.011	0.003	0.006, 0.017
C1	-0.024	0.013	-0.050, 0.002	C1	-0.032	0.012	-0.056, -0.009
C2	0.008	0.009	-0.009, 0.026	C2	0.001	0.006	-0.011, 0.014
C3	0.032	0.008	0.017, 0.049	C3	0.033	0.008	0.018, 0.049
Effect ratio (%)	19.1			Effect ratio (%)	16.2		

Confidence intervals for effects are bias corrected based on 5,000 bootstrap samples. a1. PA/NA to Trait-FoMO/State-FoMO, a2. PA/NA to smartphone addiction, b1. Trait-FoMO/State-FoMO to sleep quality, b2. Smartphone addiction to sleep quality, d1. Trait-FoMO/State-FoMO to smartphone addiction. Ind1 = PA/NA→Trait-FoMO/State-FoMO→Sleep quality, Ind2 = PA/NA→Smartphone addiction→Sleep quality, Ind3 = PA/NA→Trait-FoMO/State-FoMO→Smartphone addiction→Sleep quality. CI = Ind1 minus Ind2, C2 = Ind1 minus Ind3, C3 = Ind2 minus Ind3. Effect ratio = Total mediation effect/Total effect.

Bold values are highlighted to show where the 95% confidence interval (CI) contains zero, then the effect will not be significant at the 0.05 level.

examined and gender and age were also regarded as control variables. As **Figure 2** shows, NA was positively associated with trait-FoMO ($\beta = 0.28$, $t = 9.21$, $p < .001$) and smartphone addiction ($\beta = 0.26$, $t = 8.74$, $p < .001$). Trait-FoMO was positively associated with smartphone addiction ($\beta = 0.26$, $t = 9.41$, $p < .001$) and poor sleep quality ($\beta = 0.07$, $t = 2.84$, $p < .01$). Smartphone addiction was positively associated with poor sleep quality ($\beta = 0.17$, $t = 6.47$, $p < .001$). In addition, the total indirect effect of NA and sleep quality via Trait-FoMO and smartphone addiction was significant ($\beta = 0.078$, 95%CI: 0.055, 0.103), as well as the direct effect ($\beta = 0.336$, 95%CI: 0.282, 0.391) and total effect ($\beta = 0.414$, 95%CI: 0.362, 0.466). Three indirect paths from NA to sleep quality via Trait-FoMO ($\beta = 0.021$, 95%CI: 0.006, 0.037), smartphone addiction ($\beta = 0.045$, 95%CI: 0.028, 0.063), and Trait-FoMO and smartphone addiction ($\beta = 0.013$, 95%CI: 0.007, 0.019), were significant respectively. Moreover, differences in the three paths were tested using Model 6 of the PROCESS tool. A significant difference ($\beta = 0.032$, 95%CI: 0.017, 0.049)

between Path 2 (NA on sleep quality via smartphone addiction) and Path 3 (NA on sleep quality via trait-FoMO and smartphone addiction) was found (**Table 2**).

Testing of the Mediation Effects From NA to Sleep Quality via State-FoMO and Smartphone Addiction

NA was positively associated with state-FoMO ($\beta = 0.17$, $t = 5.55$, $p < .001$) and smartphone addiction ($\beta = 0.26$, $t = 9.65$, $p < .001$). State-FoMO was positively associated with smartphone addiction ($\beta = 0.38$, $t = 14.98$, $p < .001$) and poor sleep quality ($\beta = 0.07$, $t = 2.54$, $p < .05$). Smartphone addiction was positively associated with poor sleep quality ($\beta = 0.17$, $t = 5.84$, $p < .001$) (**Figure 3**). In addition, the total indirect effect from NA to sleep quality via state-FoMO and smartphone addiction was significant ($\beta = 0.066$, 95%CI: 0.046, 0.089), as well as the direct effect ($\beta = 0.348$, 95%CI: 0.295, 0.402) and total effect ($\beta = 0.414$, 95%CI: 0.362, 0.466). Three indirect paths from NA to sleep quality via state-FoMO ($\beta = 0.012$, 95%CI:

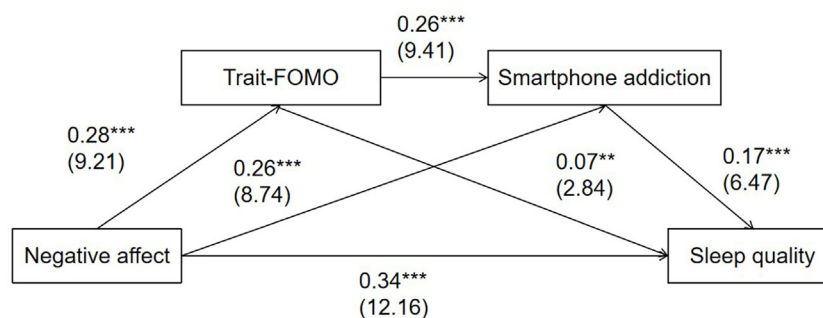


FIGURE 2 | The serial multiple mediation model of fear of missing out and smartphone addiction on negative affect and sleep quality ($n=1164$). Coefficients are standardized and t -statistics are in parentheses. *** $p < .001$; ** $p < .01$.

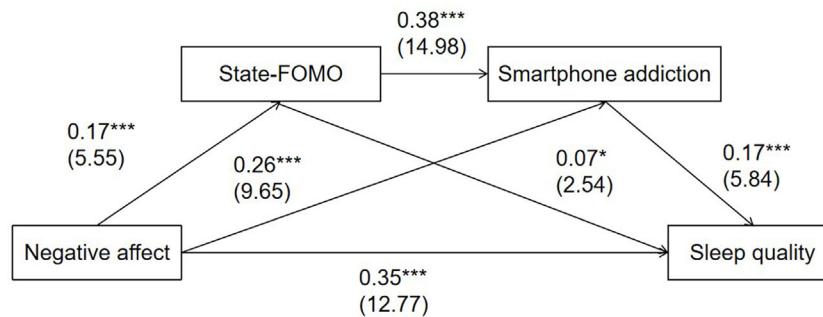


FIGURE 3 | The serial multiple mediation model of fear of missing out and smartphone addiction on negative affect and sleep quality ($n=1164$). Coefficients are standardized and t -statistics are in parentheses. *** $p < .001$; * $p < .05$.

0.002, 0.024), smartphone addiction ($\beta = 0.044$, 95%CI: 0.027, 0.062), and state-FoMO and smartphone addiction ($\beta = 0.011$, 95%CI: 0.006, 0.017) were all significant. Moreover, differences in the three paths were tested using Model 6 of the PROCESS tool. Significant differences between Path 1 (NA on sleep quality *via* state-FoMO) and Path 2 (NA on sleep quality *via* smartphone addiction) ($\beta = -0.032$, 95%CI: -0.056, -0.009), as well as Path 2 (NA on sleep quality *via* smartphone addiction) and Path 3 (NA on sleep quality *via* state-FoMO and smartphone addiction) ($\beta = 0.033$, 95%CI: 0.018, 0.049) were found. The proportion of total effect from NA to sleep quality *via* trait-FoMO and smartphone addiction was 19.1% and *via* state-FoMO and smartphone addiction was 16.2%.

DISCUSSION

The present study reported the prevalence of sleep disturbance and the mediation effects of positive and negative affect on sleep quality *via* trait-FoMO/state-FoMO and smartphone addiction among Chinese university students. The prevalence of sleep disturbance was 15.98%, which finding is similar to previous findings among Chinese samples (13.93%–15.8%) (29, 69, 70).

NA was positively associated with state-FoMO and trait-FoMO, whereas there was a positive correlation between PA and state-FoMO [e.g., “When I have a good time it is important for me to share the details online (e.g. updating status)”]. This may be because individuals with high state-FoMO like to share their enjoyment, interests, achievements with others anywhere at any time. As Przybylski et al. noted, individuals who experience high FoMO have mixed feelings [i.e., positive affect (excitement and joy) and negative affect (fear and anxiety)] when they use social media (1).

The correlation coefficient between FoMO and smartphone addiction ($r = 0.42$) was similar to study samples from other countries (ranging from 0.40 to 0.60) (11, 18, 90–92). This indicates that the impact of FoMO and excessive smartphone use are arguably ubiquitous in the global context (93–97).

NA was significantly positively associated with FoMO and smartphone addiction, which is consistent with other findings (18, 98). Elhai et al. reported that NA (i.e., depression and

anxiety) may impact on smartphone addiction *via* FoMO (91), which was also consistent with the findings here. However, depression and interpersonal sensitivity on internet-communication disorder (ICD) *via* avoidance expectancies and state-FoMO have been found, but not for trait-FoMO (4). This perhaps indicates FoMO is a more complex construct. According to self-determination theory (SDT) (99), FoMO is considered as “a phenomenon of self-regulatory limbo arising from a situational or chronic deficit in psychological need satisfaction” (1). Consequently, FoMO was described as “a relatively stable individual characteristic, representing the general fear of a person of missing out on something” (i.e., trait-FoMO) (4). On the contrary, state-FoMO is considered important in the context of utilizing social media, where messages are updated and exchanged. State-FoMO even may increase general trait-FoMO (4). Based on the Brand et al.’s theory of specific internet addiction, a person’s core characteristics (e.g., depression and social anxiety) and personality (e.g., stress vulnerability, self-esteem, self-efficacy) predict specific cognitions, consequently causing different types of internet addiction (e.g., smartphone addiction and internet-communication addiction) (100, 101). In terms of interaction in the person-affect-cognition-execution (I-PACE) model (64), State-FoMO may represent a specific cognition, which mediates individual core characteristics (NA) and smartphone addiction, whereas trait-FoMO being a dispositional trait, may develop state-FoMO and specific internet cognition (4).

Results also showed that PA and NA both predicted sleep quality, and that NA had a more prominent influence than PA. These results suggest that regulation of NA for sleep disturbance therapy may be more successful than improvement of PA (73). Therefore, treatments targeting a reduction of NA may decrease insomnia symptoms and improve sleep quality (77). The mediation effects of NA on sleep quality *via* trait-FoMO/state-FoMO and smartphone addiction were statistically significant. However, the total indirect effects of PA on sleep quality *via* trait-FoMO/state-FoMO and smartphone addiction were not found. Moreover, smartphone addiction had higher mediation effect from NA to sleep quality. The relationship between NA, smartphone addiction, and sleep quality was also consistent with findings from a previous study (79).

Smartphone use may be pleasurable and exciting in the early stage when individuals communicate with others or engage in other activities (i.e., individuals experience positive affect). However, for a small minority of individuals, excessive smartphone use can trigger greater negative affect, such as irritable, anxiety, and depression, which may lead to smartphone addiction, and disturb individuals' sleep quality. Some studies have reported that negative events impacting on sleep quality mainly included bad dormitory conditions (e.g., noisy roommates, snoring, gaming, lighting, mosquitos), interpersonal conflict, academic pressure, freshmen maladjustment, as well as romantic relationship problems) (102, 103). Due to specific characteristics of smartphones (e.g., the many different types of applications), smartphones can be considered as tools that provide self-comfort and satisfy basic need of communication with others in a timely way (i.e., individuals, especially females prefer texting, blogging and chatting *via* smartphone) (104–106). Consequently, all kinds of messages from Chinese SNSs such as *WeChat* and *QQ* (e.g., different groups comprising class, grade, students' union, different courses, etc.) can seriously influence their academic performance and daily lives among Chinese university students. Therefore, one possible explanation is that NA (triggered by negative events and all kinds of stress) may increase the level of FoMO, and leads to students constantly check their smartphones (so as not to miss out on what they perceive to be important information) which among some individuals may give rise to smartphone addiction, and subsequently deteriorating sleep quality. The mediation effect of FoMO from NA to sleep quality appears to be weaker than smartphone addiction. These finding suggest that FoMO is closely associated with social media use, whereas smartphone addiction may be related to more specific activities (e.g., smartphone gaming addiction, smartphone shopping addiction, smartphone gambling addiction, etc.).

FoMO and smartphone addiction may mediate the relationship between negative affect and sleep quality. The pressures from school, college or university may prevent face-to-face social activity but being bombarded with excessive information *via* smartphone, which could lead to greater negative affect and affect both FoMO and smartphone addiction, subsequently leading students to have poorer sleep. However, several limitations are present in the present study. First, all data were self-report which may result in some biases (e.g., social desirability and memory recall). The cross-sectional study from three universities was non-representative, and is unable to explain any causal relationships between the variables tested. Future studies should be performed using more representative samples and longitudinal designs to determine if there are causal relationships between the variables FoMO, smartphone addiction, positive and negative affect, and sleep quality. Owing to gender and age as control variables in the present study, gender differences were not examined and there may be differences in relation to smartphone addiction as well as the relationship between affect and smartphone addiction. Demographic variables may potentially impact mediation effect (e.g., gender and age). Therefore such variables should be examined in future

research. Second, further research is required to more deeply explore the characteristics of trait-FoMO and state-FoMO (e.g., studies evaluating the difference between trait-FoMO and state-FoMO as mediators). Third, further research is necessary to explain the specific positive affect and negative affect factors (e.g., alert, anxiety, fear) responsible for the relationships studied here.

Overall, the results demonstrate the mediation effects of trait-FoMO/state-FoMO and smartphone addiction between negative affect and sleep quality. More specifically, smartphone addiction had higher effect size than the role of FoMO. Based on the findings, negative affect on sleep quality may be mediated *via* smartphone addiction and FoMO among Chinese university students.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Gannan Medical University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

Conceived and designed the experiments: LL and ZN. Performed the experiments: LL and ZN. Analyzed the data: LL and MG. Contributed reagents/materials/analysis tools: SM. Wrote the paper: LL and ZN. Edited and contributed to the revised paper: MG.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Psychometric Properties of Three Simplified Chinese Online-Related Addictive Behavior Instruments Among Mainland Chinese Primary School Students

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Background/Objective: There are inadequate screening instruments for assessing specific internet-related addictions among mainland Chinese primary school students. Therefore, the present study validated the psychometric properties of three simplified Chinese online-related addictive behavior instruments among mainland Chinese primary school students.

Method: Fourth to sixth graders ($n = 1108$; 48.3% males; mean [SD] age = 10.37 years [0.95]) completed the nine-item Internet Gaming Disorder Scales-Short Form (IGDS-SF9), Bergen Social Media Addiction Scale (BSMAS), and Smartphone Application-Based Addiction Scale (SABAS) in a classroom. The factorial structures and the unidimensionality of the three scales were examined using confirmatory factor analyses (CFAs). Measurement invariance of the three scales was examined using multigroup confirmatory factor analyses (MGCFAs) across gender.

Results: The findings demonstrated that the three scales (Cronbach's $\alpha = 0.73$ to 0.84) had unidimensional structure as supported by satisfactory fit indices (comparative fit index = 0.98 to 1.00). The MGCFAs findings indicated that the unidimensional structures of the three scales were invariant across gender.

Conclusions: The findings indicate that the three simplified Chinese scales (IGDS-SF9, BSMAS, and SABAS) are valid instruments for assessing online-related addictive behaviors among mainland Chinese primary school students irrespective of their gender.

Keywords: child technology use, gaming addiction, psychometrics, social media addiction, smartphone addiction

HIGHLIGHTS

The present study tested the appropriateness of three online-related addictive behavior instruments (*i.e.*, Internet Gaming Disorder Scales-Short Form [IGDS-SF9], Bergen Social Media Addiction Scale [BSMAS], and Smartphone Application-Based Addiction Scale [SABAS]), and they were found to be suitable for use among Chinese children. These instruments will be of importance to researchers and clinicians as they may help ascertain the risk of online-related addictions among these children.

INTRODUCTION

Internet use has become an important part in individuals' daily lives, especially during the past decade given the rapid growth of modern technology. With the emergence of new technologies, internet accessibility and the availability *via* Wi-Fi enabled devices such as smartphones, tablets, laptops, and desk computers have become widespread. This technological advancement has eliminated geographical barriers between people by facilitating communication, business transactions, online games, online shopping, and other forms of entertainment (1). While there are many benefits associated with internet use (*e.g.*, communication, information searching, and entertainment), use of such technology may lead to mental health challenges such as addiction, alexithymia, and suicide risk (2, 3) for a small minority of individuals if not properly managed.

Internet-related addiction has been a notable problem among young people and increasingly among children given that children are now being given access to tablets and smartphones (4). Internet-related addiction basically involves problematic overuse of the internet for various activities such as online gaming, chatting (*e.g.*, Facebook, Twitter, QQ, and Wechat), and gambling purposes (5). For some individuals, such internet-related activities may seem entertaining and benign at first. However, with poor self-control, it may become an addictive behavior and may subsequently lead to serious and negative psychosocial effects (*e.g.*, preoccupation and cognitive distortions, worsening social behaviors, and unpleasant feelings or physical discomfort) (6). In addition, there are significant associations between internet-related addiction and poor mental health (*e.g.*, depression, anxiety, and stress) (7–9). It has further been reported that in China (where the present study was carried out) there is a pooled internet addiction prevalence rate of 7.5% among Chinese adolescents (10) and approximately 11% among college students (11). These rates were higher in males than in females (11, 12). The relatively high prevalence rate in China demonstrates a worrisome situation. Therefore, there is a need for effective measures to prevent further internet addiction.

Notwithstanding these negative effects, apart from Internet Gaming Disorder (IGD) being in the appendix of the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (DSM-5) (13), internet-related disorders are not officially recognized. Consequently, more studies are needed to establish the diagnostic criteria and course descriptions required to identify problematic internet-related behaviors as mental disorders (13). Since 2013, increasingly more studies have been conducted to identify these

behaviors and to establish how to accurately assess and diagnose the subcategories of internet-related addictive disorders.

The broad content area of online-related addictive behaviors (*e.g.*, gaming, social media) has led several studies to focus on developing and/or standardizing scales that can reliably and validly assess an aspect of internet-related behavior (or disorder) to help establish diagnostic criteria [*e.g.*, Leung et al. (14); Yam et al. (15)]. Also, knowing that specific internet-related addictions such as smartphone addiction, social media addiction, and internet gaming disorder do not share similar features with generalized internet addiction (5, 16, 17), helps researchers and practitioners to better understand general and specific internet-related addictive behaviors so as to better diagnose and offer effective treatment strategies. Additionally, there is very limited research on understanding of addictive behaviors related to internet and smartphone use among mainland Chinese children (18–20), taking into consideration that China has one of the highest prevalence rates for internet-related addictions such as internet gaming (13). Therefore, there is a need to validate culturally-specific instruments that are brief enough to assess some specific internet-related addictions among mainland Chinese children. More specifically, the simplified Chinese versions of the nine-item Internet Gaming Disorder Scale (IGDS-SF9), the Bergen Social Media Addiction Scale (BSMAS), and the Smartphone Application-Based Addiction Scale (SABAS) were the main instruments of validation in this study. Consequently, the major aims of the present study were to translate these three internet-related instruments into simplified Chinese versions and to validate these translated versions among children and to examine its relationships with different types of psychological distress (*i.e.*, depression, anxiety, and stress).

METHODS

Translation Procedure

Because the three instruments have already been translated into traditional Chinese character versions (14, 15, 21), these versions were used to create simplified Chinese character versions. More specifically, the first step was to convert every traditional Chinese character into its corresponding simplified Chinese character. The second step was to modify some terms to make the simplified Chinese character versions be better understood by mainland Chinese individuals. For example, mainland Chinese rarely use Facebook or Twitter (in fact, using Facebook or Twitter is not officially allowed in mainland China). Therefore, commonly used social media like QQ and Wechat were used instead in the simplified Chinese character versions. The final step was to ask five primary school teachers to evaluate the simplified Chinese character versions and to ensure their readability.

Participants and Procedure

The study was approved by the ethics committee of the Hong Kong Polytechnic University (IRB ref: HSEARS20190718001) before the targeted participants (*i.e.*, primary school children in the fourth to sixth grades) were approached. Three primary

schools in Sichuan were contacted and agreed to assist in this study. Teachers in the three schools further helped in distributing the study information to children in the fourth to sixth grades. After ensuring the willingness to participate from both the primary school students and their parents, several scales together with a background information sheet were given to the students to complete. Also, written informed consent was obtained for every participant (and one of their parents) who agreed to participate. The survey was conducted in the classroom under the supervision of the school teachers in the precise order outlined in the 'Measures' section. The inclusion criteria for participants were that they had to (i) understand written Chinese in simplified characters; (ii) understand spoken Mandarin; (iii) have had their smartphone with internet access over three months; and (iv) have the ability to complete the survey without difficulties. Out of 1,150 participants, 1,108 (96.35% response rate) participated in the present study. The participants did not receive any incentive; however, the present authors expressed appreciation to the participants.

Measures

Internet Gaming Disorder Scale-Short Form (IGDS-SF9)

The nine-item IGDS-SF9 developed by Pontes and Griffiths (22) is a short self-report scale that is used to assess Internet Gaming Disorder based on DSM-5 criteria (13). It uses a five-point Likert-scale response format that ranges from 1 (*Never*) to 5 (*Very often*) with a higher sum of item scores indicating a greater degree of internet gaming disorder. An example item is "Do you systematically fail when trying to control or cease your gaming activity?". The confirmatory factor analysis (CFA) of the IGDS-SF9 demonstrated a unidimensional structure with satisfactory psychometric properties which include internal consistency (Cronbach's α of 0.9), criterion and construct validity especially among Hong Kong university students (15). It also has acceptable psychometric properties in different languages including English (22, 23), Persian (24), Portuguese (25), Spanish (26), Slovenian (27), Italian (28), Malaysian (29), and Turkish (30, 31), making it one of the best scales for assessing IGD.

Bergen Social Media Addiction Scale (BSMAS)

The BSMAS, developed by Andreassen et al. (32), is a six-item scale used to assess the risk of social media addiction based on the addiction component model (*i.e.*, salience, mood modification, tolerance, withdrawal conflict and relapse) (6, 33). It uses a five-point Likert-scale response format that ranges from 1 (*Very rarely*) to 5 (*Very often*) with a higher sum of item scores indicating a greater degree of social media addiction. An example item is "How often during the last year have you felt an urge to use social media more and more?". A CFA of the BSMAS demonstrated a unidimensional structure with satisfactory psychometric properties which include internal consistency (Cronbach's α of 0.82), criterion and construct validity among Hong Kong university students (15). A national representative study among 5,961 Hungarian adolescents proposed a cutoff score of 19 out of 30 to indicate problematic use of social media (34). It has acceptable

psychometric properties in different languages including English (32), Persian (35), and Italian (36).

Smartphone Application-Based Addiction Scale (SABAS)

The SABAS, developed by Csibi, Demetrovics, and Szabo (35), is a six-item scale that is used to assess the risk of smartphone addiction and is also based on addiction components model (*i.e.*, salience, mood modification, tolerance, withdrawal conflict and relapse) (6, 33). Its items (*e.g.*, "My smartphone is the most important thing in my life.") are on a six-point Likert-scale response format that ranges from 1 (*Strongly disagree*) to 5 (*Strongly agree*) with a higher sum of item scores indicating a greater degree of smartphone addiction. A CFA of SABAS demonstrated a unidimensional structure with satisfactory psychometric properties which include internal consistency (Cronbach's α of 0.75), criterion and construct validity among Hong Kong university students (15). Furthermore, other studies reported acceptable psychometric properties in different languages which includes Persian (37), English (38), Turkish (39, 40), Italian (41), Serbian (42), and Hungarian (35).

Depression, Anxiety, Stress Scale-21 (DASS-21)

The DASS-21, developed by Lovibond and Lovibond (43), is a 21-item scale that is used to assess three types of psychological distress (*i.e.*, depression, anxiety, and stress). Each type of distress (depression, anxiety, and stress) is assessed by seven items rated on a four-point Likert scale response format ranging from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much, or most of the time*). A higher sum of item score for each type of distress indicates that an individual suffers more from that specific distress. It has been reported to have high internal consistency indices among adolescents (44, 45).

Data Analysis

The participants' characteristics were analyzed using descriptive statistics, including means (and SDs) for continuous variables, and frequency (%) for categorical variables. The associations between the studied variables (including IGDS-SF9, BSMAS, SABAS, DASS-21, and time spent on gaming, social media, and smartphone) were analyzed using Pearson's correlation. Psychometric properties of the three instruments in scale level were analyzed using floor and ceiling effects (acceptable effects were <20.0%) (46), internal consistency by Cronbach's α (acceptable value was >.7) (47), and CFA. Psychometric properties of the three instruments in item-level were analyzed using corrected item-total correlation (acceptable correlation was >.4) (48) and factor loadings derived from CFA.

CFA with diagonally weighted least squares (DWLS) estimator was applied to test whether the three psychometric instruments were unidimensional, according to the literature (27, 36, 38). Several fit indices were accordingly used to evaluate the unidimensionality of the three instruments: a nonsignificant χ^2 , the comparative fit index (CFI) > 0.9, the root mean square error of approximation (RMSEA) < 0.08, and the standardized root mean square residual (SRMR) < 0.08 (49, 50). After ensuring the unidimensionality of the three instruments, measurement invariance across gender was

carried out to examine whether male and female primary school students interpreted the three instruments similarly. Multigroup CFA (MGCFA) was used by three nested models to determine whether measurement invariance was supported. The nested models were a configural model, a model with factor loadings constrained equal across gender, and a model with factor loadings and item thresholds constrained equal across gender (51, 52). Two comparisons were conducted in the nested models (*i.e.*, configural model *vs.* model with factor loadings constrained equal, and model with factor loadings constrained equal *vs.* model with factor loadings and item thresholds constrained equal) to examine whether measurement invariance was supported. The following indices were used for the evaluation: $\Delta CFI > -0.01$ (53), $\Delta RMSEA < 0.02$ (54), and $\Delta SRMR < 0.03$ (for invariant loadings) or 0.01 (for invariant thresholds) (55). The analyses were performed using LISREL 8.8 (Scientific Software International, Lincolnwood, IL, USA) for CFA and MGCFA; IBM SPSS Statistic version 24.0 (IBM Corp., Armonk, NY) for the rest of the analyses.

RESULTS

Table 1 shows the participant characteristics ($N = 1,108$) whose mean age was 10.37 years ($SD = 0.95$). Nearly half of the participants were males (48.3%), and the participants were roughly equally distributed in three grades (fourth graders = 30.9%; fifth graders = 35.5%; sixth graders = 32.3%). On average, the participants spent 1.11 h/day ($SD = 1.64$) on their smartphone, 0.40 h/day ($SD = 0.89$) on social media, and 0.76 h/day ($SD = 1.52$) on gaming. Additionally, their psychological distress scores were 2.51 ($SD = 3.61$) for depression; 3.92 ($SD = 3.86$) for anxiety; and 4.31 ($SD = 4.10$) for stress.

Table 2 shows the satisfactory properties of the IGDS-SF9, BSMAS, and SABAS at the scale level among the primary school students, except for the slightly high proportion in floor effects (IGDS-SF9 = 24.6%; BSMAS = 28.2%; SABAS = 25.7%). More specifically, all the fit indices used in the CFA supported the unidimensional structure for IGDS-SF9, BSMAS, and SABAS. Additionally, Cronbach's α was satisfactory in all three scales: $\alpha = 0.84$ for IGDS-SF9; 0.73 for BSMAS; and 0.81 for SABAS. Moreover, the IGDS-SF9, BSMAS, and SABAS were mutually significantly

TABLE 2 | Psychometric properties of the three scales in scale level ($n = 1,108$).

Psychometric testing	IGDS-SF9	BSMAS	SABAS	Suggested cutoff
Ceiling effects (%)	0	0	0	<20
Floor effects (%)	24.6	28.2	25.7	<20
Internal consistency (Cronbach's α)	0.84	0.73	0.81	>0.7
Confirmatory factor analysis (CFA)				
χ^2 (df)	200.71(27)	25.93 (9)	19.51 (9)	Nonsignificant
Comparative fit index	0.98	0.99	1.00	>0.9
Tucker-Lewis index	0.98	0.99	1.00	>0.9
RMSEA	0.076	0.041	0.032	<0.08
SRMR	0.067	0.033	0.023	<0.08

IGDS-SF9, Internet Gaming Disorder Scale–Short-Form; no modification indices were done in the CFA; BSMAS, Bergen Social Media Addiction Scale; no modification indices were done in the CFA; SABAS, Smartphone Application-Based Addiction Scale; no modification indices were done in the CFA; RMSEA, Root-mean square error of approximation; SRMR, Standardized root mean square residual.

correlated ($r = 0.55$ – 0.69 ; all p -values < 0.01). Scores on the subscales for depression ($r = 0.34$ – 0.55 ; p -values < 0.01), anxiety ($r = 0.35$ – 0.47 ; p -values < 0.01), and stress ($r = 0.37$ – 0.52 ; p -values < 0.01) were all significantly correlated to scores on the IGDS-SF9, BSMAS, and SABAS as well as the daily time spent on smartphone, social media and gaming (**Table 3**).

The item properties were all satisfactory in the IGDS-SF9, BSMAS, and SABAS. In the IGDS-SF9, all factor loadings derived from the CFA were between 0.60 and 0.80; corrected item-total correlations between 0.55 and 0.76. In the BSMAS, all factor loadings derived from the CFA were between 0.59 and 0.73; corrected item-total correlations between 0.61 and 0.68. In the SABAS, all factor loadings derived from the CFA were between 0.63 and 0.80; corrected item-total correlations between 0.66 and 0.76 (**Table 4**).

After ensuring that both scale-level and item-level of the IGDS-SF9, BSMAS, and SABAS were satisfactory and all had a unidimensional structure, the MGCFA was applied to evaluate whether male and female primary school students interpreted the scales differently. All three instruments had their measurement invariance supported at factor loadings and item thresholds without relaxing any parameters (**Table 5**).

TABLE 1 | Participant characteristics ($n = 1,108$).

	Mean (SD) or n (%)	Missing n
Age (Year)	10.37 (0.95)	46
Gender (male)	513 (48.3%)	9
Grade		15
Grade 4	328 (30.9%)	
Grade 5	377 (35.5%)	
Grade 6	343 (32.3%)	
Time on smartphone (hours per day)	1.11 (1.64)	27
Time on using social media (hours per day)	0.40 (0.89)	43
Time on gaming (hours per day)	0.76 (1.52)	38
Depression score ^a	2.51 (3.61)	94
Anxiety score ^a	3.92 (3.86)	82
Stress score ^a	4.31 (4.10)	94

^aAssessed using the Depression, Anxiety, Stress Scale (DASS-21).

DISCUSSION

The present study validated three instruments that are brief enough to assess some specific (*i.e.*, IGDS-SF9 and BSMAS) or general (*i.e.*, SABAS) internet-related addictions among mainland Chinese children. The results demonstrated that the IGDS-SF9, BSMAS, and SABAS all had robust psychometric properties among mainland Chinese primary school students. Furthermore, all three scales demonstrated a unidimensional structure which is consistent with previous studies (14, 15). Moreover, there were significant intercorrelations between all the variables including IGDS-SF9, BSMAS, SABAS, DASS-21 subscales, and the time spent on gaming, social media, and smartphones.

TABLE 3 | Correlation matrix among the studied factors (n = 1,065–1,108).

	<i>r</i>								
	1.IGDS-SF9	2.BSMAS	3.SABAS	4.Depression	5.Anxiety	6.Stress	7.Time on smartphone	8.Time on social media	9.Time on gaming
1.	–								
2.	0.55	–							
3.	0.69	0.55	–						
4.	0.55	0.34	0.44	–					
5.	0.47	0.35	0.39	0.69	–				
6.	0.52	0.37	0.42	0.69	0.75	–			
7.	0.29	0.20	0.30	0.19	0.17	0.21	–		
8.	0.16	0.16	0.15	0.13	0.17	0.17	0.60	–	
9.	0.20	0.16	0.23	0.17	0.13	0.19	0.70	0.59	–

All *p*-values < 0.01.

Depression, Anxiety, and Stress were assessed using Depression, Anxiety, Stress Scale (DASS-21); IGDS-SF9, Internet Gaming Disorder Scale–Short-Form; BSMAS, Bergen Social Media Addiction Scale; SABAS, Smartphone Application-Based Addiction Scale.

TABLE 4 | Item properties and internal consistency (n = 1,108).

Scale or Item #	Item description	Mean (SD)	Factor loading ^a	Item-total correlation
IGD9-SF				
I1	Preoccupied with gaming behavior	1.63 (0.88)	0.60	0.63
I2	Feel more irritability, anxiety when reduce	1.46 (0.86)	0.78	0.71
I3	Spend more time to achieve pleasure	1.61 (0.91)	0.80	0.76
I4	Systematically fail when trying to control gaming activity	1.61 (0.95)	0.64	0.63
I5	Lost interests in previous hobbies	1.39 (0.85)	0.75	0.69
I6	Continued your gaming activity despite knowing it was causing problems	1.35 (0.73)	0.77	0.68
I7	Deceived about the amount of gaming activity	1.22 (0.66)	0.74	0.60
I8	Temporarily escape or relieve a negative mood	1.79 (1.12)	0.68	0.69
I9	Jeopardized or lost an important relationship	1.27 (0.74)	0.70	0.55
BSMAS				
B1	Salience	1.62 (0.88)	0.73	0.68
B2	Craving/tolerance	1.67 (0.91)	0.70	0.67
B3	Mood modification	1.36 (0.75)	0.67	0.61
B4	Relapse/loss of control	1.74 (1.06)	0.65	0.68
B5	Withdrawal	1.65 (1.02)	0.68	0.68
B6	Conflict/functional impairment	1.56 (1.01)	0.59	0.61
SABAS				
S1	Most important thing	2.00 (1.32)	0.63	0.66
S2	Conflicts have arisen	1.63 (1.21)	0.77	0.70
S3	Preoccupying myself	2.15 (1.42)	0.69	0.71
S4	Fiddle around more	1.82 (1.24)	0.79	0.76
S5	Irritable	1.78 (1.30)	0.80	0.76
S6	Fail to use less	1.90 (1.41)	0.75	0.73

IGDS-SF9, Internet Gaming Disorder Scale–Short-Form; BSMAS, Bergen Social Media Addiction Scale; SABAS, Smartphone Application-Based Addiction Scale.

^aFactor loadings were derived from confirmatory factor analysis.

The results for IGDS-SF9 specifically showed that the scale had a unidimensional structure with acceptable internal consistency ($\alpha = 0.84$). This indicates that IGDS-SF9 is reliable in assessing the risk of IGD among primary school students. These findings

TABLE 5 | Measurement invariance of the IGDS-SF9, BSMAS, and SABAS across gender (n = 1,099).

	Configural model ^a	Loadings constrained equal ^a	Loadings and thresholds constrained equal ^a
BSMAS			
χ^2 (df) or $\Delta\chi^2$ (Δ df)	33.16 (18)	8.30 (5)	5.16 (5)
<i>p</i> -value	0.016	0.011	0.015
CFI or Δ CFI	0.99	0.000	0.000
RMSEA or Δ RMSEA	0.039	–0.001	–0.003
SRMR or Δ SRMR	0.040	0.010	0.000
SABAS			
χ^2 (df) or $\Delta\chi^2$ (Δ df)	32.43 (18)	5.80 (5)	4.37 (5)
<i>p</i> -value	0.019	0.024	0.038
CFI or Δ CFI	1.00	0.000	0.000
RMSEA or Δ RMSEA	0.038	–0.003	–0.004
SRMR or Δ SRMR	0.030	0.003	0.000
IGDS-SF9			
χ^2 (df) or $\Delta\chi^2$ (Δ df)	199.61 (54)	21.15 (8)	19.24 (8)
<i>p</i> -value	<0.001	<0.001	<0.001
CFI or Δ CFI	0.98	0.000	0.000
RMSEA or Δ RMSEA	0.070	–0.002	–0.001
SRMR or Δ SRMR	0.053	0.003	0.000

BSMAS, Bergen Social Media Addiction Scale; SABAS, Smartphone Application-Based Addiction Scale; IGDS-SF9, Internet Gaming Disorder Scale–Short Form; CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; ^aConfigural models are reported using χ^2 (df), CFI, RMSEA, and SRMR; other models are reported using $\Delta\chi^2$ (Δ df), Δ CFI, Δ RMSEA, and Δ SRMR.

(unidimensional structure and reliability) are similar to previous studies [e.g., Arıcak et al. (30); Beranuy et al. (26); Monacis et al. (28); Pontes & Griffiths (22); Pontes et al. (25, 27); T'ng & Pau (29); Wu et al. (24); Yam et al. (15)]. Also, the floor effect (24.6%) was higher than the suggested cut-off although similar to a study by Yam et al. (15). This is possible because the students spent little time on internet gaming. Indeed, the present study's sample spent approximately 0.76 hours per day playing games, a shorter duration as compared with other studies (mean hours per day = 1.09 to 10.99) (15, 24, 56). The reasons for so little time spent on internet gaming may include parental restrictions on the use of gaming devices (and the like) as children. However, this floor effect finding is contrary to a study which found low floor and ceiling

effects for quality of life instruments among children (57). Therefore, a possible reason for the higher floor effect in the present study as compared with the quality of life instruments (57) may be due to the difficulty accessing technology among children. Additionally, measurement invariance across gender was supported for IGDS-SF9, indicating that both genders had similar interpretations on the item content in the IGDS-SF9.

The findings for BSMAS also indicated that the scale had a unidimensional structure with acceptable internal consistency ($\alpha = 0.73$). This indicates that the BSMAS is reliable in assessing the students' challenges with social media use. These findings (unidimensional structure and reliability) are similar to previous studies (15, 36, 58). Results also showed the floor effect (28.2%) was higher than the suggested cut-off and that in previous studies (15, 35). This may be because the students spent little time on social media. Indeed, the present study's sample spent about 0.40 h per day on social media, a shorter duration as compared with past studies (mean hours per day = 3.11 to 3.75) (15, 58). This finding is contrary to a study by Lin et al. (57) which reported low floor and ceiling effects for quality of life instruments among children. Similar to the explanation for the IGDS-SF9, the higher floor effect in the present study as compared with the quality of life instruments (57) may be due to the difficulty accessing technology among children. In addition, measurement invariance across genders was supported for the BSMAS, indicating that both genders had similar interpretations on the item content in the BSMAS (58).

The SABAS had similar psychometric properties like IGDS-SF9 and BSMAS. The scale had a unidimensional structure with acceptable internal consistency ($\alpha = 0.81$). This indicates that the SABAS is reliable in assessing the students' challenges with smartphone use. These findings (unidimensional structure and reliability) are similar to previous studies (15, 35, 37–39, 41). Also, the floor effect (25.7%) was higher than the suggested cut-off and that in previous studies (15, 37, 57). This may be possible because the students had low levels of smartphone use. The present study's sample spent about 1.11 h per day on smartphones, a shorter duration as compared with previous research (mean hours per day = 5.29) (15). This may have accounted for the increased floor effect because they did not use smartphones excessively. Nonetheless, the ceiling effects were as anticipated. In addition, measurement invariance across genders was supported for the SABAS, indicating that both genders had similar interpretations on the item content in the SABAS.

In addition, there were significant positive relationships between the three scales (IGDS-SF9, BSMAS, and SABAS) and psychological distress (depression, anxiety, stress; $r = 0.34$ – 0.55), as well as interrelationships between IGDS-SF9, BSMAS, and SABAS ($r = 0.55$ – 0.69). These results confirm the criterion validity of IGDS-SF9, BSMAS, and SABAS. Also, the results re-affirm the association between individuals who are addicted to online-related activities and possibilities of them also having psychological distress (*i.e.*, depression, anxiety, and stress). Although the present study was unable to establish cause-and-effect relationship, possible reasons for these associations among heavy-using children may be that they are using online-related activities as a coping mechanism or they encounter challenges with the use of digital devices. This is similar

to other studies (9, 15) except that the students used in this present study were children.

This study has practical implications for researchers and clinicians. The results indicate that future researchers in China may use these three scales for further studies of addiction risk to internet-related activities among Chinese children. Clinicians may also use it to assess the risk of online-related addictive behaviors among children. Although these scales are acceptable for assessing the risk of online-related addictive behaviors, they cannot be used as diagnostic tools. Consequently, further studies may be needed to help develop diagnostic criteria (or clinical cut-off scores) for the online-related behaviors examined in the present study.

The present study also has some limitations that should be considered when interpreting the findings. First, the study used mainland Chinese children. Therefore, the results cannot be generalized to other age groups. Moreover, most of the participants in the present study were Han Chinese. Therefore, the psychometric findings in the present study may not be able to generalize to other ethnic groups in mainland China. It is therefore recommended that this study be replicated in other ethnicities and age groups in China. Second, the study utilized self-reported instruments, and there is the chance that the findings may have been affected by social desirability biases or poor memory recall, especially given that children's cognition is still in development. Third, the study did not collect data on participants' psychiatric history which has the potential of confounding study findings. Fourth, the study did not examine the effect that the length of time that the student had owned a smartphone might have had on the results. This may have contributed to the slightly high floor effect found in the study. Future studies are thus needed to examine whether the length of time a student has owned a smartphone contributes to the high floor effect for the instruments. Future studies should take the recommendations into consideration when replicating this study. More specifically, future studies may consider using diagnostic measures (*e.g.*, diagnosis using DSM-5 or Structured Clinical Interview for DSM-5 [SCID-5]) to examine the psychometric properties of the three online-related addiction behavior instruments. Also, respondents' psychiatric history should be collected in the future study to avoid the influence of inherent confounding psychiatric variables.

CONCLUSION

The findings of the present study indicated that the simplified Chinese IGDS-SF9, BSMAS, and SABAS had robust psychometric properties. Therefore, they are reliably and validly capable of assessing internet-related addictions among mainland Chinese children. These scales are, to date, the shortest and easiest to use instruments for assessing specific internet-related addictions. Furthermore, the items of all the three specific scales contributed significantly to the derived factor loadings. There were significant positive relationships between these scales and depression, anxiety, and stress as well as other variables such as time spent on these behaviors or activities demonstrating good construct validity.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics committee of the Hong Kong Polytechnic University (IRB ref: HSEARS20190718001) and the Institutional Review Board (IRB) of the Jiangxi Psychological Consultant Association (IRB ref: JXSXL-2019-J022). Written informed

consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

I-HC, C-YL, and AP contributed conception and design of the study. I-HC organized the database. I-HC and C-YL performed the statistical analysis. DA wrote the first draft of the manuscript. I-HC, C-YL, and C-YC wrote sections of the manuscript. MG, C-YL, and C-YC critically commented on the draft. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Do You Feel the Same as I Do? Differences in Virtual Reality Technology Experience and Acceptance Between Elderly Adults and College Students

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Virtual reality (VR) has been widely applied in medical health areas and the entertainment and tourism industries, in which elderly people are a primary target. However, most studies on VR have focused on how people respond to this new technology and its effects on younger generations. Our study explored the differences in VR experience and acceptance between elderly adults and college students. A mixed method approach including both experiments and in-depth interviews was applied in this study. Our results show that elderly adults reported a higher level of telepresence and stronger emotional responses than young adults in VR viewing regardless of the VR device. The ways in which elderly people processed and evaluated VR content and devices were different from those of young people. Elderly people reported more positive attitudes toward the video they watched than young people, but this did not necessarily lead to more positive attitudes toward the viewing experience.

Keywords: virtual reality, technology acceptance, media experience, age differences, elderly, college students

INTRODUCTION

Virtual reality (VR) technology has been applied in various fields, such as news (La Peña et al., 2010), brand marketing and advertising (Coyle and Thorson, 2001; Klein, 2003; Hopkins et al., 2004; Fiore et al., 2005), tourism promotion (Guttentag, 2010; Huang et al., 2013), games and entertainment (Faiola et al., 2013), education (Roussou, 2004) and medical health (Bush, 2008; Garrett et al., 2014; Amin et al., 2017; Hsieh and Lee, 2018). In recent years, VR has become a powerful and popular tool for creating immersive experiences for brand marketing and advertising (Shen et al., 2019). VR technology has emerged in commercial activities, such as information dissemination, advertising and sales (Barnes, 2016). According to a business news report, 75% of the world's most valuable brands (such as Apple, Google, Coca-Cola, and Microsoft) have created VR projects to attract consumers (Korolov, 2015). VR technology also provides a variety of applications in tourism policy planning, tourism marketing, tourism attractions, entertainment and heritage conservation (Guttentag, 2010). VR has the potential to provide an immersive emotional experience in travel, including in urban and architectural landscapes, specific destinations, museum items, etc. (Barnes, 2016). Marriott Hotels uses VR to promote Hawaii honeymoon experiences, in which visitors

can walk around the virtual environment, view the scenery, and enjoy the sensory experience of fog and warm air (Huang et al., 2013). Previous research on the effectiveness of VR technology has achieved significant and promising results. Immersive VR goggles generate more telepresence than a traditional 2D broadcasting device (Shen et al., 2019), and the influence of telepresence in enhancing consumers' beliefs and attitudes toward brands, products and advertisements has been experimentally confirmed (Coyle and Thorson, 2001; Klein, 2003; Hopkins et al., 2004; Fiore et al., 2005). Nevertheless, most of these studies have focused on how people respond to this new technology and its effects on younger generations, but we do not know whether these effects exist in all age groups (Liu et al., 2020).

VR technology has been shown to be an effective health treatment approach and has achieved remarkable results in distraction from acute pain, the treatment of mental disorders and medical training (Amin et al., 2017). Herrero et al. (2014) asked patients with fibromyalgia to use VR goggles to view pictures with language guidance and found that the subjects reported significantly increased self-efficacy, increased positive emotions, decreased negative emotions and decreased pain caused by the disease. The sense of telepresence generated by VR can trigger different emotions, which is related to the emotional information provided by the application scenarios and specific virtual scenes. Felnhofer et al. (2015) created five VR park scenes with different emotional properties and successfully induced the corresponding emotions in participants. VR was found to be an effective tool for inducing emotions and has been applied to treat mental diseases. Stupar-Rutenfrans et al. (2017) significantly reduced the level of individuals' public speaking anxiety with virtual reality exposure therapy, and the effect was better for participants with higher initial anxiety levels. In addition to exposure therapy, mindfulness training has also been shown to be a therapeutic method combined with VR, and the combination has reduced negative emotions such as depression and anxiety, especially for groups with emotional problems (Flores et al., 2018). Evans et al. (2020) confirmed the better acceptability and effectiveness of personalized virtual reality experience therapy than other forms of therapy in promoting healthy emotions, and the degree of positive emotional improvement was related with personal characteristics and the initial emotional status. In addition, VR technology can also provide virtual anatomy and virtual operating tables to improve traditional medical teaching methods and medical nursing training by allowing trainees to interact with VR and reduce technical operating mistakes caused by negligence (Hsieh and Lee, 2018).

Moreover, researchers have conducted trials by applying VR technology to improve elderly adults' mental and physical well-being. To help elderly patients with impaired cognitive function problems, researchers designed a special VR therapy program for elderly patients to perform daily routines, and the program achieved allowed elderly patients to achieve significant improvements (Gamito et al., 2019). Ten veterans of the Vietnam War diagnosed with fourth-stage posttraumatic stress disorder received 10 VR therapy treatments (90 min each time), and in their 6-month follow-up assessments, their

symptoms of posttraumatic stress disorder were significantly reduced (Rothbaum et al., 2001). Levy et al. (2016) designed a virtual reality game to treat the phobia of falling among elderly people. The results showed that this intervention had a significant effect on reducing their anxiety about falls.

In conclusion, VR has been studied in different areas with specific age groups. Since VR is becoming more prevalent as a greater variety of content is available to audiences and as the cost of devices is decreasing, VR has become widely applied in many fields including medical health areas and the entertainment and tourism industries, where elderly people can be a primary target, there is a need to study VR as a daily use digital media device similar to smartphones and computers. Huygelier et al. (2019) found that elderly participants' initial attitudes toward VR were neutral before experience and turned to be positive after the first-time exposure. After using VR for 15 min twice a week for 6 weeks, those elderly participants showed high acceptance of VR and reported positive perceptions toward adopting VR (Syed-Abdul et al., 2019). A recent review study on applying immersive VR technology to the elderly proposed an immersive experience model of 20 application methods and suggested that such applications could be expanded to various fields like entertainment, education, and media in the elderly welfare centers (Lee and Park, 2020).

It was not surprising to find age group differences in acceptance and experience with new technologies. An intra-subject design study revealed significant age-related differences (seniors above 60 years old vs. adults up to 40 years old) across head-mounted display vs. desktop platforms in both assessed performance and user experience after a virtual supermarket shopping task (Plechata et al., 2019). In terms of emotion effects, an experimental study revealed differences in the processing of positive and negative emotions between age groups (seniors above 60 years old vs. college students) after watching a 360-degree video by a VR headset or an iPhone (Liu et al., 2020). However, studies that directly compare the two age groups (young people vs. elderly people) using the same VR stimuli and that explore whether they process the experience differently were still very few and lack of particulars.

The current study aims to explore the experience and acceptance differences between elderly adults and college students from the following aspects:

To evaluate the experience and acceptance difference levels in terms of perceived telepresence, video preference, viewing experience and purchase intention between the two age groups;

To test the mechanism of how telepresence, video preferences and viewing experiences work in different age groups;

To further explore the details and reasons behind those differences by qualitative in-depth interviews.

MATERIALS AND METHODS

Study Design and Materials

The study was conducted among two age groups (i.e., elderly adults aged 60 and above and college students) during 1 week of April 2019. The two experimental groups were subjected to

the same study design, procedures and measurements. A prepost treatment between-subjects design was applied in our study. The participants in the elderly group and the college student group were randomly assigned to either the VR condition (Pico 4K G2) or the smartphone condition (iPhone 8) to watch the same video, named VR China, which was an 8-min scenery documentary provided by National Geographic (China). The study received university IRB approval.

Participants

The elderly participants in the study were recruited from a community service center in Beijing, China. The research notice was sent out to all the residents of the community through WeChat. Eventually, 58 elderly adults aged 60 and above signed up, showed up and completed all the procedures in our study. Their ages ranged from 60 to 91 years old ($M = 68.84$, $SD = 7.095$). There were 36 female and 22 male participants.

To recruit the young participants (i.e., college students), a group of university staff and students helped distribute the research notice to university students through WeChat. Sixty student participants, including 30 females and 30 males, completed the study. Among them, the youngest was 18 years old, and the eldest was 25 years old ($M = 20.38$, $SD = 2.164$).

Procedure

In this study, it took approximately 1 h to complete the 5-step experiment with the assistance of research assistants. Step 1: An informed consent form was prepared for each participant to read and sign before the experiment. Step 2: Each participant completed a pretest questionnaire containing several questions related to his or her previous VR experience, preferences, and attitudes toward VR. Step 3: Each participant watched an approximately 8-min stimulus video in Chinese voice-over with Chinese subtitles using a smartphone or wearing a VR headset. Step 4: The participants were asked to complete the postquestionnaire. Step 5: The research assistant conducted a semistructured interview with each participant for approximately 30 min. Part 1 of the study (for the elderly group) was conducted in the community service center rather than in the lab due to the consideration of the possible health and safety issues of the elderly participants during the transportation and experimental period. For the elderly participants who had difficulty reading, the research assistants read aloud and explained the information on the consent form and the pre- and postsurveys. Part 2 (for the college student group) was conducted with the college students in a lab at a university in Beijing.

An approximately 7-dollar cash coupon was given as a reward to each participant who completed the study. In addition, we asked those who were assigned to the non-VR condition whether they wanted to experience the VR viewing after the experiment.

Dependent Measures

Perceived Telepresence

Telepresence was defined as a psychological state of presence brought by media content such as movies or TV dramas (Kim and Biocca, 1997; Suh and Lee, 2005), which was enhanced by the immersive VR technology (Biocca, 1997; Rupp et al., 2016;

Van Damme et al., 2019). Participants' perceived telepresence while watching the video stimuli was measured on a 7-point scale adopted from Kim and Biocca (1997), with 1 being "strongly disagree" and 7 being "strongly agree." Participants were asked to what degree they agreed on the eight statements like "During the viewing experience, I felt I was in the world the television created." The average score was calculated as the overall telepresence score for each subject (some items were reverse coded).

Video Preference

Participants' preferences regarding the video were also measured in the questionnaire by asking to what extent they liked the video in general, with 1 being "dislike a lot" and 7 being "like a lot."

Viewing Experience

Participants' attitudes toward the viewing experience were measured by asking to what extent they liked the way they viewed the video, with 1 being "dislike a lot" and 7 being "like a lot."

Both video preference and viewing experience were measured by a single-item question as the two constructs are easily and uniformly understood (Bergkvist and Rossiter, 2007). Besides, a single-item measure can avoid the bias of the common methods (Williams et al., 1989).

Purchase Intention (PI)

Whitlark et al. (1993) defined purchase intention as a purchase probability associated with an intention category at the percentage of individuals that would buy a product. Similar to a measure used in Kergoat et al. (2017), purchase intention was measured on a 5-point Likert scale two times (Bearden et al., 1984), i.e., once before and once after people watched the video, by asking the participants to what extent they would like to purchase a VR headset, with 1 being "would like very much" and 5 being "would not like very much."

Qualitative Data

The data from semistructured interviews were also recorded for further analysis.

RESULTS

Quantitative Results

Previous studies have found that males and females differ in the ways they experience VR and in the levels of perceived telepresence. To avoid potential gender differences that would bias the results, a chi-square test was conducted to check whether male and female participants were randomly assigned to the VR and smartphone before performing the main analyses. For the elderly individuals, there was no significant difference in the gender distribution between the two conditions [$\chi^2(1, 58) = 2.78$, $p = 0.096$]. For the college students, there was also no significant difference in the gender distribution between the two conditions [$\chi^2(1, 60) = 2.40$, $p > 0.5$]. Therefore, gender differences should not have affected the results of our study. Besides, we conducted Levene's test to check the homogeneity

of variance. The results showed that the Levene Statistics of perceived telepresence [$F(1,116) = 0.202, p > 0.05$], video preference [$F(1,116) = 2.487, p > 0.05$], and viewing experience [$F(1,116) = 1.646, p > 0.05$] in our study were all non-significant. Therefore, equal variances can be assumed for the following ANOVA analyses.

Perceived Telepresence

To explore the differences in the perceived telepresence in the two age groups (college students vs. elderly adults), a two-way ANOVA was conducted using the telepresence level as the dependent variable and age group (undergraduate students vs. elderly adults) and device (VR vs. smartphone) as the independent variables (see **Figure 1**). The results showed significant main effects of both the age [$F(1,116) = 7.80, p < 0.01$] and device [$F(1,116) = 7.22, p < 0.01$] on perceived telepresence. Regardless of age, viewing the video in an immersive VR environment elicited a higher level of perceived telepresence ($M = 4.5, SD = 0.66$) than viewing the video on a smartphone ($M = 4.14, SD = 0.77$). The elderly participants in both the smartphone group and the VR group reported a higher level of perceived telepresence ($M_{\text{smartphone}} = 4.38, SD = 0.93$; $M_{\text{VR}} = 4.61, SD = 0.68$) than the two groups of undergraduate students ($M_{\text{smartphone}} = 3.90, SD = 0.48$; $M_{\text{VR}} = 4.37, SD = 0.63$).

Video Preference

Then, a two-way ANOVA test was conducted to explore the difference in video preferences among the age groups and

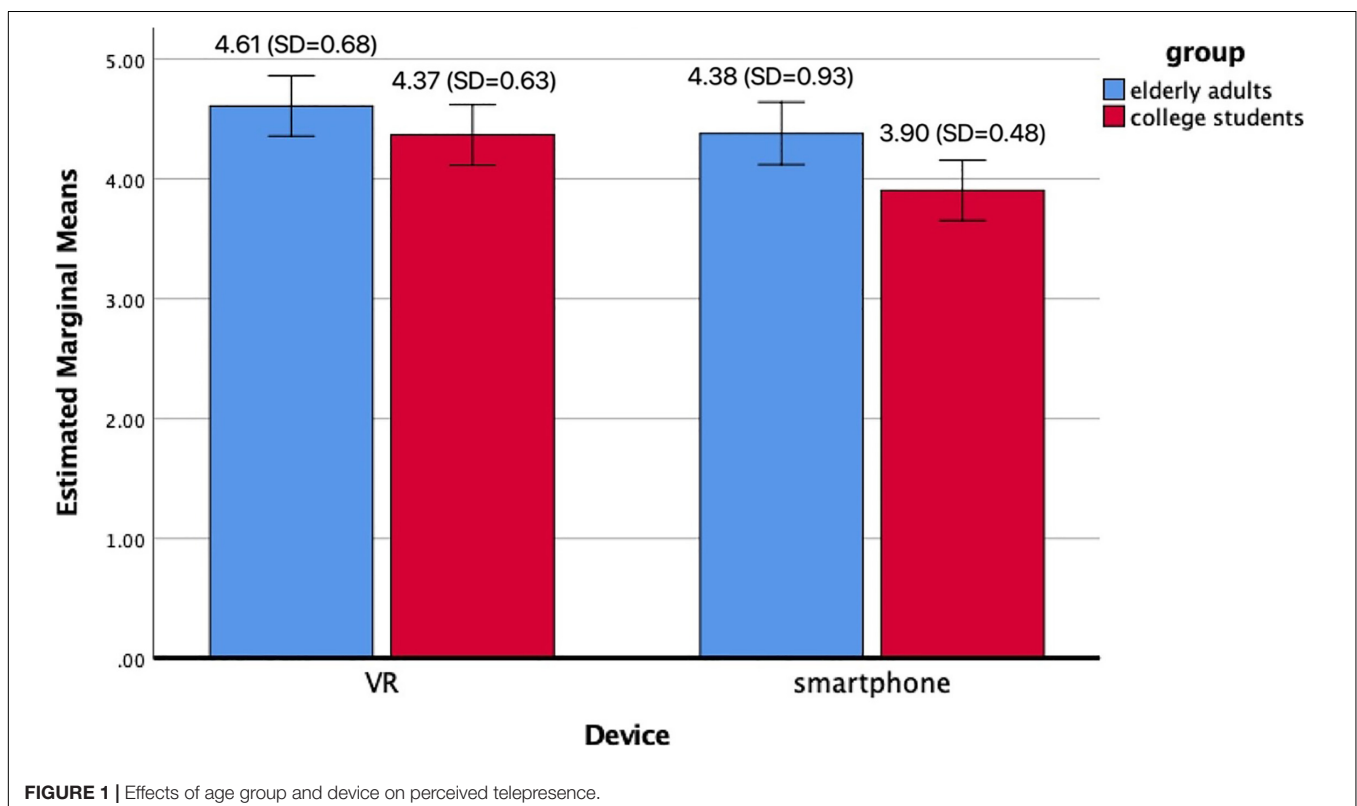
device groups. The results suggested that there were two main effects. First, the VR groups ($M_{\text{VR}} = 6.42, SD = 0.809$) showed more positive attitudes toward the video than the smartphone groups ($M_{\text{smartphone}} = 5.88, SD = 1.171$) regardless of age [$F(1,114) = 6.831, p < 0.01$]. Second, the elderly groups ($M_{\text{elderly}} = 6.4, SD = 0.897$) reported more positive attitudes toward the video than the student groups ($M_{\text{student}} = 5.92, SD = 1.109$) regardless of the device they used (see **Figure 2**).

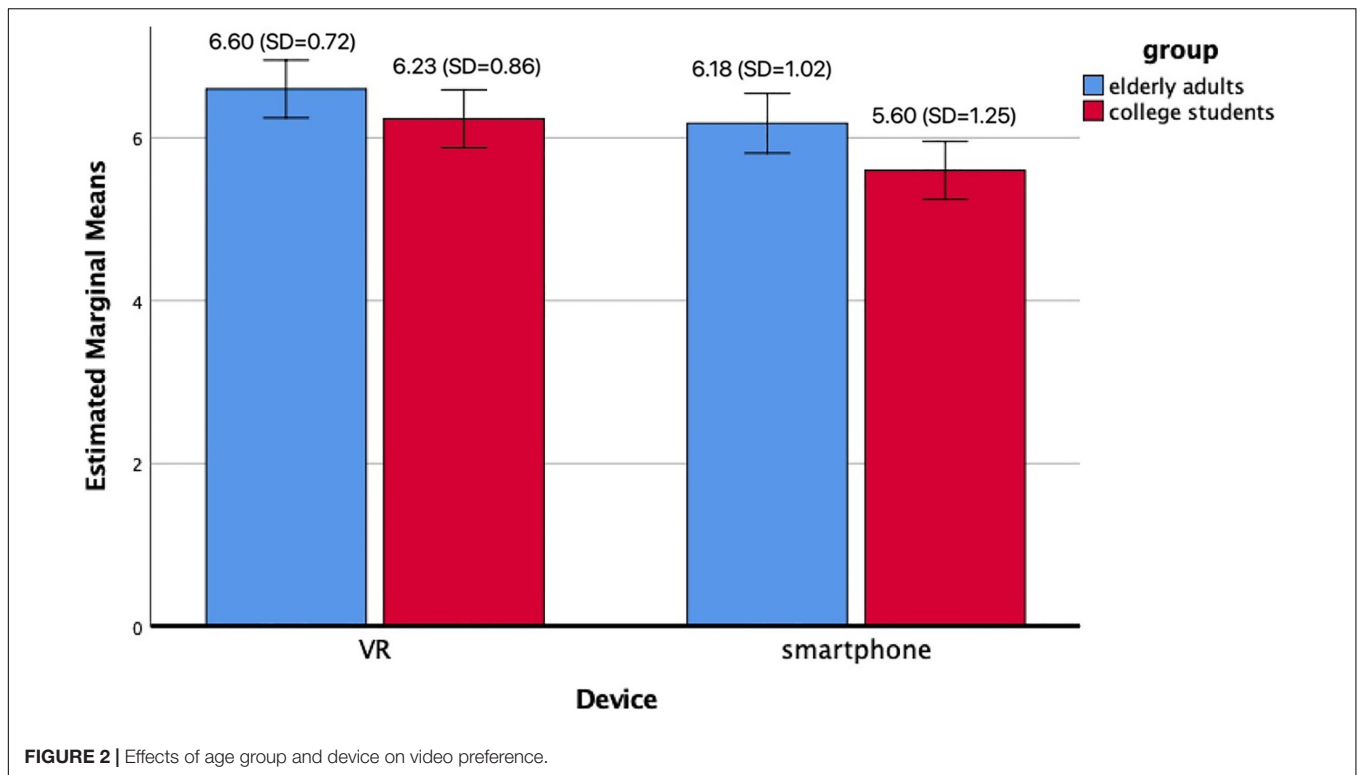
Viewing Experience

To investigate whether there were differences among the age groups and device groups, a two-way ANOVA was conducted. The results suggested that there was no significant difference among all groups. The participants in the different age groups showed equal preferences for the full immersive experience using a VR device and the non-immersive 360-degree video using a smartphone.

Mediation Effects of Age Group

To test the mechanism of how telepresence, video preferences and experience preferences work in different age groups, mediation models were tested. First, we tested the mediating role of watching experiences created by different devices in the relationship between perceived telepresence and preference for the video in the young student groups (see **Figure 3A**). Baron and Kenny's (1986) mediation analysis was adopted to test the model. Three simple regression analyses were conducted. First, the video preference was regressed on perceived telepresence. The results showed that telepresence had a significant impact on





attitudes toward the video ($\beta = 0.32$, $t = 2.574$, $p < 0.05$); thus, the first step was supported. Then, viewing experience was regressed on telepresence. We found that telepresence had a significant positive impact on viewing experience ($\beta = 0.399$, $t = 3.311$, $p < 0.005$). Finally, attitudes toward the video were regressed on both viewing experience and telepresence. The results showed that the impact of viewing experience on video preference was significant ($\beta = 0.589$, $t = 5.237$, $p < 0.001$). The influence of telepresence on attitudes toward the VR video, however, was greatly reduced to a non-significant effect ($\beta = 0.085$, $t = 0.760$, $p = 0.451$). Overall, these results demonstrated that in the college student groups, the influence of perceived telepresence on attitudes toward the video was mediated by participants' viewing experience created by different devices.

In the elderly groups (see **Figure 3B**), the same procedures were used to test the same mediation model. The result of the first regression showed that the telepresence had a significant impact on attitudes toward the video ($\beta = 0.397$, $t = 3.241$, $p < 0.01$), so step 1 was supported. For the second regression, we found that telepresence had no significant impact on viewing experience ($\beta = 0.219$, $t = 1.678$, $p = 0.099$); therefore, step two was not supported. For the last regression, attitudes toward the video were regressed on both viewing experience ($\beta = 0.28$, $t = 2.315$, $p < 0.05$) and telepresence ($\beta = 0.336$, $t = 2.77$, $p < 0.01$). Both analyses suggested a significant positive impact on video preference. Because step 2 failed to be verified, the mediation effect of viewing experience between telepresence and attitude toward the video was not observed among elderly people.

In conclusion, for young students, perceived telepresence, video preferences and attitudes toward the viewing experience

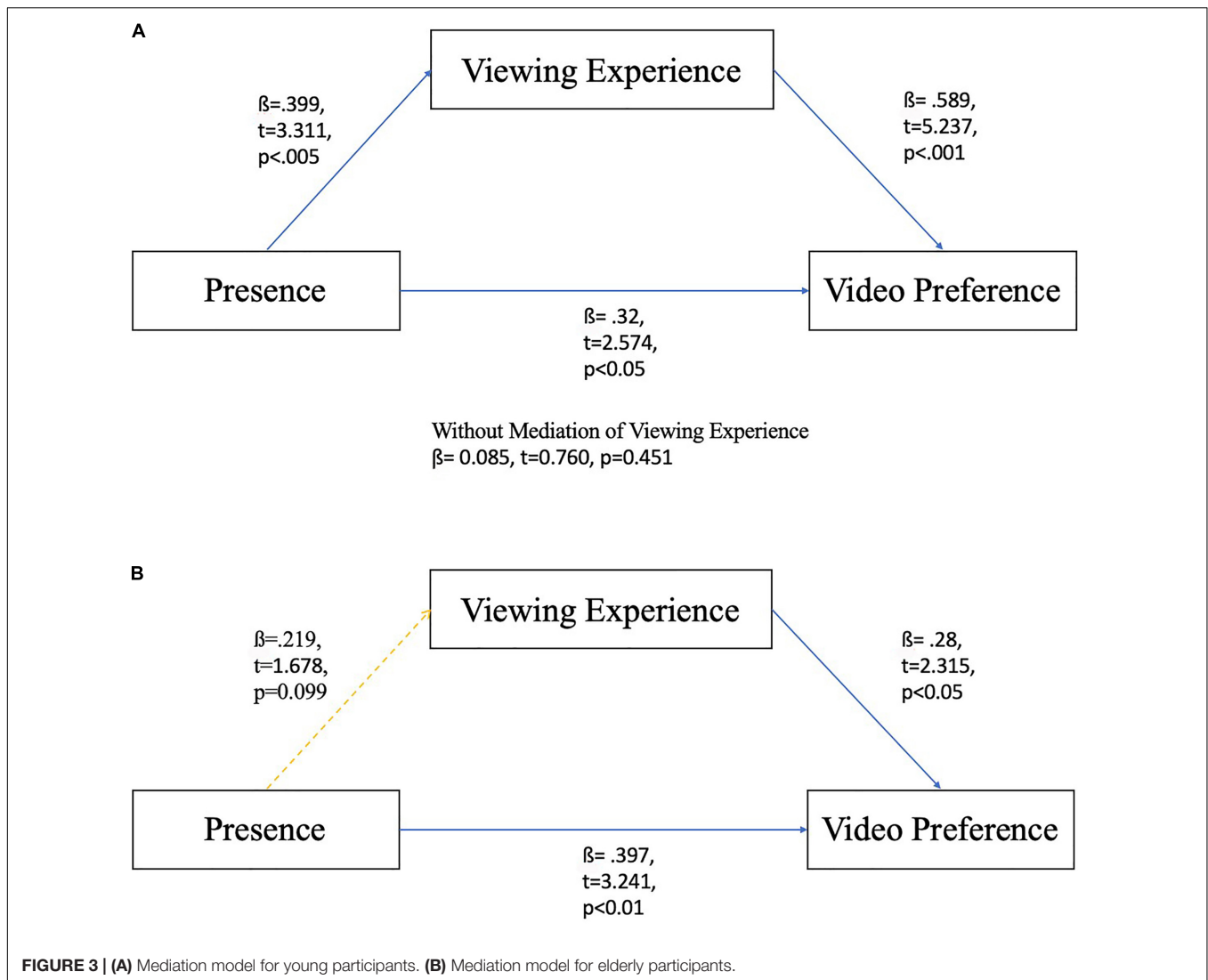
were all positively related. Moreover, their attitudes toward the viewing experience were affected by their perceived telepresence, which in turn influenced their attitudes toward the video. However, for the elderly participants, perceived telepresence did not necessarily lead to more positive attitudes toward the viewing experience, although telepresence and viewing experience were both positively related to video preference.

Purchase Intention

For the analysis related to purchasing intention toward VR devices, we only included the participants who were in VR viewing conditions. First, an independent T-test was conducted on pre-purchase intention between the elderly group and the student group. Interestingly, the results (see **Table 1**) demonstrated that elderly people ($M = 3.63$, $SD = 1.088$) reported a higher purchase intention toward the VR device than young students [$M = 2.87$, $SD = 0.346$, $t(58) = 3.528$, $p < 0.05$], even though only 13% of elderly people in the experiment had tried VR before. Then, another independent T-test was conducted on purchase intention after they watched the video. The result suggested an inverse trend: young people ($M = 2.90$, $SD = 0.995$) indicated higher purchase intention than elderly people [$M = 2.10$, $SD = 0.712$, $t(58) = 3.528$, $p < 0.01$] after viewing the video using the VR device.

Qualitative Results

To further understand the differences in VR experience and acceptance between the two age groups, we analyzed the in-depth interviews. Two different aspects were examined: subjective experience and VR device evaluation.



Subjective Experience

Regarding the subjective experiences of those who had VR viewing experiences, we found both similarities and differences between the two age groups. Generally, we extracted five themes, including (a) telepresence, (b) emotional appeal, (c) surrealness, (d) strangeness and (e) physical discomfort, from the interview materials of the elderly group. We extracted four themes from the interview materials of the student group, including

(a) telepresence, (b) privacy, (c) emotional appeal, and (d) physical discomfort.

Telepresence

Both groups mentioned that VR gave them the sense of being there, in other words, telepresence. Meanwhile, their ways of describing the experience were quite different. The elderly group talked about their experiences based on the video content extensively and described their feelings very specifically, vividly and emotionally. The following are some quotes from the elderly participants: “At that moment, I feel like I am flying up, I am running, I am floating up. You just feel like you are there”; “My heart and my mind are totally in the video, and my attention is absolutely concentrated on it”; and “It feels like that water is pouring on you. The water is so close.” The student group was more likely to use rational and abstract words to describe the experience such as “There is a sense of reality,” “There is a sense of presence,” and “There is more sense of substitution.” The overall descriptions of telepresence by the student group seemed to be

TABLE 1 | T-test for pre and post purchase intention.

Variable	Group	N	Mean	SD	t	df	p
Purchase intention (pre)	Elderly adults	30	3.63	1.088	2.72	58	0.015*
	College students	30	2.87	0.346	—	—	—
Purchase intention (post)	Elderly adults	30	2.1	0.712	3.53	58	0.001***
	College students	30	2.9	0.995	—	—	—

* $p < 0.05$ and *** $p < 0.001$.

not as strong as those of the elderly group, which was consistent with what we found in the quantitative analyses that revealed that the elderly group reported a higher level of telepresence in the VR experience than the student group.

Emotional appeal

Most of the elderly participants reported that viewing VR videos stimulated their positive emotions. For example, they stated “I feel very pleasant after watching it”; “It feels so good to look at the kind of openness, and the kind of spectacular”; and “My ears are listening and my eyes are watching, so I forgot about the unhappiness in my heart.” There were only a few people in the student group who mentioned strong pleasure, and most students reported that during the viewing experience, their moods were quite good; however, this was not only because of the VR device but also because of the uplifting content of the video. Only two students mentioned that VR viewing greatly reduced their study-related pressure: “I felt very relaxed after I watched the VR video. I had all my confidence back at once. My emotions were totally changed.” The immersive environment created by VR technology could make people feel relaxed, forget their troubles in reality and escape for a while. Regarding this point, the elderly group and the student group had similar responses. However, a small number of elderly participants reported having a sense of “fear” and “intensity,” which rarely appeared in the student group. In general, the elderly group reported stronger emotional appeal effects than the student group for both positive and negative emotions.

Physical discomfort

Both the elderly group and the student group reported physical discomfort, and more people in the elderly group reported physical discomfort than in the student group. In addition to experiencing vertigo, the student group reported being uncomfortable with the shortcomings of the VR equipment and content: “The picture is not stable. Sometimes the picture will tremble. When it trembles, it makes me feel a little dizzy” and “I feel that the experience of this type of wearing is not so good; I feel the helmet always squeezing my eyes.” In addition, the elderly group reported more serious uncomfortable feelings, probably related to their health conditions. Two elderly participants dropped out of VR viewing because of vertigo: “I feel that my heart is particularly uncomfortable. The lens is pulling too fast, and the scene is rushing toward me. I feel that I can’t stand with it” and “I just think that I can’t accept it (stun), I am a little dizzy, a little uncomfortable.”

Privacy

Responses concerning a sense of privacy were observed only in the student group. Many student group respondents mentioned that wearing fully enclosed headgear gave them a strong sense of privacy, and they liked this exclusive personal experience; for example, students described the experience as follows: “It gives you a pure feeling of quietness and enjoyment. VR is really more shocking. You feel quiet when you are alone. It feels like this is your own time” and “When I’m in VR, I feel that I’m left alone. It’s my own world, and that feeling is really good.”

Surrealness and strangeness

Surrealness and strangeness were mentioned only in the elderly group. Respondents in the elderly group showed a clear sense of distinction between virtual reality and true reality in interviews. VR produced a sense of deception and unreal feelings to the elderly interviewees, and the special use of VR produced feelings of strangeness and uneasiness in some elderly interviewees. “This kind of virtual technology actually adds a barrier to emotions, which is not so intuitive and can’t be expressed intuitively”; “It’s not real, it’s fantasy.”; “I don’t think wearing goggles is human”; “VR is something that is not practical”; and “I don’t think it can be used as normal.”

VR Device Evaluation

In terms of device evaluation, we extracted five key themes to compare the similarities and differences regarding attitudes and opinions toward VR among the two age groups: (a) virtual telepresence, (b) technology insufficiency, (c) technology acceptance, (d) applications and (e) addiction.

Virtual telepresence

Most student group respondents thought that virtual telepresence could replace physical telepresence. VR technology could provide many advantages, such as saving time and money for traveling, avoiding the congestion of scenic spots, reducing the environmental pressure on scenic spots, surpassing human limitations, and recording and protecting human culture. The student responses included the following: “If I don’t have time to travel, then I can experience it with VR”; “VR could solve the problem of traveling crowds”; and “It helps to protect cultural relics, such as the exquisite and precious murals. The risk will arise, and it is difficult to protect if there are too many visiting people.” As mentioned above, the elderly group showed a clear distinction between virtual reality and true reality. Although some elderly participants also mentioned the advantages provided by VR technology, they did not think the virtual telepresence could replace the real experience.

Technology insufficiency

Students remarked on a series of technological insufficiencies regarding the device, such as insufficient clarity, a lack of variety in content especially made for VR devices, the unportable size of the equipment, and operational difficulty. In addition, since VR device applications are not yet widespread, some students think that it is embarrassing to use VR devices in public. Some students also mentioned some inherent flaws in VR technology, especially in terms of the interactive design. Regarding content, the excessive autonomy of VR seems to weaken the expression of the work. In addition, as a new technology, there are still some ethical issues with the use of VR and content production. For example, participants noted the following: “The device oppresses you with an oppressive feeling, which always reminds you that you are using a complicated device”; “There is a black hole at the bottom of the video, which makes you actually feel that this is not in real life”; “I feel that playing games (with VR) in public is quite awkward because you have to move around and it looks a bit funny”; “VR’s panoramic display sometimes has a negative effect on movies. Movies need to

be suspended on a screen or have some lens changes, but VR can look at it from 360 degrees, which weakens the effects of expression”; and “People like me, if you don’t guide us, it is hard to mobilize our enthusiasm. I will only look in one direction. The extra 270 degrees behind me is meaningless.” Unlike the students, who had many comments on and critiques of VR, elderly participants talked more about their feelings and experiences.

Technology acceptance

Although many student group respondents noted the shortcomings of VR equipment, they all showed positive attitudes toward VR and believed that the deficiencies would be overcome eventually. They embraced VR technology actively and had confidence in the development and prospects of VR: “The development at the beginning may be limited to certain aspects, but I think there are a lot of things that are actively developing, and it (VR) should have a bright future”; “(Even though) I have to pay some price for VR equipment, it will make you and your descendants more proactive to embrace new technology”; and “Sometimes I doubt whether I really exist, but I am very convinced of science and technology. Even if research results are not necessarily correct, I think the new technology will bring changes to our lives, so I am willing to believe it. I think it is representative of the future.”

In contrast, many elderly group respondents thought that VR devices were too complicated to operate. The interactive function that required the body to be rotated autonomously was too complicated for some respondents. In addition, they preferred familiar media such as watching TV to maintain their emotional well-being: “Older people generally like things to be easy to operate. The procedure is complicated, and now my head is not clear. I can’t remember how to use it at all”; “I don’t have the ability to think through or manipulate it, so I still hope to have a set recommended viewing angle”; and “I can’t control it. . . I am afraid of operating it. I don’t usually operate (digital products).”

Applications

After the experiment, the elderly group respondents often voiced that they thought VR applications would be limited to entertainment and that VR devices would play content that they are used to watching (such as news shows and TV series); thus, they had no demand for other applications. These perceptions could help explain why the VR device experience was positive overall, but the elderly group did not accept VR: “The main reason is the demand; this is not needed at present”; “I am not very interested in this. We are too old, so it is useless to buy this thing”; and “I am having a satisfied life now, I don’t need this.”

Unlike the elderly group, the student participants proposed many imaginative insights into the application of VR technology. The multidomain applications mentioned included simulation driving, aerospace, virtual reality learning, business applications, and social science experiments. For example, students mentioned the following: “It can be distributed to poor areas, so that people in the mountains can see the world outside more. TV may still have some sense of distance” and “You can make a virtual space on Taobao and try on clothes like in a physical store.”

Addiction

Some students mentioned concerns about addiction based on their personal experience. Procrastination is a common problem among college students. Many students worried that privately owned VR equipment could reduce traveling outside and make people tend to engage in more entertainment at home: “I feel that if I really have this. . . with technology this advanced, I feel that I am not going to go out to play.” In the elderly group, there were such concerns as well: “Because it may make me want to continue to look at it, and then I can’t do what I want to do today. I may be addicted and like this thing too much.” Some elderly participants expressed that they were worried that their grandchildren would become addicted to VR technology.

DISCUSSION

VR is becoming more prevalent as a greater variety of content is available to audiences and the cost of devices is decreasing. A large amount of research has started to examine the effects of VR in different fields. However, most of these studies have only used student samples, focusing on how young people respond to this new technology and its effects on younger generations (Liu et al., 2020). It is undeniable that young people are a key audience and major users of VR, but since VR has also been widely applied in the medical health area and tourism industry in recent years (Syed-Abdul et al., 2019; Lee and Park, 2020), elderly people could become the main target. However, there are lack of studies on the experience and acceptance of VR among elderly people and how they perceive VR differently from young people. Therefore, our study provides new insights into the usage and effects of VR among the elderly.

First, our study directly compared the difference in telepresence and attitudes between young people and elderly people after having the same VR experience. The comparison results showed that elderly people reported a higher level of perceived telepresence than college students in general. This result is consistent with the qualitative data showing that the elderly people described the feeling of telepresence more frequently and used more emotional descriptions than young students in the interview. This could suggest that elderly people may be more likely to experience telepresence in VR or 360-degree videos and have more emotional responses than college students. A previous study found that the perceived level of telepresence is positively related to the attitude toward the content (Spielmann and Mantonakis, 2018). We found a consistent result that elderly people also showed more favorable attitudes toward the video than young people regardless of the device. However, we did not find any significant difference among groups regarding their attitudes toward the viewing experience. Therefore, although elderly people reported more positive attitudes toward the video than young people, this did not necessarily lead to more positive attitudes toward the viewing experience.

Second, our research adds to the body of literature on the mechanism of how telepresence, attitudes toward content and

attitudes toward technology interact in different age groups. The same mediation models were tested between young students and elderly people. We found that there is a full mediation effect of viewing experience between the perceived level of telepresence and attitude toward the content in college student groups. Specifically, for young students, a higher level of telepresence can lead to a more favorable attitude toward content and in turn lead to more positive attitudes toward the content. However, this model did not work for older people. Although the level of telepresence and attitudes toward the viewing experience were both positively related to the video preference, a higher level of telepresence was not significantly related to their preferences for the viewing experience. This finding suggested that for elderly people, there should be other factors, such as perceived difficulty of using the new technology, physical discomfort and emotional responses elicited by VR, that could influence their preferences for the viewing experience in VR. For example, as shown in the qualitative analysis, some elderly people reported that they like devices that are easy to operate. VR headsets may be too complicated for elderly people for daily use. They also mentioned that they may not be able to process so much information at the same time, so some of them said they preferred only one viewpoint instead of exploring 360-degree environments by themselves. Furthermore, the feeling of “being transferred somewhere” made some elderly people feel “fearful” during watching, which could also have an impact on their attitudes toward the VR viewing experience. Physical discomfort was mentioned in both the student group and the elderly group, but dizziness was reported more frequently in the older adult group due to their health conditions. The feeling of discomfort may be one of the most important reasons why a higher level of telepresence did not lead to more positive viewing experience in the elderly group.

Finally, our study also provides some practical implications for the VR industry. Our results showed that elderly people reported a higher purchase intention toward VR devices than younger people before they watched the video; however, this trend disappeared and even was reversed after they experienced VR. Young people were more likely to want to purchase VR devices than older adults. Although elderly people reported more positive attitudes toward the video, this did not make them feel more motivated to buy the device. This finding demonstrated that elderly people tended to separate their perceptions of content and their interests in devices. As illustrated in our qualitative results, elderly people cared more about content quality, and they believed that VR devices were not necessary in their lives. The students were more likely to associate with and accept the content on the VR device.

There were several limitations to this study. First, we collected the experimental data of the elderly group in a community center instead of in a lab, which may have affected the results. Second, we only tested one video in our study and the sample size was fairly small. These problems could be addressed in future replications of our study by including more samples and more videos with different topics in the stimuli materials. Third, we did not measure the level of discomfort in the experiment

as a covariate, which is an important factor related to viewing experience. Forth, our comparison of the young and elderly samples might have some confounders such as differences in income, educational background, and previous VR experience. Participants in our young group are all college students, but the elderly individuals in our study may have more diverse educational backgrounds. Additionally, our data showed that more young adults (56%) had VR related experience than elderly people (13%) in our study. Though we randomly assigned people in our study conditions, it might still affect the result of pre-purchase intention. Future studies should have more rigorous procedures for recruiting samples and include individuals' past VR experience into consideration. Finally, gender effect was ruled out in our study design, but it can be an important factor to be explored in future studies.

CONCLUSION

In the presented study, we used a mixed method approach, including both experiment and in-depth interviews, to explore the differences in experience and acceptance among the elderly and young groups. Several differences were found. First, our results showed that elderly adults reported a higher level of telepresence, more positive attitudes toward the video, and stronger emotional responses than young adults in VR viewing, but this did not necessarily lead to more positive attitudes toward the viewing experience. Second, how elderly people processed and evaluate VR content and devices were different from those of young people. Student participants' attitudes toward the viewing experience were affected by their perceived telepresence, which in turn influenced their attitudes toward the video. However, for the elderly participants, perceived telepresence did not necessarily lead to more positive attitudes toward the viewing experience, although telepresence and viewing experience were both positively related to video preference. Third, elderly people reported a higher purchase intention toward VR devices than younger people before they watched the video and this trend was reversed after they experienced VR. Moreover, how the two age groups evaluated the viewing experience and VR device differently were discussed in the qualitative reports.

Our study directly compared the difference in telepresence and attitudes between young people and elderly people after having the same VR experience in particular. The results revealed important implications. Although elderly people reported to have higher level of telepresence and more positive attitudes toward the video than young people, this did not mean they preferred VR viewing. In fact, through in-depth interviews, elderly people reported their concerns and discomfort, and they believed VR was not necessary in their lives. It took time for the whole society, especially for the elderly, to accept a new kind of technology. However, the results and problems revealed in our study might suggest that VR is more suitable for being applied in professional areas and for purposeful use such as medical treatment and e-learning. For the elderly population, specialized VR products with easier operation and considerate content should be considered.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Ethics Review Committee, School of Journalism and Communication, Beijing Normal University. The participants provided their written informed consent to participate in the study.

AUTHOR CONTRIBUTIONS

QL designed the study, wrote the draft, and contributed the most to the study. YW participated in the study design, conducted the quantitative data analysis, and reported the quantitative results. QT and ZL participated in the data collection and

qualitative data analysis. All authors worked on the manuscript and critically revised it.

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SUPPLEMENTARY MATERIAL

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Psychometric Properties of the Nine-Item Problematic Internet Use Questionnaire (PIUQ-9) in a Lithuanian Sample of Students

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Objectives: To date, there is no reliable instrument which could be used to assess problematic Internet use (PIU) in Lithuania. The nine-item Problematic Internet Use Questionnaire (PIUQ-9) previously validated in multiple countries, could be a potential tool for measuring PIU severity. The main objective of the present study was to explore the psychometric properties of the Lithuanian version of the questionnaire.

Methods: A total of 272 students (17% men, mean age 27 ± 9 years) completed the PIUQ-9, the Patient Health Questionnaire (PHQ) and answered questions about the impairment of daily functioning caused by PIU in an online survey.

Results: A confirmatory factor analysis indicated that a bi-factor model with one general factor “general problem” and two-specific factors “obsession” and “neglect + control disorder” fitted the data well. The presence of a strong global factor was supported by the common variance index in the bi-factor model indicating that the “general problem” factor explained 67.7% of common variance. The multiple indicators multiple causes (MIMIC) model showed that psychiatric symptoms ($\beta = 0.25$) had a moderate, while impairment due to PIU ($\beta = 0.41$) had a moderate-to-strong direct effect on the factor “general problem” supporting the construct validity of the scale.

Conclusion: The Lithuanian version of the PIUQ-9 has appropriate psychometric properties to be used in measuring PIU severity in student samples.

Keywords: internet addiction, online addiction, problematic internet use, Problematic Internet Use Questionnaire, screening instrument, psychometric properties, cross-cultural studies

INTRODUCTION

There is a growing global concern about the public health problems and societal costs of problematic Internet use (PIU), which has an estimated prevalence of 1–27% within the general population (1). PIU is increasingly recognized as disproportionately impacting young people and represents an emerging mental health research challenge (2). Excessive social media use, online streaming, gaming, gambling, online shopping, email checking and pornography viewing are all examples of behaviors that have the potential to cause significant impairment of everyday functioning. Various factors may contribute to PIU including age, gender, socioeconomic status as

well as symptoms of mental health conditions or personality traits leading to even more advanced engagement in problematic online behaviors. Furthermore, there is a huge risk that any of these behaviors could have the tendency to increase during and after the COVID-19 quarantine period (3) and may require professional intervention and support. However, it is crucial to have adequate adapted measurements for PIU before developing appropriate tailored interventions.

National health authorities are now expressing concern over the potential impact of PIU. However, there remains both a lack of agreement on what constitutes PIU and scientific data on its prevalence, clinical parameters, and socio-economic burden (2). In order to start answering these important scientific questions, we need an operational definition and reliable tools to measure PIU severity.

While the National Department of Statistics in Lithuania reports that in 2019 ~98% of people aged 16–24 and 95% of people aged 25–34 had been using the Internet daily, there are only few studies investigating PIU prevalence. However, most of the existing studies in European countries which include Lithuania have focused on problematic online behaviors in children and teenagers (4, 5). In a cross-sectional study of 1806 13–18 years old schoolchildren in Lithuania, 9.1% of the study subjects showed markedly expressed symptoms of internet addiction as measured with the Young Diagnostic Questionnaire (6). This particular study also found that symptoms of Internet addiction were also more prevalent among male than female teenagers. Nevertheless, no studies have investigated PIU in young adults and only two reliable questionnaires were used to assess symptoms of Internet addiction in teenagers (4, 5). Therefore, it is crucial to investigate this particular study group of young adults and identify a questionnaire which could be suitable for a specific assessment. A recent publication by Laconi et al. (7) investigated the psychometric properties of the Nine-Item Problematic Internet Use Questionnaire (PIUQ-9) across various different language-based samples of European internet users, highlighting that a brief scale consisting of only nine questions could reliably screen for PIU. The scale has not been used in Lithuania before and its psychometric properties, validated in other cultural backgrounds, show promising results.

Our report attempts to validate a Lithuanian language version of the PIUQ-9 scale. To the best of our knowledge, Lithuania does not have an adapted measure for PIU severity. Given the brevity of the scale, PIUQ-9 would be useful for researchers, clinicians and educators interested in measuring PIU severity.

METHOD

Procedure

Participants completed an online survey, which provided information about the study (i.e., the study objectives and assurances of anonymity and confidentiality). An online survey was made available from 2019 September until 2019 November using Google Forms. A snowballing technique was used to develop convenience sample targeting students. Firsthand networks of study volunteers and student council assistants were employed by researchers to spread the link. The initial

link was shared to Lithuanian University of Health Sciences students using social network services and messenger services such as Facebook or Skype. Researchers encouraged participants to send the link to other students, helping to reach an adequate study sample. However, the engagement rate was not monitored. A formal online consent was provided for each participant to tick before starting the survey. No incentives were given upon completion.

The study received approval from the Bioethics committee and conformed to the principles outlined in the Declaration of Helsinki. The survey included sociodemographic information, the PIUQ-9 questionnaire, and several subscales of the Patient Health Questionnaire (PHQ).

Measures

Besides collecting basic information on age and gender, we also assessed impairment due to PIU by asking study participants a single question with yes/no answer on whether they thought that internet usage impacted their ability to perform daily activities and/or engage in desired social interactions.

The nine-item version of the Problematic Internet Use Questionnaire (PIUQ-9) was used to assess PIU (8) (Refer to the Lithuanian language version in **Appendix A**). The PIUQ-9 is a short version of the 18-item Problematic Internet Use Questionnaire [PIUQ; (9)]. Originally, both scales were reported to have three subscales: obsession, neglect, and control disorder. Based on the previous study examining the psychometric properties of the PIUQ-9, the short scale has a bi-factor structure including one “general problem” factor and two-specific factors of “obsession” and “neglect + control disorder.” The severity of PIU is assessed through a five point Likert scale, ranging from “never” to “always/almost always.” The sum score of the questionnaire ranges from nine to 45. A Higher score indicates a higher risk of PIU. The internal consistency of the PIUQ-9 was 0.89 in this particular study sample. As in previous studies (7), all survey questions were translated from English to Lithuanian using the procedure of double back-translation. An experienced psychiatrist (VS) conducted the translation and the back translation was performed by a clinical psychologist (JB). The final consensus was reached by discussing significant differences in the back translation as compared to the original English version.

Psychiatric disorder symptoms were assessed using the Patient Health Questionnaire (PHQ) (10). The PHQ consists of several modules assessing symptoms of several psychiatric disorders, including depressive disorder, anxiety disorders, somatoform disorder and alcohol abuse/dependence. The depression module consisted of nine items questioning depression severity over a 2 weeks period with possible scores ranging from zero (“not at all”) to three (“nearly everyday”). The sum score of depression symptomatology ranged from zero to 27. The anxiety module contained seven questions regarding the severity of anxiety symptom levels during a 4 weeks period. Each question was rated on a scale ranging from zero (“not at all”) to two (“more than half the days”) and resulting in a total score ranging from zero to 14. The somatoform module consisted of 13 items regarding physical problems that bothered individuals over a 4 weeks period. Each

item ranged from zero (“not bothered”) to two (“bothered a lot”) resulting in a total score ranging from zero to 26. The alcohol abuse/dependence module contained five questions with answers “yes” and “no” asking about the presence of problematic behaviors related to alcohol use occurring more than once in the past 6 months. The total score for the module ranged from zero to five. For the statistical modeling, a general score for the questionnaire summing up the four aforementioned modules was used in order to evaluate the global severity of any psychiatric symptomatology. The internal consistency of PHQ in the current sample was 0.91.

Statistical Analysis

The SPSS for Windows, version 17.0 (SPSS Inc., Chicago, Illinois) and Mplus 8 (11) were employed for statistical procedures. All statistical procedures were based on the Laconi et al. study validating the psychometric properties of the PIUQ-9 (7). Using Student's *t*-tests we have also compared the PIUQ-9 scores and impairment to engage in daily activities and social life due to excessive internet use between genders. In brief, four alternative factor structures were tested: (i) the three-factor model proposed in the study by Koronczai et al. (8), (ii) a two-factor model where control disorder and neglect factors were merged into one due to the high correlation, (iii) a bi-factor model comprising a dimension of global severity on which each item is loaded, plus three specific factors on which the items belonging to the obsession, neglect and control disorder were loaded and where the correlations between specific factors were fixed at zero; (iii) a bi-factor model representing a global severity dimension plus two specific factors (obsession and neglect + control disorder). The correlations between specific factors were also fixed at zero. The degree of fit of the factor models were measured through confirmatory factor analysis (CFA) with maximum likelihood estimation with robust standard errors (MLR).

The following fit indices were used to evaluate model fit: the ratio of the chi-square to its degrees of freedom (χ^2/df ratio), the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the goodness of fit index (GFI), the root mean square error of approximation (RMSEA) and its *p* close value, and the standardized root mean residual (SRMR). The following values were required to indicate adequate fits: χ^2/df ratio ≤ 5 and preferably ≤ 2 ; CFI ≥ 0.95 ; TLI ≥ 0.95 ; GFI ≥ 0.9 , RMSEA < 0.08 , SRMR ≤ 0.10 (12).

The explained common variance (ECV) index was used to measure the degree of unidimensionality in the bi-factor model and the percentage of general factor common variance. Omega and omega hierarchical indices were chosen to measure the ability of the PIUQ-9 scores to estimate the combination of factorial constructs, as well as specific target constructs. The index of construct replicability or H index was used for the evaluation of specific factors (≥ 0.70 was considered as high).

CFA with covariates or multiple indicators multiple causes (MIMIC) confirmatory factor analysis was performed in the Lithuanian language sample to test the construct validity of the best fitting structure (i.e., the bi-factor-model with two specific factors) by exploring correlations between the general

and specific factors and four probable predictors (i.e., age, gender, psychiatric symptoms severity, and impairment due to PIU).

RESULTS

Descriptive Statistics

This study consisted of 291 students studying at the Lithuanian University of Health Sciences. Nineteen participants (7%) refused to participate in the study, leaving the total study sample of 272 participants (83% women and 17% men, mean age 27 ± 9 years). Thirty-nine participants (14%) indicated that PIU caused significant impairment in their daily living and/or social activities. Neither the PIUQ-9 scores, nor impairment to engage in daily activities and social life due to excessive internet use differed between genders ($p > 0.05$).

The Model of the PIUQ-9

The X^2 test was significant in all four factor models. The bi-factor model comprising two specific factors appeared to be the best fitting model according to the fit indices CFI, TLI, RMSEA, and SRMR (Table 1).

Factor loadings for the bi-factor model with two specific factors are presented in Table 2. All nine items had significant factor loadings on the global PIU factor. The ninth item for the specific factor “obsession” was found to be non-significant; however, this item had strong significant loadings on the main factor. This was the case for items five, seven, and eight in the specific factor “neglect + control,” as these items were not significant on the specific factor, despite having strong significant loadings on the general problem factor.

According to the ECV index of the bi-factor model, the general problem factor in the PIUQ-9 explained 67.7% of common variance, supporting a strong global factor. Table 3 shows ECV indices of specific factors. Evaluation of the precision of a questionnaire to assess the combination of general and specific factors, and a particular target construct was carried out through the calculation of the omega and omega hierarchical coefficients. For the Lithuanian sample, the specific factor “obsession” omega coefficient was 80.7 and 82.7% for the merged specific factor. The omega hierarchical coefficient for the “obsession” specific factor was 20.9% and in the case of the merged specific factor it was 12.8%. With the specific factors explaining ~13–21% of the PIU score these coefficients are considered significant. The H value above >0.70 (i.e., 0.89) indicated the “neglect + control disorder” to have good construct replicability. The obsession factor had a good replicability as well with the H value of 0.92.

The MIMIC model shown in Table 4 indicates correlations between the general and specific factors and PIU predictors, such as age, gender, psychiatric symptoms, and impairment due to PIU. Generally, psychiatric symptoms had a moderate direct effect on the general problem factor ($\beta = 0.26$). Impairment caused due to PIU had a moderate-to-strong direct effect on the general problem factor ($\beta = 0.41$). The effect of psychiatric symptoms on the two specific factors, namely “obsession” and “neglect + control disorder” was also moderate ($\beta = 0.21$; $\beta = 0.24$, respectively). Furthermore, very similar effects of the

TABLE 1 | Confirmatory factor analysis of four measurement models of PIUQ-9.

	χ^2	df	p	CFI	TLI	GFI	RMSEA [90% CI]	RMSEA p close	SRMR	SSABIC
LITHUANIAN VERSION (n = 272)										
3-factor model	92.5	24	<0.001	0.942	0.914	0.936	0.102 [0.081–0.125]	<0.001	0.056	
2-factor model	124.2	26	<0.001	0.917	0.886	0.890	0.118 [0.098–0.139]	<0.001	0.047	
Bifactor model with three specific factors	66.2	21	<0.001	0.962	0.935	0.959	0.089 [0.065–0.114]	0.004	0.034	6169.4
Bifactor model with two specific factors	54.5	20	<0.001	0.971	0.948	0.970	0.080 [0.055–0.105]	0.027	0.031	6163.3

PIUQ-9, Problematic Internet Use Questionnaire 9-item version; χ^2 , Chi-square; df, degrees of freedom; CFI, comparative fit index; TLI, Tucker-Levis Index; GFI, goodness-of-fit index; RMSEA, root-mean-square error of approximation; 90% CI, 90% confidence interval of the RMSEA; SRMR, standardized root mean residual; SSABIC, Sample size adjusted Bayesian Information Criteria.

TABLE 2 | Standardized factor loadings of the bifactor model with two specific factors of PIUQ-9.

General factor		Specific factors	
		Obsession	Neglect + control disorder
LITHUANIAN VERSION (n = 272)			
Item 3	0.832	0.959	
Item 6	0.733	0.100	
Item 9	0.685	0.024 ^{ns}	
Item 5	0.697		0.014 ^{ns}
Item 8	0.493		0.069 ^{ns}
Item 2	0.742		0.154
Item 4	0.736		0.366
Item 7	0.647		0.048 ^{ns}
Item 1	0.474		0.944

PIUQ-9, Problematic Internet Use Questionnaire 9-item version. All loadings were significant at $p < 0.005$, except when mentioned ns, not significant.

TABLE 3 | Indicators of dimensionality and reliability of the bifactor model of PIUQ-9.

	General factor	Specific factors	
	General problem	Obsession	Neglect + control disorder
LITHUANIAN VERSION			
ECV	0.677	0.151	0.172
Ω	0.898	0.807	0.827
Ωh	0.834	0.209	0.128
H	0.900	0.920	0.893

PIUQ-9, Problematic Internet Use Questionnaire 9-item version; ECV, explained common variance; Ω , omega; Ω_h , omega hierarchical; H, H index.

impairment due to PIU were observed on the two specific factors ($\beta = 0.39$; $\beta = 0.38$, respectively).

DISCUSSION

The main objective of the present study was to explore the psychometric characteristics of the PIUQ-9. Descriptive results available in our study correspond to the Laconi et al. data (7), for example the mean age of the German sample was 27 ± 10 ,

the mean age of the total sample was 26 ± 9 , while the mean age in our sample was 27 ± 9 years. The percentage of men involved in the study dramatically varied between countries in the aforementioned international study (7) ranging from 0.4 to 97% with a mean of 38%. Our study involved a relatively low number of male individuals comprising 17% of the sample. While many of the PIU studies are overrepresented by male subjects (2), our study might better reflect characteristics of Internet use in female students. However, PIUQ-9 scores as well as impairment related to the performance of daily and social activities due to excessive Internet use did not differ between genders.

The mean score of 18.4 ± 6.3 of PIUQ-9 in the Lithuanian sample was very close to the mean score of the Polish sample reported in Laconi et al.'s study (7). Lithuania is culturally closest to Poland, thus it is possible that PIU symptomatology severity corresponds. The percentage of impairment caused by PIU (14%) corresponds to the data on the European PIU prevalence in youth from 11 countries (13). However, the impairment percent in our study is slightly higher than in the Lithuanian study investigating schoolchildren (6). Several reasons might explain the discrepancy. First, students are the group with the most expressed Internet consumption. Secondly, problematic use and true clinical impairment due to PIU while overlapping are still two different concepts, which measured with different questionnaires might produce discrepancy. Thus, it is crucial to have a questionnaire which could reliably identify PIU symptomatology in prevalence studies.

Our results have confirmed good fit indices for the bi-factor model, with one “general problem” factor and two specific factors of “obsession” and “neglect + control disorder.” Psychiatric symptoms had a moderate direct effect on the general problem factor in the Lithuanian sample, showing good construct validity of the scale. Impairment related to the performance of daily and social activities due to excessive Internet use was a moderate-to-strong predictor of PIU.

The major limitation of the present study is the cross-sectional design, thereby precluding us from making causal assumptions. The Lithuanian sample consisted of students attending one university and was a comparatively small sample size. Furthermore, the gender distribution of the sample was skewed, with a considerably higher proportion of female students. Thus, the results may not represent general or clinical populations and may be subject to selection bias. Questions

TABLE 4 | Multiple indicators multiple causes (MIMIC) model with standardized coefficients (gender and age were both controlled for in the models).

	General problem		Obsession		Neglect + Control disorder	
	β	p	β	p	β	p
LITHUANIAN VERSION ($n = 272$)						
Psychiatric symptoms as measured by Patient Health Questionnaire	0.25	<0.001	0.21	<0.001	0.24	<0.001
Impairment to engage in daily activities and social life due to excessive internet use (NO/YES)	0.41	<0.001	0.39	<0.001	0.38	<0.001
Age	-0.19	<0.001	-0.11	0.037	-0.22	<0.001
Gender	0.04	0.439	0.01	0.906	0.06	0.237
R^2	0.37	<0.001	0.28	<0.001	0.35	<0.001

Gender and age were introduced in the models as control variables. MIMIC model with standardized coefficients.

on educational level (14), and socioeconomic status were not included into our survey, limiting a broader scope of the PIU context in students. While we changed the time spent online covariate with the perceived impairment one, we consider that not including this criterion is a significant limitation of this study. Differentiating time spent online on weekend might have further contributed to the general factor of the questionnaire (7).

To the best of our knowledge this is the first study validating the PIUQ-9 questionnaire in the Lithuanian language. The Lithuanian version of the PIUQ-9 has demonstrated appropriate psychometric characteristics and is suitable for screening PIU in university students. Self-reported perceived impairment related to Internet usage is a strong predictor of general PIU psychopathology. Our current study adds PIUQ-9 as a validated tool for clinicians and educators to screen for the risk and severity of PIU. During a time with an increased Internet usage due to COVID-19 requirements to self-isolate or study remotely, PIUQ-9 could be a potential tool in measuring PIU severity. Future longitudinal studies should observe PIU changes over time and establish a cut-off threshold to define individuals who are at possible risk of PIU and therefore should be advised to seek treatment.

In summary, the PIUQ-9 has good psychometric characteristics and can be applied in research, as well as for educational and clinical purposes, to screen for the risk and severity of PIU.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Lithuanian University of Health Sciences

Bioethics Center. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JB, VS, ZD, and OK conceived and designed the study. VS and JB were responsible for data collection and evaluation. Statistical analyses were performed by AP. JB prepared the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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Threats to Mental Health Facilitated by Dating Applications Use Among Men Having Sex With Men

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In the last years, dating applications (DAs) have had a significant impact on the way in which people seek sexual and romantic relationships. Social groups, such as men having sex with men (MSM), who can experience discrimination and social isolation, find DAs especially engaging and helpful in finding sexual partners. Previous studies have provided evidence showing vulnerability to mental health problems among the MSM population—these problems can be potentially facilitated by DAs use. Excessive use of DAs is associated with lower well-being and life satisfaction, depression, higher substance use, and lower sleep quality. Therefore, there is a need for a better understanding of psychological functioning and risk factors associated with the use of DAs among MSM, which we focus on in this review. We also discuss two relatively new research areas: compulsive sexual behavior disorder and chemsex, and their relation to geosocial-networking mobile technologies. Finally, we point out the limitations of available studies on the mental health of MSM using DAs and propose further research directions.

Keywords: MSM (men who have sex with men), dating applications, mental health, compulsive sexual behavior disorder (CSBD), chemsex, substance (ab)use, risky sexual behaviors

INTRODUCTION

In recent years, mobile dating applications (DAs) have become popular worldwide, changing the way people establish intimate relations, and seek sexual partners. Although a comparable number of both women and men (1) use geosocial-networking mobile applications for dating, there is a category of “apps” dedicated specifically for non-heterosexual males (2) such as Grindr, Romeo, Hornet, or Adam4Adam.

In this narrative review, we present (in section Characteristics and Mental Health of MSM Who Use Mobile DAs) the current state of knowledge on sociodemographic and mental health of men having sex with men (MSM) using the mentioned applications, presenting both the advantages (lower stigmatization, increased partner availability) and threats (e.g., exposure to risky sexual behaviors) associated with DAs use. Then, we point to emerging and socially important issues such as (in section Substance Abuse and Sexualized Drug Use Among MSM Who Use DAs) sexualized drug use [SDU; (3)], also labeled as “chemsex,” and (in section What Do We Know About CSBD Among MSM Who Use DAs) compulsive sexual behavior disorder [CSBD; (4)], which have not been fully examined yet in association with MSM DAs users. Finally (in section Discussion), we discuss the limitations of available studies and propose directions for future research.

METHODS AND MATERIALS

Literature Searching Description

For the purpose of this literature review, we have searched Google Scholar databases for scientific papers published in peer-reviewed journals. In total, we retrieved 4,270 articles published between 2010 and 2020 (the search was conducted in June 2020). The keywords used in the database search included “men having sex with men” and “mental health.” After the exclusion of studies regarding HIV infection, only 189 articles remained. Further, we narrowed the scope to DAs, which resulted in 59 articles, most of which we present in this narrative review. The titles and abstracts of the retrieved articles were evaluated, and the eligible articles were selected for full-text review. Particular manuscripts were included if (a) studies focused on MSM group, (b) studies focused on online dating and geosocial networking applications use, (c) studies focused on mental health issues and psychosocial consequences associated with DAs use, or (d) articles were published in English. Articles were excluded if (a) studies focused mainly on sexual health (promoting sexual health, HIV, and other STDs prevention) or (b) manuscript was based on a case study, observational study, or qualitative study.

Characteristics and Mental Health of MSM Who Use Mobile DAs

The difficulties in finding a romantic or sexual partner in a mainly heteronormative society are, to a large degree, alleviated in cyberspace, where LGBT communities can receive support and engage in relationships more easily (5). Online dating has become a remedy for low partner availability, social isolation, and discrimination (6).

Research has shown that homonormative people experience a lack of tolerance or acceptance, and as many as 20% of them are insulted due to their sexual orientation (7). This can contribute to higher levels of minority stress and stigmatization, which are in turn associated with a higher risk for a range of mental health disorders (8). Moreover, depression is linked to minority stressors in LGBT populations (9). Deficiency of social support, victimization, and exposure to violence have a significantly stronger correlation with poorer mental health in the LGBT group compared with the heterosexual group (10). Research (11) conducted on an LGBT and heterosexual representative sample ($n = 222,548$) showed that non-heterosexual participants, in comparison with heterosexual ones, experience a higher level of stress over a lifetime and their attachment to local society is weaker. Available research indicates that, relative to their heterosexual counterparts, homosexual and bisexual males are 1.5–3 times more vulnerable to depression, anxiety, and substance use disorders (12), as well as more likely to attempt suicide (13). Homonegativity contributes to consequences in the mental health of MSM, for example, in the form of adverse effects on well-being (14), low self-acceptance, and loneliness (15).

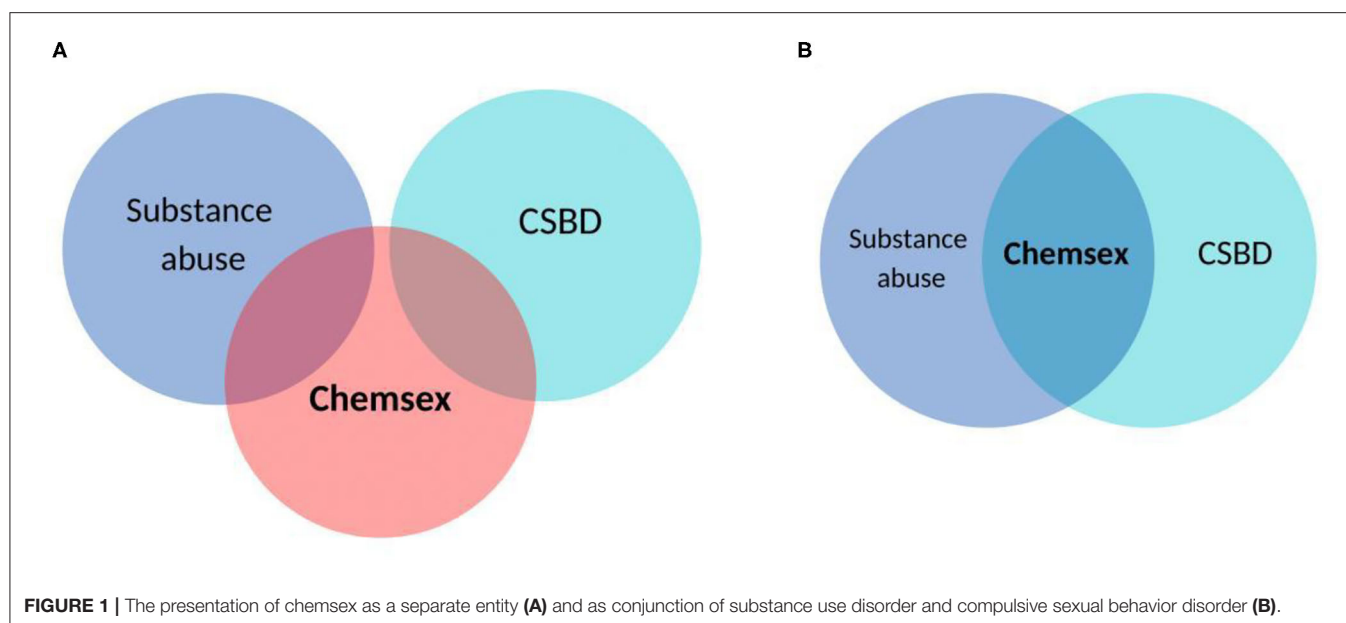
Due to the social marginalization of MSM groups, access to DAs provides a platform for establishing satisfying social and sexual relationships (16) and an outlet for sexual expression in which the threat of being a target of prejudice, stereotypes, and

stigmatization is lowered (6). The high prevalence of DAs use, in conjunction with high rates of mental health disorders in the MSM group, may be why this group is the most often studied in terms of online dating.

To the best of our knowledge, there are two systematic reviews (17, 18) investigating sociodemographic characteristics and risky sexual behaviors among MSM using geosocial networking applications. MSM is a relatively small population [5–7% of males; (16)]. Both Anzani et al. (18) as well as Zou and Fan (17), indicate that the mean age of DAs users ranges between 25 and 35 years, and compared with non-users, they have a higher level of education and income and reported a greater number of sexual encounters in the last few months and in a lifetime perspective. Landovitz et al. (19) concluded that up to 56% of MSM DAs users met sexual partners in the previous 3 months only via Grindr (the most popular app). Non-heterosexual men also constitute the most active group using DAs to hook up for sexual purposes (18). MSM using DAs engage in unprotected anal intercourse (both receptive and insertive) with partners of unknown HIV status more frequently than non-app users, usually under the influence of drugs or alcohol during sexual activity (18).

The vast majority of studies (17, 19, 20) on MSM app users are more focused on sexual health, especially on HIV and prevalence and prevention of other STDs, than on mental health. Recent research (6) on Grindr users shows that excessive use of DAs is linked to lower psychological and social well-being, and some participants reported addictive symptoms over extended time use. Zervoulis (2) confirmed that heavy use of DAs is correlated with higher isolation, lower perception of community belonging, and less satisfaction of life. Duncan et al. (21) found that MSM app users reported low sleep quality (34.6% of respondents) and short sleep duration (43.6% of respondents), which were linked to depressive symptoms, engaging in unprotected anal sex, as well as alcohol and drug use. Moreover, loneliness seemed to be negatively correlated with sharing private information through gay DAs (2). In contrast, a positive impact on sexual self-acceptance could be observed in the LGBT group of people who were digitally connecting to each other (22). MSM who mainly seek sexual partners using DAs experience a higher level of confidence and satisfaction with life than men seeking non-sexual relationships. In a group of MSM who are looking for other than sexual relations (e.g., romantic relationship or friendship), using DAs may also lead to frustration due to an unrealized need for intimacy (2).

Sexual sensation seeking (SSS), defined as a drive for thrilling novel sexual experiences (23), has been shown to be a strong correlate of risky sexual behaviors (23–25). A high intensity of SSS is positively correlated with a higher number of sexual partners met via DAs, a higher likelihood of being HIV-positive, as well as a greater amount of anal intercourse, including intercourse without condoms and in the receptive position (23–25). The moderating role of SSS in a relationship between internet use and high-risk sexual behaviors in the MSM group has been identified (20). SSS has also been found to be a moderator between using alcohol or drugs before sexual activity and higher rates of unprotected anal intercourse among MSM (26).



Substance Abuse and Sexualized Drug Use Among MSM Who Use DAs

Another relatively well-studied aspect of MSM's mental health is substance abuse, especially during sexual activity. Recreational drug use in the MSM group is more common than in the general population (8), as taking psychoactive substances may be an experimental response to or a coping strategy for social marginalization (27). Non-heterosexual males are 1.5–3 times more vulnerable to alcohol dependence and illicit substances use compared with the heterosexual male population (12). Studies showed that 30% (28) or even 48% (19) of app-using MSM had been under the influence of alcohol and/or drugs during sex in the past month. App-using MSM in comparison to non-app using MSM, reported a 59.3–64.6% higher rate of cocaine, ecstasy, methamphetamine, and injection drug use, as well as a high rate of binge drinking in a lifetime (29, 30). The MSM community is more likely to engage in sexualized drug use (SDU). SDU is also known as “chemsex,” defined as any use of specific (e.g., methamphetamine, ecstasy, GHB) drugs before or during planned sexual activity to facilitate, initiate, prolong, sustain, and intensify the sexual encounter (31, 32). A recent review (32), based on 28 studies, estimates the prevalence of engaging in chemsex among MSM between 4 and 43% depending on the assessed population (ranging from clinical settings to urban areas).

Chemsex is associated with engaging in lengthy sex sessions and with a larger number of casual partners with an unknown HIV status (33). A combination of needle sharing, condomless sexual behaviors and being under the influence of drugs enhances the transmission of STDs (34). The fact that chemsex is associated with adverse mental health outcomes and may cause negative psychosocial consequences is an issue for concern (35). Some reports (31, 36, 37) described situations where MSM chemsex participants experienced severe psychological distress, psychotic

symptoms, short-term depression, anxiety, long-term memory loss, and personality changes.

Studies show that it is quite common among MSM to use apps not only to engage in sexual activities, but also for sex parties, often associated with drug taking (38). For example, in Thailand, 73% of the MSM community use DAs for sexual purposes, as well as for inviting partners into illicit drug practice, with a 77% effectiveness of invitation rate (39). Latest review (40) provides data showing that MSM use geosocial network applications (a) to acquire drugs before engaging in sexualized drug use, (b) to sell sex in exchange for drugs, (c) to arrange sex with someone they would not have had sex with when sober, and (d) to find substance-using partners. Patten et al. (40) concluded that there is a mutual relationship between engaging in chemsex and using DAs among MSM.

Although chemsex is a social concept, it may be considered a new form of addiction to sexual experiences induced and enhanced by psychoactive substances and facilitated by geosocial network applications. Future studies should examine if chemsex could be conceptualized as a conjunction of substance use disorder and compulsive sexual behavior disorder (see **Figure 1**) or a completely separate entity.

What Do We Know About CSBD Among MSM Who Use DAs

Compulsive sexual behavior disorder (CSBD), included recently in the 11th revision of the International Classification of Disorders (ICD-11) published by the World Health Organization (4), is characterized by a behavioral pattern in which a person (a) engages in repetitive sexual activity that has become a central focus of his/her life to the point of neglecting health and personal care or other interests, activities, and responsibilities; (b) has made numerous unsuccessful efforts to control or significantly reduce repetitive sexual behavior; (c) continues to

engage in repeated sexual behavior despite adverse consequences; and (d) continues to engage in repeated sexual behavior even when he/she derives little or no satisfaction from it (4). The most common behavioral manifestation of CSBD is problematic pornography use accompanied by compulsive masturbation, and recent representative self-reported studies in the USA (41) and Poland (42) indicate that 9–11% of men and 3% of women, regardless of sexual orientation, perceived themselves as addicted to pornography. Compulsive use of paid sexual services or risky casual sexual encounters are also common among individuals meeting CSBD criteria (43).

Recognition of CSBD in ICD-11 raises a question regarding its prevalence among the MSM community and specifically among MSM using DAs. Unfortunately, CSBD has not been fully studied in the MSM community so far. Publications on the general population found a positive association between using geosocial networking applications and CSBD, showing that users of geosocial-network applications (compared to the general online population) are more likely to be young, non-heterosexual males. However, results of a recent study (44) on users of geosocial-networking applications contradict most earlier findings and suggest that the popularity of such applications increased among heterosexual populations.

Nonetheless, the majority of the data suggest DAs are more popular among MSM than among other groups, and their frequent use may potentially constitute a risk factor for CSBD development. Namely, it is possible that DAs may facilitate sexual encounters and novelty seeking in the sexual domain (especially among individuals with high sexual sensation seeking), potentially contributing to the development of CSBD at least in some subjects. A reverse relation is also possible: individuals with CSBD may be more likely to use DAs because they facilitate sexual encounters. This underdeveloped research area is of high importance, as among MSM who met sexual partners via the Internet, CSBD is associated with a higher frequency of engaging in HIV sexual risk behaviors (45).

The clear diagnostic criteria of CSBD described in ICD-11 (4) will facilitate future research on this behavioral pattern among MSM, which in turn will hopefully result in obtaining a detailed picture of interactions between CSBD, substance use

disorders and such phenomena as chemsex and DAs use among the MSM community.

DISCUSSION

In this narrative review, we aimed to present findings on research examining mental health among MSM using DAs. We focused mainly on aspects associated with substance use and risky sexual behaviors as MSM seem to be especially vulnerable to threats in this domain. Available data on mental health primarily describe the prevalence of mental disorders (depression, anxiety, personality disorders) among MSM. In short, these data show that, compared with non-users, MSM using DAs report lower perception of community belonging, higher isolation, less satisfaction with life, and worse quality of sleep (2, 21). The stigma and discrimination experienced by the MSM community may be a possible explanation for the more frequent recreational drug use in this group than in the general population. Additionally, based on previous studies reviewed above, it seems that risky sexual behaviors among MSM using DAs are inseparable from substance abuse. DAs may facilitate seeking sexual partners, and off-line sexual encounters are frequently accompanied by drug use. Sexualized drug use may be associated with an increased risk of polydrug substance abuse, risky sexual behaviors, transmission of STDs, severe psychological distress, short-term depression, anxiety, and even psychotic episodes or changes in personality (35). Currently, little is known about the prevalence of CSBD among MSM DAs users, and it remains unclear to what extent chemsex is associated with CSBD and whether it can be understood as a behavioral pattern standing at the conjunction of CSBD and substance use disorders. Available data (44) suggest that frequent use of DAs could be a risk factor for CSBD. The sexual sensation seeking may be a crucial correlate and even lead to the development of both CSBD and sexualized drug use. On the other hand, for individuals with already developed CSBD, geosocial-network apps may provide an unlimited source of sexual partners and novel experiences.

Several gaps in knowledge should be noted with respect to current studies on psychological and sexual functioning of MSM

TABLE 1 | Recommendations for future studies on mental and sexual health among DAs users.

Research area	Goals
Mental health	To explore the positive impact of DAs use on mental health and social functioning among MSM. Further examination of adverse mental health consequences associated with engaging in relationships through online DAs among MSM.
Chemsex	To investigate the relations between chemsex, CSBD and substance use disorders. To consider if chemsex could be treated as a new form of addiction to sexual experiences, engaged in under the influence of specific drugs. To examine the nature of sexualized drug use among women who have sex with women (WSW) and among the heterosexual population using DAs. To assess the prevalence of sexual dysfunction and sexual concerns beyond HIV and STDs infection among apps using MSM chemsex participants. To examine if experiencing CSBD symptoms may lead to using DAs more often, which can lead to further development of symptoms and more frequent engagement in Chemsex.
CSBD	To explain whether DAs are a way to develop symptoms of CSBD because of the availability of sexual stimuli and sexual partners. To assess the prevalence of CSBD among app users MSM and association between CSBD and SSS.

using DAs, and they should be considered important goals for future investigations (see **Table 1**).

It is also important to mention that mobile applications can be used to promote mental health, as well as for prevention or therapeutic programs (46). Ameri et al. (47) indicated that short-term interventions based on mobile phone applications and texting could decrease the rate of methamphetamine use, condomless anal intercourse, and HIV transmission among MSM. Another example of a harm reduction intervention of sexualized drug use is the German app “C: KYL” (“Chems: Know Your Limit”). C: KYL aims to reduce the risk of severe negative consequences such as dissociation and overdose through monitoring of drug-taking during chemsex sessions. Overall, mHealth strategies have a positive influence on health-promoting behaviors, appointment attendance, and accessibility to information and may present an effective means for mental health promotion and prevention if they provide optimized strategies for the MSM group (48, 49).

LIMITATIONS

This review is a preliminary investigation that highlights associations of DAs use and mental health issues among MSM. However, important limitations of the current work should be noted. First, there is a limited number of studies on the psychological functioning of MSM using DAs. This is especially true for CSBD, which is a new diagnostic unit. The vast majority of previous research examined the aspects of promoting sexual health, as so far, the primary need in the MSM group was prevention of HIV and other STIs. Second, our review encompasses studies focusing only on the group of non-heterosexual males. Mental health threats posed by DAs among heterosexual men as well as women fell outside the scope of the current manuscript. Third, the use of apps and social media for mental health promotion and prevention of mental disorders is not a focus of our analysis. Future studies should also examine the unique opportunities for mental health

promotion that dating (and other) applications, as well as social media and social networking platforms, bring [see (50)]. Lastly, our hypothesis that chemsex may be a conjunction of CSBD and substance use has yet to be validated. This hypothetical assumption should be taken as an inspiration and invitation to future research.

CONCLUSIONS

Primary mental health difficulties (e.g., stigma, social isolation, CSBD) could predispose individuals to seek partners online and then manifest in risky sexual behaviors. Engaging in online dating may in turn cause secondary adverse mental health outcomes such as depression or sexualized drug use. Identifying psychological and situational risk factors associated with use of DAs may facilitate a better understanding of mental health concerns among MSM. DAs may also have a positive impact on the social functioning of MSM in terms of greater availability of sexual or romantic partners, an increase in self-acceptance, and self-confidence. Despite some advantages, online dating seems to be associated with many severe threats in the area of mental health. Because of this, future studies should also focus on the development of prevention and therapeutic interventions relevant to the MSM group and their patterns of geosocial-networking app use.

AUTHOR CONTRIBUTIONS

KO and MG developed the idea for the paper and prepared the outline. KO and KS prepared the literature review. KO, KS, KL, and MG participated in manuscript writing. All authors contributed to the article and approved the submitted version.

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Country Indicators Moderating the Relationship Between Phubbing and Psychological Distress: A Study in 20 Countries

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Problematic mobile phone use can be related to negative mental states. Some studies indicate that behavioural dependency is related to variables associated with the country of origin. The aim of our study was to investigate if country indicators moderated the relationship between phubbing and psychological distress. Our sample consisted of 7,315 individuals from 20 countries, who completed the Phubbing Scale and the Kessler Psychological Distress Scale (K6). The analyses also included country indicators: the Gender Gap Index (GGI), the Human Development Index (HDI), the Social Progress Index (SPI), Hofstede's dimensions of culture, and the World Happiness Index (WHI). Our results showed that psychological distress was related to at least one dimension of phubbing (i.e., to communication disturbance or phone obsession) in all countries, which means this relationship is culturally universal. The results of the study demonstrate the importance of testing measurement invariance to determine what type of analysis and what type of conclusion are valid in a given study or comparison. Moreover, the increasing or decreasing correlation between phubbing and distress is related to some culture-level indices.

Keywords: country indicators, culture, phubbing, mobile phone addiction, distress

INTRODUCTION

A great body of research reports the increasing use of mobile phones (e.g., Lopez-Fernandez et al., 2017; Al-Saggaf and MacCulloch, 2019). Mobile phones are preferred for social media use and communication purposes, particularly, when face-to-face contact is not practical or possible (Karadağ et al., 2015; Chotpitayasunondh and Douglas, 2016), but their use is leading to interpersonal problems. A new phenomenon has emerged recently, whereby phone users ignore other people around them by using their mobile phones instead (Karadağ et al., 2015; Abeele, 2019; Abeele et al., 2019; Balta et al., 2020). This phenomenon is called “phubbing,” and its name is derived from two words: “phone” and “snubbing.” Phubbing behaviour is typically seen among individuals who are distracted by their phone when it is not ringing or vibrating and who are not paying attention to others around them (Afdal et al., 2019). It also manifests itself in people preferring to pay attention to smartphones rather than to their interlocutor during face-to-face interaction (Chotpitayasunondh and Douglas, 2016), such as interaction with their close family members (Al-Saggaf and MacCulloch, 2019). Phubbing can be called *absent presence* when a person uses their mobile phone in the company of others (Abeele et al., 2016). It may disrupt interpersonal relationships (Ergün et al., 2020), and people engaging in it may show withdrawal symptoms when they are away from their phones (Karadağ et al., 2015). Research has shown that other types of problematic technology use, such as Internet addiction, mobile phone addiction, mobile game addiction (Chotpitayasunondh and Douglas, 2016, 2018; T’ng et al., 2018), and fear of missing out, can lead to phubbing. Phubbing in turn often leads to violations of cultural values and to disrespectful attitudes, regardless of culture (Afdal et al., 2019).

Phubbing and Psychological Distress

Apart from the changes mentioned above, researchers have investigated the possible causes of phubbing behaviour. It has been highlighted that phubbing is a way of coping with loneliness (Jackson and Wang, 2013; Karadağ et al., 2015; Afdal et al., 2019), worry, and anxiety and that it is related to deprivation in situations when one is far from one’s phone (Karadağ et al., 2015). Phubbing is positively correlated with anxiety (Khare and Qasim, 2019) and has an impact on interpersonal relationships and personal wellbeing (WB) (Roberts and David, 2016). A high level of partner phubbing is related to depression and low relationship satisfaction (Wang et al., 2017); it also has a negative impact on intimacy (Abeele et al., 2019).

Another possible cause of phubbing behaviour is psychological distress, which is an indicator of mental health (Kessler et al., 2003). Psychological distress is defined as a state of emotional suffering characterized by inefficiency in coping, feelings of discomfort, and changes in emotional WB (Walker and Avant, 1995), such as moderate-to-severe symptoms of anxiety and depression (Drapeau et al., 2012). Phubbing has also been found to function as a mediator between phone addiction and depression (Ivanova et al., 2020). In a different study, higher partner phubbing was correlated with lower life

satisfaction and higher depression scores (Roberts and David, 2016). The experience of psychological distress was found to be related to uncertain social relations and time pressure (Türetgen et al., 2012), anxiety (Tan and Lau, 2012), and phubbing (Lian et al., 2021).

Some studies have revealed that individuals with better mental health are more likely to exhibit lower levels of phubbing behaviour (Babadi-Akashe et al., 2014). Another study showed that rumination mediated the relationship between psychological distress and phubbing among adolescents (Lian et al., 2021). Despite a Pakistani study indicating that phubbing is directly related to distress (Shahbaz et al., 2020), other researchers suggest moderator and mediator variables between psychological distress and phubbing (Lian et al., 2021). Being phubbed increases the levels of depression and stress (David and Roberts, 2017) and is related to lower self-flourishing (Davey et al., 2018). Adolescents who are phubbed by their mothers feel ignored, and the quality of their relationship with their mother decreases (Bai et al., 2020). This can be explained by the diathesis-stress model (Monroe and Simons, 1991), which underlines the fact that psychological disorders may be a result of the interaction between genetic predisposition, vulnerability, and stress triggered by life events. This model points toward certain moderators, such as personal traits, in the relationship between the environmental factors and the development of a psychological disorder (Monroe and Simons, 1991). Therefore, exploring conditional variables associated with psychological distress and phubbing is considered to be important for the understanding of the circumstances correlated with those variables. In the present study, we focused on the moderating role of country, since cultural differences have proved to be important in phubbing (Al-Saggaf and MacCulloch, 2019).

Country Indicators

Social norms play a considerable role in phubbing (Al-Saggaf and MacCulloch, 2019). Some studies have shown that people from different cultures use new media in different ways. For instance, it was found that people from individualistic countries preferred using social networking sites (SNSs) actively (e.g., Jackson and Wang, 2013; Makri and Schlegelmilch, 2017), while people from collectivistic cultures used SNSs to receive social support and strengthen social connections (Jackson and Wang, 2013; LaRose et al., 2013), people from individualistic cultures use SNSs to satisfy their individual needs, such as the need to escape from loneliness (Jackson and Wang, 2013). A meta-analysis, whose authors checked moderated effect of culture in the relation between SNSs and mental health, revealed that the relations between SNS use and mental health in collectivistic cultures were stronger than in individualistic cultures (Yin et al., 2019). Additionally, Arpacı (2019) reported that there was a link between vertical collectivism and nomophobia—a fear of not having access to one’s mobile phone.

Some studies indicate that behavioural dependency is related to country variables. For instance, some researchers suggest that cultural dimensions determine SNS usage patterns. Vasalou et al. (2010) found differences in Facebook use across different countries. For example, users from the United Kingdom spent

more time on Facebook than users from other countries. Participation in Facebook groups was more important for United Kingdom users than for United States users, while Italians preferred participating in groups and playing games. In Greece, users regarded updating their profiles as the least important activity in comparison with other countries (Vasalou et al., 2010). Culture can be a predictor of online and technology-related behaviours (Chau et al., 2002; Arpaci, 2019; Blachnio et al., 2019a). For instance, previous studies indicated that people from vertical (as opposed to horizontal) collectivistic cultures, which promote sacrificing oneself in relationships, had a greater tendency to develop nomophobia (Arpaci, 2019). Yin et al. (2019) established the moderating role of cultural background in the relationship between SNS use and positive mental health. A meta-analysis carried out by Zhang et al. (2012) showed that culture had a moderating effect on mobile commerce adoption. Another study showed that collectivism, uncertainty avoidance (UAI), short-term orientation, and power distance could be cultural moderators for the use of mobile technologies (Baptista and Oliveira, 2015). Research results highlighted the moderating effect of cultural dimensions, such as UAI, individualism, and long-term orientation, on the adoption of novel mobile services (Hung and Chou, 2014).

Understanding how phubbing behaviour is influenced by social circumstances seems to be important for professionals dealing with social life problems (Chotpitayasunondh and Douglas, 2016). Social motives and accessibility to mobile technologies are of significance in phubbing behaviour (e.g., Jackson and Wang, 2013). In an attempt to determine intercultural differences in phubbing as has been done for Facebook use (e.g., by Ji et al., 2010) and for SNS use (e.g., by Jackson and Wang, 2013), we drew on Hofstede's (1980) understanding of culture. Hofstede describes the culture in terms of dimensions, such as individualism vs. collectivism, UAI, power distance, or masculinity vs. femininity¹.

We predicted that in different countries, phubbing would correlate with distress to different degrees. Based on previous studies indicating that phubbing is negatively related to mental health (Karadağ et al., 2015; Khare and Qasim, 2019; Ivanova et al., 2020), we hypothesised that phubbing would be positively related to distress. Different cultures differ in the extent to which mental health is dependent on the quality of social relationships, the role of a social group, and social support from the group one belongs to (De Silva et al., 2007). Because phubbing involves the disruption of communication with others as a result of using a mobile phone in their presence, it leads to the deterioration of social relationships, which in turn may have different consequences for mental health in different cultures. We predicted that in those cultures where the

importance attached to social relationships was greater phubbing would have a stronger impact on mental WB (distress). We therefore examined the role of culture in this relationship to investigate whether country indicators were moderators between phubbing dimensions and psychological distress. Specifically, we selected the following indicators: the Gender Gap Index (GGI), the Social Progress Index (SPI), the World Happiness Index (WHI), the Human Development Index (HDI), and Hofstede's cultural value indices.

While mobile phones enable communication and facilitate many activities in everyday life (Luo and Tuney, 2015; Chotpitayasunondh and Douglas, 2016; Karadağ et al., 2015), their excessive use has negative consequences as well (Lopez-Fernandez et al., 2017). The main aim of our research was to explore the moderating role of the cultural specificities of countries in the relationship between phubbing and psychological distress. The study fills a gap in the knowledge regarding the role that cross-national differences play in this relationship. On the one hand, the inclusion of cross-national moderators is exploratory and aimed at identifying the cultural characteristics that play an important role in the relationship between phubbing and distress. On the other hand, testing these characteristics as potential moderators is warranted by the results of previous research.

Cultural indicators differentiate countries on different dimensions (see Bleidorn et al., 2015; Jonason et al., 2020). Previous studies have shown that different dimensions of culture can play moderating roles (e.g., Sutrisno and Dularif, 2020). The socioeconomic context was found to be a moderator in the relationship between depression and body mass index (Alvarez-Galvez and Gomez-Baya, 2017). Moreover, country indices have proved to be significant moderating factors for the level of Internet addiction (Blachnio et al., 2019b).

Countries differ in the availability (equal or unequal) of various resources and opportunities to women and men and in the status of the two genders (GGI; Bosson et al., 2021). This means that in countries with low GGI, men are more dominant while women are more subordinate (Bosson et al., 2021). In countries where the role of women is subordinate (low GGI), a weaker association between phubbing and distress can be expected. Other indices differentiate countries in terms of general WB and quality of life. The SPI shows how countries differ in terms of the real quality of life, which is closely related to the economic level and thus to the satisfaction of needs or the fulfilment of opportunities. Countries also differ in the levels of human potential, WB, life expectancy, economic growth, and access to education, reflected in the HDI. The higher the HDI, the more a country is perceived to meet the basic needs of its citizens and the more autonomy it offers in various social choices, such as work or education (Bosson et al., 2021). Previous studies have shown strong relationships between GGI and HDI (Bosson et al., 2021), which make it reasonable to predict HDI levels similar to those of GGI. The next index, the WHI differentiates countries in terms of global happiness. Research shows that countries with high WHI are those where support and WB, such as income, healthy life expectancy, social support, freedom, trust, and generosity, are

¹ Power Distance reflects the way people view the degree of power distribution in their culture and the degree to which they accept their place in the social hierarchy. The individualism vs. collectivism dimension concerns the level of integration with the group, which shows whether the importance is placed on attaining personal or group goals. The Uncertainty Avoidance dimension reflects the degree to which societies tolerate unknown situations, changes, and unexpected events. Finally, the masculinity vs. femininity dimension reflects what kind of values are respected—for instance: assertiveness, ambition, and power are masculine values, whereas relationship building is central to feminine values.

key factors (see World Happiness Report), which may translate into a higher correlation between phubbing and distress in these countries.

On the one hand, it can be expected that countries with greater access to mobile phones will be more likely to have higher rates of problematic phone use and greater distress levels associated with it. On the other hand, in less developed countries, phubbing may lead to greater distress, as the people there are less accustomed to the presence of phones in social life. The indicators that differentiate countries also include the Hofstede dimensions (we chose only those indices that had a full set of values for all the countries investigated): individualism vs. collectivism, masculinity vs. femininity, and UAI. Previous studies have used Hofstede dimensions to explain differences in the Internet or Facebook use (e.g., Nadkarni and Hofmann, 2012; Jackson and Wang, 2013; Abbas and Mesch, 2015) but these dimensions were not tested as moderators of the relationship between new technology addiction and mental health. In our study, we posed the question of how these dimensions might differentiate the relationship between phubbing and distress across countries. It could only be speculated, for example, that phubbing would lead to distress to a lesser extent in individualistic countries.

MATERIALS AND METHODS

Participants and Procedure

A sample of $N = 7,315$ mobile phone users (66.4% women and 33.6% men) was recruited for the study. Data were collected online in 20 countries: Brazil, China, Croatia, Ecuador, India, Israel, Italy, Mexico, Netherlands, Pakistan, Poland, Portugal, Serbia, Slovakia, Slovenia, Spain, Turkey, the United Kingdom, Ukraine, and the United States. The mean age of the total sample was $M = 25.50$ years ($SD = 9.66$; range: 16–85 years). Out of the total number of the participants, 79.3% were students (16.0% of them working students), 17.9% were employed, 1.7% were unemployed, and 1.1% were retired.

The individuals invited to participate in the study were mobile phone users. The study was conducted in local languages, and back-translation procedures were applied to adapt the measures. We used snowball sampling as a method of reaching a large group of respondents, varied in terms of sociodemographic characteristics. After the electronic versions of the questionnaires were prepared, the link to the research site was e-mailed to participants. The participants volunteered to take part in the study and received no monetary reward. They were informed about the anonymity of the study. The research project was approved by the institutional review board at the university of the first author.

It is important to note that 3.45% of the participants were failed to provide more than 10% of the answers and were therefore excluded from the sample. However, 0.88% of the participants were failed to provide less than 10% of answers; they were included in the sample and in the analysis. Their scores were extrapolated from their other responses on a given scale; any missing data were randomised. We found no significant effects for age and gender.

Measures

Psychological Distress

Kessler Psychological Distress Scale (K6) was used to measure psychological distress (Kessler et al., 2003). The scale consists of six questions concerning depressive and anxiety-related symptoms that a person have experienced in the past 4 weeks (e.g., “Did you feel tired for no good reason?”). Cronbach’s alpha for the K6 ranged from 0.74 (India) to 0.90 (United Kingdom).

Prior to hypothesis testing, we assessed the measurement invariance of the K6 across countries using multi-group confirmatory factor analysis (MGCFA). We found only metric invariance for the scale (**Table 1**) according to the criteria proposed by Rutkowski and Svetina (2014). This means that we could not compare means on Level 2 and establish its country-level correlates, but we could compare correlations between variables across countries (Milfont and Fischer, 2010) and identify country-level moderators. Additionally, testing measurement invariance across age groups and genders revealed metric invariance across age groups and scalar invariance across genders (see **Table 1**).

Phubbing

The Phubbing Scale (Karadağ et al., 2015) was also used in the study. The items of the scale were chosen based on other technology-related addictions (i.e., Internet addiction, SMS addiction, and social media addiction). Exploratory and confirmatory factor analyses revealed a two-factor structure of the measure. The questionnaire consists of eight items (e.g., “My eyes start wandering on my phone when I’m together with others”; “People complain about me dealing with my mobile phone”) rated on a 5-point scale (1 = *strongly disagree* to 5 = *strongly agree*). The measure comprises two factors: (1) communication disturbance, defined as disturbing face-to-face communication by dealing with one’s mobile phone (four items), and (2) phone obsession, defined as constantly needing and desiring one’s mobile phone (4 items).

Based on data collected in 20 countries, Cronbach’s alpha ranged from 0.71 (India) to 0.95 (Serbia) for the Communication Disturbance Scale and from 0.66 (Slovenia) to 0.81 (Serbia) for the Phone Obsession Scale. The results of measurement invariance for the Phubbing Scale across 20 countries, age groups, and genders are presented in **Table 2**. There was only metric invariance across countries and age groups and scalar invariance across genders. This allowed us to compare countries in terms of correlations between phubbing and other variables and identify country-level moderators of these relationships.

Cultural Indicators

We included cultural-level indicators in the analysis, choosing the indicators previously used in other studies (Bleidorn et al., 2015; Blachnio et al., 2019b; Jonason et al., 2020). We relied on the latest data comparisons available and used the following indices (the specific scores for all countries are presented in **Table 3**):

The GGI is an indicator of national gender gaps in economic participation, educational attainment, political empowerment, and health and survival criteria. GGI data are published annually, and we retrieved the 2020 GGI scores

TABLE 1 | Testing of measurement invariance for Distress Scale across countries, age categories and gender.

Invariance	Country			Age			Gender		
	χ^2 (df)	CFI	RMSEA	χ^2 (df)	CFI	RMSEA	χ^2 (df)	CFI	RMSEA
Configural	750.55(160)*	0.966	0.023	381.75(16)*	0.975	0.058	434.27(16)*	0.974	0.050
Metric	1237.09(255)*	0.946	0.023	419.08(21)*	0.973	0.053	441.96(21)*	0.974	0.053
Scalar	4203.94(369)*	0.789	0.038	784.05(27)*	0.949	0.064	617.32(27)*	0.964	0.055
Configural vs. metric	486.54(95)*	0.020	0.000	37.33(5)*	0.002	0.005	7.69(5)	0.000	0.003
Metric vs. scalar	2966.85(114)*	0.157	0.015	364.97(6)*	0.024	0.011	175.36(6)*	0.010	0.002

* χ^2 tests are significant at $p < 0.001$.

TABLE 2 | Testing of measurement invariance for Phubbing Scale across countries, age categories and gender.

Invariance	Country			Age			Gender		
	χ^2 (df)	CFI	RMSEA	χ^2 (df)	CFI	RMSEA	χ^2 (df)	CFI	RMSEA
Configural	1274.45(380)*	0.952	0.018	1059.25(38)*	0.941	0.063	1098.49(38)*	0.942	0.062
Metric	1679.89(494)*	0.936	0.018	1076.16(44)*	0.940	0.059	1103.98(44)*	0.942	0.058
Scalar	7150.84(646)*	0.648	0.037	1409.44(52)*	0.921	0.062	1242.87(52)*	0.934	0.056
Configural vs. metric	405.45(114)*	0.016	0.000	16.91(6)	0.001	0.004	5.49(6)	0.000	0.004
Metric vs. scalar	5470.94(152)*	0.288	0.019	333.28(8)*	0.019	0.003	138.89(8)*	0.008	0.002

* χ^2 tests are significant at $p < 0.001$.

(Global Gender Gap Report, 2020). An index for each country is between 0 and 1. In the present sample, GGI values ranged from 0.56 (Pakistan) to 0.80 (Spain); $M = 0.71$, $SD = 0.05$.

The SPI is a measure of the real quality of life, which is independent of economic indicators. It comprises three aspects: basic human needs (HN), foundations of WB, and opportunity (O). SPI values ranged from 48.2 (Pakistan) to 88.3 (Netherlands); $M = 76.42$, $SD = 10.66$. The values for specific aspects were as follows: from 58.5 (Pakistan) to 96.7 (Netherlands) for basic HN ($M = 87.1$, $SD = 9.7$); from 48.8 (Pakistan) to 90.3 (Turkey) for foundations of WB ($M = 77.5$, $SD = 10.8$); and from 37.3 (Pakistan) to 80.3 (United Kingdom) for O ($M = 0.82$, $SD = 0.09$).

The WHI measures the state of global happiness and ranks countries according to their happiness level. We retrieved data from the 2019 comparison.² The WHI values for the countries included in the study were ranged from 4.02 (India) to 80.3 (Netherlands); $M = 5.99$, $SD = 0.85$.

The HDI covers three dimensions of human development, namely, living a long and healthy life, being educated, and having a decent standard of living. The values of HDI range between 0 and 1, with higher values indicating higher human development. We retrieved data from the 2019 comparison³. In the present sample, HDI values ranged from 0.56 (Pakistan) to 0.93 (Netherlands); $M = 0.82$, $SD = 0.09$.

Hofstede's cultural value indices were also used in our study. We selected three cultural value dimensions identified by Hofstede⁴. The scores on each dimension range between 0 and 100. *Individualism vs. collectivism (IND)*: individualism

is a feature of those cultures where people are expected to care only for themselves and their immediate families, while in collectivistic cultures people take care of their relatives and are loyal to their community. In the present sample, IND scores ranged between 8 (Ecuador) and 91 (United States), with higher scores indicating greater individualism ($M = 44.25$, $SD = 23.99$). *Masculinity vs. femininity (MAS)*: Masculinity manifests itself in the following characteristics of a society: achievement, heroism, assertiveness, and material rewards for success. Femininity is marked by a preference for cooperation, modesty, caring for the weak, and preoccupation with quality of life. In the present sample, MAS scores ranged between 14 (Netherlands) and 100 (Slovakia), with higher scores indicating greater masculinity ($M = 51.15$, $SD = 19.60$). *Uncertainty avoidance (UAI)* was the final cultural value indicator used in our study. It indicates the degree to which people in a society feel uncomfortable with uncertainty and ambiguity regarding the future. Societies scoring higher on UAI are more emotional and less open to change. In the present sample, UAI scores ranged between 30 (China) and 99 (Portugal); $M = 71.20$, $SD = 20.79$.

Statistical Analyses

For the primary analyses, we conceptualised data as a two-level structure, in which individual respondents were nested within countries of residence. We used Mplus 7.3 software (Muthén and Muthén, 2015) to analyse a series of multilevel models (MLM). These analyses were conceptually equivalent to conducting a regression analysis for each country and then using the coefficients thus estimated as dependent measures at the next level of analysis. Level 1 represented variation among

²<https://worldhappiness.report>

³<http://hdr.undp.org>

⁴www.hofstede-insights.com

TABLE 3 | Sample characteristics, country indicators, and correlation of distress with phubbing and phone obsession within each country.

Country	Within-country variables																		
	Male		Age	Within-country variables			Cultural indicators										Within-country correlations		
	N	%		Phubbing	Obsession	Distress	GGI	HDI	SPI	HN	WB	O	IND	MAS	UAI	WHI	Ph-Dist	Obs-Dist	Ph-Obs
Brazil	311	46.6	23.52(6.05)	2.03(0.76)	3.61(0.92)	2.48(0.80)	0.691	0.761	72.87	81.79	76.56	60.26	38	49	76	6.300	0.22**	0.24**	0.44**
China	401	20.2	—	2.19(0.63)	3.66(0.86)	2.27(0.81)	0.676	0.758	64.54	81.35	68.85	43.41	20	66	30	5.191	0.08*	0.07	0.17**
Croatia	688	47.4	21.81(2.38)	1.92(0.68)	3.30(0.83)	2.24(0.75)	0.720	0.837	79.21	90.90	80.88	65.86	33	40	80	5.432	0.22**	0.18**	0.44**
Spain	511	42.9	30.16(12.66)	2.17(0.72)	2.96(0.81)	2.17(0.77)	0.795	0.893	87.47	94.77	69.97	77.30	51	42	86	6.354	0.15**	0.22**	0.50**
Netherlands	271	42.5	44.25(18.00)	2.18(0.67)	3.23(0.76)	1.68(0.64)	0.736	0.933	88.31	96.74	88.30	76.12	80	14	53	7.488	0.20**	0.14*	0.50**
Israel	390	38.2	37.32(12.33)	2.59(0.93)	3.29(0.96)	1.86(0.73)	0.718	0.906	81.44	93.58	84.46	66.27	54	47	81	7.139	0.17**	0.01	0.58**
Mexico	57	19.3	39.44(9.83)	2.89(0.86)	3.64(0.67)	1.85(0.67)	0.754	0.767	77.51	82.31	74.67	57.54	30	69	82	6.595	0.18	0.09	0.41**
Pakistan	410	30.0	22.31(3.72)	2.35(0.78)	3.21(0.90)	2.74(0.79)	0.564	0.560	48.20	58.46	48.83	37.29	14	50	70	5.653	0.24**	−0.02	0.37**
Poland	406	20.6	23.51(5.06)	1.62(0.59)	2.81(0.90)	2.31(0.79)	0.736	0.872	81.25	94.11	81.00	68.65	60	64	93	6.182	0.13**	0.22**	0.44**
Portugal	400	33.8	26.08(8.76)	2.21(0.68)	3.04(0.89)	2.25(0.78)	0.744	0.850	87.12	95.81	87.43	78.12	27	31	99	5.693	0.16**	0.18**	0.52**
Serbia	365	37.0	26.17(5.60)	2.26(1.13)	3.28(0.89)	2.26(0.65)	0.736	0.799	71.59	86.00	70.97	75.58	25	43	92	5.603	0.19**	0.23**	0.42**
Slovenia	430	21.4	22.13(4.53)	1.97(0.67)	3.11(0.76)	2.14(0.71)	0.743	0.902	85.80	95.64	86.18	75.81	27	19	88	6.118	0.20**	0.26**	0.47**
United States	190	18.2	20.98(5.26)	2.37(0.71)	3.35(0.79)	2.32(0.80)	0.724	0.920	83.62	91.64	82.05	77.17	91	62	46	6.892	0.12*	0.23**	0.39**
Italy	603	17.7	22.28(4.30)	1.96(0.58)	3.27(0.81)	2.39(0.81)	0.707	0.883	85.69	92.32	88.64	79.88	76	70	75	6.223	0.17**	0.20**	0.41**
Ukraine	402	24.9	20.96(3.36)	1.76(0.58)	2.91(0.95)	2.38(0.82)	0.721	0.750	66.97	82.21	64.22	54.47	25	27	95	4.332	0.10*	0.12**	0.45**
India	126	47.6	25.28(8.03)	2.15(0.82)	2.60(1.00)	2.31(0.76)	0.668	0.647	59.10	67.72	58.94	50.63	48	56	40	4.015	0.32**	0.36**	0.46**
United Kingdom	135	15.6	32.03(14.07)	1.98(0.68)	3.26(0.92)	2.54(0.97)	0.767	0.920	87.98	94.63	89.05	80.28	89	66	35	7.054	0.34**	0.25**	0.46**
Slovakia	181	60.0	24.95(8.98)	1.89(0.65)	3.09(0.86)	2.36(0.83)	0.718	0.857	80.43	94.04	80.97	66.29	52	100	51	6.198	0.17*	0.12	0.37**
Ecuador	415	33.5	21.87(4.26)	1.83(0.67)	2.61(0.90)	2.37(0.71)	0.729	0.758	71.88	82.57	77.01	56.05	8	63	67	6.028	0.23**	0.22**	0.50**
Turkey	623	28.1	23.55(6.52)	2.37(0.67)	3.44(0.84)	2.60(0.76)	0.635	0.806	67.49	85.00	90.34	47.50	37	45	85	5.373	0.28**	0.23**	0.46**

GGI = Global Gender Gap Index; HDI = Human Development Index; SPI = Social Progress Index; HN = Basic Human Needs; WB = well-being; O = Opportunity; IND = individualism vs. collectivism; MAS = Masculinity vs. Femininity; UAI = Uncertainty Avoidance; WHI = World Happiness Index; UK = United Kingdom; USA = United States of America; Dist = Distress; Ph = Phubbing; Obs = Obsession.
P-value for two-tailed test * $p < 0.05$, ** $p < 0.01$.

individuals within countries, and Level 2 represented variation across the 20 countries.

The relationships between psychological distress, communication disturbance, and phone obsession were examined at the individual level, and the country-level differences in these relationships were modelled at the between-country level as a function of the cultural specificity of a given country. Analyses examining such relationships are called *slopes-as-outcomes* analyses because a slope from a lower level (i.e., Level 1) becomes an outcome at an upper level (i.e., Level 2).

$$\text{Psychological_distress}_{ij} = \beta_{0j} + \beta_{1j}(\text{Communication_disturbance}_{ij})$$

$$+ \beta_{2j}(\text{Phone_obsession}_{ij}) + r_{ij}. \quad (1)$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{MODERATOR}_j) + u_{0j}. \quad (2)$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{MODERATOR}_j) + u_{1j}. \quad (3)$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{MODERATOR}_j) + u_{2j}. \quad (4)$$

In Eq. 1, Level-1 observations (psychological distress_{ij}) are modelled as a function of the intercept for each country (β_{0j}, mean psychological distress in a country *j*), the slopes (e.g., β_{1j}, representing a within-country relationship between psychological distress and communication disturbance), and error (*r_{ij}*, which is the deviation of each psychological distress score in a country from the country mean), and the variance in *r_{ij}* is Level-1 error variance.

In Eq. 2, mean psychological distress for each of *j* Level-2 units of analysis (i.e., countries; β_{0j}) is modelled as a function of the grand mean (γ₀₀ = the mean of psychological distress means), country specificity (γ₀₁ MODERATOR_j) and error (*u_{0j}*), and the variance in *u_{0j}* is the Level-2 variance. If the γ₀₁ coefficient is significantly different from zero, then there is a relationship between a country index and the average psychological distress score for people in *j* country.

In Eq. 3 (or 4), the Level-1 slope for each country (β_{1j} or β_{2j}) is modelled as a function of the intercept (γ₁₀ or γ₂₀ = the mean slopes, i.e., the average relationship across all countries), country cultural specificity (γ₁₁ MODERATOR_j or γ₂₁ MODERATOR_j), and error (*u_{1j}*). If the γ₁₁ (or γ₂₁) coefficient is significantly different from zero, then the relationship between psychological distress and communication disturbance (or between psychological distress and phone obsession) varies as a function of country cultural specificity (MODERATOR_j).

Due to the lack of scalar invariance across 20 countries in measures of distress, communication disturbance, and phone obsession, β_{0j} could not be modelled as a function of differences between countries β_{0j} = γ₀₀ + γ₀₁ (MODERATOR_j) + μ_{0j}. However, we were able to model the correlations between variables in different countries and the cultural moderators of these relationships. This is the reason why Level-1 variables were group mean-centred; consequently, Level-2 differences in these Level-1 variables were eliminated from the model. In addition, to simplify the interpretation of the regression equation, we applied

the standardized country indicators at the country level ("z"). After the centring of the variables within cluster ("c") at Level 1, the mode equations are as follows:

$$c\text{Psychological_distress}_{ij} = \beta_{1j}(c\text{Communication_disturbance}_{ij}) + \beta_{2j}(c\text{Phone_obsession}_{ij}) + r_{ij}. \quad (5)$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(z\text{MODERATOR}_j) + u_{1j}. \quad (6)$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(z\text{MODERATOR}_j) + u_{2j}. \quad (7)$$

RESULTS

Descriptive Statistics

Table 3 provides the basic statistics for each country: means and SDs for psychological distress, communication disturbance, phone obsession, and cultural indicators; it also presents correlations between the dimensions of psychological distress and phubbing within each country. These summary statistics constitute a context for the analyses focused on the primary hypothesis.

The correlation between psychological distress and communication disturbance was positive and ranged between 0.08 (China) and 0.34 (United Kingdom), while the correlation between psychological distress and phone obsession ranged between −0.02 (Pakistan) and 0.36 (India).

Slope-as-Outcome Models: Culture-Level Moderators

First, the predictors of psychological distress at Level 1 (i.e., communication disturbance and phone obsession)—centred group means—were entered with a random error term according to Eqs 6, 7 but without cross-cultural moderators (zMODERATOR_j = 0). Significance tests at Level 2 (between countries) showed that γ₁₀ and γ₂₀ coefficients, representing the mean slopes between psychological distress and communication disturbance (γ₁₀ = 0.153, 95% CI [0.113, 0.192]) and between psychological distress and phone obsession (γ₁₀ = 0.098, 95% CI [0.052, 0.144]), were significantly different from 0 and positively related to psychological distress.

Next, we analysed the previous regression model at Level 1 by including the z-standardized cultural indicators as explanatory variables at Level 2. We were interested in explaining the observed cross-cultural variation in regression coefficients at Level 1. That is, we were not interested in explaining cross-cultural mean-level differences in psychological distress, communication disturbance, and phone obsession due to the lack of scalar measurement invariance of these variables across countries. Each cultural indicator was entered separately as an explanatory variable in the slope-as-outcome models. The coefficients are presented in **Table 4** (left panel). These parameters may inform the question of what cultural indicators explain the cross-cultural variation in regression coefficients at Level 1.

As can be seen from the coefficients in **Table 4**, the GGI (γ₁₁ = −0.044, *p* < 0.01), HN (γ₁₁ = −0.033, *p* < 0.05),

TABLE 4 | Slope-as-outcome models: Cross-level moderations and mean slopes of the communication disturbance and phone obsession effects on the distress.

Moderator	Cross-level moderation of the relationship between:				Mean slope of the relationship between:			
	Communication disturbance – distress		Phone obsession – distress		Communication disturbance – distress		Phone obsession – distress	
	γ_{11}	95% CI	γ_{21}	95% CI	γ_{10}	95% CI	γ_{20}	95% CI
(lack)	—	—	—	—	0.153	0.113;0.192	0.098	0.052;0.144
GGI	−0.044**	−0.076;−0.011	0.042*	0.000;0.083	0.147	0.113;0.182	0.103	0.059;0.145
HDI	−0.028	−0.066;0.013	0.037	−0.009;0.082	0.151	0.112;0.191	0.099	0.054;0.143
SPI	−0.028	−0.065;0.012	0.038*	−0.007;0.080	0.150	0.111;0.190	0.100	0.056;0.143
HN	−0.033*	−0.070;0.006	0.038*	−0.007;0.081	0.151	0.113;0.190	0.099	0.054;0.142
WB	−0.001	−0.041;0.041	0.029	−0.016;0.074	0.152	0.111;0.194	0.098	0.052;0.143
O	−0.035*	−0.070;0.004	0.046*	0.004;0.088	0.150	0.114;0.188	0.100	0.057;0.142
IND	−0.003	−0.046;0.043	0.032	−0.016;0.079	0.152	0.110;0.194	0.100	0.053;0.145
MAS	0.012	−0.034;0.058	−0.003	−0.055;0.047	0.154	0.112;0.196	0.098	0.048;0.145
UAI	−0.026	−0.070;0.017	0.000	−0.051;0.048	0.156	0.115;0.197	0.097	0.049;0.145
WHI	0.007	−0.037;0.053	−0.014	−0.066;0.035	0.153	0.112;0.195	0.097	0.048;0.145

GGI = Global Gender Gap Index; HDI = Human Development Index; SPI = Social Progress Index; HN = Basic Human Needs; WB = well-being; O = Opportunity; IND = individualism vs. collectivism; MAS = masculinity vs. femininity; UAI = uncertainty avoidance; WHI = World Happiness Index.

p-value for one-tailed test: **p* < 0.05, ***p* < 0.01.

and O ($\gamma_{11} = -0.035$, $p < 0.05$) significantly moderate the relationship between psychological distress and communication disturbance: the lower the level of these country indicators, the higher the correlation between psychological distress and communication disturbance. The opposite direction of moderation can be observed in the relationship between psychological distress and phone obsession: the higher the GGI ($\gamma_{21} = 0.042$, $p < 0.01$), the SCI ($\gamma_{21} = 0.038$, $p < 0.05$), HN ($\gamma_{21} = 0.038$, $p < 0.05$), and O ($\gamma_{21} = 0.046$, $p < 0.05$), the higher the correlation between psychological distress and phone obsession.

DISCUSSION

The main aim of our exploratory study was to investigate the moderating role of country-level indicators in the relations between phubbing and psychological distress. It should be noted that the analyses of measurement invariance across countries for the psychological distress and phubbing variables showed only metric invariance (see Blachnio et al., 2021), which allowed us to compare countries in terms of correlations between variables. It did not, however, allow us to compare countries in terms of the levels of particular variables, which is the most common type of cross-cultural comparisons. This calls into question some of the studies to date that have compared similar variables across countries without testing measurement invariance.

To the best of our knowledge, previous studies have not considered the moderating role of cultural indicators in the relationship between phubbing and distress; therefore, we can only refer to cross-cultural comparisons, such as similar constructs (e.g., Balhara et al., 2019; Blachnio et al., 2019b; Panova et al., 2020). In our exploratory study, we tried to answer the question of whether selected country indices were related to phubbing. We also intended to

establish if country indicators moderated the relationship between communication disturbance and psychological distress. To explore this issue, we chose indicators related to quality of life, namely, the WHI, the SPI, the HDI, and the GGI, which is an indicator of national gender gaps on several levels, and selected cultural dimensions distinguished by Hofstede.

In almost all countries we found a similar pattern: the higher the phone obsession and communication disturbance, the higher the psychological distress. In other words, both social and behavioural aspects of excessive mobile phone use are positively correlated with distress. In our study, the mean correlation between distress and communication disturbance was 0.21 (95% CI [0.17, 0.25]), while the mean correlation between psychological distress and phone obsession was 0.15 (95% CI [0.11, 0.20]). This finding is in line with previous studies, where psychological distress was related to phubbing (Liu et al., 2019) and significantly contributed to SNSs addiction (Pontes et al., 2018). More specifically, a meta-analysis by Marino et al. (2018) confirmed that problematic Facebook use and psychological distress were positively correlated.

The results of the present study indicate that the amplifying or weakening effect between phubbing and psychological distress is dependent on some cultural indicators. As predicted, the findings show that in almost every country communication disturbance results in increased distress, but this happens to a different extent in different countries. In countries with lower GGI, O, and HN, phubbing has more serious consequences for distress. For example, in Pakistan and India, the social context and the nonverbal aspects of communication, such as showing respect or disrespect toward the other party, are important (see Hall, 1990). Therefore, using a phone in the presence of another person will be perceived as ignoring the communication partner and result in the deterioration of social relationships. It is likely that in these countries, due

to the prevailing system of values, the deterioration of social relationships with one person or a group of people cannot be compensated for by establishing a new and equally valuable relationship with others.

As expected, phone obsession correlated positively with distress in almost every country. However, in countries with higher GGI, SPI, O, and HN (e.g., Spain, Portugal, and Slovenia), phone addiction was associated with distress more strongly than in others. It is reasonable to assume that people in these countries are more dependent on phone availability to function in many life domains, which in turn may translate into higher levels of distress related to phone obsession. In contrast, this relationship was relatively weaker in countries with lower GGI, SPI, O, and HN (e.g., Pakistan, China, and Ukraine), which may be due to the fact that phone use in these countries tends to be more limited, and although phone obsession may be as strong there as in other countries, its effects on distress may be smaller.

It should be noted that these findings receive support from previous studies on the cultural correlates of Internet addiction (Blachnio et al., 2019b), where a high level of Internet addiction was related to the HDI. As accessibility to technologies varies across cultures (Jackson and Wang, 2013), higher Internet addiction has been reported in highly technologically developed countries. Our current study reveals a similar pattern. A great body of research has shown that problematic mobile phone use is associated with lower well-being and lower mental health indicators (e.g., Volkmer and Lerner, 2019).

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The present study is not free from limitations. Firstly, its cross-sectional design precludes any longitudinal inferences. Secondly, this was a correlational study, and it would therefore be unwarranted to draw causal conclusion. Thirdly, the study was based on self-report measures, which means we investigated subjective indicators of problematic mobile phone use. In future studies, it would be useful to incorporate the behavioural assessment of mobile phone use as well. Lastly, although we found robust results across countries, the study is limited to convenience sampling, which is why generalizing current research findings requires caution. It would be advisable to collect data from more representative samples for each country in the future.

Although we present results from 20 countries, it could be argued that they do not represent all cultures. Many researchers point to the problem of cross-cultural comparisons being conducted on WEIRD cultures (Western, Educated, Industrialized, Rich, and Democratic; Henrich et al., 2010). In future research, it is worthwhile to expand the number of countries and include more countries from outside the group called WEIRD cultures.

It is also worth noting the low Cronbach's alpha for the Phone Obsession Scale in Serbia, though it should be mentioned that in

shorter scales (up to 5 items) alpha larger than 0.65 is acceptable (Cortina, 1993).

CONCLUSION

To sum up, the results of our study demonstrate the importance of measurement invariance testing, the results of which indicate what type of analysis and what type of conclusion are valid in a given cross-cultural comparison. We have found that psychological distress is related to communication disturbance and that, for the most part, this relation is culturally universal. Other studies also revealed a similar pattern of this relationship (e.g., Tekkam et al., 2020). However, the power of our findings stems from the number of culture-level indices included, which is a contribution this research makes to the current state of knowledge. The relationship between phubbing and psychological distress has some macro-level determinants (e.g., the GGI, which has been included in our research). The presented results shed light on the relationship between phubbing and psychological distress and its universality across cultures. A better understanding of phubbing may help in coping with its effects in the social fabric of communities, regardless of the cultural background. The current findings underline the importance of clinical awareness of problematic mobile phone use. Considering the omnipresent use of mobile phones as important tools in many aspects of everyday lives, it is important to identify the signs of psychological disturbances and to prepare adequate interventions. This study may be helpful for clinicians and therapists in designing programs targeting phubbing. Interventions addressing psychological distress are considered to be important across cultures when dealing with this problematic phenomenon.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Institute of Psychology Ethics Committee (The Catholic University of Lublin). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements. However, consent was implied *via* completion of the questionnaires.

AUTHOR CONTRIBUTIONS

AB: idea of the manuscript, preparing research, supervising research in all countries, and writing the manuscript. AP: preparing research and comments on final version of the

manuscript. OG: statistical analyses, co-writing Materials and Methods section and writing Results section, preparing methods in Polish language, collecting data in Poland, and comments on final version of the manuscript. RB, MD, ESD, MB-E, and MB: preparing methods in their languages, collecting data in their countries, coding the data, and giving comments on whole stages of writing manuscript. MM: preparing methods in their languages, collecting data in their countries, coding the data, comments on final version of the manuscript, and English proofreading. AA, AMA, MJB, TB, NB, JG, JH, AI, SM, EM, AM, BM, IP, BR, GS, LD'S, MV, MW, AMSW, and SY: preparing methods in their languages, collecting data in their

countries, coding the data, and comments on final version of the manuscript. All authors contributed to the article and approved the submitted version.

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