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A meta-analysis on the relationship between the use of electronic media and psychological well-being

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ABSTRACT

The effect of digital media use on psychological well-being has been debated among scholars and the public for a long time. This study investigates the relationship between various types of media use and psychological well-being. It was proposed that communication media such as phone calls, texting, and instant messaging positively correlate with well-being. In contrast, the usage of social network sites (SNSs) and online gaming would be negatively correlated. To test this hypothesis, we conducted a meta-analysis of 292 studies. The meta-analysis revealed a positive correlation between phone calls and psychological well-being and a negative correlation between online gaming and psychological well-being. However, the overall correlations between digital media use and well-being were weak. Furthermore, the impact of digital media on well-being was influenced by how technology was utilized. For example, using SNSs for entertainment was linked to better well-being, whereas self-presentation and content consumption on SNSs were correlated to poorer well-being.

Introduction

Since the 1990s, the rapid development of new communication technologies has triggered significant changes in people's lives worldwide. Whenever a new digital platform emerges, scholars debate its potential effects on people's psychological well-being. Numerous studies have evaluated the relationship between digital media usage and psychological well-being. Still, different digital media platforms appear to have diverse effects on psychological well-being (Orben and Przybylski, 2019). The well-being outcomes within the same media platforms also vary (Verduyn et al., 2017). Few studies have considered online media channels and various digital media activities when examining the relationship between digital media use and well-being. To reconcile the conflicting findings, we carried out a series of meta-analyses to explore the relationships between the most frequently used media types and various indicators of psychological well-being. In addition, we distinguished the relationships between multiple media activities and well-being and explored several moderating effects, including culture, age, gender, publication time, and measurement types.

Main meta-analyses framework

Mental health and well-being are two terms used interchangeably. Following Meier and Reinecke's (2021) two-continua model of mental health and Valkenburg, Driel, and Beyens' (2022) "well-being versus ill-being" framework, we divided well-being into two distinct aspects: psychopathology and positive well-being. Psychopathology refers to patterns of behavior that cause personal distress or impair significant life functions, such as social relationships, and consists of indicators of anxiety and depression. Positive well-being can be defined as optimal psychological functioning and experiences, the indicators of which include high levels of life satisfaction, happiness, self-esteem, and positive affect, as well as low levels of loneliness, stress, and negative affect.

Regarding the conceptualization of digital media, this study was informed by Meier and Reinecke's (2021) computer-mediated communication (CMC) taxonomy, which comprises six levels: device, type of application, branded application, feature, interaction, and message. Research focusing on the first four levels takes a channel-centered approach, concentrating on the technological features of the channels without paying much attention to the communication processes happening within the devices or applications. Research focusing on the latter takes a communication-centered approach, aiming to understand

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the complex social processes unfolding within the channels.

Including all six levels in one study would be overwhelming; therefore, we examined one level from each approach: type of application (channel-centered approach) and interaction (communication-centered approach). When scholars study types of applications, such as email, texting, and social network sites (SNSs), they group the applications based on their core features. For example, Facebook and Instagram are grouped because they share similar features and are examples of SNSs. Scholars studying interactions move beyond technological features and explore whether and how interactions are conducted within a channel (e.g., active versus passive usage). Meier and Reinecke's review indicated that these two levels are among the most frequently studied; thus, they are appropriate for a meta-analysis.

In this study, we examined different communication media, including phone calls, texting, instant messaging (IM), social network sites (SNSs), online gaming, and face-to-face interactions. Phone calls involve direct communication via telephone with someone located at a physical distance. Texting involves sending written messages to specific individuals, usually over a mobile phone, across physical distances. IM facilitates direct communication with another person, often online, using various devices and software, enabling a back-and-forth exchange of messages akin to a written conversation.¹ SNSs are online platforms that allow users to establish connections with people with whom they want to share content, such as profile information, news, status updates, comments, and photos (Steinfeld et al., 2013). SNSs also enable direct communication with specific individuals, for example, by responding directly to someone's posts. Facebook is a well-known example of an SNS (Auxier et al., 2021). Online gaming involves playing multiplayer online social games with friends or strangers. Although face-to-face interaction is not a type of CMC, it is essential to include it as a reference point or baseline against which the associations between CMC and well-being can be assessed. Many scholars view face-to-face communication as the "gold standard" for evaluating other forms of communication (Grieve et al., 2013). If face-to-face communication is found to have a much more significant association with well-being than digital media, then the assumption that face-to-face communication is the gold standard would be valid, even in the digital age. We focused on two categories for interaction levels: (1) active versus passive SNS use and (2) content consumption, entertainment, interactions, and self-presentation on SNSs.

Stimulation or displacement? Attention to application type

The stimulation and displacement hypotheses (Kraut et al., 1998; Valkenburg and Peter, 2007) have been used to predict or explain digital communication's implications for well-being. The displacement hypothesis suggests that the psychological well-being of digital media users declines as online communication replaces time spent with close relationships. Consequently, the quality of these friendships may diminish. On the other hand, the stimulation hypothesis argues that digital media use enhances mental health by positively impacting the duration and quality of interactions with close friends.

The inconsistent findings can be interpreted through Baumeister and Leary's (1995) belongingness theory, which posits that two kinds of experiences are necessary to fulfill one's belongingness needs: regular non-negative social interactions and a continuous structure of mutual concern. The lack of one element, for example, in long-distance relationships with inadequate interaction, leads to dissatisfaction. Although communication technologies can potentially boost well-being

¹ Given the similar features between texting and IM, it is possible to view them as the same application. We conducted the analyses by both combining and separating the two, and the results remained the same. To provide readers with more detailed information, we presented the results for texting and IM separately.

by promoting increased social interaction (per the stimulation hypothesis), excessively engaging in online interactions might lead to numerous quick social exchanges without sustained mutual concern. Thus, at least some digital media communication activity could plausibly replace regular human interaction, thereby decreasing well-being (displacement hypothesis). Accordingly, whether digital media use enhances or compromises well-being depends on what applications are used and whether their features support frequent positive interactions that allow people to express mutual concern. Media with more extraordinary richness (Daft and Lengel, 1986) can convey more information, thus improving interpersonal communication and developing relationships compared to more basic, leaner media. To be clear, "greater richness" refers to a medium's capacity to transmit information effectively through multiple channels simultaneously, such as body language, tone of voice, and immediate feedback. As a result, richer media allow users to communicate more effectively and clarify ambiguous messages. In intimate relationships, individuals usually opt for a medium that is interactive, targeted, and offers relatively affluent social-contextual cues and synchronicity (e.g., phone calls) because these features enhance the expression of emotion and affection (Goodman-Deane et al., 2016; Yang et al., 2014). Conversely, media less equipped to achieve these objectives (e.g., email) are often used for weaker ties (Yang et al., 2014). Researchers studied different communication channels. They found that closer friends favored phone calls and texting, while SNSs, IM, and online gaming were more commonly used in less intimate relationships (Liu and Yang, 2016). However, they meta-analyzed studies published before 2010, and media function has dramatically changed. Evidence also indicates that people today use private digital channels such as messaging to disclose emotions (Vermeulen et al., 2018). Such personal self-disclosure usually occurs in close relationships (Altman and Taylor, 1973), suggesting that IM, similar to phone calls and texting, may be frequently used with intimate associates. As a result, we expected that phone calls, texting, and IM would reinforce strong ties, aligning with the stimulation hypothesis. This implies that the relationships between these media channels and psychological well-being are predominantly positive.

Personal self-disclosure often happens in close relationships (Altman and Taylor, 1973), indicating that instant messaging (IM), phone calls, and texting might be frequently used with close friends and family. As a result, we expected that phone calls, texting, and IM would strengthen strong connections, supporting the stimulation hypothesis. This means that the associations between the use of these communication media and mental well-being are mainly positive.

On the other hand, even though one's online social network might include some strong ties, SNSs like Facebook are primarily used to sustain a broader network of weaker ties (Liu et al., 2016). Likewise, online gamers usually interact with strangers rather than close friends during gameplay (Eklund, 2015). Consequently, the time devoted to Twitter, Facebook, and online gaming is primarily for sustaining a broad and varied network of weak connections (Ellison et al., 2011; Liu and Yang, 2016). Engaging in a vast network of superficial relationships might substitute time devoted to close ties, aligning with the displacement hypothesis (Kraut et al., 1998; Valkenburg and Peter, 2007). Hence, SNSs and online gaming could replace interactions with close relationships, consequently diminishing well-being. This leads to our first two hypotheses:

- H1: Telephone conversations, texting, and IM are positively related to well-being because they are primarily used for contact with close others.

H2: General SNS use and online gaming are negatively related to well-being because they mainly feature interactions with strangers and acquaintances, which displace interactions with close others.

Different social network site activities

Modern media platforms, including SNSs, are becoming more versatile, enabling users to participate in various activities. Recent findings suggest that these activities may affect well-being differently (Hancock et al., 2019; Verduyn et al., 2020). While scholars have proposed different typologies of social media activities (e.g., Frison and Eggermont, 2016; Verduyn et al., 2017; Yang et al., 2021), the active-passive dichotomy appears to be popular, albeit controversial. Active activities facilitate interactions with others (Verduyn et al., 2017), whereas passive activities are those in which users consume content rather than produce or exchange it (Yang et al., 2021). It has been theorized that active activities would promote well-being by enhancing social connectedness, while passive activities would compromise well-being by inducing upward social comparison and envy (Verduyn et al., 2017). In this study, to help determine whether this dichotomy is robustly associated with well-being outcomes, we categorized SNS activities into these two types and proposed the following hypotheses:

H3: Active SNS use is positively related to well-being.

H4: Passive SNS use is negatively related to well-being.

As previously mentioned, the active-passive dichotomy, although widely used, is controversial because it overlooks particular useful distinctions and does not fully capture the complexity of SNS use (Valkenburg et al., 2022). Therefore, we further divided active and passive behaviors into four specific types of SNS activities: interactions (likes, chatting, commenting, or tagging on SNSs; active use), self-presentation (posting photos or updating statuses; active use), entertainment (using SNSs for leisure or self-entertainment; passive use), and content consumption (browsing SNS content; passive use). These activities were chosen based on the most used SNS functions to comprise all possible data.

Interactions are most likely associated positively with well-being. Using SNSs to engage with others should lead to enhanced social connections, which may satisfy the need for belonging (Baumeister and Leary, 1995) and promote social support (Liu et al., 2018). Indeed, individuals who use SNSs to communicate with others report receiving more social support and experiencing better well-being (Liu et al., 2018).

Simply engaging in regular exchanges of comments and replies can signal a commitment to a relationship and care for the other person's well-being. Consistent with these expectations, online interactive activities typically correlate with improved psychosocial results, like enhanced social capital (Gray et al., 2013) and decreased feelings of loneliness (Yang, 2016). Conversely, SNS content consumption has fewer benefits and could even harm well-being. This activity primarily involves reading about others' messages and lives without interacting with them. A substantial body of literature indicates that passive SNS use frequently leads to upward social comparison (Bayer et al., 2020). Although upward social comparison can foster inspiration and motivation (Meier and Krause, 2022), most scholars caution against engaging in this activity, given its association with poor well-being (Kross et al., 2021; Verduyn et al., 2020).

The associations between well-being, self-presentation, and entertainment must be better defined. While some research indicates that self-presentation, such as updating status on Facebook, is linked to lower well-being (Yang and Brown, 2013), others argue that posting on social media can enhance well-being by increasing social support and perceived connectedness (Luo and Hancock, 2020). Moreover, certain studies suggest that the impact of self-presentation on social networking sites is complicated by both interpersonal and intrapersonal dynamics (Yang and Brown, 2016). Initial studies indicated a connection between online entertainment activities and decreased social well-being, such as diminished quality of friendships (Blais et al., 2008). However, newer studies propose that online entertainment, like mobile gaming, can be leveraged to build and sustain relationships (Yang and Liu, 2017). Hence, we expected a significant relationship between self-presentation

and online entertainment with well-being. The remaining hypotheses and research questions are as follows:

H5: SNS interactions have a positive relationship with well-being.

H6: SNS content consumption has a negative relationship with well-being.

RQ: How do SNS self-presentation and entertainment relate to well-being?

Given the complexity of the implications of digital media for well-being (e.g., Meier and Reinecke, 2021), we also examined several moderators: culture, average age, gender ratio of the sample, publication time, and measurement types. We approached these moderators in an exploratory manner; thus, specific hypotheses still needed to be developed.

Method

Literature search

Three methods were used to search for potential studies. Firstly, databases such as Communication and Mass Media Complete, Google Scholar, PsycINFO, and ProQuest Dissertations & Theses were searched using the following keyword combination. Keywords used to track the articles included "mental health", "well-being", "psychological health", "anxiety", "depression", "loneliness", "stress", "self-esteem", "life-satisfaction", "happiness", "positive affect", "negative affect" AND "online interaction", "selfies", "photo posting", "status update", "SNS gaming", "information seeking", "SNS browsing", "passive SNS use", "Facebook", "Myspace", "WhatsApp", "Twitter", "Instagram", "Snapchat", "Telegram", "WhatsApp", "Social Network Sites", "social media", "phone call", "smart phone", "mobile phone", "texting", "SMS", "instant messaging", "IM", "MSN", "ICQ", "QQ", "gaming", "online gaming", "MMORPGs", "face-to-face", "in person", "offline communication", "offline interaction". Secondly, in-press and online-first articles were also searched using logical operators like "OR" and "AND" to combine keywords. Duplicate records were removed manually. Lastly, previously published meta-analyses were also searched, and all papers included were checked. We found eight previously published meta-analysis articles to check the studies included; please check the appendix. The search was carried out up until January 10, 2022. More details about the studies included, and the analysis figures can be accessed in the supplementary material available on the Open Science Framework website (<https://osf.io/2y6r3/files/osfstorage>).

Inclusion criteria

We found 3054 potential studies through an extensive literature search. After reviewing the titles and abstracts, we removed irrelevant studies, leaving 957 studies for further examination. Our meta-analysis included quantitative statistics, such as correlation or standardized regression coefficients, and global measures of digital media use or specific media use activities. We excluded studies that focused on addictive or problematic digital media use or used duplicate samples to calculate effects. If two studies used the same dataset, we considered them to have repeated samples. We selected the study with more information if multiple articles used duplicate data. Ultimately, 292 studies met our inclusion criteria. Please see the Open Science Framework for more details about the inclusion process; all coded papers are available online. The intercoder reliability for this step was 0.87, as measured by Cohen's kappa.

Coding of studies

The included studies were coded based on several sample characteristics, including places of origin, proportion of female participants, average age, sample size, and media measurement types. After an initial set of studies were coded, a comprehensive coding manual was created,

specifying the categories and codes used. This manual was then used to code all the information from the 292 selected studies. The inter-coder reliability was satisfactory, with all values being higher than 0.75. Whenever there were differences in coding between the coders, they were resolved through discussion until an agreement was reached.

In alignment with previous research guidelines (Verduyn et al., 2015; Yang et al., 2021; Wang et al., 2014), we organized SNS activities into four distinct categories: SNS interactions, which included liking, commenting, and replying; SNS self-presentation, encompassing posting photos and updating one's status; SNS entertainment, consisting of watching videos, gaming, and other leisure activities; and SNS content consumption, which involved browsing, searching, and monitoring. Subsequently, we coded SNS entertainment and consumption as passive usage and interaction and presentation as active usage. A comprehensive breakdown of this classification can be found in Table S10 in Appendix I.

Multiple dependent results from a single study

When an article reported multiple independent effect sizes, we coded each separately to avoid overestimating the significance tests that can happen when including numerous effect sizes from the same sample. We executed individual meta-analyses for various digital media types to prevent the inclusion of interdependent effect sizes within a single meta-analysis. For example, if a study delineated effect sizes for IM use and online gaming derived from the same sample, we allocated them to separate meta-analyses for IM and online gaming. When a publication detailed multiple interrelated effects for a specific digital media category, we amalgamated them using the 'agg' function from the 'MAC' package in R, adhering to the formulas provided by Hunter and Schmidt (2004).

Data analysis

For the analysis, we employed attenuated correlations (which are uncorrected correlations). Due to significant heterogeneity (as per Lipsey and Wilson, 2001), all analyses were performed using a random effects model. We included only standardized regression coefficients in our analysis. The standardized regression coefficients were translated into correlations using the method described by Peterson and Brown (2005).

We used the I^2 statistics to assess the variability among studies (the amount of actual heterogeneity across studies as a percentage of the total variation, Higgins and Thompson, 2002). All analyses were done with R packages and Comprehensive Meta-Analysis version 3 (Borenstein et al., 2014). We have also provided an R script for readers to replicate the analyses. All analyses and plots were computed using the meta, metaphor, diameter, and meta power packages. It should be noted that the R results had minor differences from the Comprehensive Meta-Analysis 3.0 results when conducting the meta-regressions.

Publication bias analysis

To determine if there was any bias in the publication of the research, we employed two methods: analyzing the shape of a contour-enhanced funnel plot (Peters et al., 2008) and carrying out a p-curve analysis (Simonsohn et al., 2014a,b). The term "p-hacking" refers to the practice of performing multiple analyses until a statistically significant result ($p < 0.05$) is obtained, which can lead to an overestimation of the size of the effect in published research and potentially produce false-positive conclusions. The p-curve method plots the distribution of significant p-values ($p < 0.05$) to assess whether the actual impact is conclusive. The p-curve analysis we conducted only considered p-values lower than 0.05.

Influential cases analysis

Influential cases may significantly impact the final estimates of a meta-analysis. Therefore, we adopted Viechtbauer and Cheung's (2010) influential case analysis method to identify outliers and re-estimate the effects. The Metafor package in R was used for these analyses.

Results

Sample description

The ultimate dataset included ten effects for phone call and well-being, involving 3808 participants; 12 effects for texting and well-being, encompassing 1150,370 participants; 9 effects for Instant Message use and well-being, totaling 4415 participants; 260 effects for SNS use and well-being, accounting for 760,545 participants; and 26 effects for online gaming and well-being, comprising 1176,554 participants; and 13 effects for face-to-face interaction and well-being, with 7408 participants. The participant count varied widely, ranging from 26 to 835,966.

Effect sizes of overall digital media use and psychological well-being

To explore the link between the overall use of digital media and global well-being, researchers flipped the values of measures for anxiety, depression, loneliness, negative affect, and stress so that higher scores indicated greater well-being in all cases. Then, these inverted effects were amalgamated with the measures of positive affect, self-esteem, life satisfaction, and happiness to impact global well-being. Burke and Kraut (2016) verify the combination of these scales into a single well-being index with confirmatory factor analysis. Their evaluation identified a common underlying factor across the scales, validating that a one-factor solution was appropriate.

A random-effects model was employed to assess the association between different forms of digital communication and well-being. The analysis revealed a significant positive correlation between phone calls and well-being ($r = 0.08$, $p = 0.009$), with a 95 % confidence interval ranging from 0.02 to 0.15 and moderate heterogeneity ($I^2=71.38$). Texting had a non-significant effect ($r=0.00$, 95 % CI -0.03 to 0.03 ; $p = 0.788$) and high heterogeneity ($I^2=97.42$), while instant messaging (IM) correlated non-significantly with well-being ($r = 0.04$, 95 % CI -0.06 to 0.13 ; $p = 0.436$; $I^2=88.33$). Social networking site (SNS) use ($r=-0.05$, 95 % CI -0.07 to -0.04 ; $p < 0.001$; $I^2=94.35$) and online gaming ($r=-0.09$, 95 % CI -0.11 to -0.07 ; $p < 0.001$; $I^2=95.68$) were found to have negative correlations with well-being. The overall correlation between global digital media use and psychological well-being was weak, ranging between -0.10 and 0.10 . In contrast, face-to-face communication was found to have a much stronger correlation with overall well-being ($r = 0.36$, 95 % CI 0.18 to 0.51 ; $p < 0.001$; $I^2=98.51$; see Table 1).

Global digital media use, positive well-being, and psychopathology

For the next set of analyses, we disaggregated the omnibus measures of well-being. Positive well-being comprises happiness, life satisfaction, self-esteem, positive affect, and (reverse-scored) loneliness, stress, and negative affect. Psychopathology includes anxiety and depression (not reversed; a high psychopathology score reflects high anxiety and depression).

Making more phone calls was weakly linked to higher positive well-being ($r = 0.11$, 95 % CI $0.04 - 0.17$; $p = 0.001$). Phone-call data for psychopathology showed no significant associations. Neither texting nor IM use was significantly associated with positive well-being or psychopathology. Greater SNS use was linked to lower positive well-being ($r = -0.04$, 95 % CI $-0.06 - -0.02$; $p = 0.001$) and higher psychopathology ($r = 0.13$, 95 % CI $0.10 - 0.15$; $p < 0.001$). Similarly, more online gaming was associated with lower positive well-being ($r = -0.05$, 95 %

Table 1
Meta-analysis of electronic media use and psychological well-being.

	k	r	Lower CI	Higher CI	p	Q	I ²	τ ²
Overall well-being								
CALL	10	0.08**	0.02	0.15	0.009	31.44***	71.38	0.01
TEXT	12	0.00	-0.03	0.03	0.788	426.33***	97.42	0.00
IM	9	0.04	-0.06	0.13	0.436	68.53***	88.33	0.02
SNSs	260	-0.05***	-0.07	-0.04	0.000	4581.02***	94.35	0.01
GAMING	26	-0.09***	-0.11	-0.07	0.000	579.24***	95.68	0.00
F-t-F	13	0.36***	0.18	0.51	0.000	804.98***	98.51	0.12
Positive well-being								
CALL	9	0.11***	0.04	0.17	0.001	24.54***	67.41	0.01
TEXT	10	-0.01	-0.04	0.02	0.518	421.68***	97.87	0.00
IM	6	-0.01	-0.09	0.06	0.734	23.57***	78.79	0.01
SNSs	193	-0.04***	-0.06	-0.02	0.001	4683.75***	95.90	0.02
GAMING	17	-0.05***	-0.07	-0.03	0.000	341.28***	95.31	0.00
F-t-F	13	0.36***	0.18	0.52	0.000	866.84***	98.62	0.13
Psychopathology								
CALL	2	-0.01	-0.18	0.17	0.926	3.79	73.62	0.01
TEXT	3	-0.01	-0.11	0.10	0.934	7.57*	73.59	0.01
IM	4	-0.14	-0.39	0.12	0.291	80.12**	96.26	0.07
SNSs	101	0.13***	0.10	0.15	0.000	1011.93***	90.02	0.02
GAMING	12	0.14***	0.04	0.22	0.004	235.34***	95.33	0.02
F-t-F	1	-0.17***	-0.26	-0.08	0.001	0.00	0.00	0.00

r denotes the effect size between each SNS use variable and psychological well-being.

In the categories of overall well-being and positive well-being, the valence of the effect sizes of anxiety, depression, loneliness, stress, and negative affect were inverted. The inverted statistics depict the correlations between global digital media use and improved well-being states. In the psychopathology category, the original scores were used.

* refers to $p < 0.05$.

** refers to $p < 0.01$.

*** refers to $p < 0.001$.

CI -0.07 to -0.03; $p < 0.001$) and higher psychopathology ($r = 0.14$, 95 % C.I. 0.04 - 0.22; $p = 0.004$). Overall, digital media use showed larger effect sizes for its association with psychopathology (anxiety and depression) than for positive well-being.

Types of sns use, well-being, and psychopathology

To explore the association between well-being and SNS use, we initiated with the global well-being index, which amalgamates self-esteem, life satisfaction, happiness, loneliness, anxiety, depression, stress, and positive and negative affect (all scored such that higher scores

Table 2
Meta-analysis of SNS use types and overall psychological well-being.

	k	r	Lower C.I.	Higher C.I.	p	Q	I ²	τ ²
Overall well-being								
Active Use	67	-0.01	-0.05	0.02	0.503	794.55***	91.69	0.02
Interaction	30	0.00	-0.06	0.06	0.990	511.00***	94.33	0.03
Presentation	41	-0.02	-0.06	0.03	0.501	342.51***	88.32	0.02
Passive Use	38	-0.05**	-0.08	-0.02	0.002	167.89***	77.96	0.01
Consumption	23	-0.06**	-0.11	-0.02	0.007	127.32***	82.72	0.01
Entertainment	6	0.01	-0.06	0.07	0.881	7.24	30.93	0.00
Positive well-being								
Active Use	62	0.01	-0.03	0.05	0.718	1007.50***	93.95	0.02
Interaction	29	0.02	-0.06	0.09	0.652	677.18***	95.87	0.04
Presentation	42	0.01	-0.03	0.05	0.56	369.15***	88.89	0.02
Passive Use	31	-0.04**	-0.08	-0.01	0.007	134.96***	77.77	0.01
Consumption	18	-0.05†	-0.10	0.01	0.077	115.65***	85.30	0.01
Entertainment	6	0.08**	0.03	0.13	0.004	5.44	8.13	0.00
Psychopathology								
Active Use	19	0.08**	0.02	0.13	0.005	116.39***	84.54	0.01
Interaction	9	0.03	-0.07	0.13	0.56	70.37***	88.63	0.02
Presentation	14	0.09*	0.02	0.16	0.01	74.32***	82.51	0.01
Passive Use	8	0.09***	0.05	0.14	0.000	13.27***	47.27	0.00
Consumption	4	0.11***	0.06	0.16	0.000	1.90	0.00	0.00
Entertainment	—	—	—	—	—	—	—	—

r denotes the effect size between each SNS use variable and psychological well-being.

In the overall well-being and positive well-being categories, the valence of the effect sizes of anxiety, depression, loneliness, stress, and negative affect were inverted. The inverted statistics illustrate the correlations between global digital media use and improved well-being states. In the psychopathology category, the original scores were used.

In the entertainment category, the only effect was SNS gaming; all other effects were having fun, looking around, and entertaining. Excluding it will not alter the results.

* refers to $p < 0.05$;

** refers to $p < 0.01$;

*** refers to $p < 0.001$.

denoted greater well-being). There was a significant association between passive SNS use and reduced global psychological well-being ($r = -0.05$, 95 % CI -0.08 to -0.02 ; $p = 0.002$). Only SNS content consumption was linked to decreased psychological well-being ($r = -0.06$, 95 % CI: -0.11 to -0.02 ; $p = 0.007$). The other three SNS activities did not have a significant association with well-being (Table 2).

Next, we sorted the measures into positive well-being (self-esteem, life satisfaction, happiness, positive affect, reverse-scored loneliness, stress, and negative affect) and psychopathology (anxiety and depression). Passive SNS use was associated with lower positive well-being ($r = -0.04$, 95 % CI -0.08 to -0.01 ; $p = 0.007$) and higher psychopathology ($r = .09$, 95 % CI $0.05 - 0.14$; $p < 0.001$). Active SNS use was also linked with higher psychopathology ($r = 0.08$, 95 % CI $0.02 - 0.13$; $p = 0.005$).

To delve deeper into these relationships, we divided the active and passive categories into four main activities: interaction, presentation, content consumption, and entertainment. SNS interaction was unrelated to both positive well-being and psychopathology. Presentation was not associated with positive well-being but was associated with higher psychopathology ($r = .09$, 95 % CI $0.02 - 0.16$; $p = 0.010$). SNS content consumption was not associated with positive well-being but was associated with psychopathology ($r = 0.11$, 95 % CI $0.06 - 0.16$; $p < 0.001$). SNS entertainment was positively related to positive well-being ($r = 0.08$, 95 % CI $0.03 - 0.13$; $p = 0.004$).

Moderation analyses

We used culture, average age, the female ratio of the sample, publication time, and measurement types to conduct moderator analyses. First, culture was considered as the most important categorical moderator. The analyses showed that the association between SNS use and well-being was significantly less negative or even more positive in Eastern cultures compared with Western cultures (Tables S9 and 10 in the Appendix). The associations between face-to-face communication and well-being were also more positive in Eastern cultures (Table S9).

Second, we conducted meta-regressions using age and female gender as predictors. Age was not a significant factor in any of the models. The female ratio of the sample was negatively associated with the effect between IM use and overall well-being ($B = -1.561$, $p = 0.011$, $R^2 = 0.26$; Fig. S5).

Third, we conducted a meta-regression with the publication year as a predictor. We found that the correlation between texting ($B = -0.014$, $p < 0.001$, $R^2 = 0.07$) and global well-being had become more negative over the past 20 years (Fig. S3).

Finally, when using duration as a measure of SNS use, the effect size with general well-being was larger than using intensity or frequency ($Q_{contrast} = 19.11$, $p < 0.001$; Table S11). In contrast, for face-to-face communication, the correlation with general well-being was more significant when using frequency than duration ($Q_{contrast} = 5.74$, $p < 0.05$).

Publication bias analysis

We used the trim-and-fill method to correct the estimates. The funnel plots (Fig. S8 in the appendix) show that most effects were filled with effect points on the right side of the mean. We provide the corrected effect size values in Tables S12–S14 in the Appendix. Most effect estimates changed slightly, but not much. Notably, the effect of general SNS use on global well-being became non-significant after correction ($r = 0.01$; *C.I.*, $-0.00 \sim 0.03$).

All *p*-curve plots exhibited a right-skewed shape that was not $< 33\%$, indicating that all results had substantial evidential value (check the Appendix). Collectively, these tests suggested a minimal bias in the significant effect sizes.

Influential cases analysis

We detected outliers via influential case analyses (see OSF site for the Appendix). We also recalculated the effect sizes after removing the outliers (see Part V of the Appendix). The influential case analysis showed that our results have sufficient robustness and stability.

Discussion

Notably, only some associations between digital media use and well-being were significant, and those associations were generally very weak. Most of our results explain $< 1\%$ of the variance in well-being. Although a weak association (either causal or correlational) can have substantial consequences, especially when one considers the implications over time (Götz et al., 2021), our findings appear consistent with the increasing evidence that the relationship between well-being and digital communication is generally minor effects (Orben and Przybylski, 2019; Przybylski, 2014; Przybylski and Weinstein, 2017). If compared with substance use and poor sleep, it's evident that the effects of digital media would appear much weaker (Esmaelzadeh, 2018; Gardani, et al., 2022).

Some insights can also be obtained by comparing digital and face-to-face communication. As shown in Table 1, face-to-face communication remains the most impactful medium, explaining a large portion of the variance in well-being. Thus, the association between face-to-face communication and well-being is much stronger than that between digital media and well-being. If digital media use is not excessive and, crucially, does not displace face-to-face communication, then our results suggest that the connection between digital media and well-being is trivial overall. This may be important knowledge for policymakers who are sensitive to concerns from parents and other stakeholders that online activity could be seriously damaging to the well-being of children (and adults). Another important point is that some associations between technology-mediated communication and well-being were positive, as described below.

Digital media, well-being, and psychopathology

Our meta-analysis indicated that not all digital communication forms have the same relationship with well-being. It was noticed that overall well-being improved as the frequency of making and receiving phone calls increased. Conversely, a negative relationship was observed between online gaming and well-being. However, these results are correlational, and it is hardly warranted to conclude that phone calls improve mental health or that online gaming reduces life satisfaction. We also conducted separate analyses for positive well-being indicators (life satisfaction, self-esteem, happiness, positive affect, lack of loneliness, negative affect, and stress) and psychopathology (anxiety and depression). Based on the effect sizes, the relationships between digital activities (i.e., SNS use and gaming) and psychopathology were significant (although weak). In contrast, the effects of digital activities on positive well-being were too small to be considered meaningful.

Finally, we divided SNS activities into four types: interpersonal interactions, self-presentation, content consumption, and entertainment. Interactions were not linked to positive well-being or psychopathology. More self-presentation on SNS was linked to higher psychopathology. Increased content consumption was also associated with more significant psychopathology. In contrast, greater use of SNS for entertainment was related to greater positive well-being. However, these significant relationships between digital media use and well-being were also weak.

Sorting SNS activity into broad categories of active and passive use has been popular among researchers; however, more recent work has suggested that the simple notion that active use is good while passive use is bad may be oversimplified if not plain wrong (Meier and Krause, 2022; Valkenburg et al., 2022). Our results support this critique. Although self-presentation is an active form of SNS use, more

self-presentation was linked to higher psychopathology. Likewise, including both content consumption and entertainment in the passive category was misleading, as they were found to be associated with lower and higher well-being, respectively. Meier and Krause's (2022) proposal for future research on social media use and well-being is to replace the coarse active-passive dichotomy and investigate more specific components of social media use. The present study supports this effort.

Moderator analysis and effect heterogeneity

Culture. Previous evidence on cultural differences in SNS effects has been inconsistent (Meier and Reinecke, 2021). Our results suggest that the relationship between SNS use and global well-being is more favorable in Eastern cultures. However, these differences remain significant for positive well-being but not psychopathology.

Age. Previous studies have found evidence for the moderating effect of age. For example, the link between CMC measures and social anxiety was shown to be stronger among older adults (Meier and Reinecke, 2021). However, we did not find any moderating effects of age.

Gender. While previous studies have found little evidence of gender effects, we found one instance of a significant moderating effect of gender. However, our analyses notably did not make a direct comparison of gender but merely relied on the size of the female proportion in each research sample. The association between general IM use and overall well-being was less positive, with an increasing female proportion in the sample. This suggests that women are less likely to be happy than men when using IM.

Publication Year. Twenge, Martin, and Campbell (2018) found that American adolescents' psychological well-being decreased significantly after 2012, whereas their screen time increased. We used publication year to predict digital effects and found evidence that the effects have been intensifying. Thus, the association between spending more time texting and low well-being has grown stronger in recent years.

Measurement. Our results indicated that measurement type only moderates the effects of SNS use and face-to-face communication. Studies measuring the duration of SNS use have reported larger effects than those relying on measures of intensity and frequency. In contrast, the correlation between face-to-face communication and general well-being was stronger when using frequency than duration.

Effect Heterogeneity. Nearly all our analyses had a high level of heterogeneity ($I^2 > 70\%$). The moderators of publication time, age, and culture could explain a significant portion of the variance (R^2 between 13 and 35%).

Study robustness

Some meta-analyses have previously been conducted on digital media use and psychological well-being (e.g., Huang, 2017; Yin et al., 2019, see the Appendix). Given that this is a recent expansion of literature, they typically had much smaller samples of effects. Most had fewer than 100 effects with which to work, whereas our meta-analysis was based on over 700 effect sizes. This substantially greater amount of information enabled us to conduct more fine-grained analyses than was possible in previous studies.

We performed the analyses a second time using the trim-and-fill method to correct for possible publication bias and found that most results remained the same. Hence, publication bias does not appear to have altered the results. Likewise, influential case analyses were performed to remove possible outliers, and the results remained basically consistent. Hence, our findings are robust.

Implications

A broad conclusion from this work is that all associations between digital media use and well-being are weak, especially when combining all well-being indicators into one. Combining positive well-being

measures (life satisfaction, happiness, self-esteem, positive affect, low loneliness, low stress, and low negative affect) with psychopathology (anxiety, depression) increased the heterogeneity of the effects. It yielded a null overall effect for SNS use. Likewise, combining different types of SNS activities could mask the effect of individual activities. For example, although positive well-being was negatively associated with passive SNS, it was positively associated with SNS entertainment.

Therefore, a second conclusion based on the results of this work is that researchers need to have a more nuanced and differentiated perspective than a simple, broad statement about whether digital media use is good or bad for well-being. Different types and patterns of digital media use have different and sometimes opposite relationships with well-being (although most remain small). The use of digital media can positively impact well-being when it enables social interactions with significant others, but it can negatively affect well-being when it replaces such interactions (Hall and Liu, 2022). Positive associations with well-being were identified for media designed for direct communication, which can encompass not only verbal content but also emotional communication (Dienlin et al., 2017).

Most relationships between digital media use and well-being identified in this study were weak (below 0.1). If we set above 0.1 as a meaningful level for the effects of digital media, anything below 0.1 can be considered too minor to be meaningful. From the perspective of confidence intervals the confidence intervals of texting and SNS on overall well-being and the effect sizes of most SNS activities on overall well-being were completely contained in the null region (-0.10 to 0.10) and could be considered null (or at best, trivial) correlations. When excluding these null results from our analyses, SNS use, including both general use and specific activities, had more meaningful associations with psychopathology than with positive well-being. Among all types of digital media use, only the results of phone calls (for positive well-being), SNS use (for psychopathology), and online gaming (for psychopathology) were meaningful.

Limitations

The existing literature has several limits. Firstly, the evidence at hand only allows us to make correlational conclusions. It remains uncertain whether digital communication impacts well-being or well-being affects digital media use. While some scholars argue that digital media usage, primarily gaming and browsing, could decrease well-being by replacing significant interactions (Kraut et al., 1998), others believe that those who are already unhappy might use digital media more (e.g., Kross et al., 2013). There is little evidence to suggest that the relationship might be bidirectional, indicating a need for longitudinal or experimental studies.

Secondly, categorizing media types in the reviewed literature was challenging and ambiguous. The emergence of TikTok has further complicated this classification. Existing media are integrating various functions, making the boundaries between different media types increasingly blurred.

Thirdly, our analysis indicated that the effect size of some digital effects, such as instant messaging (IM) effects, was too small to be meaningful, requiring a larger sample size to detect any significant effect. More studies are required in the future to strengthen these analyses.

Lastly, the study found that digital media users are diverse, but the effects estimated were average associations across different user groups (Valkenburg, 2021). Future research should consider the variability among users and the resulting diverse impacts on various groups (Cheng, Wang, Sigerson, Chau, 2019; Valkenburg et al., 2022).

Conclusion

As digital media has become a fundamental aspect of people's lives globally, it is imperative to examine the impact of technology and communication on human well-being. There are varying opinions on the

effects of digital media on well-being. Still, a meta-analysis of a significant amount of data indicates that the connection between digital media use and well-being is generally weak or unimportant. To find more meaningful associations, it is necessary to investigate specific media applications, types of use, and user groups. Comprehending this relationship between existing media and human well-being can guide the development of new technologies that produce the best outcomes for human relationships and well-being.

CRedit authorship contribution statement

Dong Liu: Conceptualization, Methodology, Software, Data curation, Writing – original draft. **Roy F Baumeister:** Writing – review & editing. **Chia-Chen Yang:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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