

**Shyness and Social Media Use: A Meta-Analytic Summary of Moderating and  
Mediating Effects**

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### Abstract

Since the advent of social networking sites (SNSs) such as Facebook and Twitter (often called social media), the link between shyness and using these platforms has received substantial scholarly attention. We assumed that the diverging findings could be explained by the patterns of use examined in the primary studies. A three-level, random effects meta-analysis was conducted (50 effect sizes, total  $N = 6,989$ ). Shyness and SNS use across all available indicators were unrelated. As predicted, the association was moderated by the specific SNS use pattern. Shyness was negatively associated with active use (e.g., posting photos),  $\rho = -.11$ , 95% CI  $[-.20, -.03]$ , and with the number of SNS contacts (i.e., online network size),  $\rho = -.26$ , 95% CI  $[-.34, -.17]$ . Negligible or no associations were found for general use (e.g., daily logins),  $\rho = .07$ , 95% CI  $[.02, .13]$ , or passive use (reading others' posts),  $\rho = .07$ , 95% CI  $[-.01, .14]$ . A meta-analytic mediation model suggests that the number of SNS contacts can partially explain the previously identified negative association between shyness and well-being.

*Keywords:* meta-analysis; shyness; social network; Internet; computer-mediated communication; social media

## **Shyness and Social Media Use: A Meta-Analytic Summary of Moderating and Mediating Effects**

Social networking sites (SNSs) such as Facebook, Twitter, or Instagram (often referred to as social media) are part of the lives of billions of people worldwide. With the increasing popularity of social media, researchers, along with journalists and the general public, have pondered about the usage of these platforms by individuals who are inhibited in offline communication contexts due to their shyness (e.g., Jack, 2016). Whereas some have argued that shy individuals are particularly attracted to social media activities, others highlight that shy individuals might avoid SNSs, as the concerns to make a bad impression, characteristic of shyness, are present in social media contexts as well. Empirical findings on shyness and SNSs have been mixed, as positive, negative, and no associations between shyness and social media use were observed (e.g., Baker & Oswald, 2010; Petrocchi, Asnaani, Martinez, Nadkarni, & Hofmann, 2015; Scott, Boyle, Czerniawska, & Courtney, 2018). We provide the first meta-analytic summary on the association between shyness and social media use, thereby assuming that this association is moderated by patterns of use and related indicators in the primary studies (cf. Gnams & Appel, 2018). Moreover, a meta-analytical mediation analysis based on the association between shyness and online network size was conducted to illuminate the link between shyness and well-being in the digital societies of the 21<sup>st</sup> century.

### **1.1 Shyness**

Shyness as a trait is characterized by a preoccupation with the self during social interactions – real or imagined (Cheek et al., 1986; Schmidt & Buss, 2010). It manifests itself in substantial discomfort and inhibition in the presence of strangers or casual

acquaintances. Shy individuals believe they lack the skills and behavioral patterns to interact successfully in social situations and to make a good impression on others (Jones, Briggs, & Smith, 1986). Importantly, shy individuals may or may not prefer solitude over social company. Thus, shyness – albeit related – is typically distinguished from sociability and introversion (e.g., Crozier, 1986). Based on the three-dimensional theory of personality (extraversion, neuroticism, psychoticism), Eysenck and Eysenck (1969), for example, perceived a closer connection of shyness to their neuroticism dimension than to their extraversion/introversion dimension. Moreover, standard instruments for the measurement of shyness such as the scale by Cheek and Buss (1981) explicitly aim at distinguishing shyness from sociability. Shyness scales typically show good discriminant validity in this regard (for a review, see Schmidt & Buss, 2010). Shyness is conceptually distinct from loneliness, but shyness can be a source of fewer offline social contacts (Jones & Carpenter, 1986) and loneliness (e.g., Asendorpf, 2000; Cheek & Busch, 1981). Relatedly, there is ample evidence on a link between shyness and lower well-being (e.g., Liu et al., 2018; Rowsell, & Coplan, 2013). Shy individuals tend to evade social interactions, are more reluctant to engage in social activities, and, thus, perceive less social support which, in turn, may reduce their subjective well-being (Jackson, Fritch, Nagasaka, & Gunderson, 2002; Zhao, Kong, & Wang, 2013).

## **1.2 Shyness and the Use of Social Networking Sites**

Some aspects of SNS communication may be particularly appealing to shy individuals. SNSs provide means to communicate with others in an asynchronous way, loosening the requirement to respond instantly. Although SNSs are not the anonymous spaces that researchers had in mind when connecting personality to the 1990s Internet (e.g.,

Roberts, Smith, & Pollock, 2000), SNSs provide options to hide or embellish parts of the self that shy individuals are often ruminating upon, prior to and during social interactions (e.g., imperfect skin and hair, blushing, stuttering). And shy individuals might see and find opportunities to follow others' social interactions without the need to contribute and without the danger to be ridiculed as the odd bystander.

Other aspects, however, might be not appealing at all for shy individuals. Much of the SNSs content is based on users' contributions (e.g., posting photos) and others' responses to the shared content (e.g., re-tweeting, liking). These activities are typically visible by many other users with a certain degree of connection. Individuals, who tend to be particularly wary about others' reactions, might be concerned about others' opinions and public feedback on own activities, which makes a SNS a rather unattractive environment for shy individuals. Moreover, SNS contacts are often offline friends and acquaintances and their friends and acquaintances (Subrahmanyam, Reich, Waechter, & Espinoza, 2008). Given that shyness is associated with fewer offline social contacts (Jones & Carpenter, 1986), shy individuals should have a harder time at building a social network on SNSs.

## **1.2 Study Overview and Predictions**

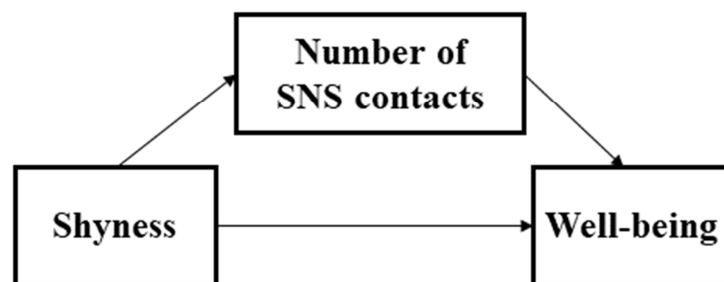
Whereas some characteristics of SNSs are likely appealing to shy individuals, other aspects are likely repulsive. Prior research on the link between shyness and SNS use has been scattered across different disciplines, using a number of different SNS use measures, including measures on overall SNS use, such as the amount of time spent or login frequency, number of contacts (e.g., Facebook friends), active contributions (e.g., posting text or photos), and passively following others' contributions (cf. Verduyn, Ybarra, Resibois, Jonides, & Kross, 2017). Starting our synthesis on prior work in the field, our

first aim was to provide an estimate of the relationship between shyness and SNS use, irrespective of how SNS use was operationalized.

Our second aim was to examine the influence of the actual usage aspect. We expected that the association between shyness and SNS use would be moderated by the type of SNS use examined (*Hypothesis 1*). Given the asynchronicity and partial anonymity provided by many applications within SNSs we expected a positive relationship between shyness and general SNS use (time spent, logins)(*Hypothesis 2a*). Passive use of SNSs, such as observing others' posts without actively commenting or contributing oneself, should be particularly characteristic of shy individuals. Thus, we also expected a positive relationship between shyness and passive SNS behaviors (*Hypothesis 2b*). Shyness is associated with smaller social networks in the offline world (Jones & Carpenter, 1986). Establishing a connection or 'friendship' on SNSs requires own initiative, or the initiative of others, the latter being a function of the offline network and an individual's self-presentation on the SNS. We assumed that shy users are less likely to take advantage of the opportunity to establish connections or 'friendships' on SNSs. Thus, we expected a negative relationship between shyness and the number of contacts (*Hypothesis 2c*). As outlined above, shy individuals, while generally attracted to SNSs, should be less inclined to engage in active contributions, such as posting photos or status updates. Therefore we expected a negative relationship between shyness and active SNS use (*Hypothesis 2d*).

Prior research indicates that shyness is negatively associated with subjective well-being (e.g., Liu et al., 2018; Rowsell, & Coplan, 2013). At the same time SNS network size is positively associated with well-being (meta-analytic evidence by Yin et al., 2018). Following our hypothesis that shyness is associated with fewer SNS contacts, the number

of SNS contacts could mediate the association between shyness and well-being (see Figure 1). We addressed this mediation model as an additional research question (cf. Cheung, 2014).



*Figure 1.* Path model for the mediating effect of the number of SNS contacts for the effect of shyness on well-being

## 2. Method

### 2.1 Meta-Analytic Database

Primary studies were identified in January 2018 searching various scientific databases (*PsycINFO*, *SocINDEX*, *ERIC*, *Medline*), *ProQuest Dissertations & Theses Database*, and *Google Scholar* (first 1000 results) using the keywords *shyness* in combination with *social networking*, *Facebook*, *Instagram*, *Twitter*, *Snapchat*, *MySpace*, *Friendster*, *Sixdegrees*, *Livejournal*, *Orkut*, *Linkedin*, *XING*, *StudiVZ*, *Renren*, *Bebo*, *Weibo*, *Habbo*, or *Hyves*. Studies were included in the database if they administered a

validated self-report instrument assessing trait shyness (introversion, life satisfaction, or social anxiety scales were not considered) and examined social networking behaviors such as durations (e.g., usage time per day), frequencies (e.g., number of logins, friends or postings), or intensity ratings (e.g., the Facebook Intensity Scale; Ellison, Steinfield, & Lampe, 2007). Comparisons between users and non-users were not included. Moreover, studies must have reported a sample size and one or more coefficient(s) that quantified the zero-order association between shyness and SNS use. This resulted in 17 independent samples (15 publications) reporting 50 correlations. The entire coding guide is available in the supplemental material. The search process is illustrated in Appendix A.

The focal information was the association between trait shyness and SNS behaviors along with the size of the examined sample. We further documented the instrument used to measure shyness and the coefficient alpha reliability of the reported shyness score. Each SNS use measure was categorized into one of the following four categories based on prior theory and research on SNS use (Gnambs & Appel, 2018; Verduyn et al., 2015; 2017): (a) *General SNS use* comprised measures of the time spent with the platform, number of logins, general intensity ratings (such as measures based on the Facebook Intensity Scale), and other nonspecific SNS activities not falling in the other categories (e.g., number of group memberships).<sup>1</sup> (b) *Number of contacts* represented the number of Facebook friends and comparable frequencies from other platforms. (c) *Active SNS use* included all variables

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<sup>1</sup> Aydin and colleagues (2013) assessed *playing games* on SNSs, La Sala and colleagues (2014) assessed the *number of groups people were members of* on Facebook. Both measures appeared to fit best the general use category as these variables were no measure of number of contacts, and they do not clearly fall into the categories of active use or passive use (Verduyn et al., 2017).



dealing with active communication activities such as posting a message or uploading a photo. (d) *Passive SNS use* reflected the passive usage patterns, such as checking others' pages, pictures, and updates. To examine potential sample effects, additional variables were assessed. We coded the platform investigated (e.g., Facebook, Twitter, etc.), the geographical origin of the sample (name of country), participants' age group (children, adolescents, undergraduates, mixed/general adult sample), and the percentage of female participants in each primary study. Details on the studies and the coded information are summarized in Appendix B.

## 2.2 Meta-Analytic Procedure

Pearson correlation coefficients were used as effect sizes for the association between trait shyness and SNS behaviors. Each effect was individually corrected for measurement error in the shyness scores using the reported coefficient alpha reliabilities (Hunter & Schmidt, 2015). Missing reliabilities were imputed with the pooled reliabilities (see supplemental material). For SNS use, respective corrections could not be applied because no reliability information was reported. These effects were pooled across samples using a random-effects meta-analysis with maximum likelihood estimation using the *metaSEM* software version 0.9.16 (Cheung, 2015a). Because some samples reported multiple correlation coefficients (e.g., for different SNS behaviors), we specified a three-level meta-analysis following Cheung (2014) that acknowledges the nesting of individual effects within samples. The heterogeneity in observed effect sizes was calculated as  $I^2$  indicating the percentage of the total variance in observed effects due to random variance. According to prevalent rules of thumb values of .25, .50, and .75 reflect low, medium, and high heterogeneity.

The focal mediated effect was examined using meta-analytic structural equation modeling (Cheung, 2015b). To this end, we reconstructed a full meta-analytic correlation matrix between shyness, number of SNS contacts, and well-being. Whereas the correlation between the first two variables was derived from the present study, the correlation between the number of SNS contacts and well-being was taken from a previous meta-analysis (Appendix C of Yin, de Vries, Gentile, & Wang, 2018) and the correlation between shyness and well-being was recalculated from four subsamples (total  $N = 10,489$ ) of a representative national survey (Brüderl et al., 2018). Then, this correlation matrix was subjected to a mediation analysis in *lavaan* version 0.6-2 (Rosseel, 2012). The coded data including the syntax files are provided in an online repository of the *Open Science Framework* (Soderberg, 2018) at <https://osf.io/p5ar8/>. Moreover, this link provides access to the supplemental material referred to in the results section.

### 3. Results

The meta-analysis comprised 17 independent samples including a total of  $N = 6,989$  participants. The studies were published between 2009 and 2017. In most studies (82%), shyness was measured with variants of the Cheek and Buss (1981) scale. The measurement precision of the shyness scales was generally good with an average alpha coefficient of .87 ( $Min = .79$ ,  $Max = .93$ ). The mean percentage of female respondents was  $M = 66\%$  ( $SD = 9\%$ ) and the mean age was  $M = 23.61$  ( $SD = 4.69$ ) years. The majority of participants (82% of the samples) were undergraduates; the remaining samples consisted of adult, non-undergraduate participants. No primary study investigated children or adolescents. Most studies examined SNS behaviors on Facebook (84%), whereas the others referred to

generic or local SNSs. Thus, we distinguished between Facebook and non-Facebook studies in our sensitivity analyses. Whereas a sizeable portion of primary studies was conducted with US samples (41%), the remaining samples originated from diverse countries and regions. Thus, geographical origin was categorized into US vs. non-US as part of the sensitivity analysis.

### 3.1 Synthesis of Effect Sizes

The uncorrected mean correlation between shyness and SNS use was  $M(r) = -.02$  ( $SD = .15$ ). Even after acknowledging sampling and measurement error, the true score correlation of  $\rho = .00$ , 95% CI  $[-.06, .07]$  indicated no meaningful association. Moreover, there was negligible random variance between samples,  $\tau_{(3)}^2 = .009$  ( $p = .18$ ),  $I^2 = .38$ . In contrast, the random level 2 variance that reflects heterogeneity between effect sizes within samples pointed at potential moderating influences,  $\tau_{(2)}^2 = .011$  ( $p = .008$ ),  $I^2 = .50$ . Therefore, three dummy-coded predictors were added to the meta-analytic model qualifying the type of SNS behavior in line with our hypotheses. Thus, we distinguished between general SNS use (reference category), number of contacts, active SNS use, and passive SNS use. Overall, the regression model provided a significantly better estimate than the baseline model without predictors,  $\Delta\chi^2 = 38.22$ ,  $\Delta df = 3$ ,  $p < .001$ , thus, supporting Hypothesis 1. Accounting for the different SNS behaviors explained about 79% of the random level 2 variance (see Table 1). The pooled effects for each SNS behavior are presented in Figure 2. In line with our hypotheses, we observed a small positive association between trait shyness and general SNS use,  $\rho = .07$ , 95% CI  $[.02, .13]$ . A similar effect was found for passive SNS use,  $\rho = .07$ , 95% CI  $[-.01, .14]$ , which was based on four effects only and was not significantly different from zero. As expected, trait shyness showed a

significant negative association with the number of SNS contacts  $\rho = -.26$ , 95% CI [-.34, -.17], a relationship of small to medium size according to prevalent guidelines (Fritz, Morris, & Richler, 2012). We further identified a small negative relationship between shyness and active SNS use,  $\rho = -.11$ , 95% CI [-.20, -.03]. Both negative associations differed significantly from the small positive association observed for general SNS use (see Table 1).

Table 1.

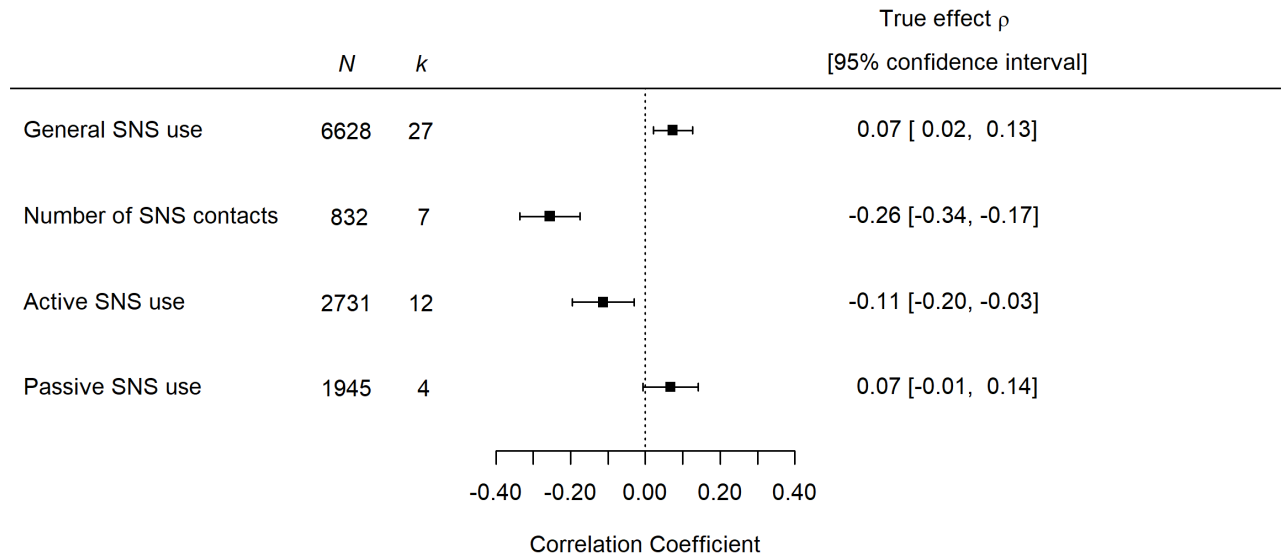
*Meta-Analytic Moderation Analyses*

	Model 1			Model 2		
	<i>B</i>	<i>SE</i>	<i>z</i>	<i>B</i>	<i>SE</i>	<i>z</i>
Intercept <sup>a</sup>	.068*	.025	2.801	.010	.054	0.191
SNS behavior <sup>b</sup>						
- SNS contacts	-.270*	.044	-6.206	-.275*	.044	-6.257
- Active SNS use	-.138*	.033	-4.202	-.135*	.033	-4.073
- Passive SNS use	.001	.042	0.014	.005	.043	0.115
Examined SNS (1 = Facebook, -1 = other)				-.001	.026	-0.021
Geographical origin (1 = US, -1 = other)				-.009	.024	-0.365
Sample type (1 = undergraduates, -1 = adults / mixed)				-.012	.029	-0.428
Percentage of females (centered at .50)				.290	.248	1.170
$\tau^2_{(2)} / \tau^2_{(3)}$	.002 / .005			.002 / .005		
$R^2_{(2)} / R^2_{(3)}$	.785 / .368			.782 / .462		

*Note.*  $k = 50$  effects in 17 samples. <sup>a</sup> Pooled average effect corrected for unreliability. <sup>b</sup>

Dummy-coded with general SNS use as reference category. Thus, the displayed results represent comparisons between general SNS use and the displayed activity.

$\tau^2$  = Random level 2 or 3 variance.  $R^2$  = Random level 2 or 3 variance explained by the predictors.



*Figure 2.* Forest plot for the association between trait shyness and types of SNS use ( $N$  = total sample size,  $k$  = number of effect sizes).

### 3.2 Sensitivity Analyses

To evaluate the robustness of these findings, we added four sample characteristics to our regression model: type of examined SNS, geographical origin of the participants, sample type, and proportion of females (see Table 1). Although we had no a priori hypotheses regarding these four variables, they were included in our analyses because the information was available from all studies and, thus, allowed us to investigate the robustness of our focal hypothesis after controlling for various factors. However, this model did not fit significantly better than the previous regression model,  $\Delta\chi^2 = 1.53$ ,  $\Delta df = 4$ ,  $p = .82$ . The additional predictors explained only 10% incremental variance and none of these variables significantly explained the observed heterogeneity in effect sizes. More importantly, the previously identified effects for the number of SNS contacts and active SNS use remained unchanged. In contrast, the positive association between general SNS use and shyness was not robust ( $B = .01$ ,  $SE = .05$ ,  $p = .85$ ). Overall, these results support hypotheses 2c and 2d, but they provide limited support for hypotheses 2a and 2b.

### 3.3 Publication Bias

A potential publication bias was evaluated by examining the funnel plot of effect sizes. PET-PEESE analyses for funnel plot asymmetry (Stanley & Doucouliagos, 2014) identified no significant association between the correlations and their standard errors (PET) or variances (PEESE) thus, providing no sign of publication bias, all  $ps > .10$  (see supplemental material). Finally, a selection model that models publication bias using weighted distribution theory (Vevea & Hedges, 1995) showed no superior fit,  $\Delta\chi^2 = 1.06$ ,  $\Delta df = 2$ ,  $p = .59$ , and, thus, gave no evidence for distortions due to file-drawer studies.

### 3.4 Meta-Analytic Mediation Analysis

The present meta-analysis identified a systematic association between trait shyness and indicators of SNS use (see Table 1). At the same time, shyness is also correlated to indicators of subjective well-being (e.g., Liu et al., 2018; Rowsell, & Coplan, 2013). Therefore, we hypothesized that the association between SNS network size and well-being of  $r = .13$  that has been identified in a previous meta-analysis (Yin et al., 2018), might partially reflect the effect of trait shyness. Thus, we examined whether the number of SNS contacts mediated the effect of shyness on well-being. The reconstructed correlation matrix for these three measures is summarized in Table 2. In line with our assumptions, we specified a path model including two regressions: (a) the number of SNS contacts was regressed on shyness and (b) well-being was regressed on the number of SNS contacts and shyness. As expected, the indirect effect of shyness ( $B = -.016$ ,  $SE = .006$ , 95% CI[-.028, -.004]) on well-being was significant ( $p = .007$ ). This is in support of our mediation model (Figure 1). However, the respective direct effect remained substantially larger,  $B = -.271$ , 95%CI[-.315, -.226],  $p < .001$ . The indirect effect, albeit significant, was rather small, accounting for less than 1 percent of the total effect of shyness on well-being.



Table 2.

*Meta-Analytic Mediation Analysis*

Predictor	Outcome: Number of SNS contacts			Outcome: Well-being			Correlations		
	<i>B</i>	<i>SE</i>	<i>z</i>	<i>B</i>	<i>SE</i>	<i>z</i>	Shyness	SNS contacts	Well-being
Shyness	-.256*	.022	-11.540	-.271*	.023	-11.940	1.00		
Number of SNS contacts				.063*	.023	2.760	-.256 <sup>a,d</sup>	1.00	
Well-being							-.290 <sup>b,d</sup>	.132 <sup>c</sup>	1.00
<i>R</i> <sup>2</sup>	.066*			.087*					

*Note.* Results of meta-analytic path model including two regressions (left and middle) using the pooled correlation matrix (right).

<sup>a</sup> From Table 1 in this study, <sup>b</sup> Recalculated from Brüderl et al. (2018), <sup>c</sup> From Yin et al. (2018, Appendix C), <sup>d</sup> Corrected for measurement error in the shyness measure.

\*  $p < .05$

#### 4. Discussion

At the early stages of Mark Zuckerberg's pursuit of developing Facebook, his roommates wondered whether he created the platform to overcome his timidity and shyness (Kirkpatrick, 2010). Following the popularity of Facebook and other SNSs, researchers, along with journalists and the general public, have explored the relationship between shyness and the engagement with SNS sites. Whereas some evidence has pointed out the new opportunities of social behavior in the social media world ("social networks, particularly Facebook, are for shy people what water is for the thirsty", summarized in a journalistic piece by Rosenwald, 2011, p. 1), theory and findings of others did not corroborate this positive association. Therefore, we reviewed the empirical basis of this conjecture and synthesized available research on the relationship between shyness and the use of SNSs with the help of a three-level, random effects meta-analysis. This methodology allowed us to pool the effects for different SNS behaviors (time spent per day or log-in frequency as indicators of general SNS use, number of contacts, active contributions, and passive use) that were gathered from one and the same study, without violating the assumption of independence (Cheung, 2014). Moreover, we conducted a meta-analytic mediation analysis, a state-of-the-art meta-analytic methodology (Cheung, 2015b), to SNS use as a potential intervening variable between shyness and subjective well-being (cf. Yin et al., 2018)

##### 4.1 Key Results on Shyness and Social Media

Shyness was unrelated to SNS use when all relationships were aggregated, irrespective of the specifics of the SNS use indicator. Supporting our first hypothesis, the heterogeneity between effect sizes within samples was substantial and the actual SNS

behavior investigated moderated the focal relationship. We found a very small positive relationship between shyness and general SNS use (such as number of logins per day), but this relationship disappeared when the type of examined SNS, geographical origin of the participants, sample type, and proportion of females were statistically controlled. Likewise, no support was found for the assumption that shy individuals engage in more extensive passive use, such as following others' contributions. As a caveat it needs to be noted that this finding is preliminary as only four primary studies included a measure on passive SNS use. Stronger evidence was identified for the assumed negative association between shyness and active usage patterns. Like in face-to-face communication, shy people tend to refrain from self-presentations and other active contributions that might be evaluated and commented on by others. Greater asynchronicity and partial anonymity of SNSs do not override this tendency. Like other recent meta-analyses on the correlates of social media use (e.g., Big Five: Liu & Campbell, 2017; narcissism: Gnambs & Appel, 2018; school achievement: Marker, Gnambs, & Appel, 2018) we demonstrated that the specific patterns of use show meaningful associations with the psychological variables of interest, whereas the mere quantity of interaction shows little connection. Finally, we identified a negative relationship between shyness and the number of contacts on SNSs (e.g., friends on Facebook). This finding provides additional support that personality correlates observed in face-to-face communication translate to similar correlates in the social media world.

A unique contribution of our meta-analysis is the demonstration of mediation process instantiated by usage behavior on social media. Applying a meta-analytical structural equation model (Cheung, 2015b), we showed that the number of SNS contacts mediated the association between shyness and well-being. Our findings suggest that social

media have not freed shy people from their inclinations (cf. Jack, 2016). Nor is there support for the notion that shy individuals have moved their social encounters disproportionately to social media (cf. Baker & Oswald, 2010). What we need to recognize, though, is that shyness can decrease the likelihood that SNSs are used to secure and establish contacts to others and to actively produce content such as status updates or photos. As outlined in cross-sectional as well as initial longitudinal and experimental research, active SNS use is a predictor of increased well-being (Verduyn et al., 2015). Shy individuals do not reap the potential of SNSs to develop social capital and connectedness, which could be a link to increased well-being (Verduyn et al., 2017).

#### **4.2 Limitations**

Some weaknesses might limit the generalizability of the reported findings. Our meta-analysis cannot disentangle causal relationships between shyness and SNS behavior. Most primary studies assumed that personality predicts SNS use, but the reverse causation cannot be completely dismissed, given that social media experiences can shape the concept of ourselves. Longitudinal research is encouraged to examine causal influences in this field. Our findings are further limited with respect to boundary conditions. As part of our sensitivity analysis we examined several moderating variables, but the primary studies' focus on Facebook and the Western origin of the studies and samples might have obscured potential effect size differences. Finally, all primary studies analyzed were based on undergraduate and adult samples. It is an open question whether the findings summarized here apply to children or adolescents. Researchers are encouraged to address the role of shyness in using digital media across younger age groups.

### **5. Conclusion**

Our quantitative summary of available research suggests that shy people are generally not more or less attracted to social media than less shy people. Shyness is, however, related to fewer active posting and sharing of content and to fewer contacts such as friends on Facebook, pointing at less social capital and connectedness online. In turn, the smaller social circle and social support can contribute to less social well-being reported by shy SNS users. Overall, the identified effects were rather small. Therefore, our findings do not warrant overtly alarming news stories on the perils of social media.

**Declaration of Conflicting Interests**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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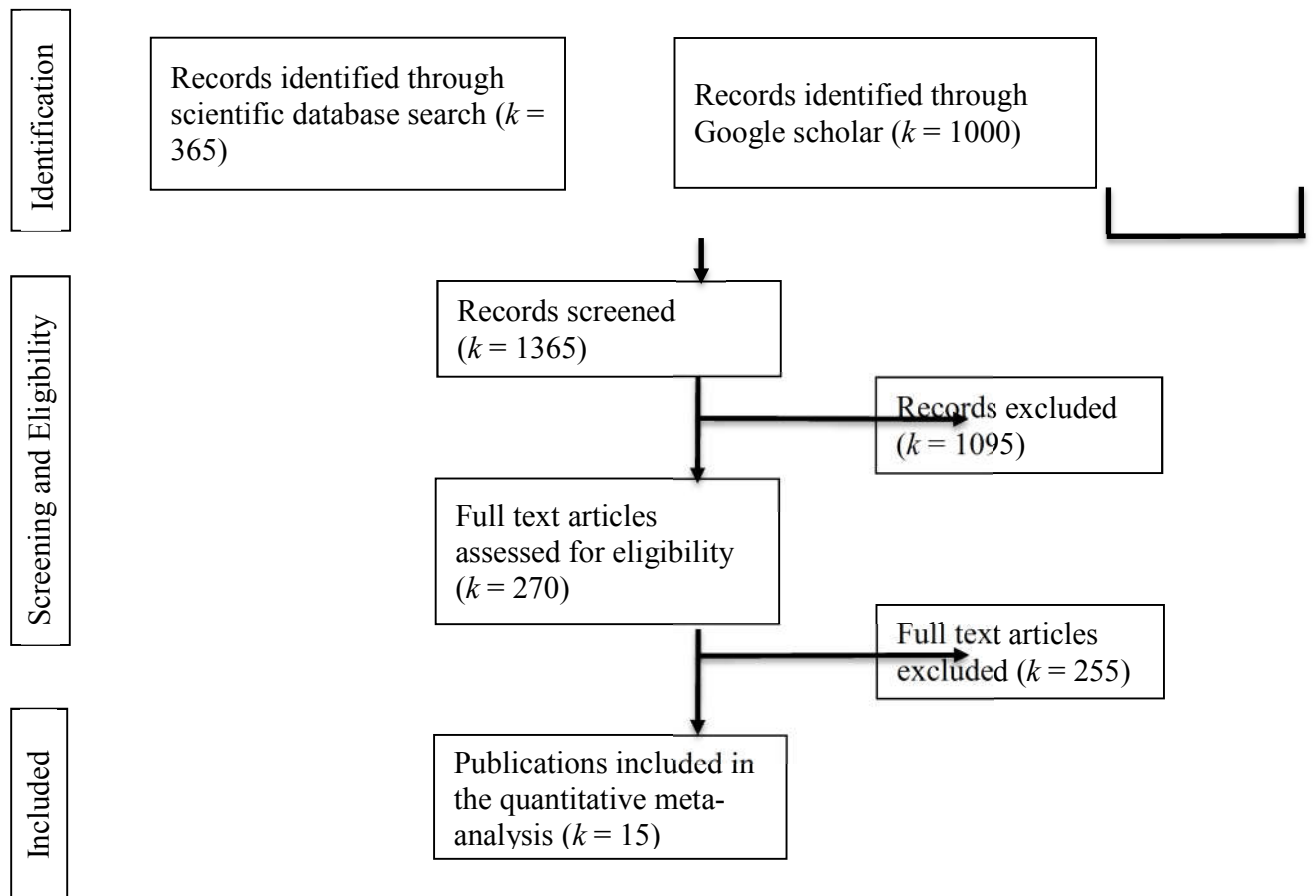
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## Appendix A

Figure A1. Flow diagram illustrating the literature search



## Appendix B

Table A1. Characteristics of the Primary Studies

Nr	Publication / Source	Sample Size	Sample Origin	Age Group	SNS Platform	SNS Activity	Activity Code	<i>r</i>
1	Albert, 2012	299	Egypt	1	Facebook	Fb attitudes/intensity scale	1	.094
2	Aydin et al., 2013	435	Turkey	1	Facebook	Following pictures, videos, comments	4	.130
					Facebook	Meeting new friends	3	-.050
					Facebook	Contacting old friends	3	.000
					Facebook	Communicating with current friends	3	.010
					Facebook	Sharing photographs, videos, and notifications	3	-.020
					Facebook	Playing games	1	-.020
3	Baker & Oswald, 2010	207	USA	1	Facebook	Time spent in minutes per week	1	.040
4	Gebre, 2017	611	USA	1	Facebook	Academic Use	1	.010
					Facebook	Social Use	1	.130
5	Klingensmith, 2010, Study 2	108	USA	1	Facebook	Fb connection/intensity scale	1	.433
6	La Sala et al., 2014, non-	184	Australia	2	Facebook	Time spent	1	.000

	students		(?)		Facebook	Logins per day	1	.000
					Facebook	Number of friends	2	-.230
					Facebook	Number of photos	3	-.140
					Facebook	Number of groups	1	.050
7	La Sala et al., 2014, students	190	Australia (?)	1	Facebook	Time spent	1	-.080
					Facebook	Logins per day	1	.000
					Facebook	Number of friends	2	-.360
					Facebook	Number of photos	3	-.310
					Facebook	Number of groups	1	.050
8	Naqshbandi et al., 2017	1165	Malaysia	1	Facebook	Fb attitudes/intensity scale	1	.097
9	Nelson et al., 2016	355	USA	1	SNSs in general	Time spent in hours at Time 1	1	.090
	Nelson et al., 2016	204	USA	1	SNSs in general	Time spent in hours at Time 2	1	-.040
10	Orr et al., 2009	103	Canada	1	Facebook	Time spent in minutes per day	1	.240
					Facebook	Number of Facebook friends	2	-.250
					Facebook	Facebook attitudes/intensity scale	1	.280
11	Petrocchi et al., 2015, sample Facebook only	96	USA	1	Facebook	Number of friends	2	-.060
					Facebook	Time spent in minutes	1	.030
					Facebook	Fb intensity scale	1	-.050
12	Petrocchi et al., 2015, sample Facebook plus Twitter	109	USA	1	Facebook	Number of Fb friends	2	-.170
					Facebook	Time spent in minutes	1	-.030
					Facebook	Fb intensity scale	1	-.120
					Twitter	Number of contacts	2	-.140

					Twitter	Time spent in minutes	1	.050
					Twitter	Twitter intensity scale	1	-.110
13	Ryan & Xenos, 2011	1158	Australia	2	Facebook	Time spent per day	1	.040
					Facebook	Active social contributions	3	-.050
					Facebook	Passive engagement	4	.100
					Facebook	News and information	4	-.040
					Facebook	Real-time social interaction	3	-.080
14	Scott et al., 2017	262	Mostly UK	2	Facebook	Posting photos	3	-.030
					Facebook	Time spent on Fb daily	1	.142
15	Sheldon 2013, Study 1	150	USA	1	Facebook	Breadth of self-disclosure on Fb	3	-.170
					Facebook	Depth of self-disclosure on Fb	3	-.270
					Facebook	Number of Fb friends	2	-.310
16	Sulaiman et al., 2017	994	Malaysia	1	Facebook	Fb engagement / intensity scale	1	.086
17	Wang et al., 2015	352	China	1	QQzone	QQ attitudes/intensity scale	1	.010
				1	QQzone	QQ active social use	3	-.010
				1	QQzone	QQ passive recreational use	4	.080

*Notes.* Nr = Sample number. Six additional publications (seven samples) were initially deemed eligible. They were excluded because partialized coefficients (betas) or differences in means (e.g., Facebook users vs. non-users) were reported and the authors did not provide zero-order correlations after being contacted. Age group was coded 1 for undergraduates and 2 for adults. Activity codes were 1 for general SNS use, 2 for number of SNS contacts, 3 for active use, and 4 for passive use.



**Shyness and Social Media Use: A Meta-Analytic Summary of Moderating and  
Mediating Effects**

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**- SUPPLEMENT -**

Main manuscript accepted for publication in *Computers in Human Behavior*

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**Supplement A: Summary of Search Process**

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Identified publications:	
From scientific databases	35
From references and other sources	21
From Google Scholar (first 1000 hits of 18700 records identified)	1,000
<hr/>	
Considered relevant after screening of title and abstract	43
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Included publications:	15

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**Supplement B: Coding Guide**

<b>Variable</b>	<b>Description</b>	<b>Coding instruction</b>
ID	Sample number	Same sample, same number. Note that one study may include two or more independent samples, for example, in a study findings for two age groups are reported separately
Sample/Study	Name of the publication / study / sample	
Origin	Country of origin of the sample	If not explicitly identified, name country of first author
Shyness measure	Instrument used to measure shyness	
Reliability	Internal consistency (Cronbach's alpha) for shyness measure	Write down the numerical score of the internal consistency (Cronbach's alpha) for the shyness measure
SNS investigated	Which SNS was investigated?	If (for example) Facebook, write down "Facebook". If the SNS was not specified, write down "unspecified".
SNS Measure	The measured SNS behavior	Write down what the measure was like (e.g., Facebook Intensity, Time spent on Facebook, number of Facebook friends)
Activity Category	Rate the category of the SNS measure	General (1) = time spent, attitude, general penchant for Facebook Facebook friends (2) = Number of Facebook friends or number of twitter followers Active (3) = communicating actively, posting stuff Passive (4) = lurking, reading information and other users' stuff
N	Number of participants from which the effect size was calculated	
% women	Percentage of women in the sample	
Participant Group	What kind of participants were included?	Undergraduates, mixed adults, children? State verbally.

Age	Average age of the participants	Write down the mean age.
Effect size verbal	Association between shyness and SNS use	Write down the effect, including the measure (e.g., $r$ , $\rho$ , or $\beta$ ).
Corr	Zero-order correlation coefficient	Just the score. Obtained from Effect size verbal. Positive sign means the more SNS use the higher participants' shyness.

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**Supplement C: Studies included in the meta-analysis**

- Albert, A. (2012). The effects of Facebook on Egyptian students' social well-being. *Scientific Reports, 1*:493. doi:10.4172/scientificreports.493
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### Supplement D: Reliabilities of the shyness scores

Of 17 samples included in the meta-analytic database, 13 samples (including a total of 6,778 participants) reported coefficient alpha reliabilities for the administered shyness scales. The unweighted mean reliability across these samples was  $M = .87$  ( $SD = .04$ ,  $Min = .79$ ,  $Max = .93$ ). A reliability generalization (Sánchez-Meca, López-López, & López-Pina, 2013) pooled these reliabilities using a random-effects model (restricted maximum likelihood estimator). Sampling variances were calculated following Bonnett (2010). The reliability generalization resulted in a pooled coefficient alpha reliability of  $.87$ ,  $SE = .01$ ,  $p < .001$ . However, there was some heterogeneity between samples,  $\tau = .04$ ,  $p < .001$ ,  $I^2 = .96$ . Overall, the administered shyness scales exhibited satisfactory reliabilities.

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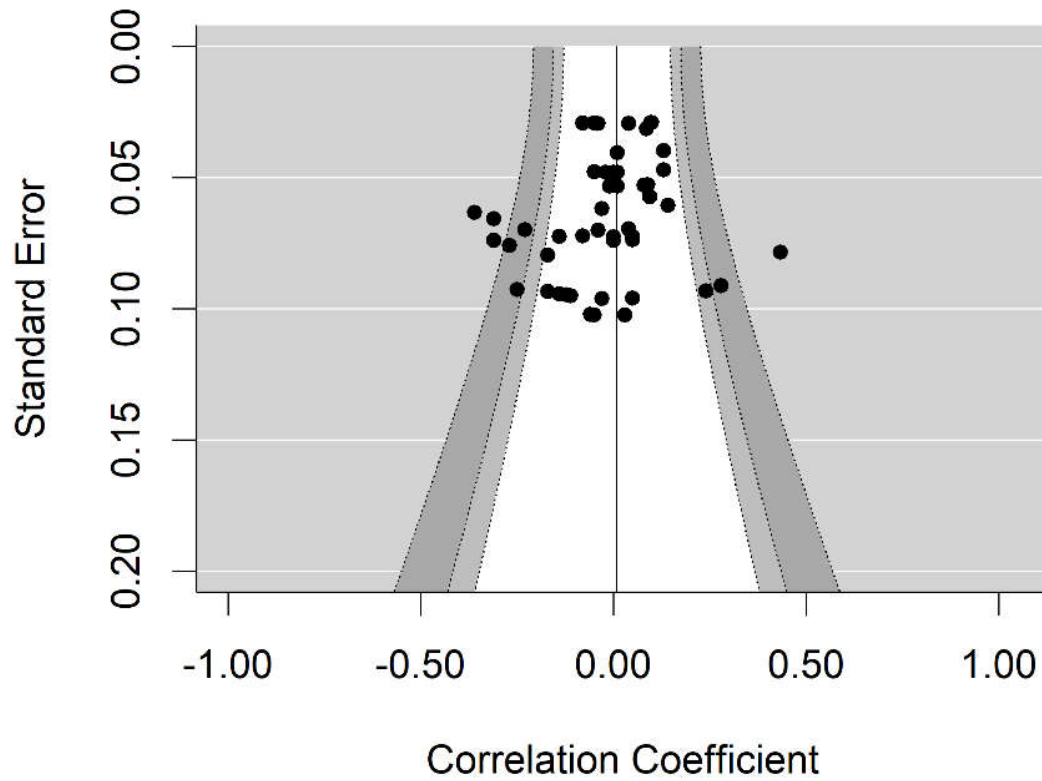


**Supplement E: Descriptive statistics for moderators**

Table S2.

*Descriptive statistics for moderators*

	<i>M</i>	<i>SD</i>	Correlations			
			1.	2.	3.	4.
1. Examined SNS (1 = Facebook, 0 = other)	0.84	0.37				
2. Geographical origin (1 = US, 0 = other)	0.36	0.48	-.24			
3. Sample type (1 = undergraduates, 0 = adults / mixed)	0.24	0.43	.25	-.42		
4. Percentage of females	0.67	0.08	.17	-.14	.01	
5. Publication year	2014	2.13	-.33	.28	-.15	-.05

**Supplement F: Funnel plot for effect sizes**

*Figure S1.* Contour-enhanced funnel plot with 90% (white), 95% (light gray), and 99% (dark gray) confidence intervals around the pooled effect (horizontal line).

**Supplement G: PET-PEESE analyses for publication bias**

Table S3.

*Meta-Regression Analyses for Publication Bias following the PET-PEESE Approach*

	$B_0$ (SE)	$t$	$B_1$ (SE)	$t$
PET	0.067 (0.041)	1.621	-1.311 (0.790)	-1.658
PEESE	0.033 (0.025)	1.358	-10.869 (6.809)	-1.596

*Note.*  $B_0$  = Intercept (i.e., the corrected estimate of the overall effect);  $B_1$  = Regression weight for the standard error (PET) or variance (PEESE) of the individual effect (i.e., the test for funnel plot asymmetry).