



## Review

Multinational comparison of internet gaming disorder and psychosocial problems versus well-being: Meta-analysis of 20 countries<sup>☆</sup>Cecilia Cheng<sup>a,\*</sup>, Mike W.-L. Cheung<sup>b</sup>, Hsin-yi Wang<sup>a</sup><sup>a</sup> The University of Hong Kong, Hong Kong<sup>b</sup> National University of Singapore, Singapore

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## ABSTRACT

Internet gaming disorder (IGD) has been viewed by scholars as (a) a pathology that co-occurs with psychological problems (comorbidity hypothesis), (b) maladaptive coping with abundant interpersonal problems (interpersonal impairment hypothesis), and (c) deficient self-regulation with the underlying motive to restore psychosocial well-being (dilution effect hypothesis). We examined the associations between IGD symptoms and four major criteria (psychological problems, interpersonal problems, psychological well-being, and interpersonal well-being), and compared the magnitude of these associations across countries. To test these hypotheses, we performed mixed-effects meta-analysis on 84 independent samples comprising 58,834 participants from 20 countries. The findings showed moderately strong positive associations between IGD symptoms and psychological problems across the countries, providing some support for the universality of the comorbidity hypothesis. The interpersonal impairment hypothesis was more tenable to countries lower (vs. higher) in power distance, which exhibited a stronger (vs. weaker) positive correlation between IGD symptoms and interpersonal problems. The dilution effect hypothesis was more tenable to countries either higher (vs. lower) in national life satisfaction or lower (vs. higher) in cultural masculinity, each of which displayed a weaker (vs. stronger) inverse correlation between IGD symptoms and interpersonal well-being.

## 1. Introduction

Video gaming has been a popular leisure pursuit since the 1970s (e.g., Wolf, 2008), with more recent advances in information technology giving it renewed impetus. Online video gaming becomes problematic when players are so engrossed in gaming that their daily functioning is impaired. Internet gaming disorder (IGD) is defined as prolonged, uncontrollable game playing via the Internet that results in significant psychosocial problems, such as depression and social isolation (e.g., Ko, 2014; Kuss, 2013). Some scholars consider IGD as a new type of psychiatric disorder in the Internet age, with “gaming disorder” included in the beta draft version of the upcoming 11th edition of the World Health Organization's International Classification of Diseases and Related Health (Saunders, 2017). IGD is also listed as a “condition for further study” in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013, p. 795).

The American Psychiatric Association (2013) advocacy of greater efforts to understand this emerging problem has led to a growth of

studies examining IGD symptoms and its psychosocial correlates. As this body of research is still at the fledgling stage, scholars espouse distinct views on the problem, with some conceptualizing IGD as an addiction that coexists with multiple psychological symptoms (e.g., Fauth-Bühler & Mann, 2017; Sigerson, Li, Cheung, & Cheng, 2017) while others as a type of maladaptive behavior adopted to cope with a multitude of interpersonal problems (e.g., Schneider, King, & Delfabbro, 2017; Young, 2009). Still others view it as a form of psychological dependency with an expectancy of need gratification (e.g., Larose & Eastin, 2004; J. H.; Wu, Wang, & Tsai, 2010). In this alternative view, IGD reflects players' attempt to fulfill unmet fundamental needs, with the ultimate goal of restoring psychosocial well-being by regaining self-esteem and replenishing social capital. These diverse views inevitably lead to the prediction of various psychosocial criteria associated with IGD symptoms (see the next section and Table 1 for details). We thus conducted meta-analysis to synthesize the growing body of literature and evaluate the empirical validity of the hypothesized associations between IGD symptoms and these criteria.

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**Table 1**  
Summary of theory-driven predictions tested in the meta-analysis.

	Psychological Problems	Interpersonal Problems	Psychological Well-being	Social Well-being
Hypothesis	Predictions – Main Effects			
Comorbidity	++		–	
Interpersonal impairment	++	++		–
Dilution effect	++	++	–/0	–/0
Country	Predictions – Country Moderation			
Higher national life satisfaction	+		–	
Lower national life satisfaction	+++		–	
Higher cultural masculinity	+++		–	
Lower cultural masculinity	+		–	
Higher power distance		+		–
Lower power distance		+++		–

Note. A larger number of + symbols indicates a stronger positive association with symptoms of Internet gaming disorder, and a larger number of - symbols indicates a stronger inverse association with symptoms of Internet gaming disorder.

### 1.1. IGD and psychosocial problems versus well-being

A major aim of this meta-analysis was to summarize the literature on IGD by examining its hypothesized associations with various psychosocial criterion variables. To realize that aim, we formulated and tested hypotheses derived from the three major theoretical perspectives on IGD: (a) a pathology that co-occurs with psychological problems (i.e., comorbidity hypothesis), (b) maladaptive coping with interpersonal problems (i.e., interpersonal impairment hypothesis), and (c) deficient self-regulation with the underlying motive to bolster psychological and interpersonal well-being (i.e., dilution effect hypothesis). Table 1 summarizes the diverse predictions put forward by these hypotheses.

#### 1.1.1. Comorbidity hypothesis

The comorbidity hypothesis proposes that IGD is related to both psychological problems and poor psychological well-being. The hypothesis is based on the disease theory of media selection and effects, which conceptualizes IGD as a type of pathology or addiction (Tokunaga, 2017). The disease theory is derived from empirical evidence showing IGD to share similar psychological symptoms and neurobiological mechanisms with other substance or behavioral addictions. For instance, when individuals with IGD are kept from playing, they experience such withdrawal symptoms as irritability and recurring game-related thoughts (e.g., Kaptis, King, Delfabbro, & Gradisar, 2016; King, Kaptis, Delfabbro, & Gradisar, 2016). Other findings have documented watching videotapes of online gameplay to increase neural activities in the brain regions involved in craving for addictive substances or gambling (Han et al., 2011).

In addition to addiction-related symptoms, IGD also co-occurs with such psychiatric conditions as major depressive disorder and attention deficit hyperactivity disorder (e.g., J. H. Park et al., 2017; Youh et al., 2017). Neurobiological evidence supports this psychiatric comorbidity by identifying similar brain and physiological functions between problematic online gamers and individuals having the aforementioned psychiatric conditions (e.g., Han, Hwang, & Renshaw, 2010; Ko et al., 2013). Studies have also documented a positive association of IGD symptoms with both psychological and psychiatric symptoms (e.g., Hyun et al., 2015; Kaptis et al., 2016; S. Y.; Park et al., 2016; Vukosavljevic-Gvozden, Filipovic, & Opacic, 2015).

The comorbidity hypothesis posits a close association between IGD and a variety of psychological problems found to disrupt psychological functioning (e.g., Floros, Siomos, Stogiannidou, Giouzevas, & Garyfallos, 2014; Müller, Beutel, & Wölfling, 2014), and thus an inverse association is also proposed between IGD and psychological well-being. This notion is in line with the scar model, which states that

psychological problems produce profound adverse changes in the individuals that undermine their psychological well-being over time (e.g., Shahar & Davidson, 2003). Taken together, the comorbidity hypothesis proposes that IGD symptoms are positively related to psychological problems but inversely related to psychological well-being.

#### 1.1.2. Interpersonal impairment hypothesis

Whereas the comorbidity hypothesis focuses solely on the psychological or personal aspects of IGD, the interpersonal impairment hypothesis highlights problems in the interpersonal milieu as well. The latter hypothesis is derived from the cognitive-behavioral theory of generalized problematic Internet use (Caplan, 2005; Haagsma, Caplan, Peters, & Pieterse, 2013). Grounded in diathesis-stress theories (e.g., Ingram & Luxton, 2005), this cognitive-behavioral theory postulates psychological problems as diathesis, and interpersonal stress as a proximal factor that elicits Internet-related problematic behaviors. In addition to psychological problems, individuals with IGD also experience a range of interpersonal problems. The interpersonal impairment perspective thus conceptualizes IGD as a maladaptive response to interpersonal stress rather than as pathology per se. Such a notion is supported by evidence showing coping with life stress to be a primary motive for going online among problematic Internet users, including problematic online gamers (Bischof-Kastner, Kuntsche, & Wolstein, 2014).

Research on IGD has revealed its susceptibility to two broad types of interpersonal stress: interpersonal conflicts and social isolation (e.g., Demetrovics et al., 2012). For instance, individuals exhibiting this problem often indulge in online games to the extent that they neglect their significant others (e.g., Wartberg, Kriston, & Thomasius, 2017; Wood, Griffiths, & Parke, 2007), and they also frequently lie about their excessive gaming (e.g., Huang, Wang, Qian, Zhong, & Tao, 2007; Lemmens, Valkenburg, & Gentile, 2015), both of which inevitably lead to arguments and deteriorations in interpersonal relations. Moreover, problematic online gamers usually lack the necessary social skills to handle interpersonal conflicts (e.g., Caplan, 2005; Lemmens, Valkenburg, & Peter, 2011), thus exacerbating the situation. A recent study showed that such individuals often fail to recognize facial expressions of disgust displayed by others, and continue their annoying behavior despite others' non-verbal communication of disapproval (Z. Chen, Poon, & Cheng, 2017). Hence, social incompetence may result in the further distancing of problematic online gamers from their significant others (Griffiths, 2010; Liao et al., 2015).

In addition to interpersonal problems, the interpersonal impairment hypothesis also posits that IGD is associated with poor interpersonal well-being, because a preoccupation with the cyber game world precludes those exhibiting such problematic behavior from accruing social

capital and gaining emotional support from real-life social networks (X. Wu et al., 2016). Moreover, damage to intimate social relations (e.g., breakups, divorce) further undermines interpersonal well-being (Young, 2009). In short, the interpersonal impairment hypothesis states that IGD symptoms are positively related to interpersonal problems but inversely related to interpersonal well-being.

### 1.1.3. Dilution effect hypothesis

Rather than gaming-related problems and poor well-being, the dilution effect hypothesis sheds light on the possible psychological gains that mitigate the negative impact of IGD on well-being. The hypothesis originates from both the social-cognitive theory of Internet uses and gratifications (Larose & Eastin, 2004) and escape from self theory (Kwon, Chung, & Lee, 2011; see also; Baumeister, 1991). The former theory positions the rationale behind frequent engagement in online gaming as an attempt to gratify fundamental psychological needs, whereas the latter explicates the motivation underlying such engagement as a desire to escape into the cyber world to avoid tackling distressing real-life problems. However, players are no longer able to regulate their gaming behavior when their ongoing behavioral engagement turns into profound cognitive immersion, which hinders or interferes with executive function. This perspective conceptualizes IGD as a deficiency in self-regulation with the underlying motive to restore well-being.

Consistent with these theoretical postulations, studies have shown individuals with IGD to experience low self-esteem and receive scant support from others (e.g., Aydm & San, 2011; Van Rooij, Schoenmakers, Vermulst, Van Den Eijnden, & Van De Mheen, 2011). They are also reported to dodge undesirable real-life experiences by dwelling in the cyber world (e.g., Cheng, Sun, & Mak, 2015; Kwon et al., 2011), with the motive to escape from the real world found to be the strongest predictor of IGD symptoms (e.g., Kardefelt-Winther, 2014; Yee, 2006). Moreover, Leung (2007) identified a positive link between the social compensation motive and online gaming, reflecting Internet users' attempts to compensate for their scant social resources by garnering the respect and support of other gamers. Such compensation appears plausible to users because many online games, MMORPGs in particular, are extremely social in nature (e.g., T. T. Chen, 2014; Cole & Griffiths, 2007). Players immerse themselves in the virtual game world, which is an inherently social milieu jointly constructed by multiple players (e.g., Newson, 2015). Their “comrades,” typically from the same team or clan, provide mutual support and encouragement to attain collective goals (e.g., Cole & Griffiths, 2007; Morschheuser, Riar, Hamari, & Maedche, 2017).

In light of these theories and empirical findings, the dilution effect hypothesis puts forward that the cyber game world is akin to a refuge in which problematic online gamers seek to rebuild deflated self-esteem and replenish scarce social capital (e.g., Billieux et al., 2015; Cheng & Li, 2014). Although this alternative perspective highlights the psychological gains likely to be obtained from the cyber game world, those gains are postulated to abate the adverse impacts of stress-induced problems rather than bolstering well-being, because the real-life problems still remain intact. Hence, the dilution effect hypothesis posits that IGD symptoms are positively related to psychological and interpersonal problems, but has weak or nonsignificant inverse associations with psychological and interpersonal well-being.

## 1.2. Multinational comparison of IGD and psychosocial problems versus well-being

The three foregoing hypotheses—comorbidity, interpersonal impairment, and dilution effect—formulate distinct predictions concerning the associations between IGD symptoms and several psychosocial criteria, but the empirical applicability of these hypotheses is unlikely to be uniform across countries with diverse sociocultural characteristics. To test such cross-country differences, the current meta-

analysis also examined the hypothesized moderating effects of three sociocultural factors identified by our literature review, namely national life satisfaction, cultural masculinity, and power distance.

### 1.2.1. National life satisfaction

Escape from self theory puts forward dissatisfaction with real life as a crucial explanatory factor in IGD at the individual level (Kwon et al., 2011). To test this theory in country-level analysis, we included national life satisfaction as a moderator to explain cross-country differences in the associations between IGD symptoms and psychological problems. Many researchers are interested in comparing levels of subjective well-being across countries (e.g., Hausmann, Mueller, Hattrup, & Spiess, 2013), and multiple indices of national life satisfaction have been created from large-scale multinational surveys, such as the Gallup World Poll and World Value Survey (WVS). These indices reflect how the residents of a given country appraise the general quality of their lives.

Multinational research has documented an inverse association between national aggregates of self-reported life satisfaction and the prevalence of a variety of societal problems, including suicide and unemployment (Hayo, 2007; Helliwell, 2007). In addition, and more relevant to the current study, there is evidence indicating a nation's life satisfaction level to be inversely associated with the frequency of Internet use (Sum, Mathews, Pourghasem, & Hughes, 2008) and the prevalence of problematic Internet use (Cheng & Li, 2014). These country-level analyses are consistent with escape from self theory, which predicts that individuals with IGD tend to encounter numerous problems and be highly dissatisfied with their real lives, which motivates them to escape into the online game world.

In this light, we speculated that IGD symptoms would exhibit stronger positive associations with psychosocial problems and stronger inverse associations with psychological well-being in countries with lower (vs. higher) levels of national life satisfaction.

### 1.2.2. Cultural masculinity

In addition to cross-country differences in life satisfaction levels, countries also differ markedly in cultural values, which guide the thoughts and behavior of their residents (e.g., Markus & Kitayama, 2001; Smith, Bond, & Kagitcibasi, 2006). Among the various cultural dimensions identified in multinational research, cultural masculinity may be particularly relevant to explaining cross-country differences in IGD. In Hofstede (1980, 2001) cultural dimensions theory, cultural masculinity refers to the extent to which members of a society embrace achievement and success as core values. Countries higher in cultural masculinity (e.g., Germany, Japan) place greater emphasis on competition and work performance (Van De Vliert, 1998). Research has supported the validity of Hofstede's cultural masculinity dimension scores by revealing their strong associations with Schwartz's mastery value scores, which comprise such agentic characteristics as ambition and competence (Van De Vliert, 1998).

In countries higher in cultural masculinity, the identity of their residents is defined largely by work-oriented outcomes (e.g., Gudykunst & Matsumoto, 1996; Van De Vliert, 1998), with leisure activities generally denigrated as impeding task performance and achievement (Hofstede, 2001). In this respect, IGD may be regarded as especially pernicious owing to its interference with work quality and scholastic performance (e.g., Brunborg, Mentzoni, & Frøyland, 2014; Wong & Lam, 2016). Research has also documented a tendency in countries higher in cultural masculinity to attribute failures to personal flaws (Kolman, Noorderhaven, Hofstede, & Dienes, 2003), and multinational research has revealed a greater prevalence of job stress and depression in these countries (Arrindell, Steptoe, & Wardle, 2003; Hofstede, 1980). Hence, in cultures higher in cultural masculinity, the performance decrement brought about by IGD may be regarded as a person's own responsibility, which is particularly distressing as it fails to align with those cultures' core values (i.e., achievement and success).

Taking together, we predicted IGD symptoms to exhibit stronger positive associations with psychological problems and stronger inverse associations with psychological well-being in countries higher (vs. lower) in cultural masculinity.

### 1.2.3. Power distance

We propose power distance to explain cross-country differences in interpersonal issues related to IGD, because numerous studies have adopted this cultural dimension to unpack cross-national differences in interpersonal communication, particularly in the realm of interpersonal conflicts (e.g., Tinsley, 1998; Tyler, Lind, & Huo, 2000). According to Hofstede's cultural dimensions theory, power distance refers to the extent to which the members of a society accept status differences. In countries higher in this dimension (e.g., Russia, Malaysia), individuals are organized in well-defined roles within the social hierarchy, with those higher up possessing more social power. The members of such societies are readier to accept unequal power distributions in groups and institutions, and have greater respect for and place more trust in powerful people (e.g., authority figures, superiors). In countries lower in power distance (e.g., Denmark, New Zealand), individuals are organized more democratically and power is distributed more or less equally. The members of such societies tend to perceive interpersonal relations as egalitarian in nature, with decisions generally made based on equality considerations (Kolman et al., 2003).

As previously noted, excessive engagement in online gaming tends to elicit discontent or fury in others, often leading to conflicts (e.g., Griffiths, 2010; Yen et al., 2017); and these relational patterns may be more prominent in countries lower in power distance. This notion stems from cross-cultural studies revealing that individuals from such countries tend to adopt a more direct communication style and deploy more assertive or confronting strategies in conflict situations (e.g., Ohbuchi, Sato, & Tedeschi, 1999; Ting-Toomey & Kurogi, 1998). In the interpersonal communication context, power refers to the degree of influence and compliance between communication parties (e.g., Ting-Toomey, 1988). In higher power distance cultural contexts, individuals are more prone to accepting the influence of others, and tend to react in a more compliant manner when conflicts arise (Tinsley, 1998). In lower power distance cultural contexts, in contrast, individuals are readier to defend and fight for their rights when others try to influence them (Tinsley, 1998). Accordingly, if significant others attempt to interfere with or stop those individuals from prolonged online gaming, the latter may display a more reactive response that elicits more conflict, resulting in a greater deterioration in interpersonal well-being.

On the basis of these theoretical postulations and findings, we predicted stronger positive associations between IGD symptoms and interpersonal problems as well as stronger inverse associations between IGD symptoms and interpersonal well-being in countries lower (vs. higher) in power distance.

### 1.3. Hypotheses

The present meta-analysis aimed to evaluate the empirical validity of three theory-driven hypotheses: comorbidity, interpersonal impairment, and dilution effect. The comorbidity hypothesis predicted a positive association between IGD symptoms and psychological problems as well as an inverse association between IGD symptoms and psychological well-being. The interpersonal impairment hypothesis predicted that IGD symptoms was positively related to both psychological and interpersonal problems but inversely related to interpersonal well-being. The dilution effect hypothesis shared the same predictions regarding the positive associations between IGD symptoms and both types of problems, but it uniquely predicted that IGD symptoms might have weak or nonsignificant associations with psychological and interpersonal well-being.

The applicability of these hypotheses was further proposed to vary by certain sociocultural characteristics. On the basis of our cross-

cultural literature review, the comorbidity hypothesis was predicted to be more tenable for countries whose residents generally express lower life satisfaction levels, or countries that value achievement and success more. The interpersonal impairment hypothesis was predicted to be more applicable to countries that place greater importance on power egalitarianism. The dilution effect hypothesis was predicted to have greater validity for countries whose residents are generally more satisfied with their lives, those placing less emphasis on achievement and success, or those that are more accepting of an unequal power distribution.

## 2. Methods

### 2.1. Eligibility criteria

The meta-analysis reported herein was carried out in compliance with the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) guidelines (Moher et al., 2015). We examined the overall associations between IGD symptoms and both psychosocial problems and psychosocial well-being, and thus our literature search sought to locate all available reports examining those associations. To be eligible for inclusion, reports needed to have adopted at least one quantitative measure of IGD and at least one of the following relevant criterion measures: (a) psychological problems (e.g., anxiety, psychiatric condition), (b) interpersonal problems (e.g., interpersonal conflicts, social isolation), (c) psychological well-being (e.g., happiness, self-esteem), and (d) interpersonal well-being (e.g., social support, social capital accrual). These four broad clusters of measures were found to be relatively independent (e.g., Dejong, Giel, Slooff, & Wiersma, 1986; Wohlfarth, Van Den Brink, Ormel, Koeter, & Oldehinkel, 1993), and should thus be examined separately.

The followings were all excluded from the review: (a) Articles containing no quantitative data; (b) studies examining only problematic Internet use or offline video gaming; (c) studies that had adopted none of the relevant criterion measures; (d) reports omitting relevant statistics for effect size computation and such data were unavailable from their authors; (e) samples containing less than 10 participants; (f) studies for which their full text was unavailable.

To maximize the likelihood of retrieving all relevant reports, we placed no restrictions on academic discipline, country, date of publication, language, participant demographics, publication status, or research design. The search process commenced in October 2016, with a follow-up search conducted in July 2017. All research work completed prior to June 30, 2017 was screened for possible inclusion in the review.

### 2.2. Information sources and search strategies

Systematic literature search strategies were carried out in multiple stages (Cooper, 2010). In the initial stage, electronic bibliographic searches were undertaken via the meta-database PROQUEST, which comprises 33 individual databases from various disciplines spanning the social sciences (e.g., PsycINFO), health and medical sciences (e.g., MEDLINE<sup>®</sup>), and business studies (e.g., ABI/INFORM Global).

Reports in the unpublished and gray literature were retrieved by additional searches through Google Scholar, ProQuest Dissertations and Theses A&I database: Social Sciences (both Global and UK & Ireland), Social Sciences Citation Index, and ERIC (conference proceedings). These searches facilitated the retrieval of diverse types of unpublished work, such as theses, conference proceedings, and technical reports by government or private organizations.

As researchers have investigated IGD using a variety of terms (e.g., online gaming dependency, pathological video game playing), conceptually relevant keywords were identified by reviewing the literature and consulting a synonym finder ([www.synonym-finder.com](http://www.synonym-finder.com)). A cluster of key terms pertaining to Internet gaming (e.g., "Internet video gam\*,"



“online gam\*”) was paired with another cluster pertaining to behavioral disorders (e.g., “addict\*,” “dependenc\*,” “disorder,” “patholog\*”) using Boolean operators of “AND” and “OR.” To broaden the scope of the database searches, we used wildcards (\*) to locate word variants. For instance, use of the keyword “dependenc\*” located reports containing both “dependence” and “dependency.”

The second stage involved a manual search via three methods. First, the reference sections of all pertinent reports identified in the electronic searches were scanned. Second, the reference sections of relevant reviews related to problematic Internet use and IGD were browsed. Finally, major journals that frequently publish empirical studies on IGD were hand-searched.

In the final stage of the literature search, the authors of the included reports were contacted to clarify uncertainties and/or provide missing information. In addition, requests for unpublished reports or data were sent out.

### 2.3. Selection and data extraction processes

Duplicate records were first identified and removed using Endnote version X7.7.1 (Thomson Reuters) and Mendeley Desktop version 1.17.6 (Mendeley Ltd.). The report selection task was then carried out by two independent reviewers with prior experience of meta-analyses in communication studies and health psychology. Before conducting the task, they received training familiarizing them with the conceptualization and operationalization of the various constructs and predefined eligibility criteria. They each scanned the titles or abstracts to screen out irrelevant records, although those of ambiguous relevance were retained. Then both met with an independent arbiter to discuss the discrepancies until consensus was reached, and a list of full-text reports was compiled for possible data extraction.

After report selection, the same two reviewers performed the data extraction task, perusing each full-text report and recording all codes on an Excel data extraction form. They individually coded the effect sizes and moderators with the guidance of a coding scheme containing basic code definitions, expanded descriptions, and illustrative examples.

The triangulation technique was adopted to enhance inter-reviewer reliability. Each reviewer initially coded 10% of the reports, and they both then met with the same arbiter to resolve any coding discrepancies. The data extraction form was also modified based on the reviewers' feedback. Upon completion of this calibration exercise, each reviewer assigned independent ratings to the remaining reports. Cohen (1968) kappa was computed to evaluate the level of inter-reviewer agreement for the final coding ( $\kappa = 0.77$ ).

For non-English reports, each reviewer first scanned their titles and abstracts using a web-based machine translation service Google Translate. Then a native speaker translated an eligible report written in a foreign language for subsequent coding by both reviewers.

### 2.4. Coding of effect sizes and moderators

#### 2.4.1. Effect size metric

Both reviewers recorded the Pearson product-moment correlation coefficient ( $r$ ) between IGD symptoms and a criterion measure. If those coefficients were unavailable, other statistics (e.g., mean,  $SD$ , and  $n$ ;  $t$  value and  $n$ ) were converted into  $r$ s using Lüdtke (2017) esc package in the R computing environment (R Development Core Team, 2018).

#### 2.4.2. A priori moderators

Three national indices were included as a priori moderators: cultural masculinity, power distance, and national life satisfaction. To code the first two, we adopted Hofstede (2018) data matrix, which contains both dimensional scores for all of the countries included in our meta-analysis. Several multinational surveys have demonstrated the validity of Hofstede's cultural dimensions by showing their convergence with conceptually similar cultural dimensions and divergence from

conceptually irrelevant ones (e.g., Hoppe, 1998; Newbury & Yakova, 2006).

To code the third index, we extracted the national means of life satisfaction score for each included country from the WVS databases (Years 2005, 2010, and 2015). Although other indices of national life satisfaction were available (e.g., New Economics Foundation, UNESCO), we chose the WVS because it collects data from large-scale representative national surveys with broad global coverage and features the longest available time series of multiple country estimates. Diener, Inglehart, and Tay (2013) noted the exceptionally high response rate (98%) of the WVS index, demonstrating their respondents' good understanding of and readiness to answer the survey questions. Moreover, the validity of the WVS national life satisfaction index has also been demonstrated by its efficacy in explaining and predicting an array of social behaviors and problems (e.g., Hayo, 2007; Helliwell, 2007).

As national indices vary from year to year, it was deemed more accurate to extract them from the year in which a study was conducted rather than that in which its report was completed. We thus recorded both the year of study and year of publication, although some reports failed to cite the former. To obtain these missing data, we estimated the time lag between the year of study and year of publication using data from all other reports containing both pieces of information. The average time lag was three years, and we thus calculated the year of study for all reports with missing data by deducting 3 from the year of publication. If the national indices of a particular year were unavailable from a database, we extracted the same data from the nearest available year.

#### 2.4.3. Other moderators

IGD symptoms were assessed by various measures developed based on diverse theoretical grounds (e.g., Király, Nagygyörgy, Koronczai, Griffiths, & Demetrovics, 2015), and thus effect size estimates may vary by measure characteristics. Some IGD measures contained dichotomous items that included “yes/no” response options (e.g., Sigerson, Li, Cheung, Luk, & Cheng, 2017; Subramaniam et al., 2016), whereas others contained polytomous items such as ordinal or Likert scales with multiple anchor points (e.g., Demetrovics et al., 2012; Lemmens, Valkenburg, & Peter, 2009). In order to explore the potential moderation effects of response format, this measure characteristic was coded as a dummy variable (0 = dichotomous, 1 = polytomous).

As we placed no limits on participant demographics in the literature search, the possible moderation effects of demographic characteristics were also examined. Hence, the gender composition (% of men) and average age of each independent sample were coded.

### 2.5. A priori statistical analytic plan

Three-level mixed-effects meta-analysis was performed using Cheung's (2015) metaSEM package and Viechtbauer's (2010) metafor package in the R computing environment. We did not conduct the conventional two-level meta-analysis because it assumes and requires the statistical independence of effect sizes. Most of the reports in our dataset contained more than one relevant effect size, and the data in some reports were derived from the same sample (i.e., published work or conference papers converted from unpublished dissertations). Although dependent effect size problems can be circumvented by the averaging of effect sizes, three-level meta-analysis is superior in yielding unbiased estimates of parameters, standard errors, and heterogeneity variances (Konstantopoulos, 2011; Moeyaert et al., 2016).

In our main-effect analyses, the maximum likelihood estimation method was adopted to compute the parameter estimates as well as their standard errors and 95% confidence intervals [CI]. The magnitude of the overall effect size estimates was interpreted in accordance with Cohen (1992) guidelines, with 0.10, 0.30, and 0.50 indicating a small, medium, and large effect size, respectively.

To check for the presence of heterogeneity, the Cochran's  $Q$  statistic

method was used to test the null hypothesis regarding the same effect size across all included reports (i.e., homogeneity; [Hedges & Olkin, 1985](#)). In addition, both absolute [ $\tau^2_{(2)}$  and  $\tau^2_{(3)}$ ] and relative [ $I^2_{(2)}$  and  $I^2_{(3)}$ ] measures of heterogeneity were examined at level 2 (within-study) and level 3 (between-study; see e.g., [Cheung, 2014, 2015](#); [Higgins & Thompson, 2002](#)). Heterogeneity was indicated by statistically significant results from both the  $Q$  test and a moderate to high  $I^2_{(2)}$  or  $I^2_{(3)}$ . Moderator analyses were then conducted to explain the variability across reports.

In the moderator analyses, we performed three-level mixed-effects meta-analysis, with  $R^2$  examined at levels 2 and 3 [ $R^2_{(2)}$  and  $R^2_{(3)}$ ]. All cases with missing values in any moderators were removed before these analyses were conducted. Statistically significant moderation effects were probed using simple slope analysis, which revealed effect size estimates conditioned on the mean and 1  $SD$  above and below the mean of the given moderator.

## 2.6. Detection of possible bias risks

### 2.6.1. Within-study bias

As the meta-analysis summarized a vast body of empirical evidence by obtaining an overall effect size estimate, the reports included in the current meta-analysis inevitably varied vastly in their methodological strength and susceptibility to diverse sources of bias. Reports with poor research quality (e.g., small samples yielding inadequate statistical power, measures with questionable validity) may distort the overall summary estimate. We attempted to detect the potential risk of bias by evaluating the study quality of each report and investigating the potential influence of specific study quality in moderator analyses.

Following the practice of previous meta-analyses (e.g., [Cheng, Cheung, & Lo, 2016](#); [Jüni, Altman, & Egger, 2001](#)), the two aforementioned reviewers coded a list of eight key categories of study quality assessment. For sampling method, the same two reviewers assigned a score of 1 to a report whose participants were drawn from a probabilistic sampling method, such as random sampling and stratified multi-stage sampling (see [Som, 1995](#)). For statistical power, a score of 1 was given if a sample size was sufficiently large to yield adequate statistical power, either indicated by power analysis stated in the report or computed post hoc by the reviewers using G\*Power software version 3.1.9.2 ([Faul, Erdfelder, Buchner, & Lang, 2009](#)). For sample heterogeneity, the reviewers gave a score of 1 to a report containing participants with diverse demographic characteristics (e.g., adolescents and adults, MMORPG players and employees). For sample descriptions, a score of 1 was assigned for clear descriptions of sample characteristics such as gender composition and average age/age range (see [Bangert-Drowns, Wells-Parker, & Chevillard, 1997](#)). For scale reliability, the reviewers gave 1 score to reports that adopted measures with acceptable reliability (i.e., Cronbach's  $\alpha \geq .70$ ; see e.g., [Nunnally & Bernstein, 1994](#); [Streiner, 2003](#)). For scale validity, 1 score was assigned to reports whose measures had been validated in the same country where the sample was recruited or in another country with highly similar cultural values ([Berry, Poortinga, & Pandey, 1997](#)). For study methodology, a score of 1 was given to reports that included measures other than self-reports to reduce common method bias (see [Podsakoff, Mackenzie, Lee, & Podsakoff, 2003](#)). For study design, 1 score was given if the reports used more than one time point to measure temporal changes and reduce common method bias (see [Podsakoff et al., 2003](#)).

If a report failed to meet or report any of the foregoing categories, it was assigned a score of 0, indicating poor methodological or reporting quality. All these categories were represented by dummy variables, except for scale reliability and scale validity that were calculated as continuous variables on a pro rata basis. For example, if a report contained five relevant measures but only three demonstrated acceptable internal consistency, a scale reliability score of 0.60 (3 divided by 5) was recorded.

### 2.6.2. Between-study bias

In addition to methodological and reporting biases, two major types of publication bias can also threaten the robustness of meta-analytic findings ([Rothstein, Sutton, & Borenstein, 2005](#)). First, studies reporting statistically significant positive findings are more likely to be published. Second, studies with larger sample sizes are likely to be judged as more methodologically rigorous, thus enhancing their chances of publication. Studies with a small sample size and those reporting negligible or contrary effects are thus likely to lay dormant in investigators' file drawers, a phenomenon commonly known as the file-drawer problem.

As previously noted, we attempted to locate unpublished and gray literature using multiple methods. In addition, moderator analysis was performed to examine whether the magnitude of each effect size estimate varied by publication status (i.e., published vs. unpublished). The file-drawer problem would be evident if published work yielded a stronger overall effect size estimate than unpublished work.

Further, several common statistical techniques were performed to detect the presence of publication bias and quantify its possible impact. First, fail-safe  $N$  was computed as a rough estimate of the robustness of a statistically significant effect size. This approach indicated the number of studies yielding zero effect sizes that were required to nullify a significant meta-analytic finding ([Rosenberg & Goodnight, 2005](#)). According to Rosenthal's rule of thumb, a fail-safe  $N$  exceeding the standard criterion for the number of hidden studies (i.e.,  $5k + 10$ ) suggested that the observed pooled estimate was largely robust to the file-drawer problem.

Second, a funnel plot was created to detect the presence of study precision-related publication bias. This visual tool presents the association between the observed effect sizes of individual reports (horizontal axis) and their standard errors (vertical axis; [Sterne, Egger, & Smith, 2001](#)). The presence of small-study bias was indicated by an asymmetrical funnel plot, with smaller-scale studies yielding negative findings typically missing in the plot's lower-left panel. In addition to this visual inspection, Egger's linear regression method was adopted as a formal statistical test of funnel-plot asymmetry, with a statistically significant result indicating an asymmetrical distribution ( $p < .05$ ).

Third, a non-parametric "trim-and-fill" procedure was executed to further evaluate the extent of symmetry in the funnel plot distribution (e.g., [Duval, 2005](#)). This procedure utilized a dual approach to detect and correct for possible publication bias. More specifically, the initial "trim" stage estimated the number of studies that should be omitted to create symmetry and recalculated the mean effect size after omission. The ensuing "fill" stage then returned the omitted set of studies and added an identical number of studies with mirror-opposite effect sizes. An estimated "true" mean and its variance were recomputed after including both sets of studies.

In addition to methods for detecting publication bias, we also conducted outlier and influential case diagnostics illustrated by [Viechtbauer and Cheung \(2010\)](#). When any outliers or influential cases were present, we reran the analyses after discarding those cases in order to assess the robustness of findings. Moreover, we computed the statistical power of random-effects tests to check whether there was adequate power for detecting a hypothesized effect based on the included reports ([Hedges & Pigott, 2004](#)).

It is important to note that all these procedures for identifying publication bias and outliers/influential cases assume independence among effect sizes. To the best of our knowledge, there are no such procedures that take the issue of dependency into account. Hence, this set of findings should be interpreted with caution.

## 3. Results

### 3.1. Characteristics of meta-analytic dataset

[Fig. 1](#) depicts an adapted PRISMA flow diagram that summarizes the report selection process. The figure shows that the meta-database

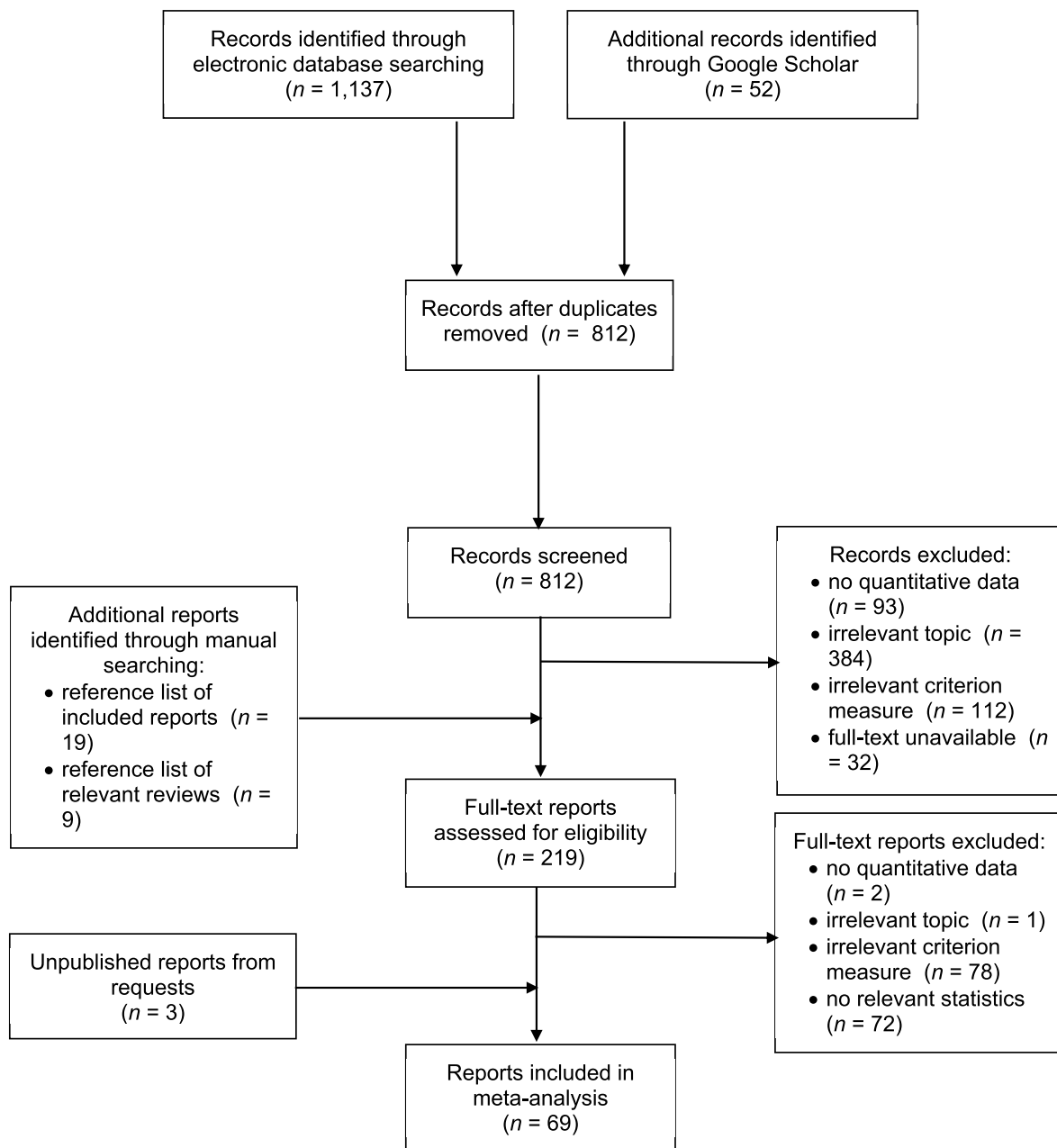


Fig. 1. PRISMA flow diagram describing the procedures of report selection for inclusion in the meta-analysis. Adapted from Moher et al. (2015).

searches initially generated 1137 hits, and Google Scholar search further identified 52 non-overlapping new reports. After filtering out duplicates using reference management software, 812 unique records remained. Scanning the titles or abstracts of all records and reports resulted in the omission of 621 ineligible ones. Manual searches then identified 28 additional reports. Full-text reports were perused at this stage, with a further 153 eliminated as illegible. Five researchers responded to our request for unpublished data, but only three datasets were relevant. As a result, a total of 69 reports met our inclusion criteria (see Appendix A for details).

All of the reports included in our analysis were completed in 2002 or after. Only 15% were conducted prior to 2010, and then more relevant work emerged as a greater number of IGD measures was available. There was a further surge of research interest after the diagnostic criteria of IGD had been proposed in the DSM-5 (American Psychiatric Association, 2013), with 61% of the relevant reports found between 2014 and June 2017. However, none of the effect size estimates varied

by publication year ( $p_s > .38$ ).

The majority constituted published work (75%). Some reports included more than one sample. Also, the samples of one published paper (Hussain & Griffiths, 2009) and one conference paper (Seay & Kraut, 2007, April) were the same as those described in two unpublished dissertations (Hussain, 2010; Seay, 2006). Samples derived from the same source were counted as one independent sample. Hence, the present meta-analysis was performed on 84 independent samples.

The total number of participants subjected to meta-analysis was 58,834 (Mean: 764,  $SD = 963.6$ , range: 24–5218), and their mean age was 21.59 ( $SD = 6.69$ , range: 11.9–39.4). On average, the gender composition of the samples was 65% men. The participants played online games for an average of 23.40 h per week ( $SD = 8.62$ , range: 10.3–41.3).

The samples were drawn from 20 countries spanning seven geographical regions: North America (the United States), Oceania (Australia), Western/Northern Europe (France, Germany, the

**Table 2**  
Summary of meta-analysis testing of theory-driven predictions.

	Psychological Problems	Interpersonal Problems	Psychological Well-being	Social Well-being
Hypothesis	Findings – Main Effects (pooled correlation)			
Comorbidity	++ ( $r = .29$ )		- ( $r = -.15$ )	
Interpersonal impairment	++ ( $r = .29$ )	++ ( $r = .25$ )		ns ( $r = -.07$ )
Dilution effect	++ ( $r = .29$ )	++ ( $r = .25$ )	- ( $r = -.15$ )	ns ( $r = -.07$ )
Country	Findings – Country Moderation (simple slope analysis)			
Higher national life satisfaction	+ ( $r = .21$ )		ns ( $r = -.04$ )	
Lower national life satisfaction	+++ ( $r = .37$ )		- ( $r = -.27$ )	
Higher cultural masculinity	+++ ( $r = .36$ )	+ ( $r = .16$ )†	- ( $r = -.26$ )	
Lower cultural masculinity	+ ( $r = .22$ )	++ ( $r = .28$ )†	ns ( $r = -.03$ )	
Higher power distance		+ ( $r = .13$ )		
Lower power distance		+++ ( $r = .40$ )		

Note. †This moderation effect is marginally significant. ns = non-statistically significant. A larger number of + symbols indicates a stronger positive association with symptoms of Internet gaming disorder, and a larger number of - symbols indicates a stronger inverse association with symptoms of Internet gaming disorder. Italics indicate findings inconsistent with predictions.

Netherlands, the United Kingdom), Eastern/Southern Europe (Czech Republic, Hungary, Italy, Serbia), the Middle East (Iran, Israel), East Asia (China, Hong Kong, Macau, South Korea, Taiwan), and Other Asia (Malaysia, Singapore, Vietnam). Such diversity reflects the global nature of concerns over IGD (e.g., Desai, Krishnan-Sarin, Cavallo, & Potenza, 2010; Rehbein, Kliem, Baier, Mößle, & Petry, 2015).

Many of the reports included multiple criterion measures, and thus there was a total of 376 effect size estimates ( $k$ ) nested within the 84 independent samples, justifying the performance of three-level mixed-effects meta-analysis. More than half of the estimates ( $k = 195$ ) included psychological problems as a criterion. The total number of such estimates including interpersonal problems, psychological well-being, and interpersonal well-being as the criterion was 37, 66, and 78, respectively.

### 3.2. Main-effect analyses

Tables 2 and 3 summarize the results of the main-effect analyses. Overall, the correlation between IGD symptoms and psychological problems was moderately strong ( $r = 0.29$ ), and there was also a

**Table 3**  
Summary statistics for main-effect analyses and homogeneity tests for the four major criteria.

	Psychological Problems	Interpersonal Problems	Psychological Well-being	Interpersonal Well-being
Main-Effect Analyses				
Averaged $r$	.2919	.2497	-.1460	-.0722
Lower 95% CI	.2309	.1759	-.2412	-.1475
Upper 95% CI	.3529	.3235	-.0507	.0031
$k$	195	37	66	78
Heterogeneity Tests				
Cochran's $Q$	88670.1964	1527.7769	1873576.9418	3496.3953
$df$	194	36	65	77
$p$	< .0001	< .0001	< .0001	< .0001
$\tau^2_{(2)}$	.0068	.0319	.1092	.0342
$\tau^2_{(3)}$	.0431	.0039	.0131	.0168
$I^2_{(2)}$	.1353	.8678	.8924	.6523
$I^2_{(3)}$	.8580	.1053	.1072	.3200
Tests for Publication Bias*				
Fail-safe $N$	3272081	25922	163349	4022
Egger's test: $z$	-2.0471	0.5013	-1.5630	-0.4410
Egger's test: $p$	.0406	.6161	.1181	.6592

Note. All estimates were derived from three-level meta-analyses, except those marked by an asterisk (\*) that were derived from two-level meta-analyses due to the unavailability of three-level meta-analytic methods.

moderately strong correlation between IGD symptoms and interpersonal problems ( $r = 0.25$ ). The direction and magnitude of these correlations were consistent with our predictions.

The overall correlations between IGD symptoms and the two indicators of psychosocial well-being were relatively weaker than those between IGD symptoms and both types of psychosocial problems. Specifically, the overall correlation between IGD symptoms and psychological well-being was statistically significant but weak in magnitude ( $r = -0.15$ ), whereas that between IGD symptoms and interpersonal well-being ( $r = -0.07$ ) was non-statistically significant as indicated by the 95% CIs, which included 0.

The Cochran's  $Q$  test results reported in Table 3 showed statistically significant between-study heterogeneity in all of the effect size estimates ( $ps < .001$ ). According to the criteria proposed by Higgins, Thompson, Deeks, and Altman (2003), the  $I^2$  results revealed moderate to high degrees of heterogeneity at level 2 or 3 for all of the effect size estimates, indicating that further analyses were warranted to detect the moderation effects.

### 3.3. Moderator analysis

#### 3.3.1. National life satisfaction

The results showed national life satisfaction to have a statistically significant moderation effect for the pooled correlation between IGD symptoms and psychological problems ( $b = -0.1512$ ,  $SE = 0.0594$ ,  $p = .0109$ ,  $R^2_{(2)} = 0.0008$ ,  $R^2_{(3)} = 0.1426$ ). Simple slope analysis specified that this positive correlation was stronger for countries lower ( $r = 0.3670$ ,  $SE = 0.0433$ ,  $p < .0001$ ) than those higher ( $r = 0.2122$ ,  $SE = 0.0427$ ,  $p < .0001$ ) in national life satisfaction.

The moderation effect was also statistically significant for the pooled correlation between IGD symptoms and psychological well-being ( $b = 0.2313$ ,  $SE = 0.0995$ ,  $p = .0201$ ,  $R^2_{(2)} = 0.0741$ ,  $R^2_{(3)} = 0.1245$ ). This inverse correlation was moderately strong in countries scored lower in national life satisfaction ( $r = -0.2650$ ,  $SE = 0.0701$ ,  $p = .0002$ ), but non-statistically significant in those scored higher ( $r = -0.0362$ ,  $SE = 0.0653$ ,  $p = .5794$ ). Taken together, both of these cross-country differences indicated that the comorbidity hypothesis was more applicable to countries with lower levels of national life satisfaction, and the dilution effect hypothesis was more applicable to those with higher levels.

#### 3.3.2. Cultural masculinity

The moderation effect of cultural masculinity was statistically significant for the pooled correlation between IGD symptoms and psychological problems ( $b = 0.0041$ ,  $SE = 0.0017$ ,  $p = .0148$ ,  $R^2_{(2)} = 0.0015$ ,  $R^2_{(3)} = 0.1121$ ), with this positive correlation stronger in



countries higher ( $r = 0.3645$ ,  $SE = 0.0420$ ,  $p < .0001$ ) than those lower ( $r = 0.2215$ ,  $SE = 0.0413$ ,  $p < .0001$ ) in cultural masculinity.

The results further revealed a statistically significant moderation effect for the pooled correlation between IGD symptoms and psychological well-being ( $b = -0.0062$ ,  $SE = 0.0027$ ,  $p = .0208$ ,  $R^2_{(2)} = 0.0467$ ,  $R^2_{(3)} = 0.3428$ ). The statistically significant inverse correlation between these two variables was found only in countries higher in cultural masculinity ( $r = -0.2607$ ,  $SE = 0.0685$ ,  $p = .0001$ ) but not in those lower in cultural masculinity ( $r = -0.0266$ ,  $SE = 0.0683$ ,  $p = .6968$ ). In summary, both cultural findings were largely consistent with our predictions, showing that the comorbidity hypothesis was more tenable for countries with higher levels of cultural masculinity, and the dilution effect hypothesis was more tenable for those with lower levels.

Unexpectedly, however, the moderation effect for the pooled correlation between IGD symptoms and interpersonal problems was marginally significant ( $b = -0.0054$ ,  $SE = 0.0032$ ,  $p = .0890$ ,  $R^2_{(2)} = 0.0000$ ,  $R^2_{(3)} = 1.0000$ ). The results showed this positive correlation to be moderately strong in countries ranked lower in cultural masculinity ( $r = 0.2837$ ,  $SE = 0.0347$ ,  $p < .0001$ ), but only modest in those higher up in this cultural dimension ( $r = 0.1593$ ,  $SE = 0.0650$ ,  $p = .0143$ ).

### 3.3.3. Power distance

There was a statistically significant moderation effect of power distance only for the pooled correlation between IGD symptoms and interpersonal problems ( $b = -0.0073$ ,  $SE = 0.0025$ ,  $p = .0035$ ,  $R^2_{(2)} = 0.1289$ ,  $R^2_{(3)} = 0.8976$ ). This statistically significant positive correlation was strong in countries with lower scores in power distance ( $r = 0.4023$ ,  $SE = 0.0618$ ,  $p < .0001$ ), but only modest in countries with higher scores ( $r = 0.1329$ ,  $SE = 0.0507$ ,  $p = .0087$ ). These cultural variations supported our predictions concerning the greater applicability of the interpersonal impairment hypothesis to countries lower (vs. higher) in power distance.

### 3.3.4. Other moderators

Overall, the moderation effects for both measure and demographic characteristics were all non-statistically significant ( $ps$  ranged from 0.12 to 0.87), with the exception of a moderation effect. Specifically, the moderation effect of response format was statistically significant only for the pooled correlation between IGD symptoms and interpersonal problems ( $b = 0.2379$ ,  $SE = 0.1202$ ,  $p = .0478$ ,  $R^2_{(2)} = 0.0485$ ,  $R^2_{(3)} = 0.2373$ ). This positive correlation was statistically significant for IGD measures containing polytomous items ( $r = 0.2929$ ,  $SE = 0.0555$ ,  $p < .0001$ ), but not for those with dichotomous items ( $r = 0.0549$ ,  $SE = 0.1052$ ,  $p = .6015$ ).

## 3.4. Detection of possible bias risks

### 3.4.1. Within-study bias

Moderator analysis performed to assess potential within-study bias revealed that study quality did not exert a statistically significant impact on any of the four effect size estimates ( $ps$  ranged from 0.19 to 0.86).

### 3.4.2. Between-study bias

The same analysis carried out to detect potential between-study bias showed no variations in any of the effect size estimates between published and unpublished work ( $ps > .37$ ).

As shown in Table 3, the results of the fail-safe  $N$  method indicated that it would take a multitude of null-result studies (i.e.,  $> 4,022$ ) to bring the various statistically significant effect size estimates to a nonsignificant level ( $p > .05$ ). As shown in the Egger's regression tests, the funnel plots exhibited no statistically significant asymmetry in the distribution of the included reports, with the exception of the one with psychological problems as the criterion that displayed slight asymmetry

( $p = .04$ ).

Similar findings were obtained from the trim-and-fill procedures, which revealed a general lack of substantial changes in the magnitude of all of the observed effect size estimates after adjustment, with the exception of the psychological problems criterion. For the pooled correlation between IGD symptoms and psychological problems, the adjusted effect size estimate grew larger (adjusted  $r = 0.36$ , 95% CI: 0.33–0.40) after imputing the set of missing studies. Despite this change in effect size magnitude, it is noteworthy that there was no indication of small-study publication bias (i.e., missing small-scale studies with negative or nonsignificant findings). On the contrary, the results showed studies with positive findings to be missing. These missing studies explained why the observed effect size was under-rather than over-estimated, and only the latter is a widespread concern in meta-analytic research.

Regarding the potential influences of statistical outliers and influential cases, the results were almost identical to the original findings derived from the full dataset, indicating that the present findings were robust to such influences. The estimated post-hoc statistical power were all very high ( $\sim 1$ ), except for the effect size estimates of IGD symptoms with interpersonal well-being that had a power of .64. Overall, these results demonstrated sufficient statistical power.

## 4. Discussion

The meta-analysis presented herein examined the associations of IGD symptoms with psychosocial problems and psychosocial well-being in 20 countries across seven geographic regions. In line with our predictions, the findings revealed moderately strong positive associations between IGD symptoms and psychological problems across the countries, indicating the universality of this association.

Also as expected, the findings identified a strong positive association between IGD symptoms and interpersonal problems in countries lower in power distance but only a modest such association in countries higher in this cultural dimension. Unexpectedly, however, there is a trend showing this positive association to be moderately strong in countries lower in cultural masculinity but only modest in those higher in cultural masculinity. A plausible explanation is that the former group of countries tend to espouse communal rather than agentic values (Hofstede, 1998). Hence, the interpersonal problems brought about by IGD may be regarded as more socially undesirable because of the high value placed on relationship enhancement in these countries (Gudykunst & Lee, 2003). As their residents are expected to nurture relationships by demonstrating concern for and rendering support to others (Hofstede, 1998), the social negligence and withdrawal tendencies exhibited by individuals with IGD may be interpreted as a lack of care, and thus be more likely to elicit conflict. These unexpected findings suggest that focusing solely on agentic goals may produce an inadequate understanding of the psychosocial problems related to IGD. The communal goals emphasized in countries lower in cultural masculinity should also be investigated, especially when examining interpersonal issues related to IGD.

Although there is a modest inverse association between IGD symptoms and psychological well-being, that overall association tends to vary by two sociocultural characteristics: national life satisfaction and cultural masculinity, respectively. Specifically, moderately strong such associations were found only in countries either lower in national life satisfaction or higher in cultural masculinity, whereas nonsignificant associations were found otherwise. These cultural findings parallel the ongoing scholarly debate regarding the devastating versus diluting effects of IGD symptoms on psychological well-being, indicating the need for more nuanced analysis of the associations between these two variables, as discussed in detail below.

## 4.1. Implications

### 4.1.1. Theoretical implications

The present findings have implications for a theoretical understanding of the nature of IGD. Our cross-country comparison revealing national life satisfaction to be a moderator in IGD symptoms provides support for escape from self theory at the country level. More specifically, these new findings revealed that the magnitude of the positive association between IGD symptoms and psychological problems varies by the level of national life satisfaction, with the association relatively stronger in countries with a lower (vs. higher) level. More importantly, there are prominent cross-country variations in the magnitude of the inverse association between IGD symptoms and psychological well-being, locating a moderately strong such association only in countries lower in national life satisfaction. As IGD is now an issue of global concern (e.g., King, Delfabbro, Zwaans, & Kaptsis, 2013; Rehbein et al., 2015), these cross-country differences demonstrate the need to take national indices into account, allowing for more extensive evaluations of the validity of IGD theories using country-level analyses.

More importantly, these cultural-moderation findings contribute to resolving the diverse predictions put forward by the comorbidity and dilution effect hypotheses. Although both may be empirically valid, the extent of their applicability likely varies across countries. Specifically, our findings imply that the comorbidity hypothesis is more tenable for countries either lower in national life satisfaction or higher in cultural masculinity. In contrast, the dilution effect hypothesis is more tenable in countries either higher in national life satisfaction or lower in cultural masculinity. For these countries, it is noteworthy that IGD symptoms had weak or nonsignificant inverse associations with psychological and interpersonal well-being, providing empirical support for the hypothesized dilution rather than bolstering tendencies.

Although past studies have indicated that some individuals indulge in online gaming as an attempt to regain self-esteem by making progress in games or beating their opponents (e.g., Yee, 2006), the weak or null findings yielded in our study suggest that such attempts are not always successful. For instance, previous research has shown that, upon the gratification of achievement needs through gaming, only highly engaged online gamers (without IGD) tend to experience intrinsically pleasant feelings that raise their self-esteem, with their counterparts having IGD experiencing no such feelings (Lin, Hung, Fang, & Tu, 2015). Similar findings have revealed that highly engaged online gamers play games to satisfy their achievement needs, whereas those with IGD do so to mitigate their strong dissatisfaction with real life (Wan & Chiou, 2006). Such prior findings thus indicate the importance of distinguishing individuals with IGD from those with a high degree of gaming engagement (Charlton & Danforth, 2007), with the former less likely to gain psychological benefits from gaming achievements than the latter.

Previous research also indicates that online gamers seek to gratify their needs for relatedness in multiple ways, such as by making friends with other online players, rendering support to others, disclosing personal details in online chats, and collaborating with other players to fulfill a group mission (Yee, 2006). These social motivations are particularly strong among individuals with IGD, who receive scant social support from their real-life social networks (e.g., Chan & Cheng, 2016; Hsu, Wen, & Wu, 2009). The Internet provides a platform for online gamers to “meet” and interact to pursue collective game missions (Lin et al., 2015). However, the type of social support garnered from other gamers is mainly confined to information support and other types of instrumental aid, both of which are categorized as bridging social capital (e.g., Huvila, Holmberg, Ek, & Widén-Wulff, 2010; Steinkuehler & Williams, 2006).

According to social capital theories (e.g., Coleman, 1990; Putnam, 2001), bridging social capital is typically derived from casual ties characterized by loose interpersonal links and scant emotional support, and studies have identified weak to nonsignificant associations between

this type of social capital and psychological well-being (e.g., Ahmad, Mustafa, & Ullah, 2016; Yoon, 2014). In contrast, bonding social capital is typically derived from intimate social ties between closely connected individuals. Characterized by genuine emotional support, this type of social capital is found to have moderately strong associations with psychological well-being (e.g., Ko & Kuo, 2009; Lima, Marques, Muñoz, & Camilo, 2017). Such diversity in the socialization benefits of social support and social capital may explain in part the nonsignificant associations between IGD symptoms and interpersonal well-being identified in our meta-analysis. Hence, IGD may be unrelated to the accrual of bridging social capital per se rather than other types of social capital or social support.

### 4.1.2. Practical implications

In addition to their theoretical implications, our results also have practical implications. Previous reviews have identified various types of intervention for treating IGD (e.g., King et al., 2017; Winkler, Dörsing, Rief, Shen, & Glombiewski, 2013), such as family therapy and motivational interviewing (e.g., Chele, Macarie, & Stefanescu, 2013; Young, 2009). As the focus and goal of different interventions vary considerably, our country-moderated meta-analytic findings provide guidelines for therapists, suggesting that they take cultural characteristics into consideration and select the intervention most suitable for clients from a particular cultural background. Of the various IGD interventions on offer, cognitive behavioral therapy is currently the most popular (e.g., Santos et al., 2016; Wölfling, Beutel, Dreier, & Müller, 2014), and pharmacological therapy has frequently been used to treat comorbid psychiatric symptoms (e.g., Dell'osso et al., 2008; Han et al., 2010).

These reviews have further shown that the various intervention programs are generally effective. However, closer examination of the work reviewed unveils that current interventions tend to be more useful in mitigating some problems than others. For instance, a cognitive behavioral therapy for treating problematic Internet use (including IGD) is found to be more efficacious in reducing problems of attention deficiency and time management than in enhancing peer relations and prosocial behavior among Chinese students (Du, Jiang, & Vance, 2010). Such mixed findings indicate that no intervention is sufficiently well-rounded to tackle the myriad problems encountered by individuals with IGD. Given the wide range of problems faced by these individuals (e.g., Caplan, 2005; Griffiths, 2010), practitioners need to pinpoint the problems that are most catastrophic for their clients, and then tailor the intervention to tackle those problems specifically.

The present meta-analytic findings document a strong positive association between IGD symptoms and interpersonal problems in cultures lower in power distance. Hence, practitioners should pay greater attention to the possible heightened interpersonal problems encountered by clients from these cultural regions. If interpersonal issues constitute the core of such clients' problems, practitioners may recommend these clients to attend social competence training, family therapy, or both. The former training targets the acquisition of effective interpersonal and communication skills (e.g., empathy development, social problem-solving) that foster appropriate social interactions (e.g., Bai & Fan, 2007), whereas the latter seeks to educate and mobilize the entire family to render help and support to clients (e.g., Young, 2009). Improvement in personal social competence and family dynamics may be particularly beneficial in mitigating the heightened levels of IGD symptoms and interpersonal problems experienced by clients from countries that value power egalitarianism.

Our findings also reveal that the hypothesized dilution effect tends to be more prominent in countries either higher in national life satisfaction or lower in cultural masculinity. When working with clients from these cultural regions, practitioners should thus be sensitive to the clients' perception of the possible psychological gains derived from online gaming. Although such a perception may dilute the devastating influence of real-life problems, a major downside is that it can sustain

or even aggravate problematic gaming behavior (Larose & Eastin, 2004). If gain-related perceptions are detected in clients, practitioners may consider helping clients to explore and develop interests beyond video gaming in addition to the standard practice of skill development. For instance, Sakuma et al. (2017) combined group psychotherapy with an outdoor activity program in which clients took part in a camp. During this nine-day period of video gaming abstinence, clients not only acquired an array of cognitive and behavioral skills, but were also afforded ample opportunities to interact with peers and participate together in such outdoor leisure activities as hiking and woodworking. The researchers found that clients tended to spend less time on online gaming three months after attending the program (Sakuma et al., 2017).

#### 4.1.3. Research implications

Finally, our meta-analysis has further implications for researchers. Our literature review revealed an abundance of studies investigating the associations between IGD symptoms and an array of psychological problems, with their collective findings lending robust support to the conceptualization of IGD as a pathology that co-exists with many psychological problems. This body of studies far outnumbered the combination of studies adopting the other three criteria of interest (i.e., interpersonal problems, psychological well-being, and interpersonal well-being). Researchers are thus encouraged to expand these relatively small bodies of literature to provide more thorough tests of the interpersonal impairment and dilution effect hypotheses.

One area particularly deserving research attention is the hypothesized dilution effect on interpersonal well-being. More in-depth investigations are needed because the two major indicators of such well-being—social support and social capital—are complex, multidimensional constructs. According to social support theories (e.g., S. Cohen, 2004; Lahey & Cohen, 2000), social support encompasses three major types. The first type is network support or social embeddedness, which refers to the structural characteristics of the social network in which a support recipient is embedded. The second type is received or enacted support, which includes support actually garnered from others. The third type is perceived support, or subjective appraisals of the support rendered by others. Prior studies have demonstrated that these three types are related to distinct psychological outcomes (e.g., Barrera, 2000; Cheng, 1998). Apart from its beneficial outcomes, social support can also bring undesirable ones, particularly when it poses an ego threat to recipients or involves a perplexing hidden agenda (e.g., Cheng, Chen, & Luokogan, 2008; Lowery & Stokes, 2005). With regard to social capital, previous findings have indicated that bridging and bonding social capital are differentially associated with psychological well-being, with stronger associations for the latter (e.g., Lima et al., 2017). Hence, more studies are needed for conducting refined analyses on the intricate associations between IGD symptoms and multiple types of social support and/or social capital.

#### 4.2. Study caveats and directions for further research

Before concluding, some caveats are discussed as guides for further research. First, the present meta-analysis focused on IGD, and thus its findings are not necessarily generalizable to problematic video gaming. Video game is an umbrella term encompassing all types of entertainment software presented through gaming consoles or devices, with online gaming representing only one genre that involves real-time gameplay and interactions with other players over the Internet (e.g., Egenfeldt-Nielsen, Smith, & Tosca, 2015). As information and communication technology continues to advance rapidly, new genres of video game will constantly emerge and sweep the market. One such example is the recent popularization of location-based mobile social games, such as Pokémon GO. This new game genre weaves the technology of augmented reality with global positioning system, requiring gamers to play and navigate both their virtual social networks and their

physical neighborhoods (e.g., Avouris & Yiannoutsou, 2012). There is empirical evidence showing some socialization benefits brought about by the game genre, such as the accrual of both bridging and bonding social capital (Sung, Sigerson, & Cheng, 2017), and the enhancement of psychological well-being and a sense of belonging to the neighborhood (Zach & Tussyadiah, 2017). Although our meta-analysis revealed no associations between IGD symptoms and interpersonal well-being, its results are not necessarily applicable to the excessive playing of other game genres, particularly those characterized by dissimilar interactional patterns and contexts. The research scope should be expanded in future work to a variety of game genres to allow comparison of their possible differing effects.

Second, although the present multinational comparison included 20 countries from seven geographic regions, the African continent was missing. Hence, the prevalence of IGD and its hypothesized associations with psychosocial problems and well-being in this major world region remain unknown. Africa is the second largest and second most populous continent in the world, and yet it has the lowest Internet penetration rate, reaching 28% of the population compared to the global average of 50% (Miniwatts Marketing Group, 2018). Such a low penetration rate implies poor-quality Internet access (e.g., Calderaro, 2010; Ngini, Furnell, & Ghita, 2002), which may elicit dissatisfaction with the Internet that, in turn, disrupts continued Internet usage (Zamani-Miandashti, Memarbashi, & Khalighzadeh, 2013). Hence, even if individuals from some African countries would like to gratify their need for relatedness by engaging in online gaming, their attempts may be thwarted by the unaffordability or inaccessibility of the Internet. Hence, such a pattern of findings may differ considerably from those of findings derived from countries with higher Internet penetration rates. Future studies should be conducted in African samples to permit a more comprehensive evaluation of IGD theories, particularly escape from self theory that highlights the prominent role of quality of real life and life satisfaction.

In summary, although our results showed IGD symptoms to be unrelated to interpersonal well-being, further research in this area is needed to facilitate more nuanced analyses testing the diverse aspects of interpersonal well-being, and expand the research scope to other game genres, particularly those involving both virtual and real-life interactions among gamers.

#### 5. Concluding remarks and future research prospects

In conclusion, the meta-analysis reported herein integrated the IGD literature by testing various theory-grounded hypotheses, namely the comorbidity, interpersonal impairment, and dilution effect hypotheses. Each of these hypotheses garnered some empirical support, but we found the extent of their applicability to vary across countries. As information and communication technology is constantly evolving, regular updates of the literature are essential to keep pace with rapid technological advances. For instance, with the new developments in virtual reality (VR) technology introduced in 2016, new systems (e.g., PlayStation VR, HTC Vive) are offering gamers more immersive experiences and interactions with VR environments. Given that these environments appear highly realistic, it is important to explore whether VR technology will promote a stronger tendency among players to evade real-life problems by escaping into VR game worlds, thereby aggravating the adverse impact of IGD postulated by escape from self theory.

As previously discussed, the augmented reality game Pokémon GO took the world by storm in the summer of 2016. Although the game has been criticized as highly addictive (e.g., Sack, 2016), it has been observed to confer some socialization benefits upon individuals experiencing interpersonal difficulties because it motivates users to explore their neighborhoods and play with other users (Sung et al., 2017). Although our findings reveal that IGD symptoms and interpersonal well-being are unrelated, it is possible that the new generation of augmented



reality games will reinforce the interpersonal well-being of players with IGD. Will these games produce bolstering rather than dilution effects, leading to the creation of new IGD theories?

Finally, video gaming has long been regarded as a leisure activity. It has recently evolved into a national sport (i.e., eSports) in a number of countries such as China and South Korea (Sigerson, Li, Cheung, Luk, et al., 2017), with eSports slated to become an official medal event in the 2022 Asian Games (Hallmann & Giel, 2018). If video gaming becomes a popular professional sports, will IGD be perceived as less socially undesirable, particularly in countries that place a high value on achievement and success? To answer these questions, the validity of the proposed hypotheses needs to be reexamined after more work has been conducted on novel video game genres and eSports.

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## Conflicts of interest

All authors declare that they have no conflicts of interest.

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## Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.chb.2018.06.033>.

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