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Abstract

As technology advances, new opportunities for partners to gain power and control in their romantic relationships are readily available. New cyber-based behaviors have slowly garnered scholarly attention, but measurement-related issues have not. We take the logical next steps to (1) develop and validate a comprehensive measure of intimate partner cyber abuse (IPCA) for adults using classical test theory and item response theory and (2) estimate IPCA prevalence rate for a range of relationship types. A sample of 1,500 adults, currently in an intimate partner relationship, 18 years or older, and living in the United States, completed an online questionnaire about their IPCA experi- ences within the 6 months prior. Two parameter logistic modeling and confirmatory factor analyses revealed a five-dimensional structure: *cyber direct aggression*, *cyber sexual coercion*, *cyber financial control*, *cyber control*, and *cyber monitoring*, with 14.85% of the sample experiencing at least one dimension. These IPCA dimensions were examined for differential functioning across gender identity, race, student status, and relationship type. Collectively, the findings have implications for IPCA measurement and related research, including theoretically derived hypotheses whose findings can inform prevention.

A persistent hurdle that undermines researchers' efforts to understand the incidence, prevalence, frequency, and risk factors of perpetration and victimization of intimate partner violence (IPV) has been the development of valid and reliable measures. Since the late 1970s, survey items intended to measure IPV have been characterized by an iterative, ongoing process. Over time, the conceptualization, definition, and measurement of IPV have expanded to include physical, verbal, psychological, and sexual abuse and stalking. This expansion has created more comprehensive measures, which is central to IPV's content validity. However, the advent of new communication technologies[1] has created opportunities for intimate partners to engage in abusive cyber behaviors that may be a form of IPV not captured by existing measures.

Researchers have developed several scales to measure cyber abuse within intimate partner relationships but have not yet reached a consensus on how to define and measure this type of abuse (e.g., Borrajo et al., 2015; Caridade et al., 2019; Morelli et al., 2018). Without a conceptual consensus, it is impossible to develop a valid and reliable standard measure, impeding the ability to collect comparable estimates of the prevalence and incidence of victimization and perpetration. A similar measurement issue has plagued IPV research resulting in decades of studies devoted to refining measures to address critiques and, in turn, has "created a number of drags on scientific innovation" (Hamby, 2014, p. 150). Although these debates regarding IPV measurement remain ongoing (e.g., Hamby, 2014, 2017), they do provide an opportunity for both innovation and expansion into new types of abuse behaviors and domains.

The development of a standard definition and a valid and reliable measure of intimate partner cyber abuse (IPCA) are new frontiers for IPV researchers. Building from prior research, we take the logical next steps to achieve these goals. To this end, we designed a 33-item measure of IPCA and administered it via a self-report survey to a nationwide sample of 1,500 adults currently involved in an intimate partnership. In this article, we describe the methodological steps taken to refine these items and the testing used to establish validity, reliability, and measurement invariance across key covariates. Finally, we provide initial prevalence estimates of IPCA victimization. As a prelude to the current study, we describe how lessons learned from the development of IPV measures guided and informed our steps.

Measuring IPV

Researchers began studying IPV in the late 1970s with two distinct approaches. One approach involved interviewing women in domestic violence shelters who experienced IPV, asking them questions about the behaviors exhibited by their partner, along with relationship characteristics (e.g., Dobash & Dobash, 1979). The second approach entailed administering surveys to general populations (i.e., inclusive of victims and nonvictims), in which respondents were asked to self- report the abusive behaviors they or their partners engaged in (Waltermaurer, 2005). The first of these survey instruments designed for the general public was the Conflict Tactics Scale (CTS), first published by Straus in 1979. Since then, at least 33 different instruments have been designed and used to collect data on IPV victimization and perpetration (Waltermaurer, 2005).

The proliferation of IPV instruments demonstrates the decades of work done to define and estimate IPV prevalence and incidence. However, the multitude of instruments also reflects the lack of consensus among researchers about several important aspects of IPV. Existing instruments vary in terms of the (1) inclusion or exclusion of relationship types for which abusive behaviors were captured, (2) behaviors respondents are asked to identify, (3) various forms of abuse the behaviors represent, and (4) time frame respondents are instructed to reference when reporting (Waltermaurer, 2005). These variations render the comparison of prevalence and incidence rates across instruments challenging, if not impossible. These four issues are discussed in detail below.

First, early measures of IPV—such as the Index of Spouse Abuse (Hudson & McIntosh, 1981) and the Wife Abuse Inventory (Lewis, 1985)—captured abusive behaviors inflicted by a spouse, thereby excluding abuse that occurs in nonspousal intimate relationships. Over time, however, researchers have recognized that violence also occurs in relationships in which partners are not married, leading to the inclusion of IPV items on surveys administered to teens and young adults (for a review, see Jennings et al., 2017) and the surveying of respondents of all ages about IPV in dating relationships. As an example, the original CTS captured conflict tactics between spouses and between parents and children (Straus, 1979) but was later revised (CTS2) to ask respondents about "their relationship to a partner in a dating, cohabitating, or marital relationship" (Straus et al., 1996,

p. 292). Further, researchers who collected data on gender identity observed IPV among same-sex couples, prompting others to expand their definitions and measures to include these relationships that may have been excluded or overlooked in previous studies (for a review, see Buller et al., 2014).

Second, researchers have debated whether certain behaviorally specific items accurately capture the nuances of abuse. Findings generated from data collected with the CTS, in particular, have been controversial because they have shown gender symmetry (i.e., similar rates among men and women) in IPV victimization and perpetration (Allen, 2010). Dobash and colleagues (1979) argue that the CTS finds gender symmetry because the items do not capture variations in the severity of certain conflict tactics that are likely associated with gender, such as physical assaults. Similarly, Saunders (1988) criticizes the CTS for inflating women's perpetration rates because women's use of violence in self-defense is included in estimates. Building from these criticisms, researchers have continued to refine IPV instruments to ensure that they are not unintentionally capturing self-defense or otherwise nonabusive behaviors.

Third, IPV instruments vary in terms of what forms of abuse are measured. Early instruments primarily captured physical violence between intimate partners. Largely guided by the qualitative research findings that IPV victims experienced a wide range of abusive behaviors, researchers began developing measures of verbal, psychological, emotional, and sexual abuse, as well as stalking, harassment, and other controlling behaviors (Waltermaurer, 2005). Other scholars categorized abusive behaviors in terms of the relationship context. For example, Johnson (2006) identified four types of IPV based on the violent and controlling behaviors exhibited by both partners in the relationship: (1) intimate terrorism, (2) violent resistance, (3) situational couple violence, and (4) mutual violent control. Johnson's (2006) findings showed that the prevalence of each type of IPV differed between surveys that sampled general populations (in which situational couple violence is most prevalent) and those surveys that sampled from courts and shelters (in which violent resistance is most prevalent), thus illustrating each of the three aforementioned measurement issues by indicating that prevalence estimates vary depending on (1) who is included in the sample, (2) what behaviors respondents are asked to report, and (3) how those behaviors are categorized into different forms of IPV.

Last, the time frame that respondents are instructed to reference when reporting IPV victimization or perpetration impacts prevalence estimates. For example, several large-scale national victimization surveys—including the National Violence Against Women Survey (Tjaden & Thoennes, 2000) and the National Intimate Partner and Sexual Violence Survey (Smith et al., 2018)—use a 12-month reference period, as does the CTS (Straus, 1979) and CTS2 (Straus et al., 1996). However, other surveys ask respondents to report behaviors for the past 6 months (Tolman, 1989), past 12 months of most recent relationship (Hegarty et al., 1999), lifetime (McFarlane et al., 1992), or duration of the relationship with current partner (Lewis, 1985). Without knowing whether the frequency of abuse is stable over time, it is difficult to compare incidence rates across different reference periods (Waltermaurer, 2005).

Attention to each of these four measurement issues has resulted in the improvement of the validity and reliability of IPV instruments. Drawing from their developments, the current study (1) broadly defines an intimate partner to include various relationship types (e.g., dating, married) and tests the measurement invariance of our IPCA instrument across these relationship types, (2) employs an iterative process of refining our instrument to ensure a comprehensive set of behaviorally specific items, (3) uses confirmatory factor analysis (CFA) and item response theory (IRT) to model the latent types of IPCA captured by behaviorally specific items, and (4) employs a 6-month reference period for which recall is likely to be more accurate than a 12-month period (Gottfredson & Hindelang, 1977; Skogan, 1986).

Measuring IPCA and Related Concepts

In the late 1990s and early 2000s, scholars began to recognize that individuals could use communication technologies to stalk or harass current or former intimate partners (e.g., Finn, 2004; Radosevich, 1996). As cellular phone ownership and Internet use have become ubiquitous in the United States (e.g., Horrigan & Dugan, 2015; Pew Research Center, 2016), opportunities to abuse intimate partners using these technologies have emerged, including abusive partners using social media to insult or humiliate (Melander, 2010), Global Positioning System (GPS) to monitor movements (Southworth et al., 2007), or communication technologies to harass or threaten (Morelli et al., 2018).

Given that these behaviors are not included in existing IPV measures, researchers began developing instruments intended to capture them (Caridade et al., 2019). Conceptualization and operationalization of abuse measured by these instruments vary across studies with some referring to technology-related abusive behaviors (Bennett et al., 2011), electronic dating aggression (Finkelhor et al., 2000), digital IPV and abuse (Hellevik, 2019), cyber dating abuse (Borrajo et al., 2015), cyber psychological abuse (Leisring & Giumetti, 2014), cyber intimate partner aggression (Marganski & Melander, 2015), cyberstalking (Marcum et al., 2016; Smoker & March, 2017), and other various terms whose definitions and constituent behaviors may both overlap and diverge.

In a systematic review, Caridade and colleagues (2019) identified 44 studies that measured 18 distinct constructs capturing some form of cyber dating abuse. Victimization prevalence rates ranged from

> 5.8% (Felmlee & Faris, 2016) in a study ... [of] students reporting on their past week victimization by "cyber aggression," to 92% (Bennett et al., 2011) ... with college students reporting within their past year some "'electronic victimization."
> (Caridade et al., 2019, p. 164)

This variation in prevalence rates is evidence of the lack of consensus regarding measuring IPCA. However, these systematic reviews (e.g., Brown & Hegarty, 2018; Caridade et al., 2019) have focused on youths, adolescents, and young adults. Thus, researchers have largely overlooked older adults in research on IPCA. As such, the current study extends prior research by collecting data on IPCA from a sample that includes adults aged 18 years and older.

Another issue that has not yet been fully addressed is whether some items used to measure IPCA inadvertently capture nonabusive behaviors, such as those that occur with the "victimized" partner's permission. The Cyber Aggression in Relationships Scale accounts for the possibility that some behaviors may occur with the partner's permission by affixing "without your permission" to the end items (Watkins et al., 2016). For example, one item reads: "Used GPS technology to track my partner's location without my partner's permission" (Watkins et al., 2016, p. 7). However, using this item, it is not possible to examine the prevalence of this behavior *with* the partner's permission, which may help establish normative relationship behaviors and define construct boundaries. Further,

some items describe behaviors that may occur with the partner's permission but do not mention permission, including "Kept tabs on the whereabouts of my partner using social media" and "Sent repeated online messages or texts asking about my partner's location or activities" (Watkins et al., p. 614). Other instruments designed to measure IPCA or related concepts do not account for the partner's permission (or lack thereof) in any of the items (e.g., Brem et al., 2019; Messing et al., 2020).

Similarly, some scales include behaviors that, on their own, may not constitute abuse. For example, Leisring and Giumetti (2014) ask nine questions about cyber behaviors including, "Has your partner sworn at you in an email, instant message, text message, or on a social networking site?" and "Has your partner used capital letters to 'shout' at you in an email, instant message, text message, or on a social networking site?" (p. 332). Arguably, these behaviors on their own may not be abusive; swearing and "shouting" can occur in nonabusive relationships. To address this limitation, we included survey items to distinguish between cyber behaviors that occurred with and without the partner's permission.

More generally, further testing of the validity and reliability of IPCA is needed. Caridade and colleagues' (2019) systematic review of 44 manuscripts observed few studies (20.5%) evaluated the validity and reliability of their measure, with only 15.9% conducting CFA and 13.6% exploratory factor analysis. Among those that did analyze the factor structure of their measure, the factor solutions varied from two to six factors. Further, these factors were defined with little to no consensus across studies (Caridade et al., 2019). Only four studies examined the convergent and/or divergent validity of their measures and only two tested for measurement invariance—with one testing for invariance across countries (Sanchez Jiménez et al., 2017) and both testing for invariance across gender (Sanchez Jiménez et al., 2017; Watkins et al., 2016). Ultimately, Caridade and colleagues' (2019) systematic review revealed "that the studies addressed [their] objectives differently and not always with the most appropriate methodology, leading to markedly variable and difficult to interpret results" (p. 166). Thus, efforts toward the systematic development of a valid and reliable measure of cyber-based intimate partner abuse should persist using a structured process, as we aim to do here.

The Current Study

Among our goals was to develop a valid and reliable measure of IPCA by following Follingstad and Bush's (2014) suggested "gold standard" for IPV measurement. Their gold standard entails the following four stages: (1) developing the concept and measurement instrument based on an extensive review of prior research and previously developed measures and issues with measurement, (2) pilot testing, (3) testing of the psychometric properties (i.e., statistical indicators of validity and reliability) of the instrument, and (4) "real-world evaluation" using controlled trials to test hypothesized relationships between the measured concept and other constructs. To our knowledge, no previous efforts to measure IPCA meet this gold standard. In the current study, we focus on the first three stages. In the Method section, we describe this process, the items used in our IPCA instrument, and the analytical strategy used to evaluate this instrument.

Method

Initial Instrument Construction

The Intimate Partner Cyber Abuse Questionnaire (IPCA-Q) was constructed to capture a wide range of topics related to IPCA, including victimization and perpetration, consequences of IPCA victimization, perceptions of IPCA, and more. The Intimate Partner Cyber Abuse Instrument (IPCA-I) was developed as part of the IPCA-Q in four iterative stages: (1) review of the previous IPV and cybervictimization research, (2) review of the proposed IPCA-I items by experts, (3) execution of three pilot tests, and (4) consultation with scholars about the findings from the first pilot test.

Stage 1. In Stage 1, the aims were to (1) develop a definition of IPCA and (2) establish face and content validity for our IPCA measure. We began by systematically reviewing published research on IPV, cyberstalking, and cyber dating abuse. As a result, we developed a definition of IPCA as *the use of communication technologies to attempt, threaten, or complete physical, sexual, or psychological harm against an intimate partner or to monitor, coerce, or control an intimate partner's behavior.* Further, these materials were referenced to create a list of cyber behaviors that individuals use to harass, monitor, control, or cause harm to their intimate partner. Next, we consulted the Duluth

Power and Control Wheel's (Pence & Paymar, 1993) eight domains (i.e., using coercion and threats; using intimidation; using emotional abuse; using isolation; minimizing, denying, and blaming; using children; using male privilege; and using economic abuse) to ensure the items captured a full range of IPCA behaviors. From these sources, we generated a list of 24 cyber behaviors. Our review of published research was repeatedly consulted and updated throughout the remaining three stages.

　　Stage 2. To further ensure that the proposed items had face and content validity, we invited 15 experts (academics, victim advocates, and victim service providers) with a range of diverse experiences and expertise in the field of IPV[2] to provide feedback on the initial version of the IPCA-I; we received 10 full responses. Specifically, they were asked to rate the relevance of each item to the dimension of the Power and Control Wheel the item was intended to capture. The experts were then invited to suggest abusive cyber behaviors that were missing from the questionnaire. Informed by their input, we refined the wording of existing survey items and added nine additional behaviors, resulting in 33 items.

　　Stage 3. Three pilot tests were conducted over a span of 9 months. During the first pilot test in September 2018, 50 Mechanical Turk (MTurk) workers who were currently involved in intimate partner relationships responded to the IPCA-Q and provided feedback on the questionnaire itself (e.g., completion duration, difficulty understanding item wording). To our surprise, the results revealed that 100% of respondents had been victims of IPCA; that is, everyone in the sample experienced at least one of the 33 behaviors within the previous 6 months. The remaining two pilot tests were conducted after Stage 4.

　　Stage 4. We presented preliminary findings from the first pilot study at the 2018 American Society of Criminology Annual Meeting. We received feedback from panel attendees and from the open-ended responses in the first pilot test that some of the cyber-based behaviors we identified as abusive may be done for legitimate and mutually agreed upon reasons, suggesting that we had inadvertently captured nonabusive behaviors in our instrument. For example, one pilot test respondent stated, "My husband and I use GPS tracking for each other for safety and convenience reasons," while another wrote, "I am bad with money, so my partner manages my online spending." Thus, the instrument was modified through the inclusion of follow-up questions to distinguish between abusive cyber behaviors and normative

Table 1. Items and Frequency of Responses From Overall and Analytic Samples.

Item (Without Permission)	Overall Sample (N = 1,500) %Yes	Analytic Sample (N = 422) %Yes
1. Kept track of your finances[a]	3.60	12.80
2. Controlled your access to online banking or billing accounts[a]	2.20	7.82
3. Controlled your online spending[a]	3.33	11.85
4. Took out credit cards or loans in your name[a,b]	1.27	4.50
5. Used your online funds[a,b]	3.27	11.61
6. Posted, threatened to post, or shared sexual/naked photographs or videos of you[a]	1.33	4.74
7. Posted, threatened to post, or shared inappropriate, unwanted, or personal information about you[a]	2.67	9.48
8. Deleted or threatened to delete your personal social media accounts[a]	2.13	7.58
9. Persistently contacted or attempted to contact you[a,c]		
10. Tracked your Internet activity[a]	8.60	30.57
11. Checked your private messages[a]	10.27	36.49
12. Logged into or attempted to log into your online accounts[a]	7.07	25.12
13. Followed or monitored you using computer software, cameras, listening devices, Global Positioning System, and so on[a]	3.00	10.66
14. Kept tabs on your physical whereabouts using social media posts[a]	5.27	18.72
15. Controlled what you posted, liked, or who you followed on social media[a]	3.33	11.85
16. Used your children or family members to relay messages via communication technologies[a,b,c]	3.93	12.09
17. Coerced or forced you into opening financial accounts[b,c]	3.73	10.66
18. Used technology to sabotage your employment or education[b]	1.60	5.69
19. Sent you threatening messages or images displaying weapons	2.07	7.35
20. Sent you messages or images threatening to harm you	3.33	11.85
21. Sent you messages or images threatening to harm family members, friends, or pets	1.60	5.69
22. Made false reports to emergency services about you[b]	1.80	6.40
23. Stole or destroyed your phone, computer, or other technological communication device	4.13	14.69
24. Intentionally ignored your attempts at communicating through technologies[c]	21.40	44.79
25. Shared, posted, or sent insulting, humiliating, or hurtful comments about you	4.13	14.69
26. Forced you to reveal your online passwords so they could access your private accounts	5.00	17.77
27. Forced you to block or remove someone from communicating with you	9.67	34.36
28. Did not allow you to communicate with your children or family members	3.33	11.84
29. Gave gifts to your children or family members that were used to monitor you[b,c]	1.87	5.69
30. Sent you unwanted sexual or naked photographs or videos	2.67	9.48
31. Pressured you to send sexual or naked photographs or videos of yourself	5.60	19.91
32. Made you feel stupid and incapable of understanding or learning to use technology[b,c]	8.20	19.19
33. Mobilized third parties to attack you via communication technologies[b]	1.47	5.21

[a] Item asked with/without permission. [b] Expert feedback. [c] Removed from the final scale.

nonabusive relationship behaviors. Specifically, respondents were asked to indicate whether Items 1 through 16 occurred *with* or *without* their permission. Behaviors occurring *with* permission would not be used as an indicator of that individual having experienced IPCA, while behaviors occurring *without* permission were operationalized as IPCA.

Using the updated 33-item IPCA-I (see Table 1), a second pilot test of 50 different MTurk workers currently involved in an intimate partner relationship revealed that 44% of the sample had experienced at least one IPCA behavior *without* their permission within the prior 6 months. The third and final pilot test was conducted to monitor quality control in the logistics of the survey (e.g., no errors in skip or display patterns) and resulted in no changes to the IPCA-Q.

Final Sample: Procedures and Participants

Data were collected between July and August 2019 as part of a larger project on IPCA. Data collection followed a multistage screening process using TurkPrime,[3] beginning with an eligibility screening in which respondents were required to have an active MTurk worker account with an approval rating of 95% or better (Peer et al., 2014). Those who met these criteria were eligible to participate in a screener questionnaire to determine the next set of eligibility criteria, which included being 18 years or older, residing in the United States, and currently in an intimate partner relation- ship (i.e., casually dating or hooking up; exclusive dating relationship; married, civil union, or domestic partnership[4]). A total of 3,923 respondents participated in the screening questionnaire, of which 2,660 met the eligibility criteria. These individuals were sent an email through the Turk- Prime platform, informing them of the full questionnaire launch (see Appendix 1 in online supplement). Data collection closed when the target sample size of 1,500 adults was reached.

As presented in Table 2, the average respondent was 36.79 years in age (standard deviation [*SD*] = 11.26). Approximately 31% identified as cisgender men and 83.6% identified as White. Sixty- nine percent of respondents were married, 26.40% were in an exclusive dating relationship, and 4.47% were casually dating. See Measures section for coding information. The average income of respondents in the sample was between US$65,000 and US$69,999.

Table 2. Descriptive Statistics.

Measures	Overall Sample (N = 1,500)		Analytic Sample (N = 422)	
	$\bar{x}(SD)/\%$	Range	$\bar{x}(SD)/\%$	Range
Respondent characteristics				
Age ($\bar{x}$ in years)	36.79 (11.26)	18–78	35.37 (10.29)	18–67
Cisgender man	31.47	0–1	35.31	0–1
White	83.60	0–1	78.44	0–1
Student	36.13	0–1	45.50	0–1
Respondent's relationship characteristics				
Married	69.13	0–1	62.80	0–1
Casually dating	4.47	0–1	7.82	0–1
Exclusive dating	26.40	0–1	29.38	0–1
Heterosexual	86.27	0–1	82.46	0–1
Relationship satisfaction (x)	4.29 (1.01)	1–5	3.93 (1.16)	1–5
Offline intimate partner violence index (x)	2.23 (3.35)	0–20	4.79 (4.63)	0–20
"Intimate partner cyber abuse" with permission ($\bar{x}$)	1.64 (2.09)	1–16	2.37 (2.72)	0–16
Health outcomes				
Headaches or stomach aches	14.80	0–1	33.18	0–1
Eating problems or disorders	8.53	0–1	19.67	0–1
Nightmares or trouble sleeping	12.80	0–1	27.01	0–1
Felt numb or detached	13.53	0–1	26.78	0–1
Loss of self-confidence or self-worth	15.93	0–1	31.52	0–1
Felt fearful or concerned for safety	5.80	0–1	10.43	0–1
Increased drug use	2.87	0–1	5.21	0–1
Increased alcohol use	8.20	0–1	17.77	0–1
Other	1.20	0–1	1.42	0–1
None of the above	44.07	0–1	41.00	0–1
Health outcomes index ($\bar{x}$)	0.84 (1.62)	0–9	1.73 (1.99)	0–9

For instrument development and analysis, an analytic sample was developed from those who reported experiencing at least one of the 27 IPCA items at least once in the previous 6 months (see tables for items). The production of this analytic sample will be described in more detail below. The average respondent age in the analytic sample was 35.37 years old (*SD* ¼ 10.29). Approximately 35% identified as cisgender men and 78.44% identified as White. Nearly 63% were married, 29.38% were in an exclusive dating relation, and 7.82% were casually dating. The average income of respondents in the analytic sample was between US$60,000 and US$64,999.

Measures

To measure *IPCA victimization*, respondents were asked to indicate the number of times (consecutively 0–10 and 11þ) their current intimate partner[5] engaged in 33 different

cyber behaviors (see Table 1) in the past 6 months. For Items 1 through 16 in Table 1, respondents who indicated experiencing a behavior were then asked whether the behavior occurred *with* or *without* their permission (see Appendix 2 in online supplement). Those indicating a behavior occurred—and, for Items 1 through 16, that the behavior occurred *without* their permission—were identified as having experienced ICPA victimization. Responses were dichotomized, so that 1 represented IPCA victimization. Several additional measures were included to help assess and establish validity, reliability, and measurement invariance of the IPCA measure.

Predictive validity. We included a measure of *health outcomes* to establish predictive validity or the degree to which scale scores predict performance on a future criterion—in our case, health consequences. Respondents were asked to indicate (1= yes, 0 = no), if they had experienced the following outcomes as "a result of the cyber-based behaviors" committed by their partner: (1) headaches or stomach aches, (2) eating problems or disorders, (3) nightmares or trouble sleeping, (4) felt numb or detached, (5) loss of self-confidence or self-worth, (6) felt fearful or concerned for safety, (7) increased drug use, (8) increased alcohol use, (9) other, and (10) none of these. These outcomes were evaluated separately and as a summative health outcomes index of Items 1 through 9.

Convergent validity. To establish convergent validity, which is the convergence or correspondence between constructs that are theoretically similar, we included a measure of *off-line IPV*, as off-line and online forms of victimization have been found to be positively correlated in previous research. As such, respondents were asked to indicate the number of times their intimate partner engaged in 20 off-line abusive behaviors (e.g., hit, slapped, or physically hurt you; called you names or put you down in front of others; physically hurt you during unwanted sexual activity) within the previous 6 months. Response options were dichotomized (1 = *experienced the behavior one or more times*, 0 = *did not experience the behavior*) and then combined to produce a summative index.

Discriminant validity. To establish discriminant validity, which is the instrument's ability to differentiate between constructs that are theoretically different, a 5-point Likert-type measure of *relationship satisfaction* was created by asking respondents, "In general, how happy are you with your involvement with your intimate partner?" (1 = *extremely unhappy*, 5 = *extremely happy*). Further- more, a summative index of *intimate partner*

cyber behaviors with permission was developed from 16 of the IPCA items that asked whether (1 = yes, 0 = no) the respondent had experienced the behavior *with* permission.

  Measurement invariance. Measurement invariance describes the quality of an instrument "such that persons in different samples with equal standing on a latent trait have equal likelihood of obtaining a given observed score" (Meade & Wright, 2012, p. 1016). This concept is key to measurement because without establishing invariance, observed scores may be conditionally dependent upon instrument or respondent characteristics (Hambleton et al.s, 1991; Osterlind & Everson, 2009). In the IRT framework, the opposing concept of differential functioning (DF; i.e., items or instruments function differently conditional upon the respondent or the instrument) is examined in the same fashion (Hambleton et al., 1991; Osterlind & Everson, 2009). In this context, we examine the DF of our IPCA measure across gender identity, race, relationship type, student status, and sexual orientation.

  Respondents' *gender identity* (1 = cisgender man, 0 = others[6]) and *race* (1 = White, 0 = non- White[7]) were each measured dichotomously. *Relationship type* captured their current primary relationship status (1 = casually dating or hooking up, 2 = exclusive dating relationship, and 3 = married, civil union, or domestic partnership). Respondent's *student status* was also a dichotomous measure (1 = were currently a student [high school, collegiate, professional, or otherwise], 0 = not). Finally, we include a dichotomous measure of the respondent's self-reported *sexual orientation* (1 = heterosexual or straight, 0 = non-heterosexual[8]).

Analytic Software Information

  All analyses in this study were conducted using R (Version 4.0.0 "Arbor Day") through RStudio (Version 1.1.463). The following packages were used: car, psych, semTools, lavaan, mirt, and lessR.

Results

  As shown in Table 1, a majority of respondents in the overall sample did not report experiencing certain individual IPCA behaviors. For example, the most commonly experienced behavior experienced was their partner intentionally ignoring

communication attempts, with about 21% of the sample reporting this. Conversely, only about 1% had their partner take out credit cards or loans in their name, posted or shared sexual/naked photographs or videos of them, or mobilized third parties to attack them. The analytic sample includes only those who reported experiencing at least one of these behaviors (with the stipulation that Items 1 through 16 were experienced without permission) one or more times in the past 6 months. Nearly half (45%) of the analytic sample reported their partner intentionally ignored their communication attempts. Notable differences between the overall and analytic samples include those who experienced having their private messages checked by a partner (10.27% in overall compared to 36.49% in analytic) and being forced to block or remove someone from communicating with them (9.67% in overall compared to 34.36% in analytic).

Final Scale Construction

Using Reed and colleagues' (2018) three-factor measure of digital dating abuse (direct aggression, sexual coercion, and monitoring/control), three members of the research team and one undergraduate research assistant independently categorized the IPCA measures to establish interrater reliability (IR = 75.76). Items (*n* = 8) that were not categorized unanimously were then discussed and categorized by the research team. Upon determining the three-factor measure was not a statistically good fit for the data based on CFA results from the analytic sample (root mean square error of approximation [RMSEA] = .092, RMSEA CI [.089, .095], Tucker–Lewis index [TLI] = .613, and comparative fit index [CFI] = .637), we modified the measure to include the categories of cyber direct aggression, cyber sexual coercion, cyber financial control, cyber control, and cyber monitoring. Items were again categorized by the research team members and examined using CFA. Through this process, a total of six items (items indicated in Table 1) were removed because they did not load well onto any one of the factors and were not deemed necessary to ensure the measure captured the full range of cyber abuse tactics. This resulted in a final IPCA measure captured with 27 items.

A visual representation of the final CFA model, which includes covariances as suggested by modification indices, is presented in Figure 1. Likewise, the results of the CFA model are displayed in Online Appendix 3. This model was built and analyzed using

the analytic sample of only those who had experienced a least one of the 27 behaviors (again, with the stipulation that Items 1 through 16 were experienced *without* permission) but was also tested using the overall sample. Focusing on the analytic sample model, all items (except for Item 7 in Table 1) significantly load onto their corresponding factors, and all covariances are significant. Additionally, model fit indicators suggest this model is a good fit for the data (RMSEA = .050, RMSEA CI [.044, .055], TLI = .913, and CFI= .901). For the overall sample, this model fell short of the thresholds for being deemed a good fit (RMSEA = .068, RMSEA CI [.065, .070], TLI = .877, and CFI = .861) but was a better fit than the previous modeling mentioned above.
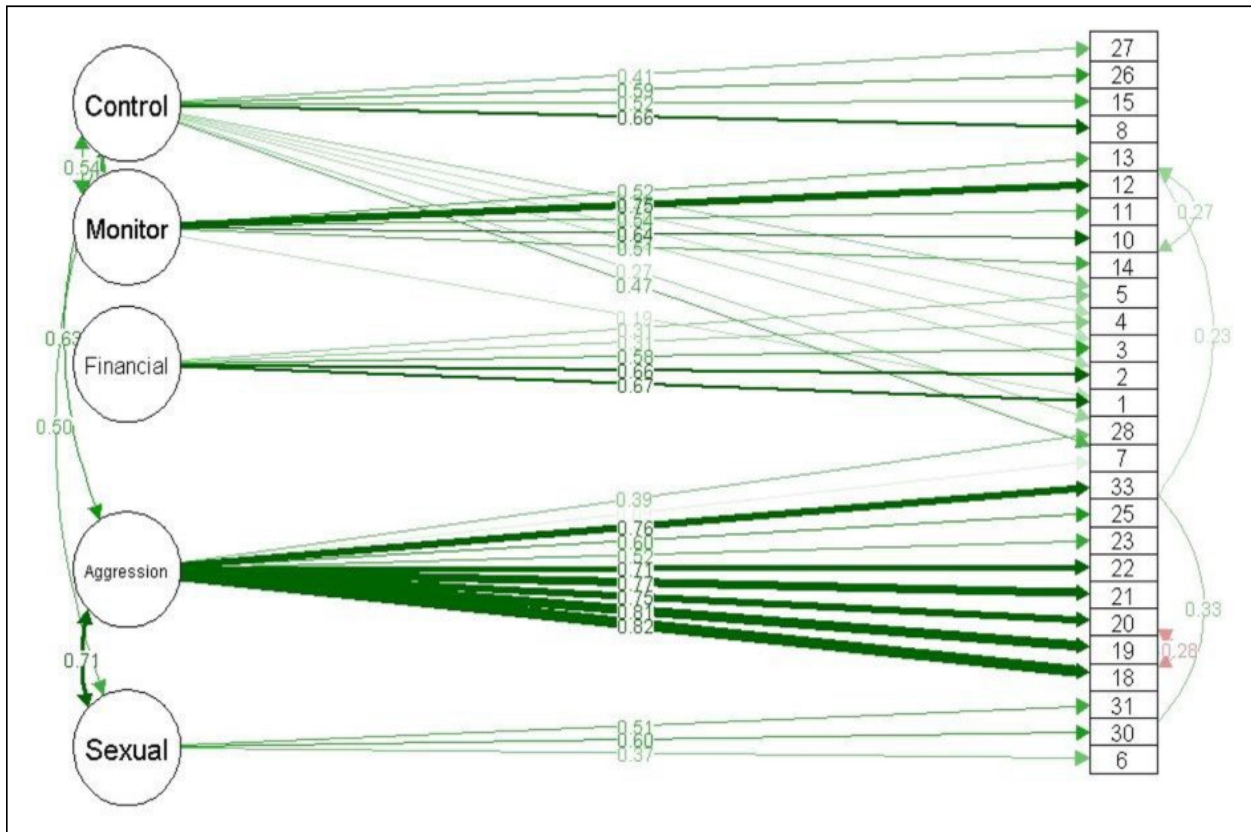

Figure 1. Confirmatory factor analysis model of analytic sample (*N* = 422). *Note.* Standardized coefficient presented; factor variances = 1; root mean square error of approximation (RMSEA) = .050, RMSEA CI [.044, .055], Tucker-Lewis index = .913, and comparative fit index = .901.

Using the final CFA model for the analytic sample (Figure 1), IRT modeling was completed to assess the psychometric properties of these items. This modeling allows for

the respondent and the item to be compared on the same continuum known as theta (y), termed "ability." The individual's "ability" is located along the underlying continuum, and the item's characteristics—known as difficulty and discrimination—help to identify where on that continuum of "ability" the respondent should be placed (de Ayala, 2013). As implied in the term, difficulty describes how challenging or "difficult," it is for the respondent to endorse an item—in our case, to indicate experiencing an IPCA behavior. This parameter can be interpreted as *SD*s from the mean (0). More difficult items are on the right end of the continuum and "easier" items toward the left end (Hambleton et al., 1991). In addition, the discrimination parameter helps to differentiate individuals of varying "ability" on the continuum in which higher discrimination parameters are deemed more beneficial for a measure (Hambleton et al., 1991). As an added benefit, IRT modeling provides item and individual estimates that are sample independent, which, assuming the test data used to build the instrument/questionnaire fit the model adequately, allows for estimates of individuals' ability in additional samples (Hambleton et al., 1991). As seen in Table 3, the IPCA items range in difficulty from 0.471 to 3.578, which suggests this scale is capturing a broad range of items that can be easily endorsed as well as those that are more challenging to endorse. Additionally, the discrimination of the IPCA items ranges from 0.936 to 2.862, which suggests that these items each possess adequate discrimination to differentiate individuals of differing abilities—in our case, experiencing IPCA.

Reliability of the Instrument

For the analytic sample, the Cronbach's a of the scale based on the final CFA model was .866, suggesting good internal validity. For each subscale (without cross-loaded items and covariances), the Cronbach's as were .686 (cyber financial control, $n_i = 5$), .461 (cyber sexual coercion, $n_i = 3$), .874 (cyber direct aggression, $n_i = 9$), .730 (cyber monitoring, $n_i = 5$), and .688 (cyber control, $n_i = 5$). For the overall sample, the Cronbach's a of the scale was .908. For each subscale (without cross-loaded items and covariances), the Cronbach's as were .729 (cyber financial control), .525 (cyber sexual coercion), .888 (cyber direct aggression), .809 (cyber monitoring), and .747 (cyber control).[9]

Table 3. Difficulty and Discrimination Parameters for Item Response Theory (2PL) Model of Analytic Sample.

Dimension (Items)	Difficulty	Discrimination
Cyber financial control		
Kept track of your finances	1.428	2.307
Controlled your access to online banking or billing accounts	1.773	2.862
Controlled your online spending	1.529	2.065
Took out credit cards or loans in your name	2.794	1.386
Used your online funds	2.026	1.240
Cyber sexual coercion		
Posted, threatened to post, or shared sexual/naked photographs or videos of you	3.578	0.936
Sent you unwanted sexual or naked photographs or videos	1.713	1.945
Pressured you to send sexual or naked photographs or videos of yourself	1.049	1.716
Cyber control		
Deleted or threatened to delete your personal social media accounts	1.959	1.830
Controlled what you posted, liked, or who you followed on social media	2.137	1.267
Forced you to reveal your online passwords so they could access your private accounts	1.147	1.818
Forced you to block or remove someone from communicating with you	0.471	1.618
Did not allow you to communicate with your children or family members	1.555	1.784
Cyber monitor		
Kept tabs on your physical whereabouts using social media posts	1.496	1.367
Tracked your Internet activity	0.681	1.817
Checked your private messages	0.558	1.420
Logged into or attempted to log into your online accounts	0.754	2.366
Followed or monitored you using computer software, cameras, listening devices, Global Positioning System, and so on	1.915	1.712
Cyber direct aggression		
Posted, threatened to post, or shared inappropriate, unwanted, or personal information about you	2.427	1.254
Used technology to sabotage your employment or education	2.050	2.284
Sent you threatening messages or images displaying weapons	1.856	1.990
Sent you messages or images threatening to harm you	1.438	2.137
Sent you messages or images threatening to harm family members, friends, or pets	2.010	2.496
Made false reports to emergency services about you	2.142	1.775
Stole or destroyed your phone, computer, or other technological communication device	1.575	1.391
Shared, posted, or sent insulting, humiliating, or hurtful comments about you	1.300	1.856
Mobilized third parties to attack you via communication technologies	2.090	2.126

Note. N = 422; 2PL = two-parameter logistic modeling.

Validity of the Scale

Predictive validity. As seen in Table 4, the cyber direct aggression, cyber monitoring, and cyber control dimensions are significantly and consistently correlated with various health outcomes, with the largest positive relationships seen between headache/stomach aches (Pearson's r = .259, .273, and .229, respectively; $p < .001$) and eating problems (Pearson's r = .267, .191, and .217, respectively; $p < .001$). Likewise, the overall health index is statistically significantly, positively, and weakly correlated with these IPCA

dimensions (Pearson's *r*= .279, .278, and .243, respectively; *p* < .001). The cyber financial control dimension does not correlate with any of the health-related outcomes. The cyber sexual coercion dimension is not highly correlated with any of the health-related outcomes.[10] However, cyber direct aggression, cyber monitoring, and cyber control dimensions are significantly, negatively, and weakly related to not experiencing any of these health-related out- comes (Pearson's *r* = -.227, -.291, and -.228, respectively; *p* < .001).

Convergent validity. As seen in Table 4, offline IPV was significantly correlated with each of the five IPCA dimensions, with a strong positive correlation occurring between cyber direct aggression (Pearson's *r* = .653, *p* < .001) and a weak between cyber financial control (Pearson's *r* = .149, *p* < .001).

Discriminant validity. The correlation between relationship satisfaction and the IPCA dimensions is not statistically significant (*p* < .001), with the exception of strongest, the cyber monitoring dimension (Pearson's *r* = -.181, *p* < .001), still considered to be a weak relationship. As another check on this scale's discriminant validity, the correlation between IPCA dimensions and intimate partner behaviors with permission was examined. The correlation with intimate partner behaviors with permission is strongest with cyber direct aggression (*r* = .366, *p* < .001), a positive and weak association, and weakest with cyber monitoring (*r* = -.072, *p* > .05), a very weak and negative association.

Invariance/DF

Using a significance-based, two-stage, MaxA5, likelihood ratio test (LRT) approach to identify non- DF "anchor items" (see Meade & Wright, 2012), we examine the DF of the IPCA measure across gender identity, race, relationship status, student status, and sexual orientation. This method com- pares nested baseline/constrained models with comparison models. The first model is a constrained "all others as anchors" model (i.e., all item parameters are estimated to be equal across groups). In the second model, only the top five non-DF items are used as anchors (i.e., estimated to be equal across groups) to examine the remaining items. The likelihood value of the items in these two models is compared for each item based on a w^2 distribution such that significant values indicate DF (Meade & Wright, 2012). None of the items in the scale—as determined by the

significance- based, two-stage, MaxA5, LRT approach described above—demonstrate DF across gender identity, race, relationship status, student status, and sexual orientation.

Table 4. Correlation Matrix.

Correlates	Intimate Partner Cyber Abuse Factors				
	Cyber Sexual Coercion	Cyber Direct Aggression	Cyber Financial Control	Cyber Monitor	Cyber Control
Offline intimate partner violence	.367***	.653***	.149***	.412***	.580***
Intimate partner behaviors with permission	.172***	.366***	−.058	−.072	.264***
Relationship satisfaction	−.031	−.051	−.100*	−.181***	.001
Health outcomes					
Headaches or stomach aches	.037	.259***	−.054	.273***	.229***
Eating problems or disorders	.129**	.267***	−.033	.191***	.217***
Nightmares or trouble sleeping	.100*	.186***	−.047	.121*	.137**
Felt numb or detached	.052	.137**	−.004	.220***	.132**
Loss of self-confidence or self-worth	.103*	.136**	.009	.169***	.130**
Felt fearful or concerned for safety	.055	.164***	.052	.189***	.128**
Increased drug use	.007	.130**	−.051	.052	.126**
Increased alcohol use	.002	.111*	−.077	.142**	.117*
Other	.060	−.029	−.028	−.047	−.030
None of the above	−.112*	−.227***	.042	−.291***	−.228***
Health outcomes index	.106*	.279***	−.043	.278***	.243***

Note. N = 422. Pearson's r presented.
*p < .05. **p < .01. ***p < .001.

Prevalence of IPCA Victimization

Findings reveal that cyber control was most commonly experienced, with 15.8% (*n* = 237) of the overall sample (*n* = 1,500) experiencing at least one of these behaviors one or more times within the prior 6 months. Just over one in 10 (*n* = 198; 13.2%) respondents reported experiencing cyber monitoring within the prior 6 months, followed by 8.6% (*n* = 129) experiencing cyber direct aggression. The remaining two factors—cyber sexual coercion and cyber financial control—were each experienced by 7.27% (*n* = 109) of the overall sample. Considered holistically, 28% of respondents (*n* = 422; 28.13%) in the overall sample experienced at least one of the IPCA behaviors one or more times in the prior 6 months. Nearly one in six respondents (*n* = 223, 14.68%) in the overall sample experienced only one dimension of IPCA, whereas 6.87% (*n* = 103) experienced two,

3.2% (*n* = 48) experienced three, 2.07% (*n* = 31) experienced four, and 1.13% (*n* = 17) experienced all five dimensions of IPCA in the previous 6 months.

Discussion

As noted, Cardiade and colleagues' (2019) systematic review identified 18 distinct constructs capturing some form of cyber dating abuse. This study sought to build and expand upon these existing scales by developing a valid and reliable instrument to measure IPCA victimization among adults. Through a rigorous and iterative process, instrument items were developed, pilot tested, reviewed, and analyzed before being fielded to a sample of 1,500 adults aged 18 years or older who were currently involved with an intimate partner and living in the United States. The results revealed a structure composed of five dimensions: (1) cyber direct aggression, (2) cyber sexual coercion, (3) cyber financial control, (4) cyber control, and (5) cyber monitoring. This supports Reed and col- leagues' (2018) model of three forms of digital dating abuse, while also taking into consideration Adams and colleagues' (2008) argument to consider economic abuse as a distinct form of IPV.

Overall, the findings provide initial evidence for the reliability and validity of the IPCA-I as an instrument to measure IPCA. These items provide internal validity, with limitations identified when used as individual dimensions. Likewise, multiple dimensions of this scale demonstrated predictive validity with physical and psychological health-related outcomes. This is supported by previous research that has observed a relationship between health consequences and IPV (e.g., Coker et al., 2000) and cybervictimization (e.g., Dreßing et al., 2014; Fissel & Reyns, 2020). Dimensions that did not adequately demonstrate predictive validity (i.e., cyber financial control) were retained on the basis of both face and content validity. It is possible that this dimension of IPCA does not lead to physical or psychological health outcomes but to other negative outcomes that were not examined (e.g., loss of income, financial dependency). In addition, the IPCA dimensions demonstrate convergent validity with off-line IPV behaviors. As expected, those who experience off-line IPV are also highly likely to experience IPCA. Furthermore, the IPCA dimensions demonstrated discriminant validity from similar constructs, such as relationship satisfaction and cyber-based intimate partner behaviors experienced *with*

permission.

As another check on the measurement properties of the IPCA-I items, DF was examined across gender identities, race, student status, sexual orientation, and relationship type. No DF was identified between these groups, which suggests that responses to these items are not conditioned upon these respondent characteristics. Thus, meaningful comparisons in responses to the IPCA-I may be made between these groups.

This study also suggests the need for further scholarly attention on this form of intimate partner abuse, as 28.13% of all respondents experienced at least one IPCA behavior within the past 6 months and 13.27% experienced more than one of the dimensions. Moreover, nearly 60% of IPCA victims experienced at least one health consequence as a result of their experience, which suggests yet another avenue of scholarly inquiry. Additional research may further explore the ways in which intimate partners may use communication technologies to gain and maintain power and control over their partners and how this behavior evolves and whether it changes over time and why

Limitations and Future Directions

As one of the first steps forward toward measuring IPCA, the current study adds to the developing body of research on cyber abuse between intimate partners, but it is not without limitations. First, our national-level convenience sample collected using TurkPrime may not be nationally representative nor representative of people experiencing IPCA victimization. That said, Thompson and Pickett (2019) note that these types of samples are useful for making inferences about the general direction of relationships, which is part of the exploratory nature of this study. Further, MTurk samples have been found to be more generalizable than the college student samples typically used in victimization research (e.g., Berinsky et al., 2012; Kees et al., 2017). In addition, the use of IRT to model the IPCA items provides the benefit of sample independence, which allows for similar estimates to be produced in other samples. Nonetheless, we encourage researchers to utilize nationally representative samples in future research to further explore and validate our IPCA measure.

Next, we recognize that the "with/without permission" criteria may not fully distinguish between behaviors that are abusive and those that are not. An individual

who does not want their partner to monitor them with GPS could permit their intimate partner to do so because they want to avoid conflict that may arise if they refuse permission. This may explain why we found that 22% of individuals who experienced behaviors with permission indicated experiencing a health consequence as a result of these behaviors. Likewise, there may be instances in which this behavior is done *with* and *without* the partner's permission within the same relationship and timeframe. Thus, future research would benefit from further exploration of this permission criterion, its meaning, and its effects on individuals.

Lastly, future research could benefit from analyses that examine the impact of the frequency (number of times and how often happened) and duration (how long) of these IPCA behaviors on measurement issues ranging from survey item wording to validity and reliability properties. In the current study, we used a dichotomous measure of each IPCA behavior (i.e., no or yes) to capture victim's experience, yet important differences may emerge when frequency and duration of behavior are considered separately and concurrently. Also, whether the IPCA behavior is currently ongoing or has stopped or the intimate partner relationship ended due to IPCA behaviors (and behaviors are still going afterward) are both measurement and theoretical issues that could be further explored by researchers.

Despite these limitations, this study makes conceptual and statistical contributions toward developing a valid and reliable measure of IPCA. As technology becomes increasingly enmeshed in our lives, it is likely that IPCA will persist in some relationships. Thus, it is methodologically critical that researchers appropriately conceptualize, identify, and operationalize this form of abuse. As noted, this study provides initial evidence of the utility of the IPCA-I, yet we argue further refinement and analyses are needed before considering this measure for use as either a clinical or risk assessment tool. The process and findings presented here are the first steps in a much-needed line of inquiry, which will eventually inform theoretical explorations of IPCA victimization and perpetration, along with the development and evaluation of prevention and intervention strategies.

Authors' Note

Drs. Fissel, Butler, and Fisher were Co-PIs on the survey development and data collection. All four authors collaborated on the measurement analyses and interpretation, with Dr. Graham taking the lead executing the analyses.

Data Availability

The data are not publicly available, but the coauthors are willing to estimate related requested analysis for the inquiring scholar.

Declaration of Conflicting Interests

Funding

Supplemental Material

Supplemental material for this article is available online.

Notes

1. Communication technologies are products that transmit or receive communication electronically. Examples include cell phones, Global Positioning Systems, laptops, and so on.
2. Collectively, the experts who were invited to review the intimate partner cyber abuse items have diverse experiences and expertise, including working in rural and urban settings, having local and statewide experiences, and serving the needs of vulnerable populations (e.g., LGBTQþ).
3. TurkPrime was designed to support social and behavioral science research by integrating Amazon's Mechanical Turk with options that allow researchers to

improve data quality and save time and resources (Litman et al., 2016).

4. From this point forward in this article, we will refer to those who are captured in this category as married.

5. Respondents were informed if they had more than one current intimate partner, they should complete the questionnaire based on the online they have been intimately involved with the longest.

6. Others include cisgender women, transgender men, transgender women, nonbinary or genderqueer, questioning, and not listed.

7. White includes all respondents who endorsed this racial category, while non-White includes those who did not (e.g., Black or African American, Asian, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or Other).

8. Nonheterosexual includes those who selected gay or lesbian, bisexual, asexual, questioning, and not listed.

9. We recognize that the Cronbach's as are low for the Cyber Sexual Coercion Scale in both the analytic and overall samples. However, as Koss and colleagues (2007) and Streiner (2003) note, a low Cronbach's a value is not uncommon for scales of this sort, for which the items define the underlying construct itself, rather than being manifestations of the construct (such as with personality inventories), nor is a low Cronbach's a a threat to reliability of such scales.

10. Using $p < .001$ as a threshold due to the number of correlations examined.

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