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Couples' sexual communication and dimensions of sexual function: A meta-analysis

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Abstract

Research and clinical data have shown that couples with sexual problems report a lack of sexual communication. However, no published meta-analyses have evaluated the relationship between sexual communication and sexual function. This meta-analysis examines the correlation between couples' sexual communication and dimension of sexual function across forty-eight studies. Sexual communication was positively associated with sexual desire (r = .16), sexual arousal (r = .21), lubrication (r = .17), orgasm (r = .23), erectile function (r = .19), less pain (r = .12), and overall sexual function (r = .35). The effect sizes for sexual desire (r = .21; r = .12) and orgasm (r = .26; r = .16) were higher for women than for men. For overall sexual function, studies with married participants (r = .47) had a larger effect size than studies with participants with multiple relationship types (r = .31) or than studies with dating participants (r = .11). Effect sizes were larger for studies conducted outside of the U.S. (r = .39) compared to studies conducted in the U.S. (r = .12). We address the importance of addressing the relationship between sexual communication and sexual function as well as future directions for research in this area.

Keywords

Sexual communication; meta-analysis; sexual function; couples

Sexual communication is critical to the development and maintenance of healthy sexual function (Masters & Johnson, 1970). Research demonstrates that couples with sexual difficulties have more sexual communication problems than couples without sexual concerns (e.g., Kelly, Strassberg, & Turner, 2006), and, relatedly, couples with sexual problems who express dissatisfaction with their sexual relationships are likely to report a lack of communication and poor sexual expression (e.g., Pazmany, Bergeron, Verhaeghe, Van Oudenhove, & Enzlin, 2015). It may be that sexual problems make communication more challenging. However, the reverse could also be true; couples that have trouble speaking openly about their concerns, both sexual and non-sexual, may be more likely to develop sexual difficulties. Either way, it is likely that sexual function and sexual satisfaction are

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both directly impacted by sexual self-disclosure, which may protect against *future* sexual dysfunction (Reese et al., 2014) and ultimately enhance future communication.

Metts and Cupach (1989) defined sexual communication as the combination of sexual self-disclosure, the quality of the sexual communication, and the frequency of the communication. Sexual self-disclosure involves talking about sexual preferences and a desire to engage in specific sexual activities (Harris, Monahan, & Hovick, 2014), as well as sexual values, past experiences, and sexual attitudes (Snell, Belk, Papini, & Clark, 1989). The quality of sexual communication has been conceptualized as a combination of satisfaction with sexual communication (Wheeless, Wheeless, & Baus, 1984) and the perception that one can talk with a partner about both the positive and negative aspects of the sexual relationship (Catania, 1986). Frequency of sexual communication captures how often couples discuss different aspects of their sexual relationships.

There are numerous potential pathways though which sexual communication may be linked to sexual function. MacNeil and Byers (2005, 2009) hypothesized that two key pathways link sexual communication to sexual satisfaction, which some researchers believe to be an important aspect of sexual function. The instrumental pathway assumes that the disclosure of sexual likes and dislikes informs a partner about one's preferences, which ultimately leads to obtaining more of what one likes and less of what one dislikes. This pathway is important for several reasons; (1) partners differ in their sexual preferences (e.g., McCarthy & Bodner, 2005), and (2) sexual preferences may change over time. Importantly, this pathway provides an avenue for altering sexual behavior, thereby potentially addressing sexual function and sexual satisfaction. The second pathway, labeled the expressive pathway, assumes that sexual communication leads to greater sexual well-being by enhancing intimacy. This enhanced intimacy facilitates sexual communication, creating a positive feedback loop. When partners fail to communicate their sexual needs and preferences, these pathways cannot operate effectively, which results in sexual difficulties.

Although MacNeil and Byers (2005) do not explicitly connect sexual communication to other domains of sexual function, they and others have found empirical support for both the instrumental and the expressive pathways. The instrumental pathway describes the relationship between one partner's disclosure of preferences to the other partner's understanding of and response to those preferences. Researchers have argued that better communication helps explain the fact that some couples remain satisfied with their sexual relationship in the face of changing desires, differing sexual scripts, and sexual difficulties (Byers, 1999; Meston & Trapnell, 2005). Indeed, greater sexual self-disclosure is associated with higher sexual satisfaction in long-term relationships (Cupach & Metts, 1991; MacNeil & Byers, 1997, 2005; Purnine & Carey, 1997). According to MacNeil and Byers (2009), disclosure of sexual preferences enables the reconciliation of disparate preferences, maximizes sexual rewards, and minimizes sexual costs, as long as partners respond to the disclosed preferences. Even after controlling for non-sexual disclosure, greater sexual disclosure to a sexual partner was associated with increased satisfaction (MacNeil & Byers, 1997). The expressive pathway suggests that greater sexual self-disclosure leads to greater emotional intimacy, which in turn facilitates increased sexual satisfaction. Emotional intimacy is challenging to operationally define and measure (MacNeil & Byers, 2009).

Perhaps for that reason, intimacy and love are not often the primary focus of empirical research; however, they are critical ingredients of healthy sexual function for many individuals and couples (McCabe et al., 2010). It is therefore likely that, by increasing emotional intimacy, sexual communication also improves other aspects of sexual function (e.g., arousal, desire).

Although research suggests a relationship between poor sexual communication and sexual problems, a meta-analysis addressing the strength of the association between these two variables, and specifically the strength of the relationship between sexual communication and specific domains of sexual function, has yet to be published. Although there are relatively consistent findings that speak to the link between sexual communication and sexual function, a synthesis of the findings will allow for a more systematic understanding of this association for different domains of sexual function. Further, identification and analysis of the moderators will elucidate how the association between sexual communication and dimensions of sexual function vary by study characteristics. Finally, the findings from our meta-analysis will help identify gaps in the literature and areas to target in future research. In this paper, we examine the link between couples' sexual communication and multiple dimensions of sexual function as well as potential moderators of this relationship (e.g., gender, age, and sample characteristics).

Literature Review

Dimensions of Sexual Function

Each dimension of sexual function likely has a unique relationship with sexual communication. Sexual problems are multifaceted and complex; a lack of desire or decreased arousal may require a different form of communication between partners than would sexual pain. Similarly, the relationships between specific sexual concerns and sexual communication may differ between men and women, as different diagnoses pertain to these two groups. In order to elucidate the relationship between communication and different types of sexual problems, it is important to examine each domain of sexual function separately.

Desire.—Sexual desire refers to the motivation to engage in or be receptive to a sexual event, whether partnered or alone. Desire may also be referred to as "interest," "drive," or "libido" (Althof et al., 2017). Women with clinically low levels of desire are diagnosed with female sexual interest/arousal disorder (FSIAD), whereas men receive the diagnosis of male hypoactive sexual desire disorder (HSDD). These diagnoses are outlined in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013). Though FSIAD and HSDD have distinct diagnostic criteria, shared symptoms include decreased or absent sexual thoughts or fantasies and decreased or absent desire/interest in sexual activity. Narratives in popular media frequently portray men as having high or unwavering levels of sexual desire, which may make it difficult for men to report low sexual desire.

Sexual communication is an important interpersonal factor for sexual desire (Mark & Lasslo, 2018), as it protects against the loss of desire in long-term relationships (Murray,

Milhausen, & Sutherland, 2014). Communicating about desire has been described as one of the primary ways in which women report remedying desire discrepancies (Herbenick, Mullinax, & Mark, 2014). Psychological treatments for low desire often highlight the importance of open dialogue and enhancing communication between partners (Greenberg, 2005).

Arousal/Erectile Function.—Sexual arousal is an emotional or motivational state characterized by physiological and mental changes in response to an internal or external stimulus (Althof et al., 2017). When accompanied by distress, low arousal or difficulty achieving erection may be diagnosed as FSIAD in women and erectile dysfunction (ED) in men (American Psychiatric Association, 2013). It is possible that individuals who are distressed about their partners' arousal or erectile function may not communicate their concerns or partake in problem-solving discussions, which could exacerbate distress. In a study that examined factors associated with sexual arousal in women, several participants noted that partner-level variables (e.g., feeling desired, accepted, or appreciated by a partner, and feeling as if one's partner is comfortable with her sexual past) had a large impact on their arousal (Graham, Sanders, Milhausen, & McBride, 2004). Conveying appreciation, acceptance, and comfort requires effective communication, which suggests that women's experiences of sexual arousal may be linked to sexual communication. Similarly, communication between partners about erectile function may improve arousal in men. Unfortunately, though positive treatment outcomes for ED are associated with better pretreatment communication (Hawton, Catalan, & Fagg, 1992), communication between partners around erectile concerns is poor. In a large sample of male callers to an ED helpline, less than 60% of men had spoken to their partner about their sexual concern (Mirone et al., 2004).

Lubrication.—Lubrication is distinct from but highly related to sexual arousal in women. Though lubrication has traditionally been considered synonymous with arousal (Bartlik & Goldberg, 2000), current research suggests that lubrication is (1) not a necessary condition for arousal and (2) only *one of many* physiological changes that women experience when they are aroused (Graham et al., 2004). No studies have directly assessed the relationship between the quantity of natural lubrication and sexual communication, but research that correlates the six domains of the Female Sexual Function Index (Rosen et al., 2000), one of which is lubrication, with measures of sexual communication may offer some insight on the association between self-reported lubrication and sexual communication.

Orgasm/Ejaculation.—Orgasm is typically conceptualized as a transient sensation of intense pleasure, most often accompanied by involuntary contractions of the pelvic muscles, which leads to a feeling of contentment and/or an altered state of consciousness (Meston, Levin, Sipski, Hull, & Heiman, 2004). In men, ejaculation is the discharge of semen that is usually accompanied by an orgasm, though they are not always linked. Orgasm disorders, which occur in both women and men, include female orgasmic disorder, premature (early) ejaculation, and delayed ejaculation; these disorders are characterized by a marked delay in the frequency or intensity of orgasm/ejaculation, the persistent absence of orgasm/ejaculation, or recurrent early ejaculation (American Psychiatric Association, 2013).

Sex education and communication skills training are often included in the treatment of orgasm disorders. Researchers and clinicians alike agree that willingness to communicate one's sexual needs and preferences may facilitate the attainment of orgasm (Heiman, 2007). Kelly, Strassberg, and Turner (2004) found that women who were unable to achieve orgasm reported more problematic sexual communication with their partners and increased discomfort when talking about sexual issues compared to women without orgasm concerns. Similarly, a significant positive correlation between poor sexual communication and premature ejaculation has been reported (e.g., Amidu et al., 2010). Amidu and colleagues (2010) found that, as men's sexual communication skills worsened, the likelihood of premature ejaculation increased. Taken together, there is limited, but consistent evidence that communication (or lack thereof) about sexual needs can be an important factor in facilitating or inhibiting orgasm.

Pain.—Some women experience significant genital pain upon or following penetrative intercourse. These women may meet diagnostic criteria for genito-pelvic pain/penetration disorder (American Psychiatric Association, 2013), which encapsulates four commonly comorbid symptoms: difficulty having intercourse, pain in the genital or pelvic area during vaginal intercourse or attempts at penetration, fear or anxiety associated with the pain of intercourse, and tensing or tightening of the pelvic floor muscles when attempting vaginal intercourse. Clinically significant distress caused by any one of these four symptoms is sufficient to warrant a diagnosis. There is great variability in the severity, location, and initiation (i.e., provoked or spontaneous) of the pain. By definition, only women receive this diagnosis, but several studies suggest that men may experience similar problems (e.g., Christensen et al., 2011; Davis, Binik, & Carrier, 2009).

Findings on the relationship between sexual communication and sexual pain are mixed. In separate studies conducted by similar research groups, there was either no association between sexual communication and sexual pain or a significant association between greater sexual communication and lower levels of pain (Rancourt, Rosen, Bergeron, & Nealis, 2016; Rancourt, Flynn, Bergeron, & Rosen, 2017). Research has also found that women and partners of women with provoked vestibulodynia (PVD) reported significantly poorer sexual communication than did women and partners of women without this condition (Smith & Pukall, 2014; Sutton, Pukall, & Chamberlain, 2009). Additionally, when male partners have more facilitative responses to women's pain during intercourse, their own and their partners' reported sexual satisfaction increases (e.g., Rosen et al., 2014). Perhaps women with better sexual communication are able to adapt sexual activities to account for their pain. In an examination of sexual intimacy among heterosexual women with PVD and their partners, sexual intimacy was associated with higher pain self-efficacy (Bois, Bergeron, Rosen, McDuff, & Grégoire, 2013). Definitions and models of intimacy include disclosure and communication as elemental aspects of the construct (Reis & Shaver, 1988; Schnarch, 1991). Greater intimacy, and therefore greater disclosure, may improve women's perceived ability to cope with their sexual pain and perhaps adjust their sexual repertoire to account for their pain and to facilitate more pleasurable sex.

Potential Moderators

We examined the following potential moderators of the link between sexual communication and sexual function to understand factors that weaken or strengthen the relationship.

Clinical sample.—By nature, studies that recruit clinical samples typically report more severe sexual dysfunction symptoms compared to those that recruit non-clinical samples. Furthermore, couples in which one partner has a sexual problem also tend to report worse sexual communication compared to couples with no such problems (e.g., Cameron & Tomlin, 2007). Thus, it is possible that the association between sexual communication and sexual function differs between clinical and non-clinical samples.

Same-sex relationships.—There is a paucity of research on the sexual function of sexual minority (lesbian, gay, bisexual, and queer) individuals (Boehmer, Timm, Ozonoff, & Potter, 2012). Sometimes, sexual minority populations are included in studies on sexual function, but they are often subsumed in the general population without consideration for potential differences. Eligibility criteria for studies on sexual function frequently specify that participants must identify as heterosexual or be in a "heterosexual relationship." These studies may not consider that individuals who identify as heterosexual might engage in sexual behaviors with same-sex partners (Nield, Magnusson, Brooks, Chapman, & Lapane, 2015), and that these behaviors may be relevant to their sexual function. Sometimes, sexual orientation is simply not assessed. Thus, we examined whether effect sizes differ based on the inclusion, lack of inclusion, or inattention to sexual minorities.

Relationship status, relationship length, age, year of the study.—There were a number of variables that we tested as moderators that may be interrelated and may change over time: relationship status, relationship length, age, and year of publication. For example, satisfaction with sexual communication follows a curvilinear pattern over the course of a relationship (Wheeless et al., 1984). Specifically, satisfaction with sexual communication increases as a relationship moves towards more commitment, with the highest scores occurring when individuals enter committed relationships. This trajectory may impact the effect size of the association between sexual communication and sexual function, as commitment should be greater in longer relationships or marriages.

In both longer relationships and marriages, the link between sexual communication and sexual function may be stronger than in shorter or dating relationships. It is possible that, as relationships develop, sexual needs and desires may change; communication would be necessary to meet new needs. There is also evidence that sexual function decreases with age for both men (Corona, Rastrelli, Maseroli, Forti, & Maggi, 2013) and women (Hayes & Dennerstein, 2005). We therefore examined age as a potential moderator.

Lastly, as the self-report instruments that assess sexual communication and sexual function have changed between the oldest and most recent studies included in our analysis, we tested publication year as another potential moderator.

Country of study.—Although direct comparisons of cultural differences in sexual communication are scarce, it is generally accepted that values about sexuality and

communication between partners vary from culture to culture (Hofstede, 2015). The available evidence also indicates that there are cultural differences in both the prevalence of sexual dysfunction (Bhugra & de Silva 2007; Laumann, Paik, & Rosen, 1999) as well as in the perceived impact of sexual distress (Burri & Graziottin, 2015). Therefore, we examined the effect of the country in which a study was conducted on the relationship between sexual communication and sexual function.

Female Sexual Function Index.—The Female Sexual Function Index (FSFI), despite its limitations (Forbes, Baillie, & Schniering, 2014; Rosen, Revicki, & Sand, 2014), is considered to be the gold standard assessment tool for the evaluation of women's sexual function. Used in over 1,500 studies (Forbes et al., 2014), the FSFI is a 19-item self-report measure that assesses six dimensions of female sexual function (desire, arousal, lubrication, satisfaction, orgasm, pain) as well as overall sexual function. The measure has high internal (r = .89-.97) and test-retest (α = .79-.88) reliabilities, and it has been shown to discriminate between women with and without sexual problems (Rosen et al., 2000). Given the strong psychometric properties of the FSFI, we examined whether the relationship between sexual communication and sexual function differs between studies that used the FSFI and studies that used other tools to measure sexual function.

Current Study

The goal of the current study was to assess the strength of the association between couples' sexual communication and dimensions of sexual function. We investigated the relationship between sexual communication and separate dimensions of sexual function, both un-stratified by gender and for men and women separately (i.e., stratified), for both moderated and unmoderated analyses.

Method

Eligibility criteria

Both published and unpublished (i.e., dissertations) articles were included. It was required that studies (a) measured at least one of the following: sexual desire, arousal, erectile function, lubrication, orgasm, ejaculation, pain, or overall sexual function; (b) be published in English; (c) include sufficient information to calculate at minimum one effect size; (d) include a majority of participants who were currently in a relationship; and (e) include a measure of interpersonal sexual communication that did not focus on sexual risk.

Database searches were conducted for articles between 1980 and May 2017. Two searches were conducted to maximize the number of included studies. One set of search terms specified measures of sexual communication ("the specific search"); the other set specified sexual communication and dimensions of sexual function ("the sexual function search").

Prior to conducting the specific search, pertinent measures were identified via the *Handbook of Sexuality-Related Measures* (Fisher, Davis, Yarber, & Davis, 2013), which includes measures published through 2011 that assess a wide variety of sexual topics, and by reviewing highly cited articles on sexual communication. A database search was then

conducted (i.e., Academic Search Complete, ERIC, Family Studies Abstracts, Gender Studies Database, Medline, PsycINFO, socINDEX, LGBT Life, and ProQuest Dissertations) using the names of scales in the text of each article ("*Hurlbert Index of Sexual Assertiveness*," *OR* "*sexual communication satisfaction" OR "dyadic sexual communication scale" OR "female partners communication during sexual activity scale" OR "sexual self-disclosure questionnaire" OR "sexual self-disclosure scale" OR "The Sexual Satisfaction Scale for Women*" *OR* "*Sexual Function Scale" OR "Golombok Rust Inventory of Sexual Satisfaction"*). We excluded studies on parent-child communication and qualitative studies on this topic (*NOT "parent-child" NOT "qualitative"*). The database search returned 1,080 articles for the specific search. After removing duplicates, 745 abstracts were screened. Next, using the same databases, we conducted a search looking specifically for sexual communication and dimensions of sexual function (((*sexual communication*) *AND* (*couples OR relationship*)) *AND* (*"sexual dysfunction*" OR "desire" OR "orgasm" or "erection" OR "arousal" OR "lubrication" OR "pain" OR "ejaculation"*) *NOT "qualitative"*) which returned 357 hits, and, after removing duplicates, 186 abstracts were screened.

The screening process resulted in 41 articles. The authors reviewed the references lists of the 41 articles and identified any other articles that may have not been captured in the database searches. This search process produced an additional eight articles (See Figure 1 for a summary of article selection process). Ultimately, 48 articles were included in this review. In total, these articles included 12,145 participants, and they led to the calculation of 159 effect sizes (see Table 1 for number of effect sizes and studies for each dimension of sexual function).

Measurement of Couples' Sexual Communication

We were interested in evaluating the relationship between sexual function and *interpersonal* communication. There are a few sexual communication scales that measure what we would call *intrapsychic* sexual communication, which we believe to be distinct from interpersonal communication. These scales typically assess an individual's ability, willingness, or desire to talk about their sexual relationship with a partner, but they do not indicate if the communication actually takes place, nor do they document an individual's perception of the communication (Harris et al., 2014). It is important to disentangle these two types of sexual communication for several specific reasons. First, it is unclear from an assessment of individual willingness or desire to communicate if any direct communication has taken place within the context of a partnership. Second, most studies that use intrapsychic measures focus on the individual and therefore document individual outcomes. We were interested in the dyadic nature of sexual communication and its association with sexual function, so measures that capture shared or interpersonal sexual communication were more appropriate for this analysis.

Because one of the searches relied on the names of the psychometric tools that measured sexual communication, the scales were identified a priori so that we could determine which dimension of sexual communication they assessed. Each of the measures described below were designed to specifically assess one of the three aspects of interpersonal sexual communication (sexual self-disclosure, quality of the communication, or frequency of the

communication) or contain a subscale that assessed sexual communication. For the sake of brevity, we only discuss the measures that were included in the meta-analysis.

Sexual Self-Disclosure.—Measures of sexual self-disclosure included the Sexual Self-Disclosure Questionnaire (SSDQ; Byers & Demmons, 1999) and the Revised Sexual Self Disclosure Scale (SSDS-R; Snell et al., 1989). The SSDQ inquires about the degree to which a person has shared his or her sexual likes and dislikes of six behaviors (e.g. oral sex) with a partner. The SSDS-R has 24 subscales with three items each that assess the degree to which partners have discussed specific sexual topics.

Quality of Sexual Communication.—Measures of sexual communication quality include the Sexual Communication Satisfaction Scale (SCSS; Wheeless et al., 1984), the Dyadic Sexual Communication Scale (DSCS; Catania, 1986), and the Sexual Satisfaction Scale for Women, Communication Subscale (SSS-W; Meston & Trapnell, 2005) The SCSS assesses an individual's satisfaction with sexual communication and includes behavioral items (e.g., "I tell my partner when I am especially sexually satisfied"). The DSCS measures participants' perception of the quality of the sexual communication in their relationships (e.g. "My partner and I never seem to resolve our disagreements about sexual matters"). The SSS-W includes six dimensions of women's sexual function, one of which is communication about the sexual relationship. This measure is unique in that it asks about emotional aspects of sexual communication (e.g., "I have no difficulty talking about my deepest feelings and emotions").

Frequency of Sexual Communication.—Measures of frequency of sexual communication are the Golombok-Rust Inventory of Sexual Satisfaction, Non-Communication Subscale (GRISS; Rust & Golombok, 1986) and Hurlbert's Index of Sexual Assertiveness (HISA; Hurlbert, 1991). A number of researcher-created measures for specific studies measure the presence (yes/no; e.g., Ferroni & Taffe, 1997; Merwin, 2017) and frequency of sexual communication (Applebaum, 1983; McIntyre-Smith, 2010; Perlman, 1980).

Coding Procedure

A detailed code sheet was developed to collect relevant information for the meta-analysis. The following study elements were coded (see online Supplementary Table S16): study characteristics (e.g., type of publication); sample characteristics (type of sample (e.g., convenience), data collection method (e.g., internet survey), study design (e.g., where participants were recruited)); description of the sample (e.g., mean age and mean relationship length of the sample); measurement (e.g., name of the sexual communication measure, and alpha of the scale); and effect size information (e.g., dimension of sexual function, type of statistic reported).

Some dimensions of sexual function were consolidated because they were examined in only a few studies. For example, ejaculation was grouped with orgasm for men. The vast majority of studies examined premature ejaculation rather than delayed ejaculation; to maintain consistent effect sizes, we did not analyze studies that examined delayed ejaculation. Studies

that included female participants varied in the ways in which they measured pain; some used a numerical rating scale, whereas others used a validated psychometric instrument, and still others used a clinical diagnosis. Further, due to the time range of our study sample, the diagnostic nomenclature varied; therefore, dyspareunia, vaginismus, and vestibulodynia were grouped under sexual pain.

Articles were coded in Qualtrics (www.qualtrics.com) by the three authors. All articles were cross-coded. Discrepancies were discussed when they arose, and ultimately the three authors selected a final code. Coding discrepancies were recorded in order to calculate a kappa reliability statistic (k = .94).

Analysis Plan

As needed, statistics were converted to correlations (e.g., if a study only provided mean differences; see online Supplementary Table S16) and all correlations were coded so that higher scores on sexual communication and sexual function reflect better sexual communication and sexual function. Correlations were transformed into Fisher's Z for analysis and converted back to Pearson's correlations for the presentation of results (Card, 2011). We conducted a series of meta-analyses using random effects analyses, which allow for generalization beyond the set of included studies (Card, 2011), and mixed effects analyses to test moderators of the mean effect sizes. For mixed effects analysis, continuous moderators were coded as such (e.g., mean age was coded in year), two-level moderators (e.g., gender) were dichotomized, and three level moderators (e.g. relationship status) were dummy coded and one was left out as a reference for analyses. A number of studies had multiple reports—either partners in a couple or multiple measures of a dimension of sexual function. Studies that assessed desire, arousal, orgasm, and overall sexual function had multiple effects sizes for both men and women. We therefore used three-level and two-level multilevel models (Konstantopoulos, 2011), respectively, to model dependence where multiple effect sizes were nested within gender, and gender within studies for desire, arousal, and orgasm, as well as multiple effect sizes nested within studies for lubrication, erection, and pain. In our first analysis, we assessed the mean effect size for each dimension of sexual function un-stratified by gender with three-level models and also stratified by gender using two-level models. Next, we tested the dimension of sexual function as a moderator of the overall effect size in both un-stratified and gender stratified models. We then tested three-level models with moderators un-stratified by gender. We also stratified our analyses by gender to assess effect sizes with two-level models and finally, we analyzed the effect of publication bias.

We used Q, tau (τ), I^2, and R^2 to interpret the total heterogeneity, standard deviation from the mean effect sizes, and proportion of variability between studies, respectively. Q represents the total heterogeneity in an aggregate effect size, and when moderators are included in the model, Q represents residual heterogeneity, and Q_M the variability accounted for by moderators. τ quantifies the standard deviation from the mean effect size between-studies, and when τ is squared, it indicates the variance of the mean effect size—the higher the value, the more variance between studies. I^2 represents the *proportion* of the total heterogeneity that can be attributed to between-study variance (Borenstein, Higgins, Hedges,

& Rothstein, 2017) and it is interpreted on a scale of 100%; an I^2 of 0 indicates that all of the variability in effect sizes is within studies, whereas an I^2 of 100 indicates that all heterogeneity is due to between-study variability. Less between-study variance suggests that the differences in effect sizes can be attributed to sampling or measurement error rather than to "true" differences between studies and effect sizes (Borenstein et al., 2017). When testing moderators, R^2 is used to examine the amount of variance explained by including the moderator in the model. In a three-level multi-level modeling framework, it is possible to parse apart the variance explained at the within levels from the variance explained at the between levels of the model. We present the R^2 data in the tables of all three-level model analyses and discuss them in the text when moderators are significant.

A primary threat to meta-analyses is publication bias (Rosenthal, 1979). Publication bias refers to researchers' and reviewers' preference for statistically significant results. Based on the significance or non-significance of results, researchers may choose or not choose to submit a manuscript, and manuscripts with significant results are more likely to be published. When studies with small or null effects are not present to balance results, published effect sizes are biased away from zero leading to an over estimation of the mean effect size (Stanley, 2008).

We addressed publication bias a priori by searching multiple databases, including dissertations, and reviewing reference lists of included articles. We statistically tested for publication bias using Vevea and Woods' (2005) three parameter selection method (3PSM) for small meta-analyses, which we conducted using the weightr (Coburn & Vevea, 2017) package in R (R Foundation, 2015). The 3PSM for small meta-analyses estimates reasonable[1] corrected effect size and variance parameters with researcher-specified weights (i.e., the probability that a study within a particular p-value range would be published) for a range of p-values (e.g., $.01 \geq p \leq .05$). Because the weights values are set a priori by the researcher, standard errors are not estimated and statistical significance cannot be calculated. Instead, we assessed how much the estimates of corrected effect sizes change in the presence of moderate and severe, one- and two-tailed publication bias using the weights described in Vevea and Woods (2005). Small or no change in effect size and variance suggests that the effect size is not sensitive to publication bias. We also assessed how many of the effect sizes included in this meta-analysis fell outside of typical levels of significance (i.e., $p < .05$), which provides additional information about the proportion of studies with null effects. It is important to note that the 3PSM estimates do not reflect estimates that account for multiple effect sizes nested within a study and should be interpreted with this in mind.

Lastly, we used Egger's regression (Egger, Smith, Schneider, & Minder, 1997) to assess for publication bias. To do this, we first tested an un-stratified three-level model and a gender stratified two-level model to account for all dimensions of sexual function. We then extracted the effect sizes and standard errors from the estimated model and used them in an Eggers regression. This approach allowed us to control for the different dimensions of sexual

[1]Vevea and Hedges used the term "reasonable" because the corrected effect sizes produced by the weight functions can only be considered "corrected" if we assume the weight functions are an accurate representation of underlying distribution of p-values and probability (weights) of studies with those p-values being published.

function while assessing the presence of publication bias in the literature on sexual communication and sexual function as a whole. Assessing publication bias in the general literature, rather than for specific dimensions, also provided more power which was a concern because Egger's regression tends to be underpowered with small samples (Stanley, 2008).

Results

Overall Effect Sizes by Dimension

Un-stratified by gender, sexual communication was positively associated with sexual desire ($r = .16$, $\tau_{between} = .13$, $\tau_{within} = .05$, 95% CI [.10, .22]). Sexual communication was positively associated with sexual desire for both men ($r = .12$, $\tau = .11$, 95% CI [.04, .20]) and women ($r = .23$, $\tau = .10$, 95% CI [.16, .29]). Similarly, sexual communication was positively associated with sexual arousal un-stratified by gender ($r = .21$, $\tau_{between} = .00$, $\tau_{within} = .11$, 95% CI [.13, .29]) and positively associated with sexual arousal for both men ($r = .16$, $\tau = .09$, 95% CI [.03, .27]) and women, ($r = .24$, $\tau = .12$, 95% CI [.14, .32]). For men, sexual communication was positively associated with erectile function ($r = .19$, $\tau = 0.14$, 95% CI [.07, .31]). For women, sexual communication was positively associated with lubrication ($r = .17$, $\tau = .14$, 95% CI [.01, .32]). Un-stratified by gender, sexual communication was positively associated with orgasm ($r = .23$, $\tau_{between} = .05$, $\tau_{within} = .07$, 95% CI [.19, .27]); it was also positively associated with orgasm for men ($r = .17$, $\tau = .10$, 95% CI [.10, .25]) and women ($r = .24$, $\tau = .05$, 95% CI [.20, .28]). For women, sexual communication was positively associated with less pain ($r = .12$, $\tau = .07$, 95% CI [.07, .18]). Lastly, sexual communication was positively associated with overall sexual function ($r = .35$, $\tau_{between} = .19$, $\tau_{within} = .06$, 95% CI [.28, .41]) for both men and women, for men alone ($r = .37$, $\tau = .18$, 95% CI [.28, .45]), and for women alone ($r = .36$, $\tau = .18$, 95% CI [.28, .43]). Overall, sexual communication was positively associated with all domains of sexual function (see Table 1).

Moderation by Dimension of Sexual Function

We first tested if the four dimensions measured for both men and women (desire, arousal, orgasm, and overall function) differed in the size of their associations with sexual communication in an un-stratified model (see online Supplementary Table S1). Dimension moderated the effect size ($Q_M(3) = 111.87$, $\tau_{between} = .00$, $\tau_{within} = .13$, $p < .001$). Overall sexual function had the largest effect ($r = .38$, 95% CI [.33, .41]) compared to the other dimensions. However, there were no differences between arousal ($r = .17$, 95% CI [.11, .23]), desire ($r = .17$, 95% CI [.12, .21]), and orgasm ($r = .17$, 95% CI [.13, .22]). No variance was explained at the between level ($\tau_{between} = 0$) and a minimal amount of variance was explained at the within level ($R^2_{within} = .01$). This suggests that dimension alone does not explain the association between sexual communication and sexual function.

Next, we compared effect sizes for women where dimension also moderated the effect size ($Q_M(3) = 98.86$, $\tau = .12$, $p < .001$; see online Supplementary Table S1). Overall function had the largest effect size ($r = .35$, 95% CI [.30, .40]), followed by arousal ($r = .26$, 95% CI [.20, .31]), which was not significantly different from desire ($r = .24$, 95% CI [.18, .29]).

Orgasm (r = .21, 95% CI [.16, .26]) was the next largest, but it only significantly differed from pain and overall function. Lubrication (r = .16, 95% CI [.08, .24]) was the second to smallest effect size and only differed significantly from arousal and overall function. Pain (r = .10, 95% CI [.04, .15]) had the smallest effect size, but it did not significantly differ from lubrication.

Finally, we compared effect sizes for men where dimension also moderated the effect size ($Q_M(4) = 83.42$, $\tau = .10$, $p < .001$; see online Supplementary Table S1). For men, overall function had the largest effect size (r = .37, 95% CI [.32, .43]), followed by arousal (r = .22, 95% CI [.13, .30]). Arousal did not significantly differ from orgasm (r = .14, 95% CI [.08, .21]) or erection (r = .16, 95% CI [.08, .24]). Orgasm and erection only differed from each other and overall function. Desire (r = .10, 95% CI [.03, .17]) was the smallest effect size, but it only significantly differed from arousal and overall sexual function.

Moderator analyses by Dimension

Desire.—The only moderator of the association between sexual communication and sexual desire was gender ($Q_M(1) = 7.34$, $\tau = .12$, $p < .05$) (see Table 2). The effect size for sexual communication and sexual desire was stronger for women (r = .21, 95% CI [.15, .27]) than for men (r = .12, 95% CI [.05, .19]).

Arousal.—There were no significant moderators of the association between sexual communication and sexual arousal (see online Supplementary Table S3).

Lubrication.—There were too few effect sizes to examine moderators for lubrication.

Orgasm.—Gender was the only significant moderator of the relationship between sexual communication and orgasm ($Q_M(1) = 10.45$, $\tau = .08$, $p < .001$; see online Supplementary Table S4). The effect size for sexual communication and orgasm was stronger for women (r = .26, 95% CI [.21, .30]) than for men (r = .16, 95% CI [.11, .22] (see Table 2).

Overall Sexual Function.—The relationship status of the participants in a study was a significant moderator of the association between sexual communication and overall sexual function ($Q_M(2) = 11.11$, $\tau_{between} = .15$, $\tau_{within} = .06$, $p < .001$; see online Supplementary Table S6). The effect size for sexual communication and overall sexual function was strongest when participants were married (r = .47, 95% CI [.37, .56]) compared to participants who were dating (r = .11, 95% CI [−0.12, .34]) or to participants who were either dating or married (r = .31, 95% CI [.23, .38]).

The location in which the study took place (inside vs. outside the U.S.) was also a significant moderator ($Q_M(1) = 8.55$, $\tau_{between} = .15$, $\tau_{within} = .06$, $p < .001$) of the relationship between sexual communication and overall sexual function (see online Supplementary Table S6). The location of the study accounted for 27% of the variance between studies. The effect sizes for the association between sexual communication and overall sexual function were higher for studies conducted outside of the U.S. (r = .39, 95% CI [.32, .45]) than for studies conducted in the U.S. (r = .12, 95% CI [.06, .18]). There were enough studies from five specific countries (the U.S., Australia, Ghana, Canada, and the Netherlands) that we were able to

compare their effect sizes. Ghana had the largest effect size ($k = 6$, $r = .46$, 95% CI [.35, .56]), followed by Canada ($k = 11$, $r = .40$, 95% CI [.29, .49]). The next largest effect size was the Netherlands ($k = 6$, $r = .33$, 95% CI [.17, .47]); however, it was not significantly larger or smaller than those of the other countries. The next largest was Australia ($k = 5$, $r = .21$, 95% CI [.04, .37]); Australia's effect size was significantly smaller than Ghana's. The U.S. had the smallest effect size ($k = 6$, $r = .14$, 95% CI [−.01, .28]), and the U.S.'s effect size was significantly smaller than the effect size for Ghana.

To further elucidate differences in the association between sexual communication and overall sexual function by country, we examined two country-level cultural dimensions post-hoc: indulgence and individualism. These two dimensions come from Hofstede's model of cultural dimensions (Hofstede, Hofstede, & Minkov, 2010) and may help explain cultural differences in the association between sexual communication and overall sexual function.[2] Briefly, indulgence reflects a culture's tendency to favor engagement in or restraint from instant gratification of natural human drives (Hofstede et al., 2010). Countries that score highly on the indulgence dimension exhibit a willingness to engage with their impulses and desires, whereas lower scores reflect a culture of restraint. The degree of individualism associated with a given country indicates the degree to which a culture defines the self individually or through close social networks (i.e., collectivism; Hofstede et al., 2010); high scores on this dimension indicate greater individualism. Although this analysis was exploratory, we expected that cultures higher in indulgence would speak more freely about sex and have less restrictive social values about sexuality, weakening the link between sexual communication and sexual function. In more collectivistic cultures, prioritizing in-group harmony might lead to a stronger association between sexual communication and sexual function. That is, poor sexual communication may be more strongly linked with poor sexual function. Cultures that value the group over the individual typically engage in more indirect and context driven communication (Hofstede, 2015), which may not be practical for discussing individual-level concerns about sexual function (Leclerc, 2015).

Indulgence did not moderate ($Q_M(1) = .62$, $\tau_{between} = .18$, $\tau_{within} = .06$, $p < .001$) the association between sexual communication and overall sexual function (b = −.004, 95% CI [−0.01, 0.01]). However, individualism did moderate ($Q_M(1) = 10.81$, $\tau_{between} = .14$, $\tau_{within} = .06$, $p < .001$) the relationship between the two constructs (b = −.004, 95% CI [−0.01, 0.00]); individualism accounted for 37% of the variance between studies. We used the predict () function in the *metafor* package (Viechtbauert, 2010) to predict the magnitude of effect sizes at different levels of individualism. We used the un-centered individualism variable, and examined changes in effect sizes at different levels of individualism in increments of 20. At zero ($r_0 = .54$), there is a large effect size. However, as individualism increases ($r_{20} = .49$, $r_{40} = .43$, $r_{60} = .37$, $r_{80} = .30$, $r_{100} = .23$), the magnitude of the effect size shrinks. This indicates that in more individualistic cultures there may be a smaller association between sexual communication and sexual function.

[2]We obtained the scores of individualism and indulgence from Hofstede's website for the cultural dimension model (https://www.hofstede-insights.com/). In addition to providing an overview of the model, the website has an online tool to compare countries across all six dimension of the cultural dimensions model. A description of the cultural dimension model and how the scores are calculated can be found in Hofstede et al., 2010.

Moderators stratified by gender.

There were no significant moderators for any of the men's effect sizes and there were too few effect sizes to test moderators for men's arousal and erection (see online Supplementary Tables S11-S13), so all moderators discussed here pertain to women.

The effect size for sexual communication and sexual arousal was moderated by the clinical status of the sample ($Q_M(2) = 11.01$, $\tau = .06$, $p < .001$). The effect size was largest for studies with mixed samples ($r = .39$, 95% CI [.28, .46]) compared to non-clinical ($r = .21$, 95% CI [.13, .29]), and clinical ($r = .08$, 95% CI [−.10, .27]) samples (see online Supplementary Table S7).

Sample type (clinical, non-clinical, or mixed) also moderated the association between sexual communication and orgasm ($Q_M(2) = 12.19$, $\tau = 0$, $p < .001$). The effect size was largest for mixed samples ($r = .29$, 95% CI [.25, .33]) compared to non-clinical samples ($r = .19$, 95% CI [.14, .23]). However, there was no significant difference between clinical ($r = .26$, 95% CI [.20, .21]) and mixed samples nor was there a difference between clinical and non-clinical samples (see online Supplementary Table S8).

The country in which the study was conducted moderated the association between sexual communication and overall sexual function ($Q_M(1) = 7.46$, $\tau = .15$ $p < .01$; see online Supplementary Table S10. The effect sizes from studies conducted outside of the U.S. ($r = .40$, 95% CI [.33, .48]) were larger than those from studies conducted in the U.S. ($r = .17$, 95% CI [.00, .32]). However, there were not enough studies in each country to compute the same country-level comparison as with the un-stratified model. Further, neither indulgence ($Q_M(1) = 2.12$, $\tau = .17$ $p = .15$) nor individualism ($Q_M(1) = 2.17$, $\tau = .17$, $p = .14$) moderated these effect sizes for women (see online Supplementary Table S10).

There were no significant moderators for the associations between sexual communication and desire, sexual communication and pain (see online Supplementary Tables S6 and S9), and moderation was not tested for sexual communication and lubrication.

Publication Bias

The three-parameter selection method (3PSR; Vevea & Woods, 2005) showed little indication that publication bias explained the associations described above (see Table 3). Un-stratified by gender, arousal (67%) had the most effect sizes that were $p > .05$, followed by lubrication (60%), pain (50%), desire (41%), orgasm (32%), erection (29%), and overall sexual function (20%). Thus, based only on the number of significant and non-significant effect sizes, there is little indication of publication bias for the un-stratified effect sizes for sexual arousal and lubrication. For sexual pain and desire, there were a similar number of significant and non-significant effect sizes. The effect sizes for erection and overall sexual function had an overrepresentation of significant effect sizes, which may indicate publication bias.

In the presence of moderate one-tailed publication bias, effect sizes decreased on average by 13% and the standard deviation increased by 10%. With respect to severe one-tailed publication bias, effect sizes decreased by an average of 40% and the standard deviation

increased by 30%. In the presence of moderate two-tailed publication bias, effect sizes decreased by 7%, and the standard deviation decreased by 2%, whereas severe two-tailed publication bias led to a 7% decrease in effect sizes and a 4% increase in the standard deviation. With the exception of the severe one-tailed publication bias, the 3PSM generally suggested little influence of publication bias (see Table 3).

The dramatic attenuation of effect sizes in the context of severe one-tailed publication bias does warrant attention. Orgasm and overall sexual function had the smallest decrease in effect size (12% and 18%, respectively) in the severe one-tailed publication bias scenario, which may indicate that these estimates are not explained by publication bias. In contrast, effect sizes for desire, arousal, lubrication, erection, and pain may be partially explained by publication bias. The same pattern was found when examining publication bias in effect sizes stratified by gender. Women's effect sizes (see online Supplementary Table S14) were not attenuated as severely in the presence of severe one-tail publication bias (mean %Δ = 17%) compared to men's (mean % Δ = 41%; see online Supplementary Table S15). Thus, there is evidence that effect sizes for women are likely not due to publication bias and that publication bias present in overall effect sizes may be due to effect sizes from men.

In sum, there is evidence that for overall sexual function, orgasm, and erectile difficulties, there are fewer studies with null effects. However, in three of the four publication bias scenarios, effect sizes were not severely attenuated, supporting the notion that publication bias does not fully explain the reported effect sizes, particularly for orgasm and overall sexual function. In the context of severe one-tailed publication bias, men's effect sizes might be more biased and there are notably fewer effect sizes for men, which may explain the presence of publication bias.

Finally we used Egger's regression to assess publication bias using the effect sizes and standard errors extracted from a three-level model of the aggregated effect size for studies that assessed desire, arousal, orgasm, and overall sexual function. These dimensions were included as moderators. There was no indication of publication bias ($Z_1 = -.42$, $p = .96$, $k = 125$). The same was true for the two-level model for men which also included erectile difficulties as a moderator ($Z_1 = .82$, $p = .51$, $k = 53$) and the two-level model for women which also accounted for lubrication and pain as moderators ($Z_1 = 1.33$, $p = .80$, $k = 99$). Taken together, the results from Egger's Regression provide little evidence for publication bias.

Discussion

To our knowledge, this is the first meta-analysis to assess the relation between couples' sexual communication and the various dimensions of sexual function in both men and women. Sexual communication was positively associated with all domains of sexual function (desire, arousal, erection, lubrication, orgasm, less pain) and overall sexual function, but the strength of the associations varied across domains, with the largest effect size for overall sexual function. With respect to desire and orgasm, associations with sexual communication were stronger for women than for men. Gender also moderated the relationships between sexual communication and desire and between sexual communication

and orgasm, which were both stronger for women than for men. Relationship status was an important moderator of the link between sexual communication and overall sexual function (un-stratified by gender). The association was stronger for studies in which participants were married than for studies that included participants with a range of relationship statuses, and the link between sexual communication and overall sexual function was stronger in studies conducted outside of the U.S. than in those conducted within the U.S. Among women, the associations between sexual communication and arousal and sexual communication and orgasm were larger in samples with mixed clinical statuses compared to homogenous clinical or non-clinical samples. Consistent with the un-stratified effect sizes, studies conducted outside of the U.S. had larger effect sizes than those conducted within the U.S. for women. There were no moderated effect sizes for men.

Though our findings indeed indicate that better sexual communication is associated with greater sexual function, we found that sexual communication plays a particularly strong role in facilitating women's sexual desire. This finding is supported by a large (N > 10,000), nationally representative study of men and women living in Britain, which found strong, negative associations between ease of talking about sex and lack of interest in sex for both men and women; however, this association was stronger for women (Graham et al., 2017). One possible explanation for this finding is that women may be more likely to experience responsive rather than spontaneous desire (Basson, 2000, 2001, 2002; Both & Everaerd, 2002), and responsive desire may depend more on effective communication than does spontaneous desire. Basson (2002) has argued that a woman may have little or no desire at the start of a sexual encounter, but may be receptive to the experience for other reasons, such as increased emotional closeness. This receptivity may lead to positive emotional and physical outcomes, which increases motivation and receptivity to future sexual encounters (Basson, 2004, 2005). Sexual communication facilitates this cycle, as women who are more likely to respond positively to their partners' advances may also be more comfortable discussing sexual topics within the context of the relationship.

Couples' sexual communication, though important for both men and women's orgasmic function, appears to be particularly relevant to the orgasmic function of women with sexual problems. It is not surprising that this finding emerged specifically for women, as evidence has consistently suggested that when women openly communicate about sexual likes and dislikes with their partners, they report more frequent orgasms (Meston et al., 2004). A similar mechanism may be at play with respect to lubrication (for women) and erection (for men). In accordance with MacNeil and Byers' (2005, 2009) instrumental pathway, perhaps individuals who are more able to communicate their sexual likes and dislikes may also be able to communicate both the level and type of stimulation they need in order to experience these aspects of physiological arousal (Masters & Johnson, 1970). Receiving appropriate levels of stimulation and reaching a certain level of physiological arousal is necessary for achieving orgasm.

We also found that relationship status moderated the association between sexual communication and overall sexual function, such that there was a stronger correlation for studies with married participants than for studies that included participants with mixed relationship statuses. Often, mean relationship lengths tend to be longer in samples of

married participants than in samples of single participants, and married participants are typically older (see Brien, Lillard, & Stern, 2006). These characteristics make it challenging to determine how the relationship status variable moderates the link between sexual communication and sexual function. For example, erectile function declines with age (Corona et al., 2013), and, though patterns for women vary, sexual function generally decreases after age 45 (Hayes & Dennerstein, 2005). In marriage, sexual satisfaction gradually declines over time (Schmiedeberg & Schröder, 2016), and there is only cross-sectional data indicating that sexual communication increases with relationship duration (e.g., Wheeless et al., 1984). Similarly, data on the association between sexual communication and age is mixed, likely due to the limitations of cross-sectional studies. Given that relationship status is an important moderator of the link between sexual communication and sexual function, future research should attempt to identify the specific ways in which relationship status interacts with different domains of sexual function.

Our study also highlights the importance of considering the country in which the study was conducted when interpreting results. We found there to be a stronger effect of sexual communication on sexual function in studies that took place outside of the U.S. compared to those that were executed within the U.S. In particular, sexual communication appears to be strongly tied to sexual function in more collectivistic countries like Ghana, where discussions about sex may be considered taboo (Cobbett, McLaughlin, & Kiragu, 2013). One potential explanation for the differences in effect sizes by country is that a stronger group mentality may strengthen the link between sexual communication and sexual function while more individualistic tendencies may weaken this link. For example, young people in Ghana rarely discuss their sexual relationships with adults outside of church and school (Bochow, 2012). If they do, adults may consider the youth disrespectful because talking about sex is seen as similar to making claims to seniority (Bochow, 2012). It is possible that this influences the association between sexual communication and sexual function.

Alternatively, if discussing sex is considered taboo in collectivistic cultures (Triandis, 2018), it is possible that individuals may not often directly communicate their sexual likes and dislikes with their partners. It would arguably be more challenging to engage in mutually satisfying sexual activities without such communication. Thus, the lack of common sexual discourse may magnify the effect of talking about sex with one’s partner. Relative to collectivistic cultures, sexuality is less taboo in individualistic cultures such as Canada, the Netherlands, Australia, and the U.S., and therefore may be discussed more frequently or more openly. Individualistic cultures also tend to tolerate a variety of sexual beliefs and practices which may deemphasize cultural norms around the topic, thus decreasing the effect of sexual communication on sexual function.

The clinical status of the sample emerged as a significant moderator of the association between sexual communication and arousal and between sexual communication and orgasm. Mixed clinical samples had the largest effect size. In clinical samples, participants may be in treatment for reasons other than sexual dysfunction, such as cancer (e.g., Ussher et al., 2016). These diagnoses might account for changes in arousal or orgasm and mitigate the impact of sexual communication on sexual function. Alternatively, an exclusively non-clinical sample may not, on average, have the same level of difficulty with sexual

communication or distress about sexual function as would a clinical sample. A mixed sample might therefore provide a broader range of factors related to sexual distress and to sexual communication.

Limitations and Future Directions

This meta-analysis has several limitations that should be noted. First, more studies assessed female sexual function than male sexual function. Beyond the positive association between sexual communication and erectile function, we could only draw limited conclusions on the relationships between sexual communication and other domains of male sexual function. Moreover, there was some, though not conclusive, evidence for publication bias with respect to the relationship between erectile function and sexual communication. Although publication bias does not fully explain the reported effect sizes, it is important to consider the implications of this potential bias. Selective publication of significant results suggests that there may be unreported relationships between sexual communication and erectile function and potentially between sexual communication and other components of male sexual function. This seems consistent with the larger body of male sexual function research, which appears to be largely phallocentric and neglectful of other dyadic and relationship dimensions (McCabe & Althof, 2014). Societal narratives often equate erections with healthy sexual function in men. Future research should attempt to identify the ways in which other domains of sexual function contribute to positive sexual experiences among men, and then examine potential associations between all relevant domains and sexual communication.

Unfortunately, there is almost no research on sexual communication and sexual function among same-sex or mixed orientation couples. Only three studies included in our analyses (Applebaum, 1983; Holmberg & Blair, 2009; Ussher et al., 2016) explicitly recruited lesbian, gay, and/or bisexual participants who were in a relationship, one of which was a dissertation from over 30 years ago. Future studies should examine the association between sexual communication and sexual function among sexual and gender minorities in relationships. Such studies could inform future prevention programs and intervention efforts, potentially leading to reductions in sexual difficulties among these populations.

The country in which a study was conducted played a substantial role in understanding the link between sexual communication and overall sexual function. However, no studies examined these differences or similarities across countries. There is little research on cross-cultural differences in sexual communication, and despite relatively extensive global research on the prevalence of sexual problems around the world, we know little about how culture influences the relationship between sexual communication and sexual function. Additionally, though the majority of studies were conducted outside of the U.S., we were only able to include studies published in English, and these studies are more likely to have statistically significant results (Egger et al., 1997). We attempted to address this limitation by testing for publication bias, but ultimately we cannot conclusively determine if we missed critical papers that were not published in English.

Methodologically, four limitations in this study can inform future research on couples' sexual communication and sexual function. First, as we collected studies, we noticed a lack

of longitudinal research on sexual communication and sexual function. This observation reflects a larger problem in sex research. Given that sexual function changes over time (Corona et al., 2013; Hayes & Dennerstein, 2005), longitudinal research on sexual function would allow researchers to better understand the changes in the association between sexual communication and sexual function over time.

Second, it is critical that future studies collect data from both partners. Emerging evidence suggests that dyadic sexual communication plays an important role in mitigating sexual pain for women (Rancourt et. al., 2016, 2017; Rosen et. al., 2014). However, the paucity of dyadic research on sexual communication and sexual function made it impossible to examine partner effects of sexual communication.

Third, all measures of sexual communication were self-report; observational studies were not included in this meta-analysis. Observational methods are slowly emerging as a way to study affect and behavior between partners when they discuss sexual problems (e.g., Rehman, Lizdek, Fallis, Sutherland, & Goodnight, 2017). These methods have yet to be used in studies that focus on sexual function. Data from observational studies could enhance our understanding of couples' sexual communication by providing a more nuanced context for the content and context of the conversation.

Finally, while some treatments for distinct sexual concerns may contain modules on sexual communication (e.g., cognitive behavioral therapy for genito-pelvic pain), there is a lack of evidence-based interventions that specifically aim to improve sexual communication among couples (for an exception, see Rosier & Tyler, 2017). This dearth of psychosocial treatment options is concerning, especially given the abundance of interventions that focus on improving general communication among couples (e.g., Markman, Stanley, & Blumberg, 1994). Further, although our meta-analysis found small positive associations between sexual communication and sexual function for men and women, experimental studies are needed to better understand the directionality of these relationships, identify relevant mediators and moderators, and document potential negative associations between sexual communication and sexual function. Future research should also aim to develop dyadic interventions that focus on improving sexual communication to assess if sexual communication does enhance sexual function. Relatedly, future research may to be needed to determine if couples' sexual communication is an appropriate outcome measure for sexual dysfunction intervention studies.

Conclusion

Despite these limitations, this study is the first to examine the associations between sexual communication and the relevant domains of sexual function for both men and women. As such, it provides critical information on the aspects of sexual function that are most strongly linked with sexual communication and on the moderators that influence these relationships. Our finding that both gender and relationship status significantly moderated the association between sexual communication and specific domains of sexual function has implications for the development or refinement of couples-based interventions to enhance sexual communication and sexual function. These interventions should be developed with careful

consideration for gender, relationship type, and researchers should aim to recruit sexual and gender minority populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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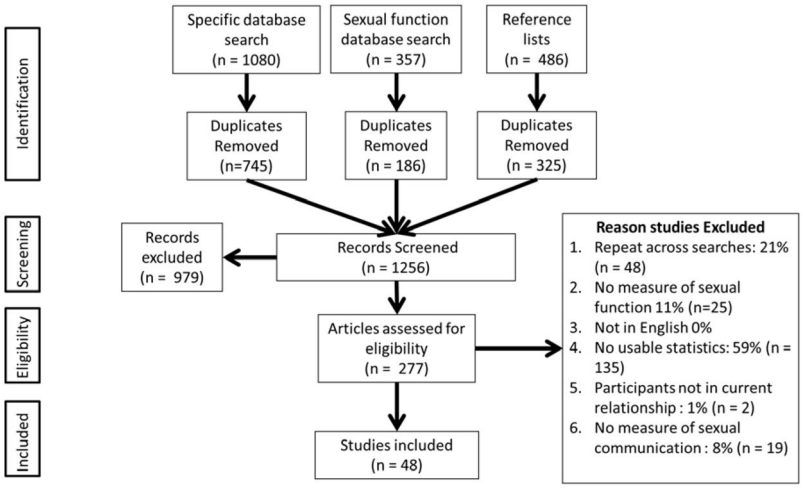

Figure 1.
Flow Diagram of Article Screening Process.

Table 1

Overall Effect Sizes

Dimension	*r*	*SE*	*ciLL*	*ciUL*	*crLL*	*crUL*	*studies*	*k*	$\tau_{between}$	τ_{within}	I^2_{total}	$I^2_{between}$	I^2_{within}	Q_{total}
Un-stratified														
Desire	0.16***	0.03	0.10	0.22	−0.11	0.41	23	34	0.13	0.05	78.31	69.74	8.57	175.85***
Arousal	0.21***	0.04	0.13	0.29	−0.03	0.43	11	15	0.00	0.11	73.01	0.00	73.01	45.33***
Orgasm	0.23***	0.02	0.19	0.27	0.09	0.36	25	37	0.05	0.07	56.13	13.44	42.69	83.19***
Overall	0.35***	0.04	0.28	0.41	−0.01	0.63	28	40	0.18	0.06	87.21	77.46	9.75	254.44***
Men														
Desire	0.12***	0.04	0.04	0.20	−0.11	0.34	11	13	0.11	--	67.37	--	--	37.48***
Arousal	0.16**	0.06	0.03	0.27	−0.06	0.36	3	4	0.09	--	61.46	--	--	7.75
Orgasm	0.17***	0.04	0.10	0.25	−0.04	0.38	11	12	0.10	--	67.27	--	--	39.12***
Overall	0.37***	0.05	0.28	0.45	0.02	0.63	16	17	0.18	--	84.83	--	--	99.43***
Erection	0.19***	0.06	0.07	0.31	−0.11	0.46	7	7	0.14	--	76.95	--	--	24.70***
Women														
Desire	0.23***	0.03	0.16	0.29	0.01	0.42	16	19	0.10	--	69.91	--	--	78.59***
Arousal	0.24***	0.05	0.14	0.32	−0.01	0.46	10	11	0.12	--	72.64	--	--	31.36***
Orgasm	0.24***	0.02	0.20	0.28	0.13	0.34	19	24	0.05	--	35.76	--	--	30.15
Overall	0.36***	0.05	0.28	0.43	0.01	0.62	19	20	0.18	--	86.43	--	--	133.20***
Lubrication	0.17*	0.08	0.01	0.32	−0.15	0.46	5	5	0.14	--	74.17	--	--	17.39***
Pain	0.12***	0.03	0.07	0.18	−0.02	0.26	17	20	0.07	--	43.52	--	--	37.19**

Note. For the un-stratified models, we used a three-level model with effect sizes nested within gender, nested within study. For the gender stratified models, we could not nest the effect sizes within gender, so a two-level model was used. *r* = effect size; *SE* = standard error; *ci* = confidence intervals which represents the bounds where estimates would fall 95% of the time if the analysis was replicated an infinite number of times; *cr* = credibility/prediction intervals which represent the bounds where 95% of the true outcomes fall for the effect size; *LL* = Lower limit of 95% confidence or credibility/prediction interval; *UL* = Upper limit of 95% confidence or credibility/prediction interval; studies = the number of studies; *k* = the number of effect sizes; τ =standard deviation in effect size; I^2 = proportion of heterogeneity. Q_{total} = total heterogeneity in mean effect size.

Table 2

Gender Differences in Effect Sizes

Dimension	Moderator	*r*	*SE*	*ciLL*	*ciUL*	*crLL*	*crUL*	*k*	τ	I^2	Q_E	Q_M
Desire	Men	0.12***	0.04	0.05	0.19	−0.12	0.35	13	0.12	72.93	116.07***	7.34**
	Women	0.21***	0.03	0.14	0.27	−0.03	0.42	19				
Arousal	Men	0.16***	0.05	0.05	0.26	−0.09	0.39	4	0.11	70.76	39.11***	2.74
	Women	0.23***	0.04	0.14	0.31	−0.01	0.44	11				
Orgasm	Men	0.16***	0.03	0.11	0.22	0.00	0.32	12	0.08	55.37	69.27***	10.45***
	Women	0.26***	0.03	0.21	0.30	0.10	0.40	24				
Overall	Men	0.34***	0.04	0.26	0.41	−0.02	0.62	17	0.19	87.02	232.63***	2.65
	Women	0.39***	0.03	0.31	0.45	0.03	0.65	20				

Note. *r* = effect size; *SE* = standard error; ; *ci* = confidence intervals which represents the bounds where estimates would fall 95% of the time if the analysis was replicated an infinite number of times; *cr* = credibility/prediction intervals which represent the bounds where 95% of the true outcomes fall for the effect size; *LL* = Lower limit of 95% confidence or credibility/prediction interval; *UL* = Upper limit of 95% confidence or credibility/prediction interval; studies = the number of studies; *k* = the number of effect sizes; τ =standard deviation in effect size between studies; I^2 = proportion of between study heterogeneity. Q_{total} = total heterogeneity in mean effect size. When Q_M is significant it indicates a significant gender difference.

Table 3

Three Parameter Selection Tests for Publication Bias Un-stratified by Gender

	Un-adjusted Random Effects Model					Weight Function Models															
						Mod one-tail				Severe one-tail				Mod two-tail				Severe two-tail			
Model	***k***	***Z***	***SE***	**τ**	**%ns**	**B_0**	**%Δ**	**τ**	**%Δ**	**B_0**	**%Δ**	**τ**	**%Δ**	**B_0**	**%Δ**	**τ**	**%Δ**	**B_0**	**%Δ**	**τ**	**%Δ**
Desire	34	0.19	0.03	0.13	0.41	0.16	0.16	0.14	0.08	0.09	0.52	0.17	0.28	0.17	0.07	0.13	0.00	0.16	0.07	0.13	0.00
Arousal	15	0.21	0.04	0.11	0.67	0.18	0.12	0.12	0.13	0.12	0.41	0.15	0.40	0.19	0.07	0.11	0.05	0.18	0.07	0.12	0.09
Lubrication	5	0.17	0.07	0.12	0.60	0.14	0.18	0.13	0.10	0.07	0.60	0.16	0.33	0.16	0.08	0.12	0.01	0.14	0.08	0.12	0.01
Orgasm	37	0.22	0.02	0.08	0.29	0.21	0.05	0.08	0.07	0.19	0.12	0.09	0.18	0.21	0.04	0.08	0.04	0.20	0.04	0.08	0.11
Erection	7	0.20	0.06	0.13	0.29	0.17	0.15	0.14	0.12	0.10	0.52	0.17	0.37	0.18	0.07	0.13	0.02	0.16	0.07	0.13	0.03
Pain	20	0.13	0.03	0.07	0.50	0.11	0.16	0.08	0.11	0.07	0.44	0.09	0.32	0.12	0.09	0.07	0.00	0.10	0.09	0.07	−0.02
Overall	40	0.36	0.03	0.18	0.20	0.33	0.06	0.19	0.08	0.29	0.18	0.22	0.23	0.34	0.04	0.18	0.03	0.32	0.04	0.19	0.07
Mean %Δ							0.13		0.10		0.40		0.30		0.07		0.02		0.07		0.04

Note. Because weights at each interval of p-values were not estimated a standard error was not provided for the reasonable corrected effect sizes. We report Fishers Z, rather than Pearson's correlations because the estimates provided (B_0 and τ) do not account for dependent effect sizes. Additionally, the reasonable corrected effect sizes should not be interpreted as truly corrected because they only represent the corrected effect size if the amount of publication bias specified is accurate which is not knowable. *k* = the number of effect sizes; *Z* = Fisher's Z transformation of correlations; *SE* = standard error; *τ*= between study standard deviation in effect size; *%ns* = the percent of studies in the meta-analysis where p > .05; B_0 = intercept of weight function model (i.e. the reasonable corrected effect size); %Δ = Percent change—note that percentages are reported as decimals to conserve space and represent *absolute* change; Mod 1-tail = moderate one-tail publication bias; Severe1-tail = Severe one-tail publication bias; Mod 2-tail = moderate two-tail publication bias; Severe2-tail = Severe two-tail publication bias.