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MOTIVATIONAL INTERVIEWING FOR PROBLEM AND PATHOLOGICAL GAMBLING: A SYSTEMATIC REVIEW AND META-ANALYSIS

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BY

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DISSERTATION

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"No one is alone" – Stephen Sondheim, *Into the Woods*

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Abstract

As the prevalence of gambling problems is expected to rise, there is interest in psychological interventions that address them. A meta-analysis (Yakovenko, 2015) concluded that Motivational Interviewing (MI) was associated with reductions in gambling frequency and intensity. Yet, that analysis only included five studies and had methodological limitations. The current study performed an updated systematic review and meta-analysis that 1) characterized the literature on MI-based interventions (MBIs) targeting gambling, 2) quantified their effect on gambling outcomes, 3) identified conditions that strengthen or weaken MBI's effects. Ten studies were identified in the search. MBIs showed a small superior effect on gambling frequency (g=-.12) and intensity (g=-.15) and no effect on gambling severity, relative to controls. Higher effect sizes were associated with the inclusion of assessment feedback and the use of inactive comparison groups. Recommendations for future research are offered and include the use of objective fidelity monitoring to ensure MI delivery.

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Introduction

In 2018, the United States (US) Supreme Court overturned the Professional and Amateur Sports Protection Act, granting states the power to determine the legality of sports gambling (Liptak & Draper, 2018). Since the ruling, 33 states have legalized sports wagering as of [insert year], and calls to the National Problem Gambling Helpline have correspondingly increased by 84% from 2020-2021 (National Council on Problem Gambling, n.d. -a). As in-person gambling becomes increasingly accessible and Internet gambling opportunities proliferate, researchers warn that the rates and absolute numbers of disordered and problem gambling and related harms will rise (Abbott, 2020).

The term "gambling disorder" (pathological) refers to behavior that is persistent and compulsive, disrupting individuals' social and/or professional functioning according to at least four of nine diagnostic criteria described in the Diagnostic and Statistical Manual of Mental Disorders. These criteria include preoccupation with gambling, repeated unsuccessful attempts to control, cut back, or stop gambling behavior, gambling with increasing amounts of money to achieve the desired excitement, and negative interpersonal, occupational, or educational consequences attributable to gambling behavior (American Psychiatric Association, 2013).

Problem gambling describes subclinical gambling behavior, resulting in harm but not fully meeting diagnostic criteria (Weinstock et al., 2017). The standardized past year prevalence rate of pathological and problem gambling in adults is 3.2% in the U.S. (Gabellini et al., 2023). The National Council on Problem Gambling estimates the social cost of problem gambling in the US to be $7 billion annually, including criminal justice and healthcare spending, job loss, bankruptcy, and other societal costs (n.d. -b).

The harms associated with pathological and problem gambling are well-documented and include financial impacts, damage to personal relationships, vocational problems, and psychological distress (Abbot et al., 2018). These harms disproportionately affect those already experiencing social and economic disadvantage, exacerbating these inequities, including through financial problems that have generational effects (Langham et al., 2016; Wardle et al., 2019).

Additionally, prevalence data suggest that 96% of those who meet DSM criteria for pathological gambling also meet lifetime criteria for one or more additional psychiatric disorders (Kessler et al., 2008). Specifically, individuals with problem or pathological gambling experience elevated rates of substance use (57.5%), mood (37.9%), anxiety (37.4%), and personality (47.9%) disorders (Dowling et al., 2015; Lorains et al., 2011). Indeed, individuals who experience problem gambling also attempt suicide at higher rates than the general population (Kristensen et al., 2023), and in one study, a 15-fold increase in death by suicide compared with the general population was found (Karlsson & Håkansson, 2018). Suicide mortality is also positively associated with the geographical density of casinos and gambling opportunities (Markham et al., 2023).

Motivational Interviewing (MI) is a popular behavioral treatment with demonstrated efficacy in addressing addictive behaviors including alcohol, smoking, and substance use (DiClemente et al., 2017; Lundahl & Burke, 2009; Lundahl et al., 2010). Individuals with gambling problems are often reluctant to seek or accept professional help and identify internal resistance as a primary barrier to treatment (Dabrowska et al., 2017).

A recent meta-analysis found that one in five individuals with problem gambling and one in 25 with moderate-risk gambling seek gambling-related help (Bijker et al., 2022). Various conceptualizations of how addiction and problem/disordered gambling develop in individuals all

include impairment of control and motivation as key components (Heather, 2005; Hodgins, 2015).

The first study of MI for gambling problems found that participants who received MI plus a self-help CBT workbook had superior 3- and 6-month outcomes compared to those who only received the workbook and those in a waitlist condition (Hodgins et al., 2001). Although this did not provide evidence of a direct effect of MI on gambling behavior, it demonstrated that incorporating MI into gambling treatment could be beneficial and paved the way for future research. Numerous studies targeting gambling outcomes have been conducted using MI as either a standalone treatment or in conjunction with another treatment such as cognitive-behavioral therapy, allowing for the combined analysis of mixed findings across studies.

A meta-analysis of MI for gambling (Yakovenko et al., 2015) found a superior overall effect of MI on post-treatment gambling frequency and expenditure compared with non-motivational controls. That work improved understanding about MI's utility in gambling treatment but is limited in several important ways. First, the study reported on a narrow set of gambling outcomes – frequency and expenditure. It did not quantify the impact of MI on gambling disorder symptom severity (measured as the number of symptoms endorsed for a gambling disorder diagnosis), although this outcome is in treatment studies (Walker et al., 2006) as it reflects the potential harms and consequences of gambling behavior. Other meta-analyses show that gambling disorder symptom severity, indicated by measures such as the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV; Frances et al., 1995), is the outcome most improved by treatments such as cognitive-behavior therapy (Pfund et al., 2023). To gain a fuller understanding of MI's effect on problematic gambling, it is important to investigate a broader set of outcomes, including severity.

Second, the previous meta-analysis was limited in the scope of its estimates of MI's effects. The Yakovenko et al., (2015) analysis focused primarily on the statistical significance of the observed effects of MI on gambling frequency and intensity, answering the question about whether the effect of MI on gambling outcomes is precisely zero. One limitation of this approach is that it does not advance understanding about the magnitude of MI's effects on these outcomes. Gaining a precise estimate of the magnitude of the effect of an intervention in a given population via meta-analysis requires a large sample size of studies that are similar in study design, methods, samples, and outcome measures. However, in the absence of a robust and consistent literature, the focus of a meta-analysis can shift to generating a preliminary estimate of a treatment effect across a set of studies, examining the consistency of the effect, identifying differences among the studies that are associated with variation in effects, and providing an estimate of how the variation in effects impacts the certainty of the overall estimated effect size. Yakovenko et al. (2015) tested for heterogeneity using the I^2 statistic, but offered a commonly mistaken interpretation of this statistic, and were unable to probe heterogeneity further due to the limited number of studies in their analysis (Borenstein, 2019). To improve knowledge of MI's impact on gambling behavior and severity, it is important to identify the study conditions under which it exerts stronger and weaker effects, where possible. This would allow researchers to direct their attention and resources to the elements of MI gambling studies that are most likely to have meaningful impacts. The inclusion of a prediction interval would provide an indication of the robustness of MI's effect by estimating what the strength of MI's effect can be expected to be in a future study (IntHout et al., 2016).

A third challenge of the Yakovenko et al. (2015) analysis was the inclusion of individual studies from the third author's research group that used MI interventions in conjunction with

CBT workbooks. Of the five studies included in the meta-analysis, three of them (60%) combined person-delivered MI with a CBT workbook in the same condition and compared participants' outcomes with those who only received a CBT workbook. Such analyses provide useful information about how MI improves or weakens the effect of a CBT workbook, but do not constitute a test of MI's effect on gambling behaviors, the focus of Yakovenko et al.'s (2015) analysis. This is because it is unclear whether MI would offer any benefits without the inclusion of the CBT workbook. Therefore, conclusions about MI's effect on gambling outcomes based on analyses of MI + CBT workbook conditions are potentially misleading and require careful analysis and discussion in the context of other studies. This was not addressed in the previous work.

Fourth, the previous meta-analysis did not sufficiently report on important characteristics of the MI interventions and samples used in the included studies. The study reported on the MI duration, mode of delivery, and therapist, but only provided vague descriptions of the content of the MI interventions. MI is a multi-component intervention that uses a variety of intended therapist skills in concert, some of which have consistent empirical support from numerous research labs. Yet, research on MI delivery finds a high degree of variability in MI practice across therapists, settings, and sessions (Hallgren, 2018). When evaluating MI's effect across different studies via meta-analysis, it is important to determine whether the interventions that were actually, rather than purportedly, delivered constitute the same treatment. Relatedly, the Yakovenko study did not include an evaluation of MI fidelity in the included studies. Reliable coding instruments such as the Motivational Interviewing Treatment Integrity (Moyers et al., 2010) have been developed to measure MI fidelity in practice and research studies. To reliably estimate the summary effect of MI on gambling, it is optimal to demonstrate that studies

reporting to have used MI did indeed use MI and the quality with which it was delivered. Regarding sample characteristics, the previous analysis did not report on the racial or ethnic make-up of participants, leaving issues of generalizability to various groups an open question. Characteristics of gambling severity and recruitment sources of participants across studies were also not included.

Fifth, as Yakovenko et al., (2015) point out, all five of the studies included in their analysis came from the same two research groups. Therefore, there was likely little variation in the various conditions of the studies on which MI's summary effect was based. This makes it difficult to assess whether the observed effects are due to MI itself, or the characteristics of these two research groups that may differ from other contexts in which MI would be targeted to gambling problems. The inclusion of studies that used similar methods performed by different research groups would increase confidence that the effects observed in the previous analysis were not research-group specific.

Finally, several new randomized controlled trials of MI for gambling have been published since the 2015 meta-analysis, allowing for a larger sample size in a potential meta-analysis. For example, Abbott et al., (2018) recruited 188 participants who self-identified a problem with gambling from the New Zealand Gambling Helpline and randomized them to one of four conditions including a one-hour session of MI by phone and a one-hour session of treatment-as-usual (TAU) by phone and compared the groups on posttreatment gambling frequency and severity. The authors found no advantage for MI compared to TAU on gambling intensity and no overall difference between the groups for gambling frequency, although MI showed an advantage in some subgroup analyses. The Abbott et al., (2018) study is notable for

its inconsistency with the findings of the previous meta-analysis and would be important to include in an updated meta-analysis of MI's effects.

Therefore, the purpose of the current study was to expand on the Yakovenko et al. (2015) meta-analysis and conduct an updated systematic review and meta-analysis of motivational interviewing-based interventions (MBIs) for problem and pathological gambling. We chose the term 'motivational interviewing-based interventions' rather than MI because of the variability in the details of the interventions found across gambling studies. For example, some studies report using "Motivational Interviewing" while others report using interventions that are "based on Motivational Interviewing", and still others use Motivational Enhancement Therapy (MET) which adds assessment feedback to traditional MI. Given the lack of consistency in intervention descriptions and the scarcity of objective MI fidelity coding in the studies included in the previous meta-analysis, we believed the MBI descriptor would most accurately reflect the body of work we set out to analyze. Given the modest number of studies and high variability we expected to find in the MI interventions, our purpose was not to generate a precise estimate of MBI's effect on gambling outcomes, but rather to serve as a starting point for future research towards that end. Specifically, we pursued the following two research questions: 1) What is the preliminary quantified estimate of the effect of MBIs compared to non-motivational interventions on gambling behaviors and severity in adults, how robust is this effect, and under what conditions is the effect increased or dampened, based on the extant literature? 2) What are the study-, sample-, and intervention-level characteristics of MBIs used in studies targeting problematic gambling? Answers to the research questions will enhance our understanding of MI's utility in gambling treatment, providing guidance for future research.

Method

This study was conducted in accordance with guidelines put forth in the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA; Page et al., 2020) and A Measurement Tool to Assess Systematic Reviews-2 guidelines (AMSTAR-2; Shea et al., 2017). All study procedures were led by David Forman (DPF). Joseph Bougher (JB), an undergraduate in psychology at the University of Memphis, and Rory Pfund (RAP) Research Assistant Professor at the University of Memphis contributed to study identification, data extraction, and risk of bias procedures, where indicated.

Inclusion and Exclusion Criteria

In line with the purpose of the review, criteria for inclusion in the meta-analysis were intentionally broad to capture all relevant gambling studies that used MI in what is a small RCT literature. Studies were included if they examined the effect of an MI-based intervention (MBI) compared to any comparison group. MBIs were required to be conducted by a person (not web-based, workbook, or technology-based), and MBIs qualified if the authors referred explicitly to MI or Motivation Enhancement Therapy (MET; MI plus assessment feedback) in their descriptions of the interventions, even if only some or vague MI components were described. All non-motivational comparison groups were eligible regardless of the comparison strength (e.g. waitlist, assessment only, CBT). The incorporation of all comparison groups was intended to capture all relevant studies and to allow examination of the impact of comparison group strength on MBI's effects.

Studies were also included if they used (a) participants who were 18 years of age or over, (b) a sample of individuals with problem or pathological gambling based on a validated assessment, or who expressed concern about their gambling, (c) data on gambling behavior (e.g.

frequency, expenditure, duration) and/or severity of gambling harm (e.g. score on a validated assessment like South Oaks Gambling Screen (SOGS) or some measure of DSM criteria met) as a treatment outcome, (d) randomization of participants to an MBI group and the comparison group.

Studies were excluded if they were secondary analyses or included pharmacotherapy in any way, either in conjunction with the MI intervention or as a comparison group. Studies that used combination interventions (e.g. MI and CBT delivered in the same condition) were excluded unless they included a comparison condition that used the additional intervention alone. Although such comparisons are problematic for reasons discussed in this paper, we decided to include them in the interest of the overall purpose of the meta-analysis which was to explore the dispersion of effects for MI under various conditions and for consistency with a previous meta-analysis that included several comparisons of this type. The impact of this decision was examined through sensitivity analyses. There were no restrictions on language, publication date, or grey literature. The search was initially conducted in October 2023 and repeated in February 2024. The earliest study that met inclusion criteria was published in 2001 and the most recent was published in 2018.

Data Sources

Searches were conducted in Cochrane Database of Systematic Reviews, Embase, PsycINFO, and PubMed. Google Scholar was also used to locate additional reference by use of the cited by function. The reference lists of a previous meta-analysis (Yakovenko, 2015) and all studies meeting inclusion criteria were also reviewed to identify additional relevant studies.

Search Strategy

Searches were conducted in the electronic databases with keywords reflecting gambling and intervention (Embase: ('intervention':ti OR 'treat*':ti OR 'therapy':ti) AND 'gambl*':ti; PsycINFO: TI ("intervention" OR "treat*" OR "therapy") AND TI "gambl*"; PubMed ("intervention"[Title] OR "treat*"[Title] OR "therapy")[Title]) AND ("gambl*"[Title]); Cochrane Database of Systematic Reviews: Title abstract keyword ("intervention" OR "treat*" OR "therapy") AND Title abstract keyword "gambl*"). The search strategy was purposefully broad to conservatively capture all studies on MBIs, including those on other interventions (e.g., CBT). There were no restrictions placed on year, publication type, or language.

Study Selection

A two-stage procedure was followed to determine study inclusion. First, initial search results were reviewed at the title and abstract level by JB and RAP to screen for studies that would potentially meet inclusion criteria. In the second stage, studies that were identified in the title and abstract search for possible inclusion were subject to a full-text review by JB and DPF (independently) and evaluated for inclusion and exclusion criteria using a form created for the study (Appendix A). Agreement between the two reviewers was assessed using the Kappa statistic. The interrater reliability in stage 2 was $k = 0.94$. Discrepancies were resolved through a consensus discussion among JB, DPF and RAP.

Data Collection Process

A codebook was created to collect characteristics of the study, participants, interventions, comparison groups, and outcomes of each included study (Appendix B). A second codebook was created to collect data regarding features of the MBIs (Appendix C). A third codebook was

created to collect outcome data (Appendix D)**.** Two reviewers (DPF and JB) extracted the data (independently). Any discrepancies were resolved by discussion. The codebooks for outcome data were evaluated by RAP for accuracy. Again, discrepancies were resolved by discussion.

When data were not provided in a manuscript, the primary author of the study was emailed. This resulted in outcome data from one study (Carlbring et al., 2010) being emailed to RAP. In one case (Petry et al., 2008), outcome data were not published in an included study, but were published in a meta-analysis that included the study. In that case, the data were obtained from the meta-analysis (Cowlishaw, 2012).

For studies that used more than one intervention group that included an MBI, we extracted outcomes for the group that would allow us to statistically isolate the effect of MBI. If this was possible in more than one MBI group, as was the case in Hodgins et al. (2009), we combined the outcomes of the two MBI interventions into one intervention group (Borenstein et al., 2009; Higgins & Green, 2011). This approach allowed us to use data obtained from all recipients of the MBI while not double counting the comparison group.

A precise estimate of MBIs effects on gambling outcomes would require a group of studies that used the same comparison groups. For our purpose of gaining a broader picture of MBIs effect from a small literature, we opted to use any non-motivational group for comparison and to examine the influence of the strength of the comparison group in sensitivity or subgroup analyses. Therefore, in studies with more than one possible comparison group, outcomes were extracted for the group that was deemed the weakest comparison group. This decision was made to maximize the likelihood of detecting small effects for MBIs should they exist. That is, it would allow a test of MBIs *potential* effect rather than its maximum effect, which is important in early stages of intervention research. Determinations of the strength of comparison groups were

based on classifications of various control and comparison groups used in clinical trials (Carroll, 2001).

Data from one study (Carlbring, 2010) were obtained both through the primary publication and in response to email request by RAP. Upon inspection, we determined that the sample sizes reported in the datafile offered a more accurate picture of how many participants in that study should be included in each timepoint analysis and used those numbers in our analyses. This accounted for the much smaller sample size for Carlbring et al. (2010) in our analyses as compared to the primary publication.

Data items

Study Characteristics

Study author(s), year of publication, country of publication, funding source (if any), recruitment source, type of gambling outcomes reported (e.g. frequency), and whether the study was pre-registered were extracted from the studies.

Sample Characteristics

When reported, we extracted the mean age of the sample, percentage of the sample that was male, percentage of the sample that was Asian, Black, Hispanic, or White, and the gambling criterion that was used for inclusion in the study.

Intervention and Comparison Group Characteristics

We extracted several aspects of the MBIs for the purposes of characterizing the consistency of the interventions across studies, examining potential relationships to outcomes,

and examining MBI components in relation to existing empirical knowledge of MI practice. These included descriptions of the MBIs provided by study authors, MBI duration, MBI number of session, MBI format (phone or face-to-face) and MBI therapist (e.g. doctoral student). We also extracted the type of comparison group (e.g. waitlist, assessment only) selected for inclusion in the analyses. Because different comparison groups provide answers to different questions regarding an intervention's potential effects (Carroll, 2001), comparison groups were then categorized as either "inactive" or "active" to allows us to evaluate weaker and stronger comparisons, respectively. Groups were categorized as "active" only if they included an established intervention (e.g. CBT) or controlled for therapist time and attention that approximated that of the MBI.

MBI training and fidelity characteristics

To examine the fidelity of intervention delivery in the studies, we extracted data provided by the authors about instruments used to monitor fidelity, and the fidelity outcomes when provided. We also extracted the description of the therapist training in the MBI.

Outcomes

The primary outcomes assessed in the meta-analysis were gambling frequency, gambling intensity (monetary expenditure), gambling duration, and severity of gambling problems. The outcomes were chosen on the basis of recommendations for gambling research from the Banff, Alberta Consensus (Walker et al., 2006) and for consistency with other gambling meta-analyses (Pfund et al., 2023; Yakovenko et al., 2015). There were no restrictions placed on the specific measures used by studies for each outcome. Data were extracted as long as they were determined

to indicate the general outcome of interest. The most common measure of gambling frequency was participant-reported days gambling/month. The most common measure of gambling intensity was participant-reported dollars gambled or lost/month. There was large variation in the measures used to assess gambling problem severity, including the South Oaks Gambling Screen (SOGS); Problem Gambling Severity Index (PGSI); Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV); Addiction Severity Index – gambling (ASI); NORC Diagnostic Screen for Gambling Problems (NODS) and the Gambling Symptom Assessment Scale (G-SAS).

Requests for data were made to a study's primary author for any missing outcome data. No data were imputed for any outcomes. If a study did not provide data for one of the outcomes or timepoints, it was not included in the corresponding analysis.

Timepoints

Outcomes from the first assessment timepoint after the completion of the intervention were used as the posttreatment outcomes and usually occurred three months after the first week of the intervention. Outcomes assessed at the furthest timepoint from posttreatment were considered follow-up outcomes.

Risk of Bias

The Cochrane Risk of Bias Tool, which evaluates features of randomized trials for potential bias that may threaten internal validity, was used to assess the included studies (Higgins & Green, 2011). DPF and RAP independently evaluated the studies for risk of bias with randomization procedures, condition allocation concealment, completeness of outcome data, and

the masking of study assessors to participants' treatment conditions. Discrepancies were resolved through discussion.

Data Analysis Plan

The Hedges's *g* effect sizes were calculated and reported for each study outcome. Hedges's *g* is the recommended effect size measure for studies with small sample sizes (Hedges & Olkin, 1985). Effect sizes for all outcomes were calculated so that negative numbers represented a favorable effect for the MBI relative to the comparison group. An effect size of 1.0 represents a one standard deviation difference between MBI and comparison group. Therefore, an effect of g = -0.5 for gambling frequency would mean that the MBI reduced gambling frequency half a standard deviation more than the comparison group.

To measure the average effect of MBIs relative to non-motivational comparison groups, gambling behavior and gambling disorder severity outcomes were subject to random effects meta-analysis using Comprehensive Meta-Analysis V. 4 software (Borenstein, 2002). The consistency of the effects was assessed with a *Q*-statistic and the magnitude of heterogeneity was assessed using the I^2 statistic. Prediction intervals, which are important for estimating the expected true effect of MBIs on gambling in a future study (IntHout et al., 2016), were also calculated as a measure of heterogeneity in effect sizes. Moderation analyses were conducted for treatment variables with enough data to permit analysis using meta-regression for continuous moderators and subgroup analysis for categorical moderators. Sensitivity analyses were also conducted to determine the robustness of the observed effects to alternative methodological decisions.

To determine whether the selective publication of studies based on their findings biased the results, contour-enhanced funnel plots were examined for asymmetry, and the Egger's regression test was conducted.

Results

Study Selection

A flowchart of the study identification process is provided in Figure 1. The initial database search yielded 3,629 results. After 1,460 duplicates were removed, 2,045 studies were screened at the title/abstract level. After full text review, an additional 114 studies were considered ineligible. Leading reasons for ineligibility were that the study had no motivational interview based intervention (45%), the study was either incomplete or did not report results (27%), or the study included pharmacotherapy as a treatment or control group (15%). The search resulted in 10 studies for inclusion in the analysis. All five of the studies used in the previous meta-analysis (Yakovenko et al., 2015) were included, doubling the total number studies.

One study (Hodgins, 2009) met all inclusion criteria except that it included the use of a CBT workbook in the MBI condition. However, this study also included a workbook only comparison group so that the only difference between the two groups was the use of the MBI. Therefore, the difference in outcomes between these two groups could reasonably be attributed to the MBI. This comparison did not amount to a strong test of the MBI as it cannot demonstrate that the MBI would have any effect without the addition of the workbook. However, we decided to include this study for two primary reasons. First, this comparison was included in the previous meta-analysis (Yakovenko, 2015; it should be noted that the primary author of the study was also a contributing author to the meta-analysis) and including it would assist in making comparisons

of MBI studies over time. Second, our aim was to generate an estimate of MBIs effects in the context of an expectedly small group of studies with variability in study designs in the interest of identifying important directions for future research. The impact of Hodgins et al., (2009) on the overall effects was evaluated in sensitivity analyses.

Study Characteristics

Table 1. presents characteristics of the included studies which were published from 2001 to 2018 in Canada (k = 4), US (k = 3), Australia (k = 2) and Sweden (k = 1). Sample sizes ranged from 14 to 188 and the total number of participants included in the meta-analysis was 915, nearly doubling the number of participants in the previous work (Yakovenko et al., 2015). Forty percent (k = 4) of the studies were pre-registered. Half of studies (k = 5) recruited community samples not receiving any formal treatment, while 20% (k = 2) recruited through treatment clinics, 20% (k = 2) recruited on college campuses, and 10% (k = 1) recruited through a gambling helpline. The most common gambling-related study inclusion criteria was self-reported concern about gambling (40% of studies), followed by endorsement of at least three items on the South Oaks Gambling Screen (30%), endorsement of at least three times on the Problem Gambling Severity Index (20%), and meeting at least one of ten criteria for pathological gambling according to the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (10%). All studies were published in peer-reviewed journals, except one (Thomas et al., 2015) that was a government white paper report funded and published by the Victorian Responsible Gambling Foundation through the Grants for Gambling Research Program.

Sample Characteristics

Details of the study participants are presented in Table 2. The mean age of participants ranged from 20 to 77 years across studies and the percentage of male participants ranged from 47-87%. Only studies conducted in the US ($k = 3$) provided details on the race/ethnicity of their samples, which were largely identified as White (60-91%). Gambling severity at baseline was measured with various instruments described in Table 2.

MBIs Characteristics

The MBIs in the studies varied in terms of their descriptions, format, and duration (Table 3). Studies were coded as either including assessment feedback ($k = 6$) or not ($k = 4$). Descriptions of the MBIs varied from general to somewhat detailed regarding therapist intention and behavior and are provided verbatim in Table 3. Thirty percent of studies ($k = 3$) used a CBT self-help workbook in conjunction with the MBI. Half of studies ($k = 5$) specifically mentioned aspects of the therapist-client relationship in the MBI such as empathy or avoiding argumentation. Twenty percent of studies ($k = 2$) referenced specific therapist behaviors that are common to MI (e.g., open-ended questions, summarizing) and 30% ($k = 3$) mentioned use of a specific MI tool such as a readiness ruler or decisional balance. Only one study (Hodgins et al., 2009) made specific reference to the reinforcement of favorable change language (“change talk”) that is described as MI’s unique and essential component (Miller & Rollnick, 2023; Waltz et al., 1993).

All MBIs were conducted in individual format. Seventy percent ($k = 7$) of studies conducted the intervention face-to-face, and the remainder were conducted via telephone. The duration of each MBI session ranged from 20 to 90 minutes with an average of 53 minutes. Most

MBI sessions were offered over one session (k = 6), and four MBIs (40%) included 4-6 sessions resulting in considerable variability in total dose of the MBIs (20 to 360 minutes).

MBI Training and Fidelity

Details of the training and fidelity of the interventions are provided in Table 4. Therapists in the studies were mostly bachelor's or graduate students (k = 6), followed by licensed providers (k = 3) and helpline counselors (k = 1). Regarding therapist training, 50% of studies (k = 5) described training from a supervisor that included role playing and/or viewing training tapes; 40% (k = 4) provided no information on therapist training; and one study (10%) trained therapists by providing them with a manual. No study described a minimum threshold skill level for the therapists prior to the intervention.

Treatment monitoring was mentioned in 80% (k = 8) of studies. Of these, half (k = 4) used a checklist that was created by the authors specifically for their respective studies, none of which were provided in study manuscripts or appendices. Two additional studies from one research group used a modified version of the Yale Adherence Competence Scale (Carroll et al., 2000) to monitor the distinguishability of the MBI from the comparison conditions and reported that they were distinguishable. Two final studies used the Motivational Interviewing Treatment Integrity (MITI) tool; an established and objective tool developed for measuring MI treatment integrity in clinical trials (Moyers et al., 2005). Of these two studies, one reported that fidelity was "good", and the other reported that therapists had a mean score of 5.3 out of 7 for "MI spirit." No additional therapist scores from the MITI were reported. Therefore, overall, only 20% of studies included in the meta-analysis provided any information on the quality of the MBI delivery.

To further characterize the integrity of the interventions from the standpoint of Motivational Interviewing, studies were reviewed for the three criteria proposed by Miller & Rollnick (2012) for establishing an intervention's fidelity in a clinical trial (Table 7.). These were 1) the theoretically or empirically supported elements of the intervention were included, 2) study therapists were trained to a minimum threshold skill level prior to delivering the interventions, and 3) fidelity of the intervention was monitored and during the study and reported using an objective measure.

Comparison Group Characteristics

Descriptions of the comparison groups are provided in Table 3. Studies varied in the strength of the comparisons they made relative to the MBIs with seven studies (70%) using inactive comparisons conditions and three (30%) using active conditions. Of the inactive groups, three (30%) were assessment only, two (20%) provided a self-help workbook, one (10%) conducted a single session non-specific intervention, and one (10%) placed participants on a no-contact waitlist. Of the active groups, one study (10%) conducted Client-Centered Therapy matched for time with the MBI, one (10%) provided treatment-as-usual matched for time with the MBI, and one (10%) provided a semi-structured non-specific interview with empathy, approximating the duration of the MBI.

Risk of Bias Assessment

The results of the Cochrane Risk of Bias Tool assessment are presented in Table 5. Overall, four studies (40%) of studies were rated as having a low risk of bias across all four risk domains. Regarding the risk domains, five studies (50%) did not adequately describe steps taken

to conceal the allocation sequence of participants to groups from relevant study personnel, three studies (30%) did not adequately mask outcome assessors to participants' group membership, two studies (20%) did not adequately describe their randomization process, and two studies (20%) did not report complete outcome date or used completer analyses instead of intent-to-treat analyses.

Results of Individual Studies

Table 6. summarizes which outcomes were reported by each study at posttreatment and follow-up timepoints. All studies (k = 10) reported posttreatment outcomes for gambling intensity, 9 studies (90%) reported posttreatment gambling frequency, and 5 studies (50%) reported posttreatment gambling severity. Follow-up outcomes that were included in the analysis were available from 7 studies (70%). Posttreatment frequency data for Petry et al. (2008) were included in the previous meta-analysis by Yakovenko et al. (2015) but were not reported in the source study and could not be located in any other publications. An email was sent to the first author of Yakovenko et al. (2015) requesting these data and was not responded to at the time of this writing.

Gambling Outcomes

Posttreatment

Gambling Frequency.

What was the Estimated Effect of MBIs On Gambling Frequency? The analysis of posttreatment gambling frequency was based on nine studies (n = 886; Figure 2). MBIs had a small superior effect on gambling frequency relative to non-motivational comparison groups at

posttreatment (g = -0.12, 95% CI = [-0.26, 0.01], p = 0.07, I^2 = 0). On average, participants who received an MBI reduced their gambling by approximately one additional day per month relative to those in the comparison groups. The Q-statistic was 7.86, which was lower than the degrees of freedom (8), indicating that heterogeneity of effect sizes across the studies was not detected. However, estimates of heterogeneity based on fewer than ten studies are generally lacking in statistical power (Borenstein et al., 2010) and are therefore offered tentatively. Although we cannot rule out the hypothesis that MBIs were not superior to non-motivational comparison groups, the mean true effect of similar future studies of an MBI on gambling frequency can reasonably be expected to fall within g = -0.26 and 0.01 amounting to a small common effect.

To evaluate differences in effects between studies that combined an MBI with a CBT workbook and those that used an MBI alone, we re-ran the analysis for each group separately (Figure 3). Doing so, the average effect of MBIs on gambling frequency relative to non-motivational comparison groups doubled for studies that included a CBT workbook (g = -0.25, 95% CI [-0.47, 0.22], p = .03) and was reduced by two-thirds for those that only used an MBI (g = -0.041, 95% CI [-0.21, 0.13], p = .64), suggesting that the observed overall effect of MBIs on gambling frequency was inflated by including studies that added a CBT workbook. We did not evaluate the statistical difference between the two groups as such an analysis would be underpowered (Cuijpers, 2021).

Did the Effect of MBIs on Frequency Change by Comparison Group? The relatively low number of studies precluded a reliable analysis of whether any study characteristics moderated the observed effects. Therefore, we conducted sensitivity analyses to test the robustness of the effects to our study inclusion decisions. First, we divided the studies by comparison group category (Figure 4**)**. When only studies that used an inactive comparison

group were included in the analysis (k = 6; n = 485), the effect size favoring MBIs for gambling frequency was doubled (g = -0.26, 95% CI = [-0.44, 0.08], p = 0.005, I^2 = 0), and reached statistical significance. That is, on average, participants who received an MBI reduced their gambling frequency by two days more per month than those who received minimal or no intervention. Conversely, when only studies that used a strong comparison group were analyzed (k = 3; n = 401), the superior effect for the MBI condition observed in the original analysis disappeared (g = 0.037, 95% CI = [-0.16, 0.21], p = 0.71, I^2 = 0). Those who received an MBI showed no meaningful difference in their posttreatment gambling frequency compared to those who received another active treatment for a similar amount of time.

Was Publication Bias Detected in Frequency Outcomes? Visual inspection of the funnel plot for gambling frequency did not indicate significant publication bias as studies were well distributed about the mean effect **(**Figure 5**)**. Additionally, the Egger's test for small-study effects suggested that small-sample bias was not a concern in the pool of studies based on the non-significant p-value (p = 0.35).

Gambling Intensity.

What was the Estimated Effect of MBIs on Gambling Intensity? The analysis of posttreatment gambling intensity was based on ten studies (n = 985; Figure 6). MBIs reduced gambling intensity relative to non-motivational comparison groups at posttreatment (g = -0.15, 95% CI = [-0.31, 0.01], p = 0.07, I^2 = 31.55). Because studies varied both in their measure for intensity and the range of intensity in their samples (means ranging from $62/month – $9,342/month) we cannot provide one number that captures the clinically relevant reduction in intensity. As an example, however, the results indicate that on average, participants from the

population studied by Diskin and Hodgins (2009), with a mean intensity of $365 reduced their expenditure by $78 more in the MBI group relative to the comparison group.

The *Q*-statistic, which tests the null hypothesis that all studies share a common effect size, was $Q = 13.15$ ($df = 9$, $p = 0.16$) indicating the presence of heterogeneity in true effect sizes across studies. A prediction interval was calculated to estimate the range of variation in true effect sizes and predicted that the average true effect size in future studies would fall between $g = -0.525$ and 0.225, inclusive. The I^2 statistic indicated that 32% of the observed heterogeneity in effect sizes was due to variance in true effects rather than sampling error.

To evaluate differences in effects between studies that combined an MBI with a CBT workbook and those that used an MBI alone, we re-ran the analysis for each group separately (Figure 7). In studies that included a CBT workbook, the average effect of MBIs on gambling intensity relative to non-motivational comparison groups increased ($g = -0.24$, 95% CI [-0.57, 0.09], $p = .15$). For those that did not include a CBT workbook the effect decreased slightly ($g = -0.11$, 95% CI [-0.31, 0.09], $p = .26$). We did not evaluate the statistical difference between the two groups as such an analysis would be underpowered.

Did the Effect of MBIs on Intensity Change by Comparison Group? To probe the heterogeneity in Hedges's *g* effect sizes we conducted a subgroup analysis using comparison group strength as the grouping variable (Figure 8). Studies that judged MBIs against an active comparison group ($k = 3$; $n = 401$) showed a slight decrease in effect size compared to the combined analysis ($g = -0.12$, 95% CI [-0.37, 0.12]) and MBIs judged against an inactive comparison group ($k = 7$, $n = 584$) showed a slight increase in effect size ($g = -0.17$, 95% CI [-0.39, 0.61]). The difference between the two was not statistically significant ($p = .80$), which may be partly due to underpower given the relatively small number of studies and the

unevenness of the groups (Cuijpers, 2021). However, the trend is notable for its consistency with the direction of the frequency results demonstrating stronger effects for MBIs when judged against inactive comparison groups and no effects relative to active comparisons.

Was Publication Bias Detected in Intensity Outcomes? Visual inspection of the funnel plot (Figure 9) for gambling intensity did not indicate significant publication bias as studies were well distributed about the mean effect. Additionally, the Egger's test for small-study effects suggested that publication bias was not a concern in the pool of studies based on the non-significant p-value ($p = 0.28$).

Gambling Duration.

Because only two studies reported on gambling duration, the results would not substantially contribute to our understanding of MBIs effects, and we did not conduct analyses.

Gambling Severity.

What was the Estimated Effect of MBIs on Gambling Disorder Severity? The analysis of posttreatment gambling disorder severity was based on five studies ($n = 429$**;** Figure 10). MBIs had no favorable effect on gambling disorder severity relative to non-motivational comparison groups ($g = 0.01$, 95% CI = [-0.35, 0.38], $p = 0.95$, $I^2 = 72.02$). There was evidence of considerable heterogeneity in effect sizes across the studies. The I^2 value indicated that 72% of the variance the observed effects were attributable to variance in true effect sizes rather than sampling error. The average true effect of a future similar study is predicted to fall in the range of $g = -1.25$ and 1.28.

Did the Effect of MBIs on Severity Change by Comparison Group?

Given that tests of heterogeneity and subgroup difference are likely be underpowered in the case of five studies, we did not further probe the effect on gambling disorder severity.

Was Publication Bias Detected in Severity Outcomes? Visual inspection of the funnel plot (Figure 11) for gambling disorder severity did not indicate significant publication bias as studies were well distributed about the mean effect. Additionally, the Egger's test for small-study effects suggested that publication bias was not a concern in the pool of studies based on the non-significant p-value ($p = 0.28$). These results should be interpreted with caution due to the limited number of studies.

What was the Influence of Risk of Bias on MBIs Effect? To evaluate the influence of studies' risk of bias on MBIs' effects on gambling behaviors, we conducted a subgroup analysis combining gambling behavior outcomes (frequency, intensity, and duration) and using risk of bias category (low vs. high) as the grouping variable (Figure 12). The overall effect size of MBIs compared with non-motivational comparison groups was $g = -0.17$ (95% CI [-0.32, -0.01]) which was also the effect size for both the high-risk group ($g = -0.17$, 95% CI [-0.35, -0.01], $p = .07$) and the low-risk group ($g = -0.17$, 95% CI [-0.49, -0.16], $p = .32$). The difference between the two groups was not statistically significant ($p = 0.99$) suggesting that the effect size of MBIs for gambling behavior was robust to ratings of risk of bias across the studies.

What was the Influence of Comparison Group on MBIs Effect? To evaluate the influence of comparison group strength on MBI's effects on gambling behaviors, we conducted a subgroup analysis combining gambling behavior outcomes (frequency, intensity, and duration) and using comparison group category (active vs. inactive) as the grouping variable (Figure 13). On average, studies that used an active comparison group ($k = 3$, $n = 401$) showed no meaningful advantage for MBIs on gambling behavior ($g = -0.01$, 95% CI [-0.21, 0.18], $p = 0.88$). Meanwhile, studies that used inactive comparison groups ($k = 7$, $n = 584$) showed a small favorable effect for MBIs on gambling behavior ($g = -0.24$, 95% CI [-0.41, -0.07], $p = 0.05$).

What was the Influence of MBI Format (Phone vs. Face-to-Face) on Overall MBI Effect? A subgroup analysis was conducted to evaluate differences in Hedges's *g* effect sizes based on whether MBIs were delivered by phone or face-to-face (Figure 14). There was no clinically meaningful difference in the mean effect sizes for the two groups and the difference was not statistically significant ($p = 0.68$). For the phone group, on average, MBIs showed a small but favorable effect relative to comparison groups ($g = -0.11$, 95% CI [-0.30, 0.73], $p = 0.23$). For the face-to-face group, on average, MBIs also showed a small but favorable effect ($g = -0.17$, 95% CI [-0.39, 0.05], $p = 0.12$).

What was the Influence of MBI Duration on Overall MBI Effect? To evaluate the influence of MBI dose, we conducted a meta-regression using gambling behavior (frequency, intensity, and duration) as the dependent variable and MBI duration (in minutes) as the independent variable (Figure 15). The relationship between MBI duration and gambling outcomes was not statistically significant ($b = 0.001$, $z = 1.63$, $Q = 2.65$ ($df = 1$), $p = 0.10$).

What was the Influence of MBI Fidelity on Gambling Outcomes? Due to the low degree of reporting and high variability on characteristics of treatment fidelity, analyses of its impact on effect sizes were too underpowered for meaningful interpretation.

How Did Effects on Combined Gambling Behavior Differ Between Studies that Used MBIs Plus a CBT Workbook and Those That Used Only an MBI?

To evaluate potential differences in effect sizes for gambling behavior outcomes between studies that included a CBT workbook with an MBI and those that did not, we analyzed the two groups separately (Figure 16). On average, studies that blended a CBT workbook with the MBI ($k = 3$, $n = 211$) showed an advantage for MBIs relative to non-motivational comparison groups on gambling behavior that reached statistical significance ($g = -0.21$, 95% CI [-0.43, -0.01], $p =$

0.045). Studies that did not add a CBT workbook (k = 7, n = 629) showed a smaller but favorable effect for MBIs on gambling behavior, and this did not approach statistical significance, despite a much larger sample size (g = -0.12, 95% CI [-0.33, -0.09], p = 0.27). We did not evaluate the statistical difference between the two groups as such an analysis would be underpowered.

What was the Influence of Assessment Feedback on Overall MBI Effect?

To evaluate potential differences in effect sizes for gambling behavior outcomes between studies that included assessment feedback and those that did not, we analyzed the two groups separately (Figure 17). On average, studies that included assessment feedback with the MBI (k = 6, n = 651) showed an advantage for MBIs relative to non-motivational comparison groups on gambling behavior (g = -0.21, 95% CI [-0.41, -0.00], p = 0.05). Studies that did not include assessment feedback (k = 4, n = 334) showed no meaningful effect for MBIs on gambling behavior, (g = -0.05, 95% CI [-0.27, -0.16], p = 0.64).

Follow-Up

Gambling Frequency. Six studies provided follow-up data on gambling frequency (n = 643**;** Figure 18). MBIs had no favorable effect on follow-up gambling frequency compared with non-motivational controls (g = -0.08, 95% CI = [-0.31, 0.14], p = 0.47). Tests of variance found evidence of heterogeneity across the studies and that almost half of the variance was due to difference in true effects rather than sampling error (Q = 9.62 (5), p = .09; I^2 = 48.04). The prediction interval suggested that the average true Hedges's g effect size of similar future studies would fall in the range of g = -0.70 and 0.54.

Gambling Intensity. Seven studies provided follow-up data on gambling intensity (n = 732**;** Figure 19). MBI's had almost no favorable effect on follow-up gambling intensity

compared with non-motivational controls (g = -0.07, 95% CI = [-0.25, 0.12], p = 0.49). Tests of variance found evidence of heterogeneity across the studies and that one third of the variance was due to difference in true effects rather than sampling error (Q = 9.00 (6), p = .17; I^2 = 33.30). The prediction interval suggested that the average true effect of similar future studies would fall in the range of g = -0.50 and 0.37.

Gambling Duration. Only one study provided follow-up data on gambling outcomes. No synthesis was performed.

Gambling Severity. Four studies provided follow-up data on gambling severity (n = 271**;** Figure 20). MBI's had almost no favorable effect on follow-up gambling severity compared with non-motivational controls (g = -0.11, 95% CI = [-0.52, 0.23], p = 0.60). Tests of variance found evidence of heterogeneity across the studies and that almost two thirds of the variance was due to difference in true effects rather than sampling error (Q = 8.55 (3), p = .04; I^2 = 64.9). The prediction interval suggested that the average true Hedges's g effect size of similar future studies would fall in the range of g = -0.50 and 0.37.

Discussion

This systematic review and meta-analysis provided an in-depth examination of the effectiveness of motivational interviewing-based interventions (MBI) for problem and pathological gambling. It improved on prior work in three substantial ways. First, a more in-depth review revealed that only 20% of studies utilized objective fidelity measurement tools to ensure intervention delivery, and no study met the criteria for establishing MI intervention integrity in clinical trials proposed by its originators (Miller & Rollnick, 2014). Second, by doubling the sample size in the quantitative analysis we increased the power and precision of the effect size estimates in the population of MBI/gambling studies. Third, with the inclusion of

additional studies, we were able to conduct sensitivity analyses to evaluate study and intervention level factors such as intervention purity that influenced the observed effects. The results suggested that previous estimates of MBIs' effects on gambling behavior were inflated by studies that combined MBIs with a CBT workbook. Additional results showed that effect sizes were also higher in studies that included assessment feedback or used inactive comparison groups.

Variability of Interventions

Motivational Interviewing is a therapeutic approach that combines the elements of building a strong client-therapist relationship and facilitating the occurrence of favorable change language (Miller & Rose, 2009). These components are not just theoretical to the method, but also supported by empirical evidence. Research on the process of MI has highlighted the significance of certain qualities within the therapeutic relationship, such as empathy, as key predictors of both therapeutic engagement (Moyers et al., 2016) and behavioral outcomes such as alcohol use (Moyers & Miller, 2013). Studies have also underscored the importance of client language that expresses openness to change, known as "change talk." Analyzing individual utterances during MI sessions has shown that the balance between favorable and unfavorable change language spoken by clients can predict their outcomes. Additionally, research indicates that the evolution of this language throughout the intervention can be even more crucial (Forman et al., 2024). Glynn and Moyers (2010) have demonstrated that the emergence of this language is significantly influenced by the therapeutic approach employed by the interventionist. This work has been extended to establish an empirically-supported causal chain in which specific therapist behaviors (e.g., complex reflections, open-ended questions) encourage improved client change

language during the session, which predicts post-session outcomes (Houck et al., 2013; Moyers et al., 2009; Vader et al., 2010). The importance of clients' language about change in predicting outcomes has now been demonstrated in two meta-analyses (Magill et al., 2019; Pace et al., 2017). Few other interventions have such a well-supported mechanistic account of their effects, and this serves as a major strength of the MI approach. Although questions remain about which MI processes account for the most variance in its positive outcomes, its two main theoretical components have substantial support and are therefore essential to include in any test of the method's potential in a new behavioral domain such as gambling.

As is common in research literatures outside of gambling, there was considerable variation in the interventions that were described as MI, MET, or MI-based (Hettema et al., 2006; Lundahl et al., 2010). Despite a well-articulated set of empirically-supported therapist behaviors and processes, few studies made explicit mention of MI's relational component, and no study made specific reference to therapists' effort to differentially reinforce favorable change language or minimize language favoring the status quo. Study descriptions often included MI components such as open-ended questions or expressing empathy that are necessary but not sufficient for MI to occur (Moyers, 2014). This may be partly attributable to the time frame when many of these studies were published, as the studies span from 2001 – 2018 and MI process research has accumulated over time. Yet, it is incumbent upon researchers of a particular method to stay up-to-date regarding their interventions evidence base.

Most studies included in the review described their interventions by reference to the overall intention of their intervention or general principles of MI. For example, Abbott et al. (2018) described the intervention condition only by saying it was "structured to build commitment and reasons to change." Although this is reflective of MI's overarching purpose,

this description does not provide enough detail about how therapists went about this, which is what differentiates MI from other approaches. A therapist who asks their client to choose three important reasons to change from a pre-specified list of five may be generating reasons to change, but may not be employing the person-centered style of evoking reasons for change that characterizes MI. In other studies, authors referred to employing "standard MI principles" but also included details that left uncertainty as to whether such principles were applied uniformly throughout the intervention. For example, one study noted that participants were "encouraged to decide about gambling and create change plan" or "completed a change plan worksheet." This approach may run counter to MI's principle of "rolling with resistance" should a client express hesitation about committing to a plan of action. While change plans can be useful in helping those who are ready for the how of change, from the MI perspective, they are of little use for those who have not sufficiently addressed the why of change. Therefore, to demonstrate a thoroughgoing commitment to the MI method, it is crucial for gambling researchers to include detailed descriptions of the therapist behaviors and processes employed in MBIs, including both prescribed and proscribed elements (e.g., confrontation). Doing so will reassure readers of their commitment to the central components of MI. In addition to improving the descriptions of their intervention and ensuring to include its core components, gambling researchers must demonstrate to consumers that the interventions they intended to deliver were delivered with fidelity.

Intervention Training and Fidelity

In order for intervention researchers to correctly attribute their study effects to the method they intend to investigate, they must demonstrate that the method was actually delivered

to its participants (Perepletchikova & Kazdin, 2005). Without reliable fidelity monitoring to measure an intervention's essential and unique components, it is unclear whether any observed effects occurred because of that intervention specifically or because of common intervention factors such as therapist attention. This poses a challenge for psychotherapy interventions in general. Even when treatment manuals are used in clinical trials, research shows that uniform intervention delivery can be difficult to achieve (Miller & Binder, 2002). Unfortunately, psychotherapy trials at large suffer from a lack of objective fidelity monitoring to ensure intervention integrity (Toomey et al., 2020). This problem may be especially apparent in the case of MI. Since its inception, MI has been confused with a host of other approaches, concepts, and therapy behaviors, including decisional balance or general client-centered counseling. Even among expert trainers, although there is much agreement about the elements that comprise skillful motivational interviewing, there is disagreement about its core features as well, such as the therapist's appropriate investment in a client's direction (Forman & Moyers, 2019). This lack of clarity is not only theoretical but also reflected in the finding that MI practice in clinical trials is highly variable across treatment locations, therapists, and sessions (Hallgren et al., 2018), possibly contributing to the uneven effect sizes for MI observed in multisite trials (Ball et al., 2007). For example, a study that does not include all of MI's empirically supported ingredients, such as cultivating favorable change language, may only reflect the effect of general counseling skills or an "MI style" rather than its complete set of empirically-validated mechanisms, possibly dampening reported effects. This problem is well-recognized by MI researchers and has been the subject of much work.

Recognizing the challenges of low fidelity monitoring in intervention research at large, Miller & Rollnick (2015) proposed three criteria for demonstrating fidelity to complex

interventions such as MI. These are 1) including theoretically or empirically supported intervention components 2) training therapists to a specified threshold of proficiency prior to the start of the trial, and 3) monitoring and reporting on the interventionist's fidelity to the method during the trial through the use of objective measurement tools. Applying these criteria to the studies in this review, no study amounted to an adequate trial of Motivational Interviewing (Table 7). Regarding the second criterion, the training that therapists received in the studies included in this review was usually only briefly described and varied considerably in duration and training activities (Table 4). This is despite a substantial literature investigating the optimal ways for practitioners to learn MI (see reviews from Madson et al., 2009; Maslowski, 2022). For example, although MI workshop training leads to some short-term skill improvement (Miller & Mount, 2001), the combination of follow-up personalized feedback and individual consultation are required for skills to become evident in measures of clients' change language (Miller et al., 2004). Recent work also showed that learning MI through practice with a virtual standardized patient resulted in significantly greater skill in both relational and technical MI skills compared to simply reading MI materials (Reger et al., 2020). Importantly, not everyone learns MI equally. Although MI is often described as "easy to learn," research suggests that those with a low level of baseline counseling skills prior to MI training require considerable time and resource investment to improve their skill level (Moyers et al., 2008). These findings may be particularly relevant for clinical trials of MI that use bachelor's or graduate students with little prior counseling experience as interventionists.

To address these concerns about MI fidelity in clinical trials, numerous monitoring tools have been produced and disseminated. A full review of various tools is available, describing their relative strengths and limitations for different research contexts (Hurlocker et al., 2020). One

such tool is the Motivational Interviewing Treatment Integrity Code (MITI 4.2; Moyers et al., 2016), which evaluates competency in vital aspects of MI practice including expressing empathy and cultivating change and has reliable psychometric properties. The MITI and other similar tools are available publicly for free, and trainings in their use are available. Despite the importance and availability of fidelity monitoring instruments, they were underutilized by the studies included in this review. Although eight of 10 studies included some kind of monitoring of their interventions, only two used a measure of MI proficiency. Neither of those studies provided a sufficient set of MITI results to allow an evaluation of MI fidelity. Instead, most relied on study-specific checklists that were not detailed in study manuscripts.

Although intervention checklists provide some value for distinguishing conditions from one another, they are limited in significant ways that hamper reliability and provide little information on the quality of MI. Study-specific checklists likely include study-specific intervention components rather than those that comprise bona fide MI. Moreover, proficient MI is as notable for what it includes as what it does not include. Certain therapist behaviors such as confrontation and giving unsolicited advice are proscribed in MI, and monitoring tools such as the MITI evaluate these aspects of intervention delivery that may undermine MI's positive effects as well. A final limitation of using checklists to measure intervention fidelity is that they only produce binary evaluations (an intervention component was present vs. not). This kind of outcome provides no information on the quality or frequency of therapist behaviors. This is a problem for an intervention such as MI where a relatively limited set of powerful skills are employed consistently and skillfully across the entire session. For example, while a checklist may indicate whether an MI interventionist used reflections, it would not inform how often they used reflection in relation to other skills, or the *depth* of the reflection or its service in cultivating

change language. In addition to demonstrating overall fidelity to MI in clinical trials that intend to employ it, reliable coding of therapist behaviors with instruments such as the MITI allow for evaluations of the *quality* of MI in the study.

To advance knowledge about the impact of different MI skills levels on client outcomes, the continuous and categorical scores from the Motivational Interviewing Treatment Integrity Code (MITI) can be quantitatively analyzed with client outcomes. For example, a meta-analysis by Palacio (2016) found that overall MI fidelity was associated with improved rates of medication adherence. Utilizing therapist scores from the MITI, McCambridge et al. (2011) found that higher fidelity to motivational interviewing (MI) techniques was linked to subsequent cannabis cessation among adolescents. Another comprehensive review of MI studies conducted by Frost et al. (2018) revealed that higher quality MI was correlated with better client outcomes, including engagement with treatment, adherence to health behaviors, and overall health improvements. Regarding the relational components of MI specifically, Moyers et al. (2016) found that higher global ratings of therapist empathy were predictive of better outcomes in alcohol use.

However, the finding that higher quality MI leads to better outcomes should not be taken for granted. For instance, Spohr (2016) conducted a study on substance use with a community corrections sample and found that scores on the MITI predicted better engagement with treatment but not better substance use outcomes. Similarly, Schmidt et al. (2019) observed that scores on the MITI had no association with alcohol outcomes in a sample of 60+ year-old Danish citizens seeking treatment for alcohol use. Taken together, these results suggest that MI quality is associated with improved client outcomes but not in all contexts. Therefore, it will be crucial for

researchers to evaluate this relationship in various contexts within the gambling domain to advance knowledge of how to best tailor MI to these populations.

Although the studies contained in this review were not considered adequate trials of bona fide MI, they likely included some degree of MI-consistent therapist behavior that differed in frequency or quality from comparison conditions. Therefore, the quantitative results are offered not as precise estimates of MI's effects but as preliminary indicators of whether motivation-focused interventions can have a desirable impact on outcomes in the gambling domain.

Statistical Improvements and Findings

The quantitative findings were based on 10 studies, representing 985 participants (Table 2), and offer a nuanced view of MBIs' relative impacts on gambling outcomes. Consistent with previous work (Yakovenko et al., 2015), when studies were pooled, MBIs showed a small superior effect on posttreatment gambling frequency ($g = -.12$) and intensity ($g = -.15$) relative to non-motivational comparison groups, which was not maintained at follow-up time points. Although these effects are informative of the range of effects that can be expected in an average future study that intends to use an MBI to target a gambling outcome, the pooled estimates obscure important differences among studies that may strengthen or dampen MBIs' benefits.

When sensitivity analyses were conducted to evaluate the robustness of these results to our study inclusion decisions, important trends emerged. Most notably, the favorable effects on gambling frequency and intensity that were observed in the pooled estimates appeared to be driven by the inclusion of three studies that blended a CBT workbook with the MBI. When analyzed as a group, these three studies had effects that were double those in the pooled analysis ($g = -.26$ for frequency and $g = -0.24$ for intensity). These three studies also comprised 60% of

those included in the previous meta-analysis (Yakovenko et al., 2015), which suggests they had a considerable influence on their overall effect size estimates. When we analyzed the group of studies (k = 7) that used MBIs without combining them with another intervention, the effects were eliminated or reduced on gambling frequency (g = -0.04) and intensity (g = -0.11). The difference in the gambling frequency effect sizes between these two groups of studies has clinical significance. For example, a gambler who received an MBI + CBT workbook was expected to reduce their gambling frequency by about two days per month, on average, compared to controls, while a gambler who received an MBI alone was expected to reduce gambling by one-third of one day. In addition to this intervention-level variable influencing the effect sizes of MBIs, other study-level variables had an influence.

The relatively small sample size of 10 studies precluded our ability to conduct reliable subgroup analyses to statistically compare effect sizes on the basis of study characteristics (Cuijpers, 2012). However, we were able to analyze groups separately and examine the patterns of effects. It is common for established interventions to show strong effects when judged against inactive or weak comparison groups and equal effects when judged against other bona fide treatments (Lubrosky et al., 2002). When applying an established intervention in a new behavioral domain, it is sensible to begin with inactive control conditions as this helps to answer the questions of the intervention's potential effect compared to other known facilitators of change such as expectancies and time. Therefore, we separated studies into two groups on the basis of the comparison conditions for the MBIs and conducted two separate analyses on gambling frequency and intensity. In each case, MBIs showed no superiority relative to active control groups (e.g., Behavior Therapy) and small superior effects relative to inactive controls (e.g., waitlist). This aligns with findings from previous meta-analyses of motivational

interviewing across a wide range of behavioral outcomes such as alcohol, substance use, and health behaviors (Lundahl & Burke, 2009; Lundahl et al., 2010). This finding also suggests to future investigators that comparisons of MBIs against established treatments for gambling problems are likely premature until more rigorous studies can establish its superiority to inactive controls.

The inclusion of assessment feedback was another study dimension on which studies differed. Several studies included in our analysis described their interventions as Motivational Enhancement Therapy (MET), which is an adaptation of MI that incorporates all of its principles and therapist skills with the addition of domain-specific assessment feedback to the participant. Other studies referenced basic MI but also included gambling assessment feedback. Studies that included assessment feedback ($k = 6$) had a small effect on combined gambling behaviors ($g = -0.21$), while studies that did not ($k = 4$) showed no effect ($g = -0.05$). This finding is consistent with other meta-analytic findings that in study contexts where specific behavior change is the goal, MET considerably outperforms MI (Lundahl et al., 2010). Given the discrete targets of gambling treatment (decreasing the frequency, duration, and expenditure of gambling), including gambling-specific assessment feedback may be a powerful synergizing factor when combined with basic MI. Indeed, counselors in a study by Jonsson et al. (2019) telephoned a randomized sample of top .5% of spenders from Norwegian Norsk Tipping gambling websites and provided feedback on their spending habits in an MI-style. Those who received the call (a mean of 6 minutes) decreased their online bets significantly more than a no-contact control group, lending support for combining behavioral feedback and MI.

The relative influence of the various factors that were associated with comparatively different outcomes could not be determined in the present analysis due to issues of low power

and confounding. There was considerable overlap among these variables across the studies, making it difficult to determine which factor may be exerting the influences in a particular analysis. For example, of the six studies that included assessment feedback, five used an inactive comparison group. Likewise, several components that did not appear to influence outcomes (risk of bias, publication bias, delivery format, MBI duration) may, in fact, exert an influence in subgroup analyses that require sample sizes an order of magnitude larger than ours to be sufficiently powered (Cuijpers, 2012). Therefore, the results of the sensitivity analyses we present should not be used to draw firm conclusions about the influence of study conditions on MBIs effect sizes but rather to encourage careful consideration of these factors and making study design decisions on the basis of the research context, question, and population.

Sources of Heterogeneity

The sources of variation in the included studies that appeared to influence gambling outcomes require further consideration. Here, we will examine each of the components in more depth considering their impact on the results, concordance with existing literature, and implications for future gambling studies.

Blended Interventions

Three of the studies included in the analysis blended an MBI with a CBT workbook, and several others included conditions that blended an MBI with other interventions but were not used in our analyses because a condition of the MBI alone was also available. Combining motivational interviewing with other interventions, such as CBT, is common practice both in clinical trials and clinical practice in areas outside of gambling. This is often because MI is

viewed as a method for building motivation for change but not as a more comprehensive intervention for addressing complex psychopathology. Therefore, interventionists who face challenges with client initiation and adherence in their treatments view MI as a useful tool for keeping clients engaged in skill-building or other more elaborate treatment components that they view as necessary.

For example, there are research literatures examining how MI can be combined with CBT to treat severe anxiety disorders (Westra et al., 2016), depression (Arkowitz & Westra, 2004), and improve medication adherence (Spoelstra, 2015), to name a few. Therefore, it is sensible that researchers in gambling treatments would see opportunities to employ motivational interviewing as a tool for facilitating additional treatment. However, without a thoughtful study design, this poses a significant challenge for evaluating MI's unique contribution to gambling outcomes. In the case of Hodgins (2001), Hodgins (2009), and Diskin & Hodgins (2009), participants were given a CBT self-help workbook right after receiving the MI interview, and their outcomes were evaluated one month later. Therefore, it is impossible to determine whether favorable outcomes were attributable to the MI interview, the workbook, or both (Papa et al., 2014). Comparing such outcomes to a workbook-only condition does not solve the problem as this would amount to a test of the effect of an MI-workbook combination, and not the effect of MI alone. Although the numerical outcomes of the workbook-only conditions can be subtracted from those of the combination condition, this does not subtract the influence of both interventions on the individual and does not demonstrate that MI would be useful in the absence of the workbook. For these reasons, we encourage research on the effect of MI-combinations to improve important outcomes but also caution against attributing favorable results to MI in the absence of well-designed dismantling studies.

Comparison Groups

In our analysis, we observed considerable variability in the nature and strength of comparison groups utilized in the studies. The selection of comparison groups is critical as it influences the interpretation of treatment effects and the generalizability of findings. This is because different comparison groups serve different purposes in evaluating treatment efficacy. Weaker comparison groups, such as waitlist controls or assessment-only conditions, provide insights into the potential effects of an intervention, while stronger comparison groups, such as active treatments like cognitive-behavioral therapy (CBT), offer insights into the maximum effects of the intervention. In our analysis, the majority of studies did not amount to a well-controlled test of MI since most comparison groups differed from the experimental group on variables other than the intervention. This discrepancy raises questions about whether observed changes are attributable to specific factors of the MBIs or to common elements shared across interventions.

Intervention Duration

Although the duration, or dose, of the MBI was not associated with any gambling outcomes in this meta-analysis, this finding should be considered in light of the small sample of studies and other research into the impact of MI dose. For example, Hardcastle et al. (2012) identified a dose-response relationship for MI within health research, suggesting that the duration of motivational interviewing interventions may impact outcomes such as physical activity for those recruited through primary care in disadvantaged communities. These findings were supported by a larger meta-analysis that similarly found a dose-response relationship for MI with behavioral outcomes related to alcohol, drugs, and diet and exercise (Burke et al., 2003). Finally,

a rigorously conducted meta-analysis of MI across various domains found trends across domains that more MI was better, that no duration of MI was harmful, and that although very brief episodes of MI can have effects, they are likely not enough for lasting change to occur. These findings should encourage gambling researchers to think closely about the appropriate doses of MI to evaluate in the context of different gambling outcomes and contexts and to investigate the dose-effect relationship in their analyses.

Clinical Implications

The meta-analysis results suggest that Motivational Interviewing-based interventions (MBIs) do not pose any discernible harm, and therefore there is little risk in counselors' efforts to incorporate aspects of the included studies into their gambling interventions. The favorable findings for MBIs, given the lack of intervention specificity or quality fidelity indicators, suggest that a basic adherence to MI principles may yield positive effects compared to standard or minimal treatments. Despite variability, almost all studies referenced principles of motivational interviewing such as expressing empathy, rolling with client resistance, supporting self-efficacy, and developing discrepancy between an individual's values and their behavior. Abiding by these principles is likely to guide interventionists to a clinical style that resembles the relational aspects of MI and is therefore recommended.

Personalized feedback on gambling behavior also emerged as a seemingly important component of MBIs. Such feedback on one's behavior relative to others may itself have a benefit for clients and can also provide very clear behavioral targets for therapists to focus on when delivering MBIs. Combining MI with self-help workbooks also demonstrated effects beyond the

use of workbooks alone. This suggests that providers offering workbooks should integrate MI principles, even in brief encounters, to optimize treatment outcomes.

The study results also provide useful information on which gambling outcomes are the most fruitful targets of MBIs. The favorable findings for MBIs on gambling frequency and intensity, but not for gambling severity, suggest that MBI conversations may be most useful for addressing proximal targets of problematic gambling such as limiting the number of days of gambling rather than more distal outcomes such as relationship problems. This makes sense when one considers that longer-term consequences of gambling are the likely results of proximal gambling behaviors. One target of MBIs that was unexplored in the current set of studies was treatment initiation. MI has been used in other areas to increase treatment engagement and retention with positive results (Carroll et al., 2006), and this is a promising area for gambling interventionists to explore given the brief windows of opportunity they often have to intervene (Forman & Moyers, 2019).

Limitations

This systematic review and meta-analysis offer valuable insights into the use of motivational interviewing-based interventions (MBIs) targeting problem and pathological gambling in clinical trials. However, several limitations must be acknowledged to provide a nuanced interpretation of the findings and guide future research.

First and foremost, the heterogeneity among the included studies poses a significant limitation. This heterogeneity encompasses various aspects of the studies, including intervention components, comparison groups, outcome measures, and participant characteristics. As a result, the meta-analysis does not yield a precise and reliable estimate of MI's impact on gambling

behavior. Moreover, the non-random selection of studies and underpowered analyses further compound this limitation, potentially affecting the robustness of the synthesized evidence.

Another important methodological consideration is the violation of the assumption of normality in some of the outcome data. Specifically, gambling expenditure, a commonly assessed outcome measure, is known to be positively skewed in gambling studies, primarily due to participants who cease gambling entirely. While log-transforming such data would align with the assumptions of meta-analysis, the absence of participant-level data precluded this approach.

Additionally, the homogeneity of the sample in terms of race and gender raises concerns regarding the generalizability of findings to diverse populations with gambling problems. Those from low socio-economic status minority communities are disproportionally harmed by gambling problems and are therefore a crucial population to include in gambling research. The meta-analysis was restricted in its ability to evaluate the impacts of motivational-interviewing-based interventions in these populations due to their exclusion from the primary studies. Therefore, the conclusion drawn in this work may not reflect important trends that are useful for guiding gambling research towards those who are most impacted by gambling problems.

In terms of the inclusion criteria, the reliance on a small sample of randomized controlled trials (RCTs) may limit the comprehensiveness of our analysis. This approach may inadvertently exclude relevant studies and fail to capture the full spectrum of interventions and outcomes related to MI for gambling disorders. Furthermore, missing data, discrepancies in reported findings, and the exclusion of certain studies due to methodological constraints may have biased the results in unknown ways.

Lastly, it is also important to acknowledge the inherent limitations of meta-analysis as a method. While it offers a systematic approach to synthesizing evidence, meta-analysis does not

provide insights into the underlying mechanisms or processes of MI, which are crucial for understanding and improving treatment outcomes. Moreover, subgroup analyses require substantially larger sample sizes than typically available in the gambling literature for MI, posing challenges to conducting robust subgroup analyses now or in the near future.

Recommendations for Future Research

Addressing Intervention Variability

Motivational Interviewing (MI) is characterized by its unique blend of building a strong client-therapist relationship and fostering favorable change language. However, the variability in intervention descriptions across studies highlights the need for greater clarity and specificity in detailing the components of MI in gambling intervention studies. If researchers intend to draw conclusions about MI, they should provide detailed descriptions of therapist behaviors and processes, including both prescribed and proscribed elements, to ensure fidelity to MI principles. Emphasizing the relational component of MI, such as empathy and collaborative engagement, alongside techniques for eliciting change talk, is essential for maintaining the integrity of MI interventions. By way of example, in a study examining the benefit of MI as a prelude to intensive treatment for post-traumatic stress disorder, Seal et al. (2012) provided rich descriptions of specific therapist behaviors included in the MI condition such as “open-ended questions to elicit concerns, responding with empathic reflective listening…attempts to elicit self-motivational statements (“change talk”) and to avoid confrontation” (p. 452).

Improving Intervention Training and Fidelity Monitoring

To accurately attribute study effects to the intended intervention method, researchers must demonstrate fidelity to MI principles throughout the intervention delivery process. This necessitates comprehensive training of interventionists to a specified threshold of proficiency, and employing objective fidelity monitoring tools, such as the Motivational Interviewing Treatment Integrity Code (MITI). Researchers should not only use instruments such as these to monitor fidelity throughout the intervention but must also report on all available measures of fidelity to reassure readers that certain outcomes are not being withheld and to permit comparisons across studies.

Addressing Blended Interventions

The prevalence of blended interventions, such as combining MI with cognitive-behavioral therapy (CBT) workbooks, poses challenges for evaluating the unique contribution of MI to treatment outcomes. While combining MI with other interventions may offer benefits in enhancing treatment engagement and adherence, researchers must employ thoughtful study designs to disentangle the effects of each component and refrain from drawing conclusions about MI from studies that did not measure its unique and direct contributions to outcomes.

Diverse Populations

The studies included in the analysis were conducted in four different countries and therefore had an element of cultural variation that is important for generalization. However, participants were homogenous in terms of race/ethnicity, such that populations of minority groups appeared largely underrepresented. In most studies, no data were provided on the racial/ethnic makeup of the sample. Yet, in the U.S., Blacks and Native Americans are at a

higher risk for problem gambling as compared with the rest of the population and have higher rates of co-morbidity with gambling problems and heavy drinking (Barnes et al., 2017). A recent systematic review shows that the omission of low socio-economic-status racial minority groups in gambling studies is the norm and offers specific recommendations for improvement (Peter et al., 2021).

Outcome Selection

The findings suggest that MBIs have the most reliable effect on gambling frequency and a small but unreliable effect on gambling intensity. Therefore, we encourage researchers to focus on these two outcomes in future studies. In addition, gambling researchers are encouraged to take cues from other MI literatures and consider investigations on MI's potential as a prelude to other gambling treatments such as CBT, self-help workbooks, or contingency management. In such a hypothetical study, it will be important for study designs to permit the analysis of MI's effect on the engagement with the subsequent treatment as well as any indirect effects it may have on gambling behaviors.

Conclusion

In conclusion, this study has addressed critical gaps in the literature regarding Motivational Interviewing (MI) for gambling problems. The systematic review improved on previous work by highlighting that most studies that reported investigating MI did not incorporate its empirically-supported elements nor demonstrate fidelity to the method during the trials. Despite these challenges, the meta-analysis portion of the study offers a "light in the fog", finding that interventions based on MI had a small effect on reducing gambling intensity and a

small and consistent benefit for reducing gambling frequency. The analysis also identified several factors that increased the effectiveness of the interventions, including the incorporation of cognitive-behavioral workbooks and the use of assessment feedback. The clinical implications, though broad in nature, offer practitioners in gambling settings their clearest direction yet for how MI may improve their important work. The recommendations for gambling researchers were based on the empirical findings of this work and considerable work on Motivational Interviewing in more mature research literatures whose lessons can be leveraged. These insights provide valuable guidance for optimizing intervention protocols and enhancing treatment outcomes for individuals with gambling problems.

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LIST OF APPENDECES

Table 1. Characteristics of the randomized controlled trials

Author(s)	Year	Location	Funding source	Pre-registered?	Frequency measure	Expenditure measure	Severity measure
Abbot et al.	2018	AUS	Ministry of Health New Zealand	Y	Mean days gambled/month	Mean dollars lost/day	NR
Carlbring et al.	2010	SWE	Swedish National Institute of Public Health	N	Mean days gambled/month	Mean dollars waged/month	NODS
Diskin & Hodgins*	2009	CAN	Alberta Gaming Research Institute	N	Mean days gambled/month	Mean dollars waged/month	PGSI, SOGS
Hodgins et al.*	2009	CAN	Alberta Heritage Foundation for Medical Research	N	Mean days gambled/month	Mean dollars lost/month	NR
Hodgins et al.*	2001	CAN	Canadian Institutes of Health Research, Ontario Problem Gambling Research Centre	N	Mean days gambled/month	Mean dollars lost/month	NR
Larimer et al.	2012	USA	National Institute on Mental Health	Y	GQPN subscale	GQPN subscale	DSM-IV criteria
Petry et al.	2008	USA	National Institute on Drug Abuse, National Institute on Mental Health	N	NR	Mean dollars waged/month	ASI
Petry et al.*	2009	USA	National Institute on Drug Abuse, National Institute on Mental Health	Y	Mean days gambled/month	Mean dollars waged/month	ASI
Thomas et al.*	2015	AUS	Victorian Responsible Gambling Foundation	Y	Mean days gambled/month	Mean dollars waged/month	G-SAS
Tonetato	2016	CAN	None	N	Mean % days gambling/month	Mean dollars per gambling day	DSM-IV criteria

Note. NR = Not reported; CBT = Cognitive Behavior Therapy; SOGS = South Oaks Gambling Screen; PGSI = Problem Gambling Severity Index; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, 4th Edition; ASI = Addiction Severity Index – gambling; NODS = NORC Diagnostic Screen for Gambling Problems; G-SAS = Gambling Symptom Assessment Scale. Studies with an * were included in Yakovenko et al. (2015).

Table 2 Characteristics of the samples used in the randomized controlled trials

Study	Sample size	Recruitment source	Gambling inclusion criteria	Mean age (years)	% male	% Asian	% Black	% White	% Hispanic
Abbott et al.	188	New Zealand Gambling Helpline	Self-identified gambling problem	39	47	NR	NR	NR	NR
Carlbring et al.	15	Outpatient dependency clinic	Self-identified gambling problem	40	84	NR	NR	NR	NR
Diskin & Hodgins	81	Community media	≥ 3 on PGSI	45	57	NR	NR	NR	NR
Hodgins et al. (2001)	64	Community media	≥ 3 on PGSI	46	48	NR	NR	NR	NR
Hodgins et al. (2009)	145	Community media	Self-identified gambling problem	NR	45	NR	NR	NR	NR
Larimer et al.	81	College students	≥ 3 on SOGS	21	65	28	NR	60	3
Petry et al.	95	Treatment clinics	≥ 3 on SOGS + expenditure + frequency	43	62	NR	23	59	14
Petry et al.	64	College students	≥ 3 on SOGS + expenditure + frequency	20	87	7	NR	91	NR

Thomas et al.	132	Community media	Self-identified gambling problem	55	56	NR	NR	NR	NR
Toneatto	50	Community media	≥ 1 DSM-IV gambling disorder criteria	77	49	NR	NR	NR	NR

Notes. AUS = Australia; CAN = Canada; N = no; NR = not reported; SWE = Sweden; Y = yes; USA = United States of America

Table 3 Characteristics of MBIs and comparison groups

Study	Format	Study description of MBI	MBI session duration	MBI sessions number	Comparison group (active/inactive)
Abbot et al.	phone	• structured to build commitment and reasons to change	40-60 min.	1	Treatment as usual, matched time (active)
Carlbring et al.	face-to-face	• manualized • standard MI principles • explored the positive and negative consequences of gambling • encouraged to decide about gambling and create change plan.	50	4	Waitlist, no contact (inactive)
Diskin & Hodgins	face-to-face	• manualized but flexible • reflective listening, summarizing, and supporting self-efficacy • a decisional balance exercise and a readiness ruler • CBT workbook	75	1	Semi-structured interview with empathy (M=54 min, SD, 13.8min) (active)
Hodgins et al. (2009)	phone	• assessment feedback • expression of empathy • development of a discrepancy between behavior and goals • avoidance of argumentation • rolling with resistance • support of self-efficacy	33*	1-6	CBT workbook (inactive)

		• summary of stated reasons for changing and specific short-term goals • CBT workbook			
Hodgins et al. (2001)	phone	• assessment feedback • principles of motivational enhancement therapy • asked to rate their motivation to meet their goal and their confidence in meeting their goal • CBT workbook	20-45	1	CBT workbook (inactive)
Larimer et al.	face-to-face	• assessment feedback • open-ended questions about contextual factors associated with gambling • review of each feedback section • encouraged to consider the feedback in light of their personal goals.	60-90	1	Assessment only (inactive)
Petry et al.	face-to-face	• assessment feedback • explored + and - consequences of gambling • discussed how gambling fit with goals and values • completed a change plan worksheet	50	1	Assessment only (inactive)
Petry et al.	face-to-face	• assessment feedback • explored + and - consequences of gambling • discussed how gambling fit with goals and values • completed a change plan worksheet	50	1	Assessment only (inactive)

Thomas et al.	face-to-face	• assessment feedback • expressing empathy • rolling with resistance • supporting self-efficacy • developing discrepancy	45-60	6	Client-Centered Therapy, matched time (active)
Tonetato	face-to-face	• goal of strengthening the commitment to action and moving the individual towards the maintenance stage of change • resolution of ambivalence • clarification of core values • awareness of gambling consequences, decisional balance analysis	60	6	Multi-component intervention, 90-minute (inactive)

Note. Descriptions of MBIs are taken directly from study manuscripts. MBI = Motivational interviewing-based intervention MET=motivation enhancement therapy; MI=motivational interviewing; MITI=Motivational Interviewing Treatment Integrity; YACS = Yale Adherence and Competence Scale; OARS = open questions, affirmations, reflections, summaries; *Outcomes for two MBI groups were averaged for this study. Both groups received an initial 33-minute session. One group received up to 6 additional contacts averaging 16 minutes each.

Table 4 Training and Fidelity of Motivational Interviewing-based Interventions

Author(s)	**MBI therapist**	**MBI Training**	**Fidelity measure**	**Fidelity outcome**
Abbot et al.	helpline counselor	NR	checklist	6.6-7.3 of 8 MI elements used
Carlbring et al.	licensed psychologists and social workers	previous MI experience	MITI 2.0	MITI rating = good
Diskin & Hodgins	graduate students	study of MI materials, supervised role-plays, peer-supervised practice	checklist	NR
Hodgins et al. (2009)	graduate students	reading, viewing training tapes, role-plays, supervision of two cases	checklist	NR
Hodgins et al. (2001)	licensed psychologist	NR	NR	NR
Larimer et al.	bachelor's and master's	NR	MITI 2.0	mean MI spirit score of 5.3 (SD = 0.96) out of 7
Petry et al.	bachelor's and master's	didactic training	YACS (modified)	MET was distinguishable from other conditions
Petry et al.	bachelor's, master's, doctoral student and PhD	didactic training + close supervision of one case	YACS (modified)	MET was distinguishable from other conditions

Thomas et al.	licensed psychologist	three group meetings reviewing manuals	checklist	"more than 90 percent adherence across sessions"
Tonetato	graduate students	provided manuals	NR	NR

Note: NR = not reported by authors; YACS = Yale Adherence Competence Scale; MET = Motivational Enhancement Therapy; MI = Motivational Interviewing; MITI = Motivational Interviewing Treatment Integrity

Table 5 Assessment of Study Quality using the Cochrane Risk of Bias Tool

Study	Randomization Sequence Generation	Allocation Concealment	Masking of Assessors	Outcome Data
Abbott et al. (2018)	+	+	+	+
Carlbring et al. (2010)	+	+	-	-
Diskin & Hodgins (2009)	+	?	+	+
Hodgins et al. (2001)	?	?	-	-
Hodgins et al. (2009)	+	?	+	+
Larimer et al. (2012)	?	?	+	+
Petry et al. (2008)	+	+	+	+
Petry et al. (2009)	+	+	+	+
Thomas et al. (2015)	+	+	+	+
Toneatto (2016)	+	?	?	+

Notes. + = low risk of bias; – = high risk of bias; ? = unclear risk of bias

Table 6 Summary of Hedge's G and standard errors for individual studies.

	Frequency		**Expenditure**		**Duration**		**Severity**		Length of Follow-up (months)
Author(s)	*Post*	*Follow*	*Post*	*Follow*	*Post*	*Follow*	*Post*	*Follow*	
Abbot et al. (2017)	.022(.146)	.111(.166)	.000(.146)	.10(.166)					12
Carlbring et al. (2010)	.226(.551)		.071(.550		.484(.561)		.772(.279)		-
Diskin & Hodgins (2009)	-.068(.220)	-.454(.223)	-.445(.223)	-.414(.223)				-.111(.240)	12
Hodgins et al. (2001)	-.077(.247)		-.427(.250)						-
Hodgins et al. (2009)	-.393(.146)	-.015(.155)	.010(.145)	.174(.155)					12
Larimer et al. (2012)	-.252(.211)		.044(.220)				-.406(.222)		-
Petry et al. (2008)			-.662(.205)	-.170(.210)			.222(.200)	-.083(.210	9
Petry et al. (2009)	-.318(.249)	-.531(.256)		-.384(.254)			-.315(.249)	-.659(.258)	9
Thomas et al. (2015)	.121(.173)	.194(.181)	-.051(.173)	.118(.181)	.214(.174)	.155(.181)		-.125(.174)	12
Toneatto (2016)	-.075(.281)	-.006(.280)	.009(.280)	-.252(.282)				.459(.284)	12

Table 7 Ratings of studies based on Miller & Rollnick's criteria for establishing MI fidelity in clinical trials.

	Included components with theoretical or empirical support		Therapists trained to specified criteria	Reliable fidelity coding that permits comparison
Author(s)	*Theoretical*	*Empirical*		
Abbot et al. (2017)	✔			✔
Carlbring et al. (2010)	✔			
Diskin & Hodgins (2009)	✔	✔		
Hodgins et al. (2001)	✔			
Hodgins et al. (2009)	✔			
Larimer et al. (2012)	✔	✔		✔
Petry et al. (2008)	✔	✔		
Petry et al. (2009)	✔			
Thomas et al. (2015)	✔	✔		
Toneatto (2016)	✔			

(1) The treatment should clearly contain the components that are theoretically or empirically related to its efficacy; (2) providers should be trained to an adequate and specified criterion of proficiency before treating trial patients; and (3) the fidelity of treatment should be documented by reliable coding of practice throughout the study and reported in a manner that permits comparison with skill levels in other trials.

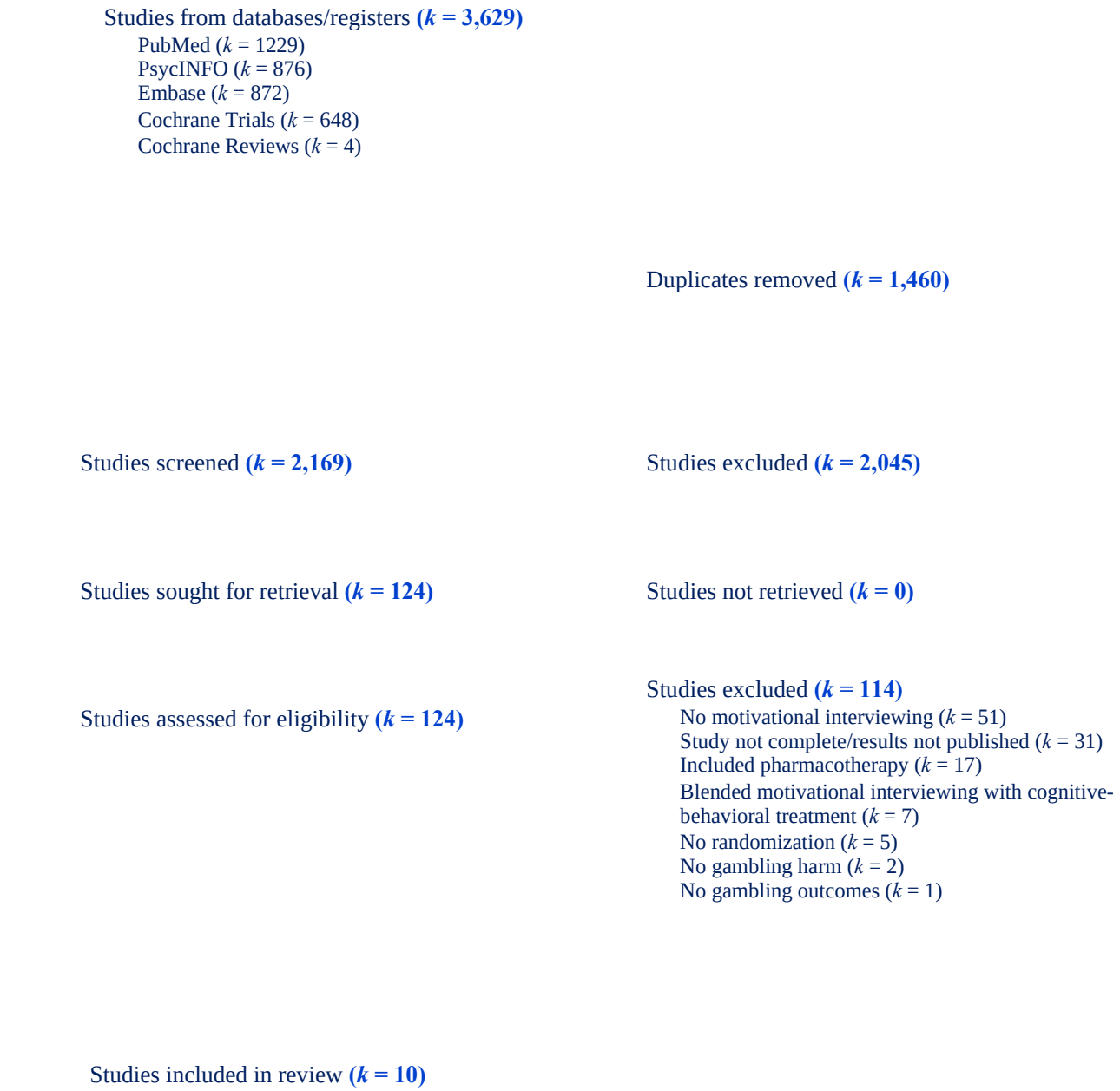
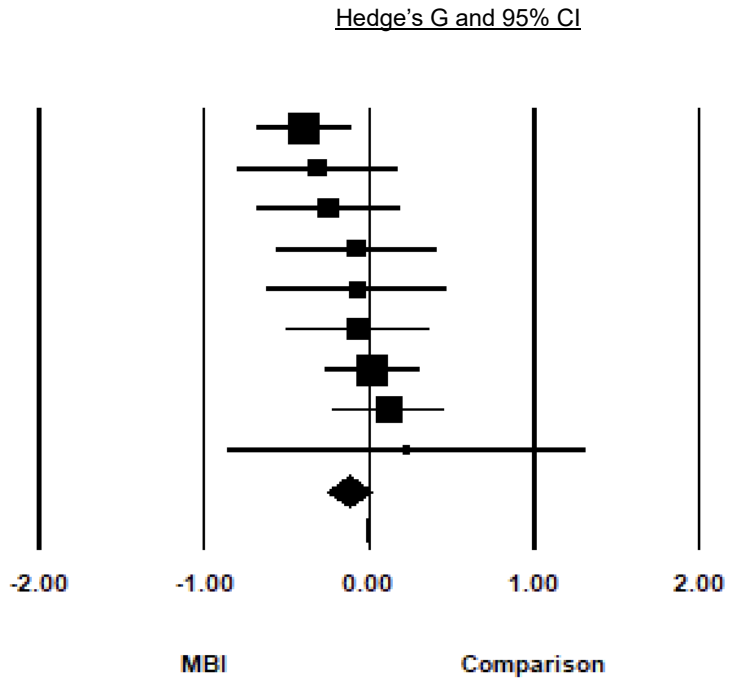


Figure 1. PRISMA flowchart for identification of studies.

Posttreatment Gambling Frequency

Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	p-Value
	Statistics for each study					
Hodgins et al. (2009)	-0.393	0.146	0.021	-0.680	-0.106	0.007
Petry et al. (2009)	-0.318	0.249	0.062	-0.806	0.170	0.201
Larimer et al (2012)	-0.252	0.221	0.049	-0.685	0.182	0.255
Hodgins et al. (2001)	-0.077	0.247	0.061	-0.561	0.408	0.757
Toneatto (2016)	-0.075	0.281	0.079	-0.625	0.474	0.788
Diskin & Hodgins (2009)	-0.068	0.220	0.049	-0.500	0.364	0.758
Abbott et al. (2018)	0.022	0.146	0.021	-0.263	0.308	0.878
Thomas et al. (2017)	0.121	0.173	0.030	-0.218	0.461	0.484
Carlbring et al. (2010)	0.226	0.551	0.304	-0.854	1.306	0.681
Pooled	-0.122	0.068	0.005	-0.255	0.011	0.073
Prediction Interval						



Note. Size of boxes corresponds to study's weight in analysis

Figure 2. Forest plot of posttreatment gambling frequency

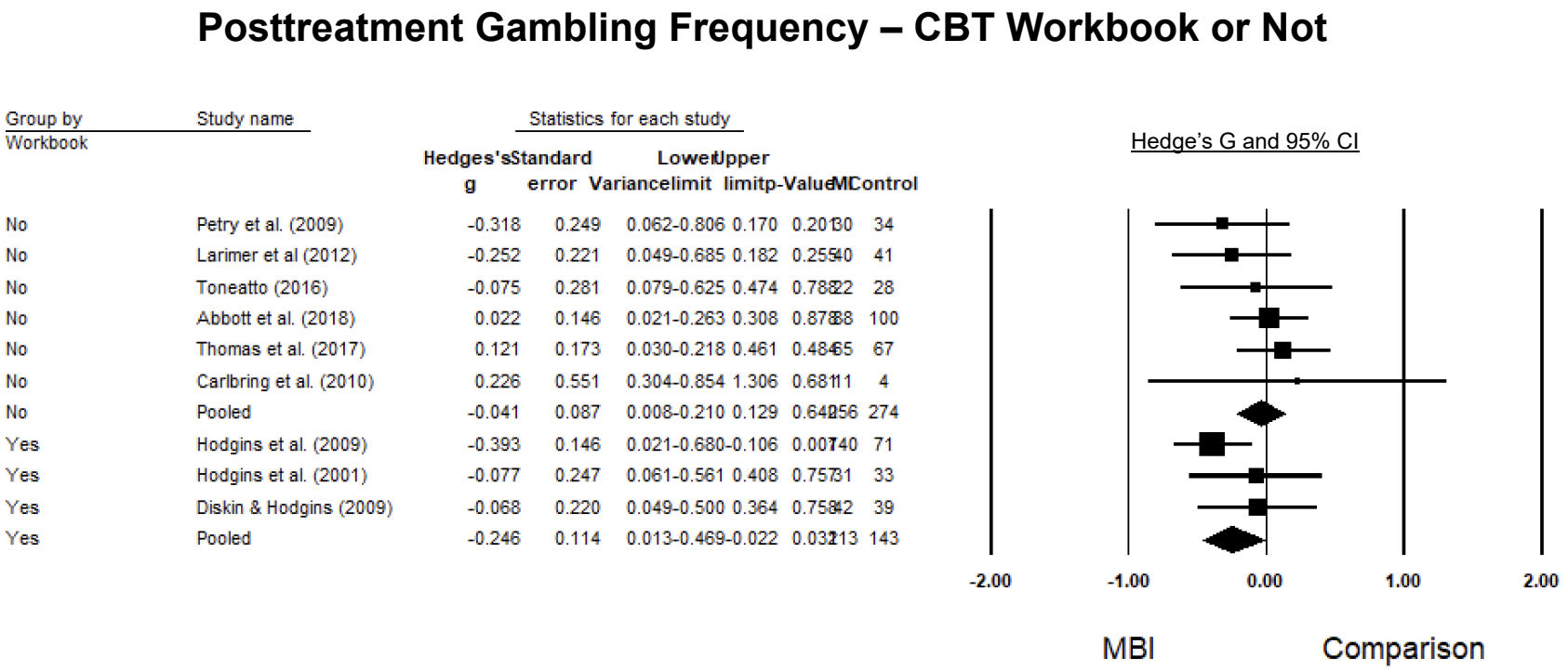


Figure 3. Forest plot of posttreatment gambling frequency, grouped by inclusion of a CBT workbook

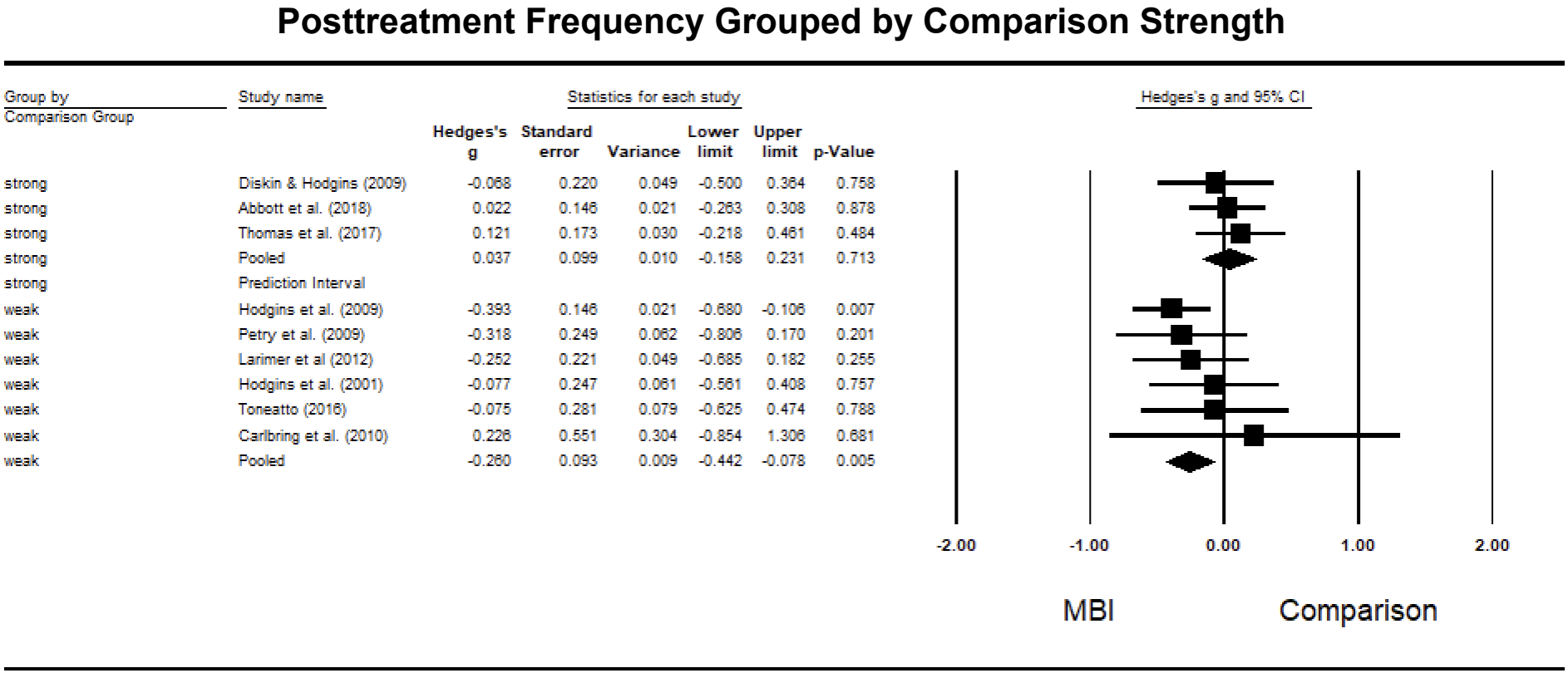


Figure 4. Forest plot of posttreatment gambling frequency grouped by comparison strength

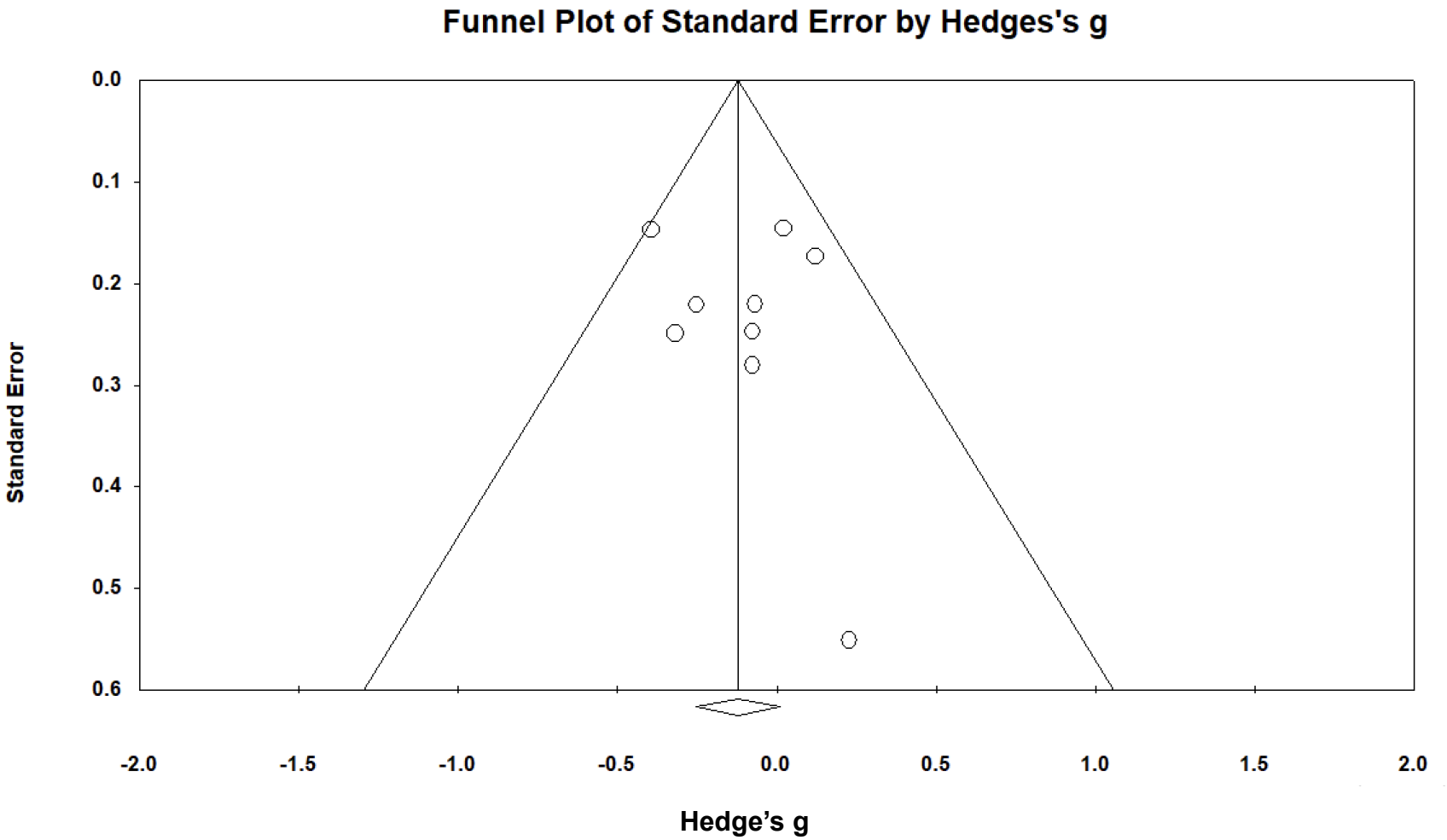


Figure 5. Funnel plot for posttreatment gambling frequency

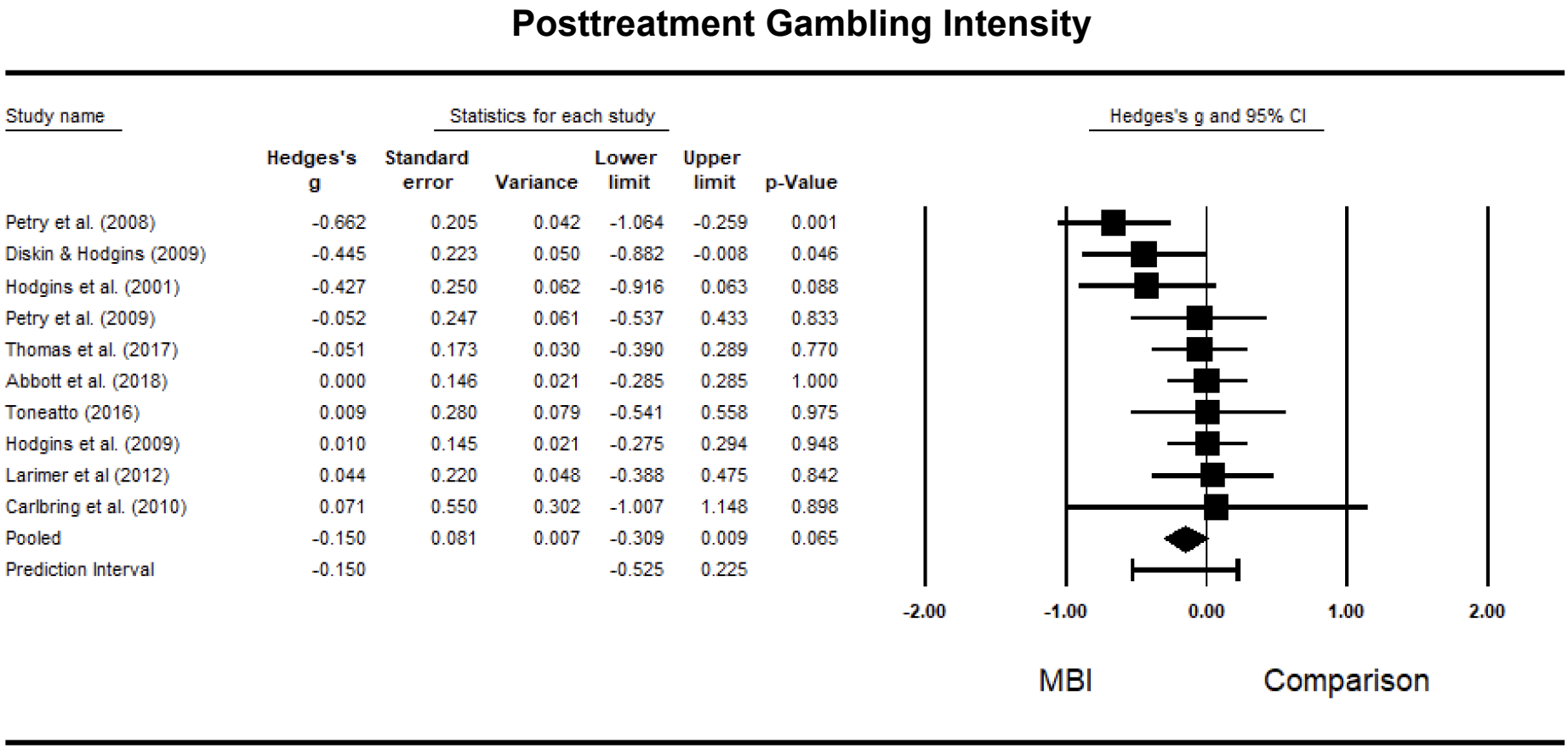


Figure 6. Forest plot of posttreatment gambling intensity

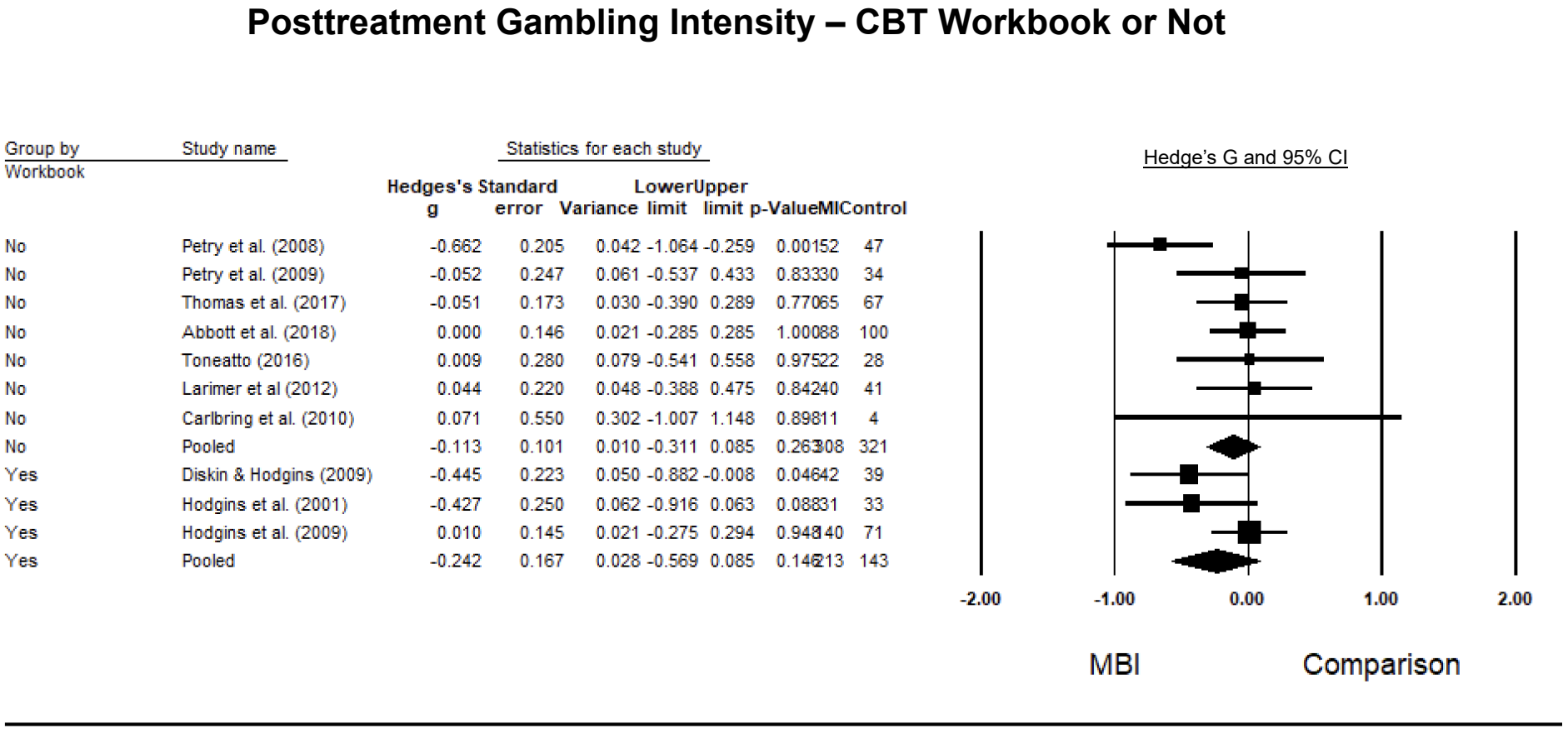


Figure 7. Forest plot of posttreatment gambling frequency, grouped by inclusion of a CBT workbook

Posttreatment Frequency Grouped by Comparison Strength

Group by Comparison Group	Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	p-Value
strong	Diskin & Hodgins (2009)	-0.445	0.223	0.050	-0.882	-0.008	0.046
strong	Thomas et al. (2017)	-0.051	0.173	0.030	-0.390	0.289	0.770
strong	Abbott et al. (2018)	0.000	0.146	0.021	-0.285	0.285	1.000
strong	Pooled	-0.122	0.124	0.015	-0.365	0.120	0.322
weak	Petry et al. (2008)	-0.662	0.205	0.042	-1.064	-0.259	0.001
weak	Hodgins et al. (2001)	-0.427	0.250	0.062	-0.916	0.063	0.088
weak	Petry et al. (2009)	-0.052	0.247	0.061	-0.537	0.433	0.833
weak	Toneatto (2016)	0.009	0.280	0.079	-0.541	0.558	0.975
weak	Hodgins et al. (2009)	0.010	0.145	0.021	-0.275	0.294	0.948
weak	Larimer et al (2012)	0.044	0.220	0.048	-0.388	0.475	0.842
weak	Carlbring et al. (2010)	0.071	0.550	0.302	-1.007	1.148	0.898
weak	Pooled	-0.167	0.116	0.013	-0.394	0.061	0.152

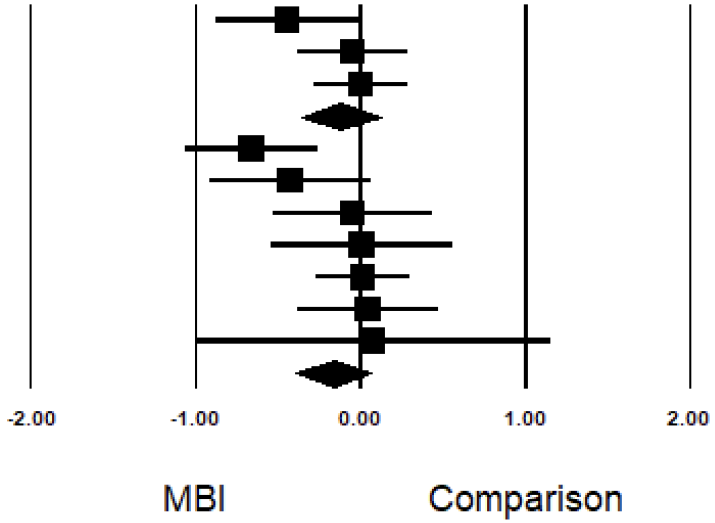


Figure 8. Forest plot of posttreatment gambling intensity grouped by comparison strength.

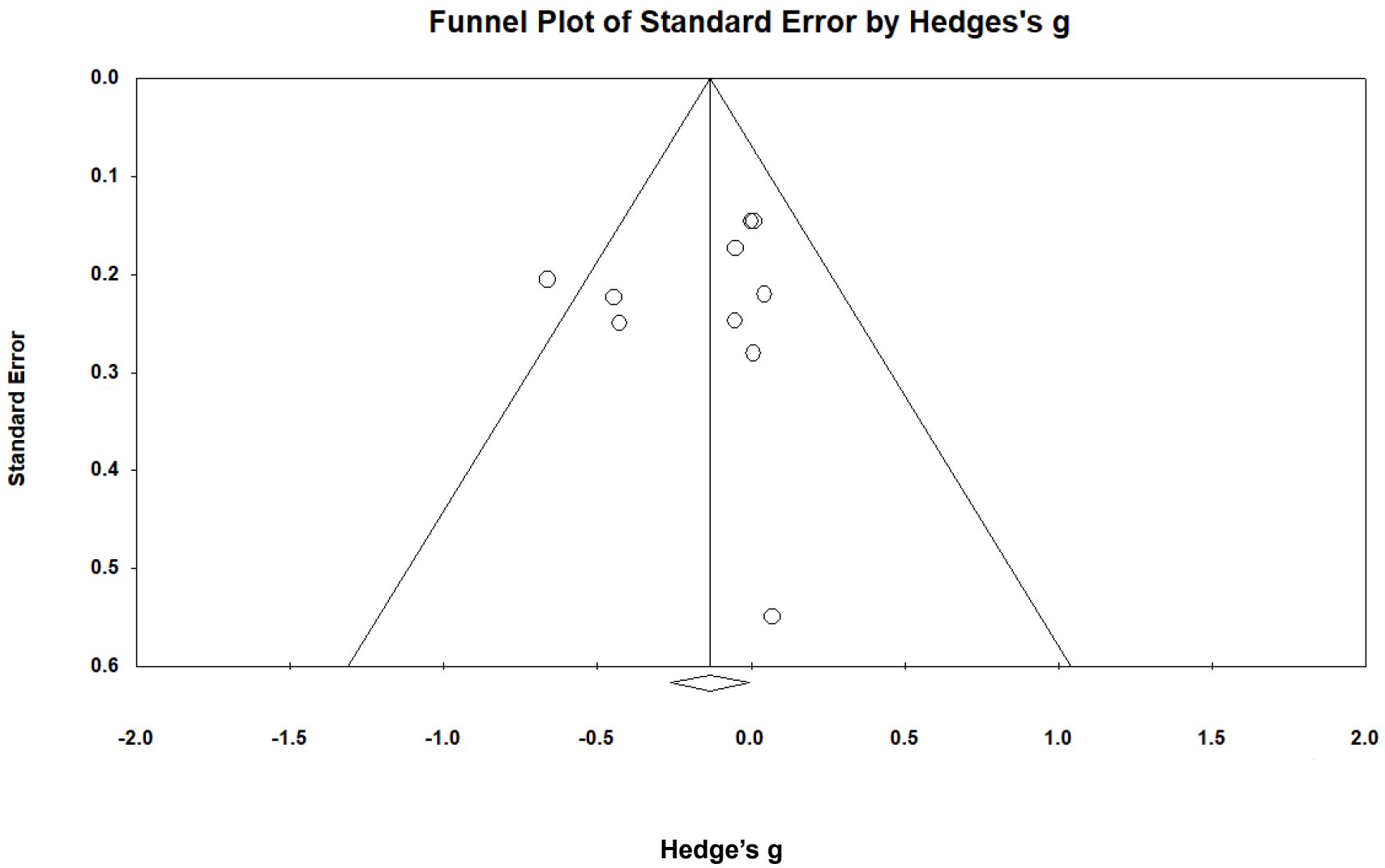


Figure 9. Funnel plot for posttreatment gambling intensity

Posttreatment Gambling Severity

Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	p-Value
Larimer et al (2012)	-0.406	0.222	0.049	-0.842	0.030	0.068
Petry et al. (2009)	-0.315	0.249	0.062	-0.803	0.173	0.206
Thomas et al. (2017)	-0.125	0.174	0.030	-0.466	0.216	0.473
Petry et al. (2008)	0.222	0.200	0.040	-0.171	0.615	0.268
Carlbring et al. (2010)	0.772	0.279	0.078	0.225	1.319	0.006
Pooled	0.012	0.186	0.035	-0.354	0.377	0.950
Prediction Interval	0.012			-1.254	1.277	

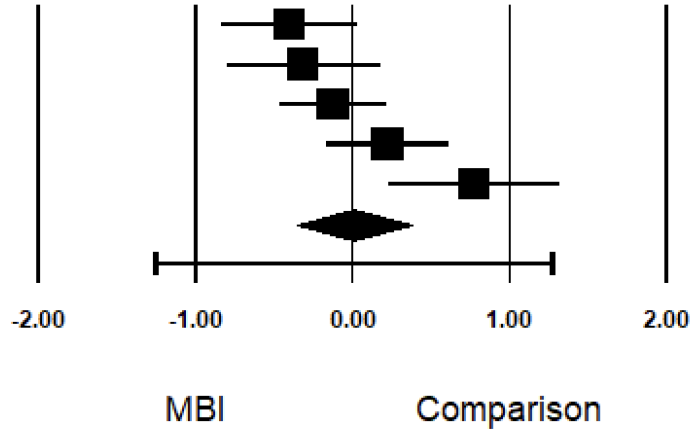


Figure 10. Forest plot of posttreatment gambling severity

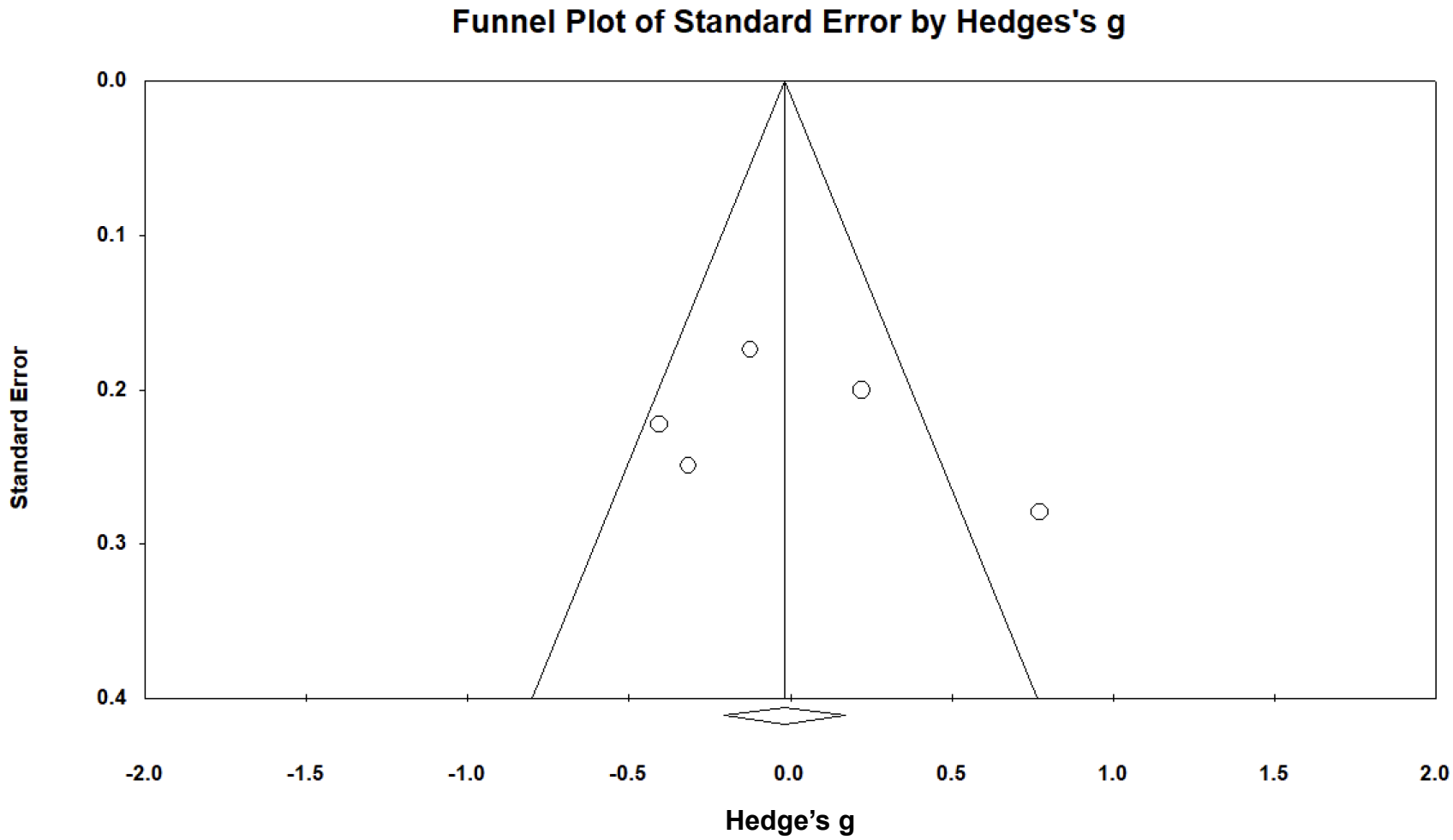


Figure 11. Funnel plot for posttreatment gambling severity

Posttreatment Gambling Behavior with Risk of Bias Groups

Group by ROB	Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	p-Value
High	Diskin & Hodgins (2009)	-0.257	0.222	0.049	-0.691	0.178	0.247
High	Hodgins et al. (2001)	-0.252	0.249	0.062	-0.739	0.236	0.312
High	Hodgins et al. (2009)	-0.192	0.146	0.021	-0.477	0.094	0.189
High	Larimer et al (2012)	-0.104	0.221	0.049	-0.536	0.328	0.638
High	Toneatto (2016)	-0.033	0.280	0.079	-0.583	0.516	0.906
High	Carlbring et al. (2010)	0.260	0.554	0.307	-0.826	1.346	0.638
High	Pooled	-0.167	0.091	0.008	-0.346	0.012	0.068
Low	Petry et al. (2008)	-0.662	0.205	0.042	-1.064	-0.259	0.001
Low	Petry et al. (2009)	-0.185	0.248	0.062	-0.672	0.301	0.456
Low	Abbott et al. (2018)	0.011	0.146	0.021	-0.274	0.296	0.939
Low	Thomas et al. (2017)	0.095	0.173	0.030	-0.245	0.435	0.584
Low	Pooled	-0.167	0.167	0.028	-0.494	0.159	0.316

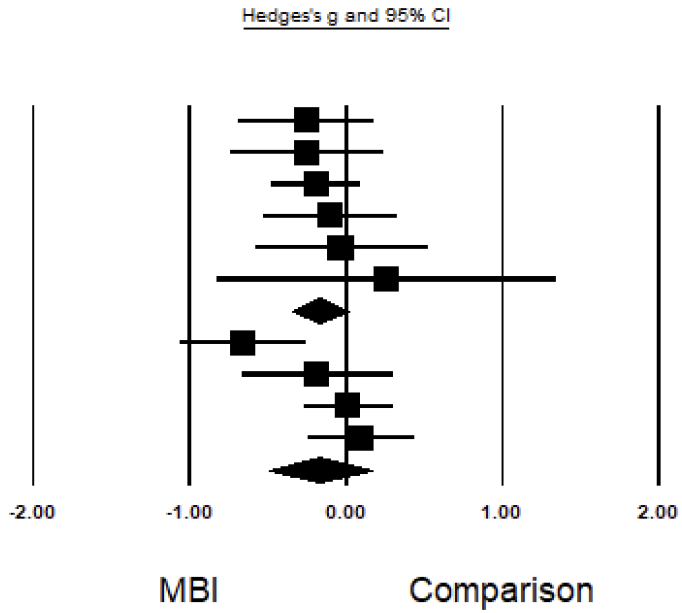


Figure 12. Forest plot for posttreatment gambling behaviors with risk of bias subgroups

Posttreatment Gambling Behavior with Comparison Strength Groups

Group by Comparison Group	Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	p-Value
strong	Diskin & Hodgins (2009)	-0.257	0.222	0.049	-0.691	0.178	0.247
strong	Abbott et al. (2018)	0.011	0.146	0.021	-0.274	0.296	0.939
strong	Thomas et al. (2017)	0.095	0.173	0.030	-0.245	0.435	0.584
strong	Pooled	-0.015	0.100	0.010	-0.210	0.180	0.878
weak	Petry et al. (2008)	-0.662	0.205	0.042	-1.064	-0.259	0.001
weak	Hodgins et al. (2001)	-0.252	0.249	0.062	-0.739	0.236	0.312
weak	Hodgins et al. (2009)	-0.192	0.146	0.021	-0.477	0.094	0.189
weak	Petry et al. (2009)	-0.185	0.248	0.062	-0.672	0.301	0.456
weak	Larimer et al (2012)	-0.104	0.221	0.049	-0.536	0.328	0.638
weak	Toneatto (2016)	-0.033	0.280	0.079	-0.583	0.516	0.906
weak	Carlbring et al. (2010)	0.260	0.554	0.307	-0.826	1.346	0.638
weak	Pooled	-0.240	0.086	0.007	-0.408	-0.071	0.005

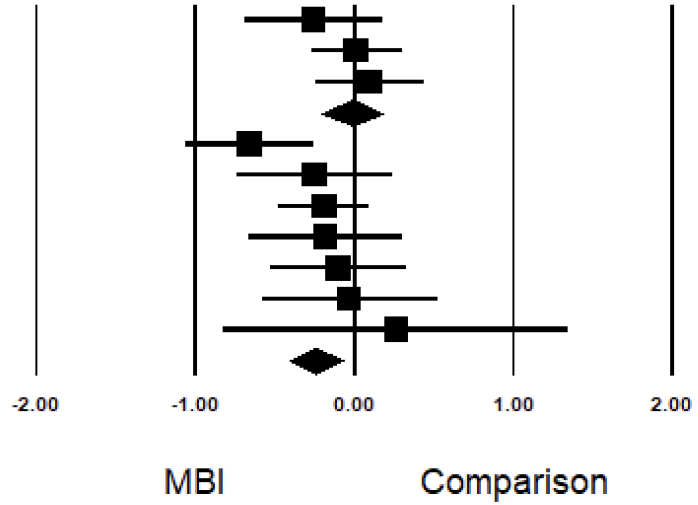


Figure 13. Forest plot for posttreatment gambling behaviors with comparison strength subgroups

Posttreatment Gambling Behavior with MBI Delivery Format Groups

Group by Format	Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	p-Value
person	Petry et al. (2008)	-0.662	0.205	0.042	-1.064	-0.259	0.001
person	Diskin & Hodgins (2009)	-0.257	0.222	0.049	-0.691	0.178	0.247
person	Petry et al. (2009)	-0.185	0.248	0.062	-0.672	0.301	0.456
person	Larimer et al (2012)	-0.104	0.221	0.049	-0.536	0.328	0.638
person	Toneatto (2016)	-0.033	0.280	0.079	-0.583	0.516	0.906
person	Thomas et al. (2017)	0.095	0.173	0.030	-0.245	0.435	0.584
person	Carlbring et al. (2010)	0.260	0.554	0.307	-0.826	1.346	0.638
person	Pooled	-0.174	0.112	0.013	-0.393	0.046	0.121
phone	Hodgins et al. (2001)	-0.252	0.249	0.062	-0.739	0.236	0.312
phone	Hodgins et al. (2009)	-0.192	0.146	0.021	-0.477	0.094	0.189
phone	Abbott et al. (2018)	0.011	0.146	0.021	-0.274	0.296	0.939
phone	Pooled	-0.114	0.095	0.009	-0.300	0.073	0.232

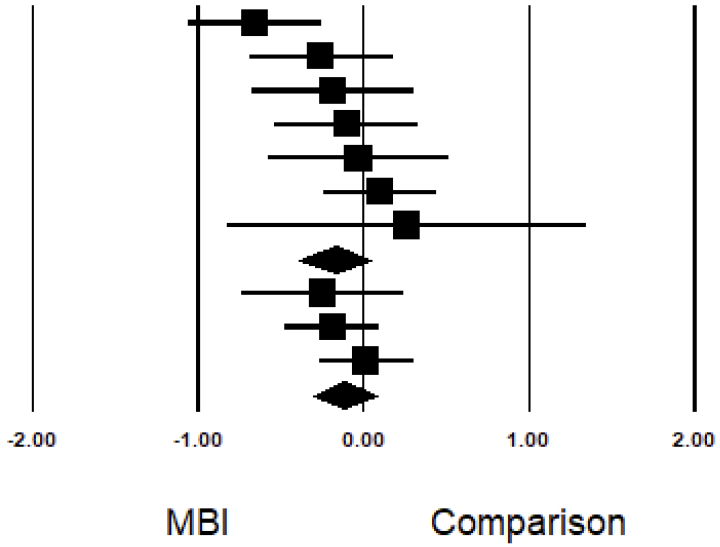


Figure 14. Forest plot for posttreatment gambling behaviors with MBI delivery format subgroups

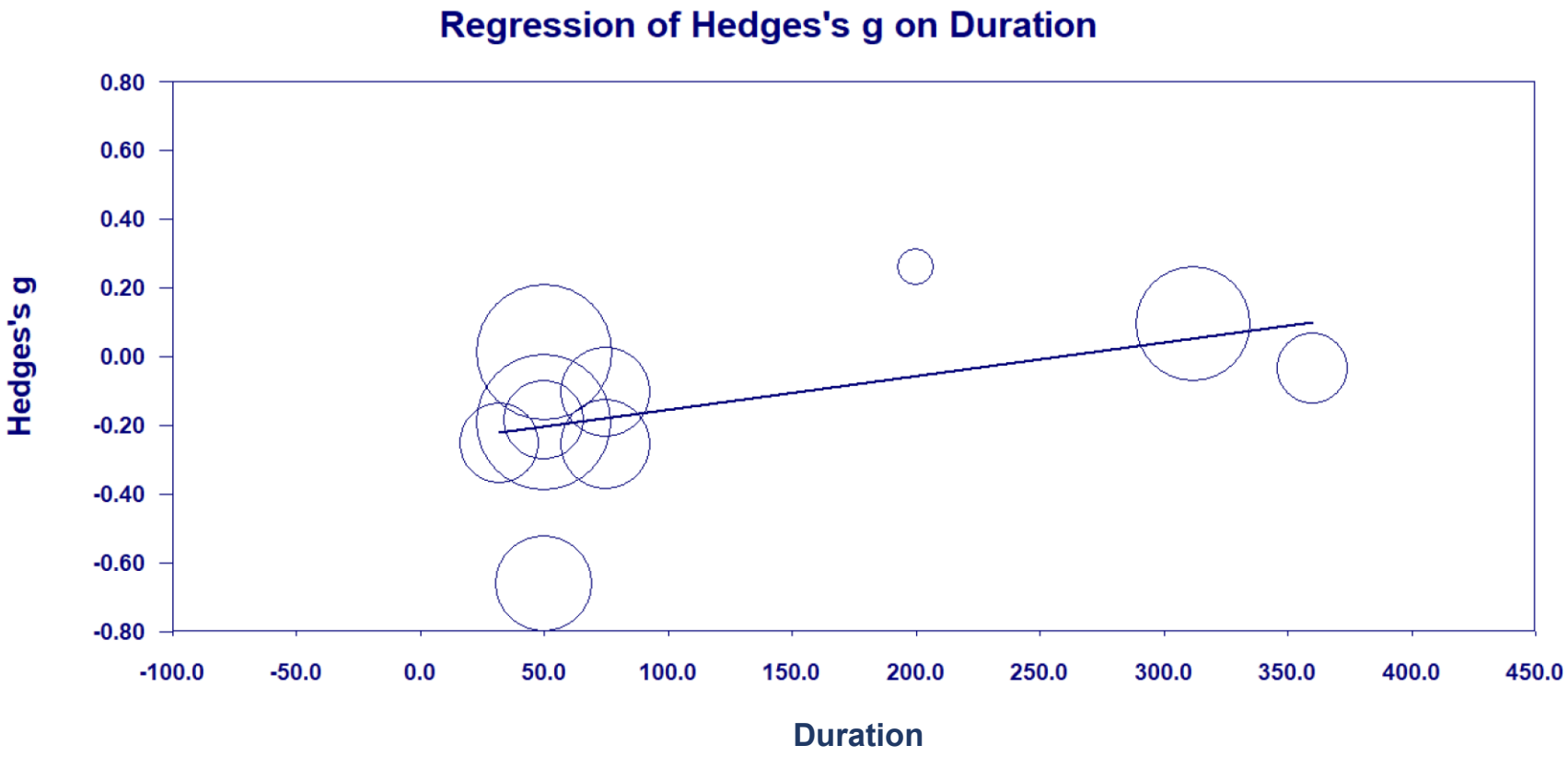


Figure 15. Meta-regression of gambling outcomes on MBI duration in minutes

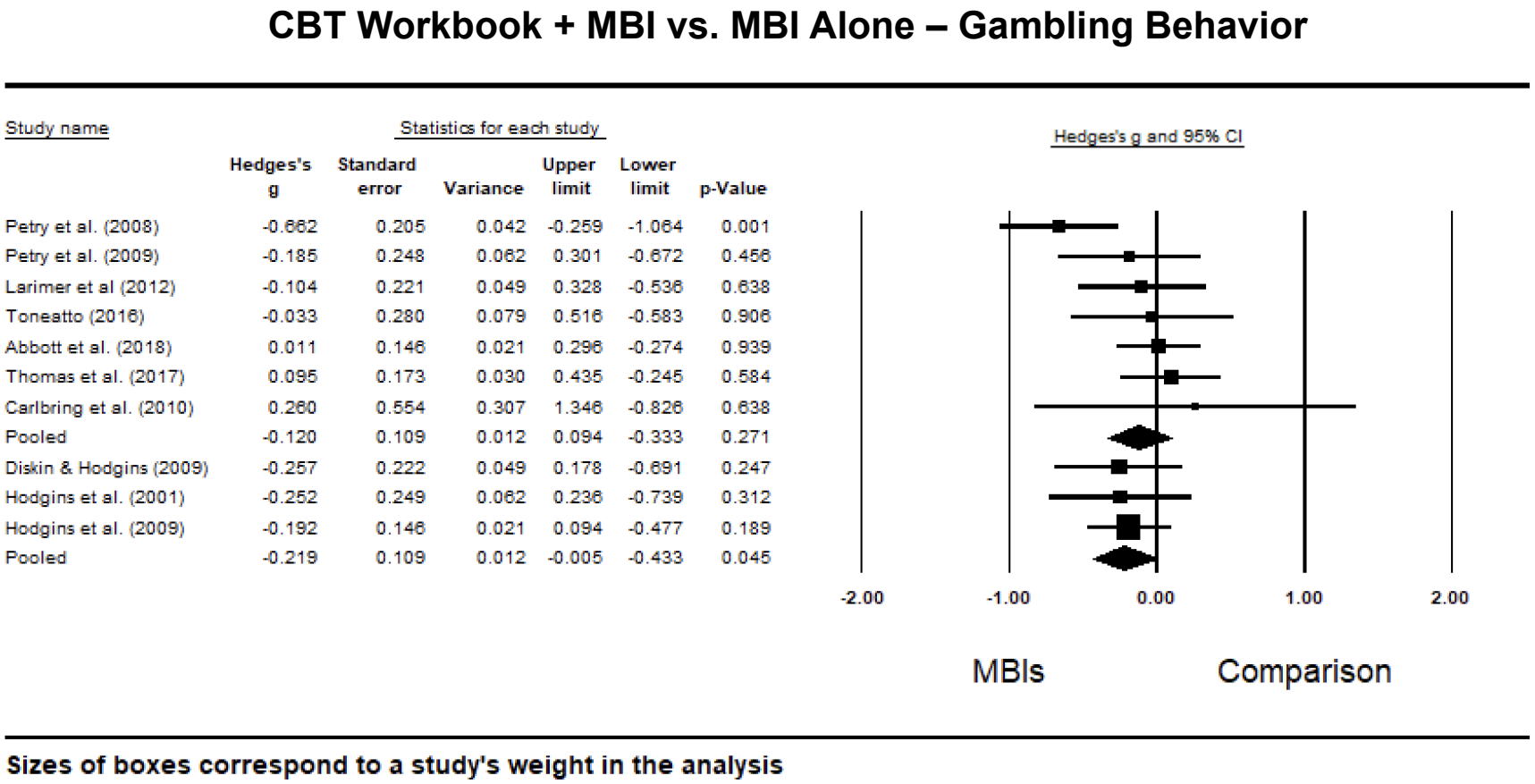


Figure 16. Forest plot for group of studies that included CBT workbook and those that did not.

Assessment Feedback or Not – Gambling Behavior

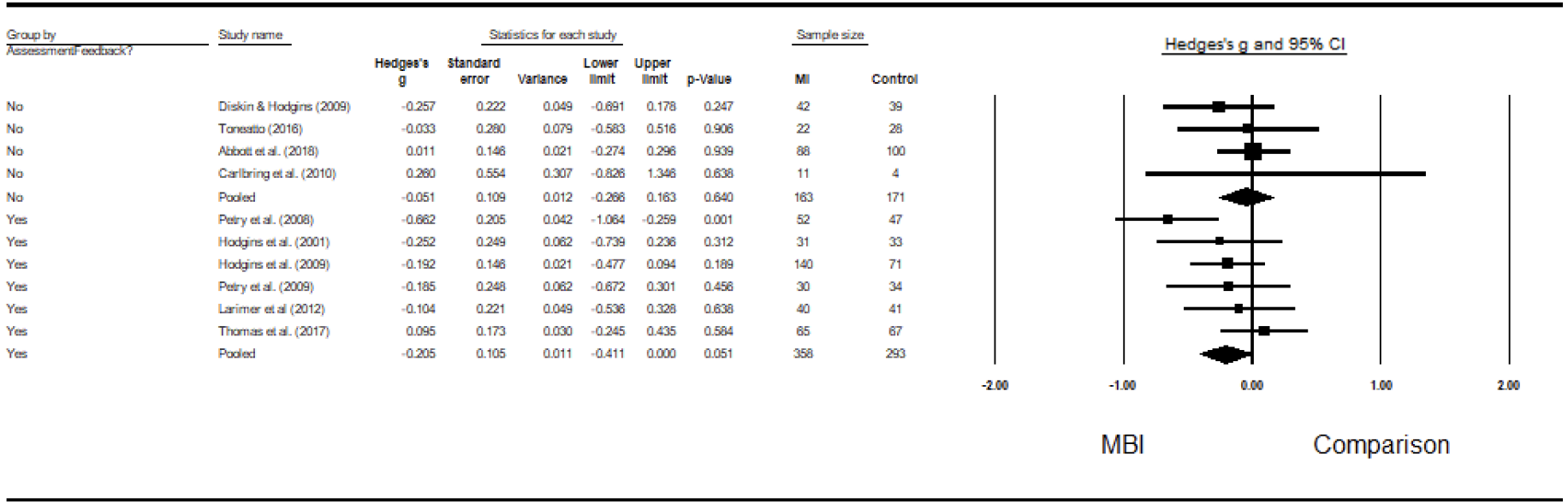


Figure 17. Forest plot for group of studies that included assessment feedback and those that did not.

Follow-up Gambling Frequency

Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	p-Value
Petry et al. (2009)	-0.531	0.256	0.065	-1.033	-0.030	0.038
Diskin & Hodgins (2009)	-0.454	0.223	0.050	-0.891	-0.016	0.042
Hodgins et al. (2009)	-0.015	0.155	0.024	-0.318	0.288	0.922
Toneatto (2016)	-0.006	0.280	0.079	-0.556	0.543	0.982
Abbott et al. (2018)	0.111	0.166	0.028	-0.216	0.437	0.507
Thomas et al. (2017)	0.194	0.181	0.033	-0.162	0.549	0.285
Pooled	-0.082	0.114	0.013	-0.306	0.142	0.474

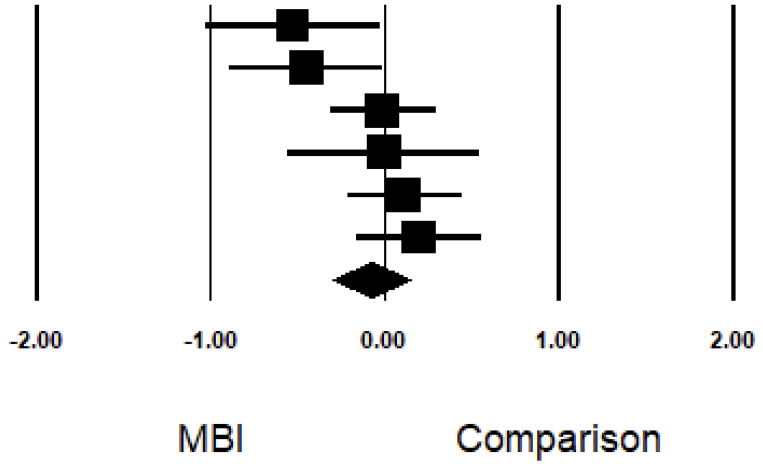


Figure 18. Forest plot for gambling frequency at follow-up.

Follow-up Gambling Intensity

Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	p-Value
Diskin & Hodgins (2009)	-0.414	0.223	0.050	-0.850	0.022	0.063
Petry et al. (2009)	-0.384	0.254	0.064	-0.881	0.114	0.130
Toneatto (2016)	-0.252	0.282	0.079	-0.804	0.300	0.371
Petry et al. (2008)	-0.170	0.210	0.044	-0.582	0.241	0.417
Abbott et al. (2018)	0.100	0.166	0.028	-0.226	0.427	0.547
Thomas et al. (2017)	0.118	0.181	0.033	-0.237	0.472	0.515
Hodgins et al. (2009)	0.174	0.155	0.024	-0.129	0.478	0.260
Pooled	-0.065	0.093	0.009	-0.248	0.119	0.489

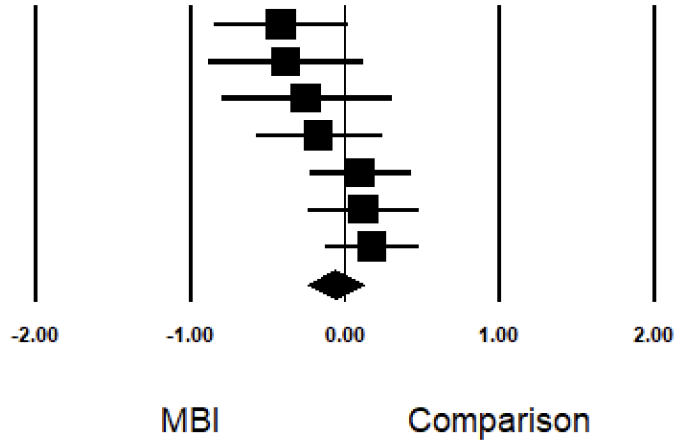


Figure 19. Forest plot for gambling intensity at follow-up.

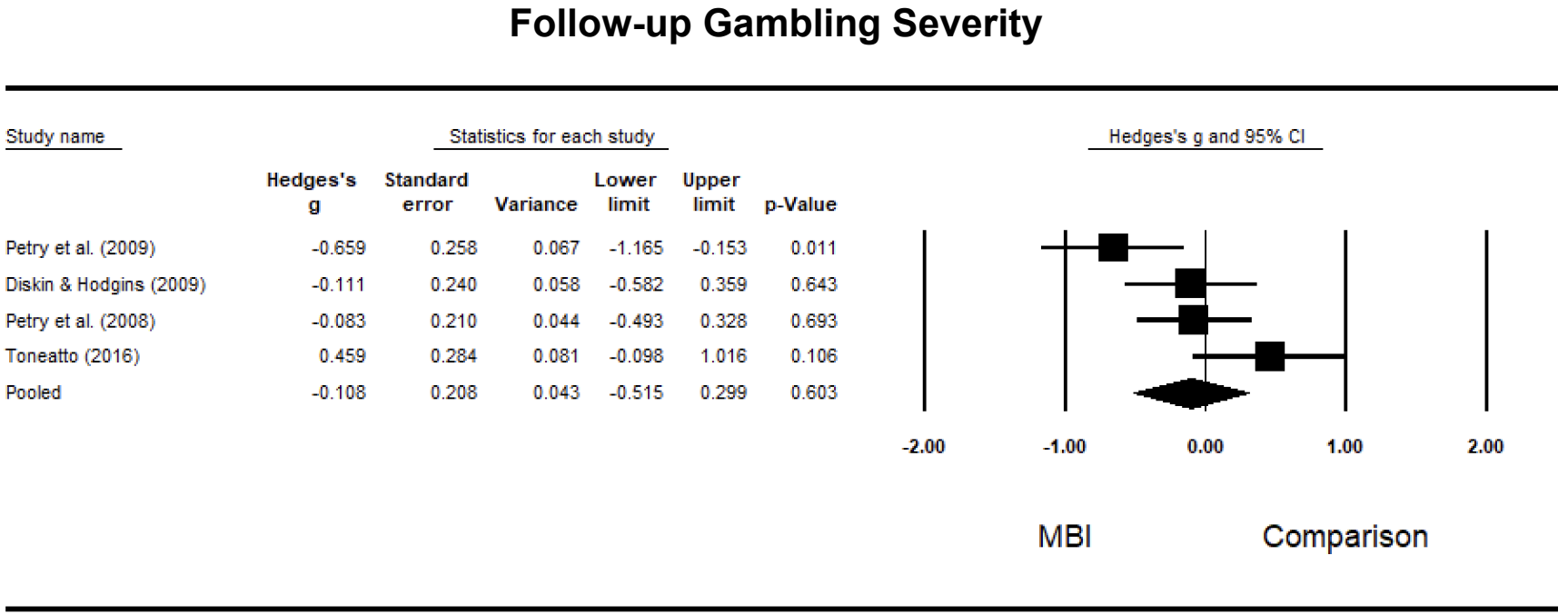


Figure 20. Forest plot for gambling severity at follow-up.

APPENDIX A.

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APPENDIX B.

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APPENDIX C.

A	B	C	D	E	F	G	H	I	J	K	L
Reference	**Overall Include or Exclude**	**Secondary Analysis**	**Age 18**	**Gambling Disorder**	**MI**	**Isolated MI**	**Pharmacotherapy**	**Randomized 2+ groups**	**Notes**		
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Inclusion/Exclusion Criteria	**Meaning**	
Overall Include or Exclude	**Include** = The study will be included in the meta-analysis **Exclude** = The study will not be included in the meta-analysis	0 = no, 1 = yes
Secondary analysis	**Include** = The study is not a secondary data analysis **Exclude** = the study is a secondary analsis	0 = include based on this criteria, 1 = exclude based on this criteria
Age 18	**Include** = The study does not include participants under age 18 **Exclude** = The study includes participants under age 18	0 = include based on this criteria, 1 = exclude based on this criteria
	Include = The study includes a sample of individuals with problem gambling or gambling disorder based on a validated assessment. Perception of gambling problems is OK **Exclude** = The study does not include a sample of individuals with problem gambling or gambling disorder (e.g., prevention studies)	0 = include based on this criteria, 1 = exclude based on this criteria
MI	**Include** = The study includes a MI intervention that is not web-based or self-help/workbook based. Telephone is OK. **Exclude** = The study does not include a MI intervention	0 = include based on this criteria, 1 = exclude based on this criteria
Isolated MI	**Include** = The effect of the MI intervention on either gambling outcomes or engagement in gambling treatment CAN be statistically isolated **Exclude** = The effect of the MI intervention on either gambling outcomes or engagement in gambling treatment CANNOT be statistically isolated	0 = include based on this criteria, 1 = exclude based on this criteria
Pharmacotherapy	**Include** = The study does not involve a pharmacotherapy condition or a pharmacotherapy and MI combination condition. **Exclude** = The study involves a pharmacotherapy condition or a pharmacotherapy and MI combination condition.	0 = include based on this criteria, 1 = exclude based on this criteria
Randomized 2+ groups	**Include** = The study includes randomization to 2+ groups **Exclude** = The study does not include randomization to 2+ groups	0 = include based on this criteria, 1 = exclude based on this criteria

APPENDIX D.

Author Last, First	Publication year	Pre-registered?	% Female	Country of publication	Mean sample age	Funding source	Sample size	Recruitment Source	Gambling inclusion criteria	Mean age (years)	% Asian	% Black	% White	% Hispanic

APPENDIX E.

B	C	D	E	F	G	I	J	K	O	P	R	S	T	U	V	W	X	Y	Z	AA	AB	AD
last name	year	Is the MI isolated from other approaches?	Intervention	Is the MI intervention described in detail?	Comparison Group	Are aspects of relational components mentioned?	Are aspects of technical components mentioned?	If yes, paste the description	Is therapist MI training prior to the study described?	Training Description	Is MI monitoring / fidelity during the study described?	Fidelity Description	Was a measure of MI fidelity during the intervention used?	Is the MI fidelity measure established or one-off for the study?	Fidelity Measure Used	Is the outcome of the fidelity monitoring reported?	Outcome of fidelity measure	critique of fidelity	MI duration	MI delivery format (in-person, phone, online)	Interventionist (grad student, psychologist, social worker, peer, etc.)	Sample Type (severity, problem/pathological)

APPENDIX F.

A	B	C	D	E	F	G	H	I
Study	Outcome	Timepoint	TREATMENT			CONTROL		
			Mean	SD	Sample Size	Mean	SD	Sample Size