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Katerina Rinaldi

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A Meta-Analysis of Sex Differences in Ruminative Thinking

By

Katerina Rinaldi

Dr. Donna Maney

Adviser

Department of Psychology

Dr. Donna Maney

Adviser

Dr. Sherryl Goodman

Committee Member

Dr. Katrina Karkazis

Committee Member

2021

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Katerina Rinaldi

Dr. Donna Maney

Adviser

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Abstract

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Depression is a common and debilitating diagnosis that is more prevalent in women than in men. The 2:1 ratio of women to men with depression has been consistently replicated, leading to a large body of research into why women are especially vulnerable. Possible reasons for this sex difference include a variety of biological and social risk factors, but one of the most commonly cited explanations is that women ruminate more than men. This idea, called “Response Styles Theory” was proposed in the 1980s, and is still used to justify research into “hard-wired” biological sex differences. Here, I conducted a meta-analysis of 41 studies that included adult men and women’s scores on the Ruminative Response Scale, in order to examine whether this sex difference is large enough to make a substantial contribution to the 2:1 ratio. A pooled effect size of sex on rumination was calculated using the “metafor” package in R. The result was a small effect size, $d=0.25$, that is not likely to contribute meaningfully to the sex difference in depression prevalence. In 290 of the excluded studies, the reason the authors did not report means separately for both men and women was that they tested for a sex difference, found none, and then pooled the sexes. Therefore, the effect size is almost certainly smaller. This study provides evidence that both popular and scholarly literature over-emphasize a variable that is unlikely to be clinically meaningful. Researchers should explore more clinically relevant explanations for the 2:1 ratio, like stigma of depression in men.

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Introduction

As much as we would like to believe that gender inequality is a vestige of the past, men and women continuously face a stark inequality in mental health. Research shows a substantial sex difference in the prevalence of depression, with a female to male ratio of approximately 2:1. This ratio seems consistent across a variety of epidemiological studies (de Graff et al., 2012; Kessler et al., 2003; Seedat et al., 2009). The causes of this sex difference are doubtlessly multiple in nature, and include biological variables. For example, research shows that the endocrine system governing the stress response may be especially reactive in women because of fluctuations in ovarian hormones (Altemus et al., 2014). While boys and girls have similar rates of depression in childhood, girls' risk increases relative to boys' in adolescence, but that risk decreases as women reach menopause (Altemus et al., 2014). Environmental explanations like susceptibility to stressful events, particularly to sexual assault (Kendler & Aggen, 2014) or financial stressors such as lower wages for women could also play a role in the sex discrepancy in depression diagnosis. (Kuehner, 2017).

One of the most popularly cited explanations for the sex difference in depression diagnoses is that women have greater interpersonal sensitivity than men, which leads to a greater tendency in women to ruminate about negative experiences (Watkins & Roberts, 2020). Rumination is a negative response style that involves the tendency to repeatedly think about interpersonal problems, and then dwell on the negative emotions these problems elicit (Nolen-Hoeksema, 1987). A depressed individual may ruminate about any number of negative experiences, but rumination is often centered on interpersonal concerns, which result from an underlying fear of rejection (Pearson, Watkins, & Mullan, 2011). Rumination can be divided into two distinct constructs—reflective rumination and brooding rumination. Engaging in reflective

rumination consists of examining where one made mistakes and actively planning how to avoid making errors in the future. Brooding rumination is a more passive thought process, as an individual reflects on personal failures or negative events, but does not plan how to better a situation. The risk of developing depression is especially linked to brooding rumination (Moulds, 2007). Rumination, and its role in psychopathology, is currently such a popular topic that, in 2018 alone, over 800 papers were published on the subject (Watkins & Roberts, 2020). Rumination is certainly not the only explanation for the sex differences in depression prevalence, but in terms of frequency, it retains a longstanding prominence in the literature.

Sex differences in rumination were first proposed by Dr. Susan Nolen-Hoeksema (1987). In a still widely cited paper, Nolen-Hoeksema argued that men and women have different responses to depressed mood, saying that “the responses of females to their episodes of depression tend to be inactive and likely to focus their attention back on the mood and the self. These sex differences in responses to one's own affective state contribute to the sex differences observed in rates of depression”. Nolen-Hoeksema hypothesized that women dwell on their negative thoughts and depressed mood so much that they fall deeper into a depressive spiral, while men can pull themselves out of this spiral more easily, before they reach a point of clinical depression. Evidence supporting Nolen-Hoeksema’s model, which she termed Response Style Theory, came from studies on children’s responses to unsolvable tasks and college students’ responses to the question of “how likely they would be to engage in the thoughts or behaviors described *if* they were depressed” (Nolen-Hoeksema, 1987). Though these studies have questionable generalizability to adults with a diagnosis of depression, Response Style Theory became a popular framework for understanding the etiology of sex differences in depression. In the following years, researchers found statistically significant differences in men and women’s

ruminative tendencies with random samples of adults (Nolen-Hoeksema, 1999), adults diagnosed with Major Depressive Disorder (Nolen-Hoeksema, 2000), and college students with depression symptoms (Zalta & Chambless, 2008).

Following these results, sex differences in rumination became such a popular topic in clinical psychology that some researchers tried to explain the differences with evolutionary theories. Evolutionary psychologists believed that the difference in men and women's response styles was substantial enough to be a "hard-wired" biological difference. Theories focused on a link between women's ruminative tendencies and their reproductive success (Altemus, 2014). Researchers referred specifically to women's superior social cognition and attunement to others, which help their offspring develop but leave them especially sensitive to rejection (Altemus, 2014). Similarly, psychologists who proposed the "primary caretaker hypothesis" explained that women need to recognize threats to their infant's survival by paying attention to their negative emotions (Thompson & Voyer, 2014). These evolutionary theories tend to oversimplify the complexity of depression risk by placing considerable importance on the single variable of ruminative response style; nonetheless, they appear in scholarly literature.

Sex differences in rumination are still appearing in the scientific literature as a potential explanation of the 2:1 female to male ratio in depression diagnoses. Such differences in rumination have commonly been cited as justification for research into potentially sex-based biological differences, such as neuroanatomical (Andreano et al., 2014), hormonal (Graham et al., 2018), and psychopharmacological (Bolea-Alamanac et al., 2018) differences that make women more vulnerable to depression. Ando et al. (2020) concluded that women seem not to accept negative emotions, which is why they are more likely to ruminate and perpetuate those emotions. In an article in *Assessment* on the psychometrics of the RRS, researchers concluded

that the sex differences in rumination found in prior studies do support Nolen's Response Styles Theory. According to those researchers, Response Styles Theory is widely studied and widely accepted as a reason for well-established gender differences in depression (Whisman et al., 2020).

The idea that women ruminate a great deal more than men has made its way from scholarly literature to pop psychology sources. It might be tempting to dismiss these sources because of their notorious inaccuracy in reporting research, but they are important sources of information for the general public. We need to examine what information someone who is struggling with depression symptoms is likely to receive. According to one of the first results of a Google search on "women and depression", women's increased tendency to ruminate makes them predisposed to anxiety and depression (Harvard Health Publishing, 2011). Similarly, an article on the same site titled "Recognizing depression in men" included a section on protective factors unique to men that mentally "buffer" them from depression. Men not only ruminate less than women do, but apparently also feel more in control and positive about life in general (Harvard Health, 2011). The average internet user is likely to encounter these ideas early and often in searches for information on depression.

Psychology Today is another especially popular source for information on depression. The statement that men are biologically hard-wired to be more resilient than women appeared in one of the most visited articles on depression risk (Herbert, 2018). In another Psychology Today article titled "Does depression discriminate against women?", the author wrote that women are more empathetic, prosocial, warm and agreeable than men and that they "care more deeply about being liked" (Degges-White, 2018). The author argued that these traits cause them to ruminate over their failures and become more vulnerable to depression than men (Degges-White, 2018).

Researchers can sometimes assert that response style is one of many possible factors contributing to the sex difference in depression prevalence. However, popular psychology sources can miss this nuance. In these sources, the generalizations about women's sensitive nature and its role in depression risk have reached the point of sexist stereotyping, but they are unfortunately easy to find.

It is important to note that the link between sex differences in rumination and sex differences in depression prevalence is emphasized in textbooks used for undergraduate-level psychology courses. For example, the 2017 edition of *Child and Adolescent Psychopathology* included a passage on women's tendency to cope with adversity and sadness by ruminating, explaining that this sex difference contributes to sex differences in rates of depression symptoms (Beauchaine & Henshaw, 2017). The *Sage Encyclopedia of Abnormal and Clinical Psychology* included a similar section on women's greater engagement in rumination than men and how, because rumination is so consistently associated with depression risk, it plays a substantial role in the 2:1 ratio of women to men diagnosed. (Wenzel, 2017). These claims warrant evaluation because it is essential that students receive accurate information at this foundational level of learning. Is the link between rumination and depression risk as straightforward as these texts assert?

In order to explain a meaningful amount of the sex difference in depression prevalence, as described in scholarly and popular literature, the effect of sex on rumination must be substantial. However, there is recent research that shows that women are not significantly more likely to engage in rumination than men (Hasegawa et al. 2015, Kuehner, 2017, Muñoz-Navarro et al., 2020). It is thus becoming less clear whether sex differences in rumination are important to understanding the sex difference in depression prevalence, as is commonly argued in both

scholarly and popular literature. The goal of this study was to determine the extent of sex differences in rumination through a systematic review and meta-analysis, in order to determine whether the data support the emphasis placed on them in literature on depression.

Methods

Study Measures

This analysis included studies published from 2000 to 2020 that contained data on rumination, collected using the Ruminative Response Scale (RRS), in men and women. The RRS is the most widely used measure of rumination (Nolen-Hoeksema, 1991; Treynor et al., 2003; Whisman et al., 2020). It includes two distinct types of rumination—reflective and brooding. Reflective rumination is represented by 5 items that assess the extent to which a person actively explores and plans how to relieve a negative mood, while brooding rumination is represented by 5 items that assess the extent to which a person remains passively preoccupied with thoughts that maintain a negative mood (Treynor, 2003). Each item is measured by a Likert scale ranging from 1 (never) to 4 (always). The RRS has high internal reliability coefficients ranging from .86 to .90 (Treynor, 2003).

Search Strategy

The words “Ruminative Response Scale” were entered into the computerized PsycInfo database as a full text search. A full text search was performed in order to retrieve as many studies as possible, including those that did not have the search term in the title or abstract. The retrieved studies were uploaded into the Covidence platform for screening and data extraction.

Inclusion Criteria

Studies had to be published in English in a peer-reviewed journal. The sample for these studies needed to include both men and women over the age of 18. Men and women’s mean

scores on the RRS as well as measures of variance had to be reported in the study results so that pooled effect size could be calculated.

Statistical Analysis Plan

In order to determine the size of the sex difference in rumination, effect size was calculated as Cohen's *d*. Cohen's *d* score represented the difference between men and women's group means on measures of rumination in terms of standard deviation units. While some of the studies' authors calculated effect size for sex differences in scores on the RRS, most used *t*-tests to evaluate difference in group means. Cohen's *d* for these studies could be calculated using the group means, standard deviations, and sample sizes included as part of those studies' results. Pooled effect size was calculated using the "metafor" package in R. Additionally, the "metafor" function includes the *Q*-within statistic, which indicates whether effect sizes are more variable than would be expected if the only source of variation was sampling variability (Higgins & Thompson, 2002).

Using the effect size for each study, I performed a Pearson test for a correlation between effect size and year of publication to test for a significant relationship.

Results

Search results

The literature search on PsycInfo identified 2,206 articles that included the RRS. 1,093 articles were screened after duplicates were removed. Title and abstract screening of these articles showed that 53 included participants under the age of 18, so those studies were excluded. 1,040 remaining articles were then screened for data on both men and women's mean scores and variance on the RRS. 999 studies were excluded because they did not have these data for both sexes. In 290 of these studies, the authors did measure rumination in men and women, but did

not publish the data because no statistically significant sex difference was found. 41 articles were included for meta-analysis. In one study, authors used a scale that is slightly different from the RRS, called the Mistake Rumination Scale, that measured brooding and reflective rumination in the context of a specific mistake (Flett et al., 2019). Figure 1 shows the PRISMA flow diagram for the review process. Table 1 shows studies' characteristics.

Effect of sex on rumination

Figure 2 is a forest plot showing the effect sizes of the included studies. The overall effect size of sex on RRS score was $d = 0.25$. Heterogeneity of the studies selected was not significant, $Q = 55.0, p > .05$. I^2 , another measure of heterogeneity, was 29.44%. Figure 3 is a scatterplot of year of publication and effect size. A Pearson correlation between year of publication and effect size showed an r value of -0.20 , with a p value of 0.20 .

Discussion

In this meta-analysis, data from studies that included men and women's scores on the RRS were used to calculate a pooled effect size of sex on rumination. The overall effect size of sex on rumination was $d = 0.25$, a value that, while not trivial, is small according to interpretation guidelines suggested by Cohen (1988). In clinical research, sex is generally not noted as a contingent variable if the sex difference has an effect size under 0.5 (Klein, 2015; Maney, 2016). For comparison, the effect size of sex on height is $d = 1.97$. Though this effect size is quite large, there is still an overlap (based on Weitzman's d) between men and women of about 32%. In other words, we know that not all men are taller than all women. An effect size of $d = 0.25$ means the overlap between men and women's scores on the RRS is even larger, at 89%. Given this effect size and overlap, the clinical significance of this sex difference is questionable. In other words, with such a large overlap in men and women's scores, we certainly could not

predict RRS score based on sex. It is unlikely that such a small difference in rumination could contribute substantially to the 2:1 ratio in depression prevalence.

The overall effect size of sex on rumination found in this meta-analysis was small. Even so, it is probably an overestimation because of the likelihood of a file-drawer problem. 999 studies were excluded from this meta-analysis because they did not report scores on the RRS separately for men and women. In fact, in 290 of these studies, researchers did measure rumination in men and women but did not publish the data separately because no sex difference was found. The addition of these non-significant findings, were the data available, would make the actual pooled effect size smaller than $d = 0.25$.

If sex differences in rumination are clinically meaningful, we would expect men and women to respond differently to a treatment focused on rumination. Cognitive Behavioral Therapy is a standard-of-care treatment for depression that specifically addresses negative, ruminative thinking patterns. In a meta-analysis of CBT's efficacy, researchers found that men and women had comparable responses to both CBT and pharmacotherapy; that is, men and women responded equally to both interventions, and neither sex responded better to CBT over medication or vice versa (Cuijpers et al., 2014). If men and women have an equal response to a treatment that focuses on rumination, the idea that women ruminate more than men so significantly that their depression risk is higher as a result becomes questionable. One way to determine more definitively whether sex differences in rumination affect clinical outcomes would be to conduct a study with a targeted intervention for brooding rumination, as CBT addresses a variety of maladaptive thinking patterns in addition to rumination.

Sex differences in rumination likely do not contribute meaningfully to the large sex difference in depression prevalence. Thus, we should also consider other explanations for this

difference. A model predicting depression risk will necessarily be complex because of the multitude of variables that would each make a small but meaningful contribution. We have evidence that the pathway to a diagnosis of depression looks different for men and women (Kendler & Gardner, 2014). No single difference between sexes could account for the 2:1 ratio, but we can examine which individual risk factors contribute more strongly to the major depression pathway in males or females.

The Sequenced Treatment Alternative to Relieve Depression, or STAR-D study, was one of the largest recent efforts to compare the symptoms of men and women with depression. While the authors did replicate the approximately 2:1 ratio of women to men diagnosed with depression, they also found that men experienced more episodes of depression before seeking help than women did (Marcus et al., 2008). The authors say this greater number of episodes reflects low treatment-seeking in men, who may not reach out for help as readily as women do (Marcus et al., 2008). The STAR-D study used data obtained from participants who had gone to their doctors for care, so we cannot know how many men with symptoms of depression were overlooked because they had not yet sought help. The 2:1 ratio could be different if we did have these data.

Men often avoid professional help because of stigma (Addis & Mahalik, 2003). Stigma also prevents men from being honest about their symptoms in their interpersonal relationships, so they may not have examples of male friends or family members who got professional help (Cole & Ingram, 2020). The 2:1 ratio of depression diagnoses could be more of a by-product of harmful gender role stereotypes, and less of a result of sex-based differences in response style and emotional regulation (Cole & Ingram, 2020). In fact, the stereotype that it is feminine to

ruminate and develop depression perpetuates stigma and makes men less willing to acknowledge symptoms (Cole & Ingram, 2020).

Even when men do seek professional help, they are on average more reluctant to acknowledge symptoms in the clinical setting (Addis & Mahalik, 2003). Depressed men may restrict emotional expression because it does not fit into masculine norms, so they can be reluctant to report the classic depression symptoms of sadness and crying. Instead, men with depression are more likely to show an externalizing pattern of behavior, with anger attacks, substance abuse, and irritability (Martin et al., 2013). Women can also show these symptoms, but they are significantly more common in men. Notably, when Martin et al. (2013) created scales that assessed these alternative symptoms along with the more classic ones, they found no significant sex difference in depression prevalence. When clinicians or researchers use traditional diagnostic criteria, a sex difference could emerge that reflects the variation in symptomology rather than depression itself.

The sex difference in depression rates might be explained in part by outright clinician bias. Particularly in the primary care setting, women are more likely to be misdiagnosed with depression than men (Aragones et al., 2006). This overdiagnosis could be the result of physicians mistaking the non-specific symptoms of several different health issues, like irritable bowel syndrome or fibromyalgia, for the somatic symptoms of depression. Physicians are more likely to ascribe such symptoms to psychological causes if the patient is female (Aragones, 2006). Additionally, women experience more of these health issues than men (Barsky et al., 2001), making them even more vulnerable to misdiagnosis of depression. Together, clinician bias, assessments lacking symptoms commonly reported by men, and stigma of depression in men could explain a significant part of the sex difference in depression prevalence.

The RRS was originally published in 1991, but this meta-analysis included studies published between 2000 and 2020. An earlier meta-analysis of sex differences in RRS score, published by Johnson & Whisman (2013), included studies from 1994 until 2011. These authors found an aggregate effect size of $d = 0.24$. The current analysis shows an effect size of $d = 0.25$, suggesting that the addition of those studies published before 2000 would not have significantly changed the results.

Meta-analyses can be limited by the heterogeneity of the included studies. The I^2 and Q -*within* statistics in this meta-analysis showed acceptably low heterogeneity (Higgins & Thompson, 2002). However, summarized results from variable findings of studies conducted by different groups, using different methods, should be interpreted with caution. The studies that were analyzed assessed rumination in varying age groups. Some samples were comprised solely of young adults, while others included a wider age range. Although all included participants were over the age of 18, the tendency to ruminate could vary according to the stage of adult life. It is also important to note that, while many of the samples were made up of adults diagnosed with Major Depressive Disorder, some studies included only undergraduate students who had submitted self-report questionnaires of depression symptoms. An additional limitation to consider is that the RRS contains items assessing both reflective and brooding rumination. However, we know brooding rumination is specifically associated with depression risk (Moulds, 2007). Those studies included here did not tend to break the two concepts apart in analysis, and so it was necessary to consider RRS score as a whole.

The operationalization of sex in these studies also warrants further scrutiny. Many of the studies' authors used sex and gender interchangeably, when in fact, they are distinct constructs. The included studies gave participants only "male" and "female" options, presenting gender as

binary. Lindqvist et al. (2020) explained that, while sex is determined by biology, gender has multiple facets: bodily aspects, legal gender, self-defined gender, or gender expression. They suggested that social science researchers ask about participants' gender using these facets as a four-option checklist. This checklist of multiple options for gender identity will help participants feel affirmed and could also be more informative to researchers. The literature on sex differences in depression prevalence shows that masculine norms like refusing to express sadness hold individuals back from seeking and receiving help. It would be informative if future studies ask more specifically about gender identity and expression in order to see which participants significantly identify with these masculine gender norms, as they may not all be men (Joel et al., 2013).

Overall, this study showed a small effect size of sex on rumination. Furthermore, because of the likelihood of a file-drawer problem, the actual sex difference in rumination is almost certainly negligible. With such a small effect size, we could not reliably predict RRS score from sex. It is unlikely, therefore, that sex differences in rumination explain a clinically meaningful part of the sex difference in depression prevalence. The striking sex difference in depression prevalence is more likely to be explained by other variables in a complex model of risk. These variables include sex differences in the expression of classic symptomology, overdiagnosis in women, and masculine norms that discourage men from seeking professional help. Future research should focus on the identification and treatment of depression in both sexes.

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Table 1:

Table of study characteristics

Authors	Men	Women	Mean(m)	Mean(f)	SD(m)	SD(f)	Mean age	Country
Besharat et al., 2014	144	156	25.54	26.93	9.16	10.76	19.8	Iran
Cheung et al., 2004	56	69	42.95	48.23	10.72	9.71	23.6	UK
Conway et al., 2000	82	133	34.02	36.27	11.22	10.11	22.7	Canada
Denton et al., 2012	268	189	9.15	9.89	3.11	3.32	61.0	USA
Dupont et al., 2019	362	402	1.88	2.05	0.57	0.64	23.0	USA
Flett, Nepon, & Hewitt, 2019*	63	222	17.95	18.17	5.04	4.98	20.4	Canada
Garcia, Duque, & Cova., 2017	412	338	8	8.73	5.2	5.22	38.7	Chile
Goldstein, 2006	51	57	1.17	1.25	0.54	0.53	19.8	USA
Gordon et al., 2012	268	512	8.43	8.86	3.04	3.2	19.3	USA
Gorini et al., 2017	14	84	24.21	25.24	4.52	3.53	56.0	Italy
Johnson et al., 2014	278	354	1.9	2.03	0.57	0.64	22.7	USA
Kwon et al., 2013	131	253	9.44	9.65	3.76	3.38	21.0	Korea
Lam et al, 2003	49	60	32.9	37.5	10.7	12.1	44.4	UK
Leach et al., 2008	1153	1231	8.7	10.81	5.07	5.34	42.0	Australia
Merino et al., 2014	183	291	9.91	10.42	2.9	3.3	36.9	Spain
Mezo & Baker, 2010	109	301	21.36	23.08	5.86	5.65	20.5	Canada
Moulds et al., 2007	30	74	6.17	6.64	2	2.21	20.1	Australia
Nolen-Hoeksema & Aldao, 2011	237	254	1.98	2.04	0.46	0.32	45.0	USA
Nolen-Hoeksema & Jackson, 2001	323	417	1.7	1.93	1.16	0.51	45.0	USA
Nolen-Hoeksema et al., 2000	528	604	39.64	42.01	10.03	10.64	45.0	USA
O'Connor et al., 2007	137	138	1.09	1.17	0.58	0.65	26.0	UK
Opwis et al., 2017	90	205	3.07	3.61	1.31	1.22	30.2	Germany
Perlick et al., 2012	55	94	21.95	23.22	6.15	6.39	45.8	USA
Polanco-Roman et al., 2016	384	991	10.2	10.84	3.84	3.84	19.9	USA
Roelofs et al., 2008	87	111	48.9	51.5	10.8	12.1	42.2	Netherlands
Roelofs et al., 2008	42	150	26	27.2	8.8	8	21.1	Netherlands
Sigmon et al., 2009	236	413	20.07	23.48	12.15	12.44	20.3	USA
Smith et al., 2019	67	196	1.95	2	0.82	0.77	20.3	USA
Tomito Agari, 2006	83	105	44.5	47.7	12	11.1	19.1	Japan
Topper et al., 2014	147	310	32.94	37.04	9.38	10.39	19.7	Netherlands
Treynor, 2003	526	605	8.87	9.46	2.68	3.03	45.0	USA
Turan & Edur-Baker.,2014	308	278	44.24	46.36	8.47	8.95	22.4	Turkey

Watkins, 2009	38	61	57.31	60.1	11.39	12.92	43.4	UK
Watkins & Moulds, 2005	14	18	56.8	58.6	10.7	11.9	41.8	UK
Whiteman et al., 2016	20	20	38.8	39.65	2.66	2.03	20.4	USA
Weinstock & Whisman, 2006	124	120	41.21	44.77	11.15	14.16	19.1	USA
Wuppermann & Neumann, 2006	211	378	35.69	39	10.82	10.46	19.0	USA
Yoder & Lawrence, 2011	74	94	2.12	2.48	0.69	0.74	19.0	USA
Yselldykk et al., 2007	55	128	2.09	2.33	0.57	0.63	20.1	Canada
Zalta & Chambless, 2008	302	379	43.05	46.18	14.04	14.17	18.3	USA

*Authors used Mistake Rumination Scale instead of RRS

Figure 1:

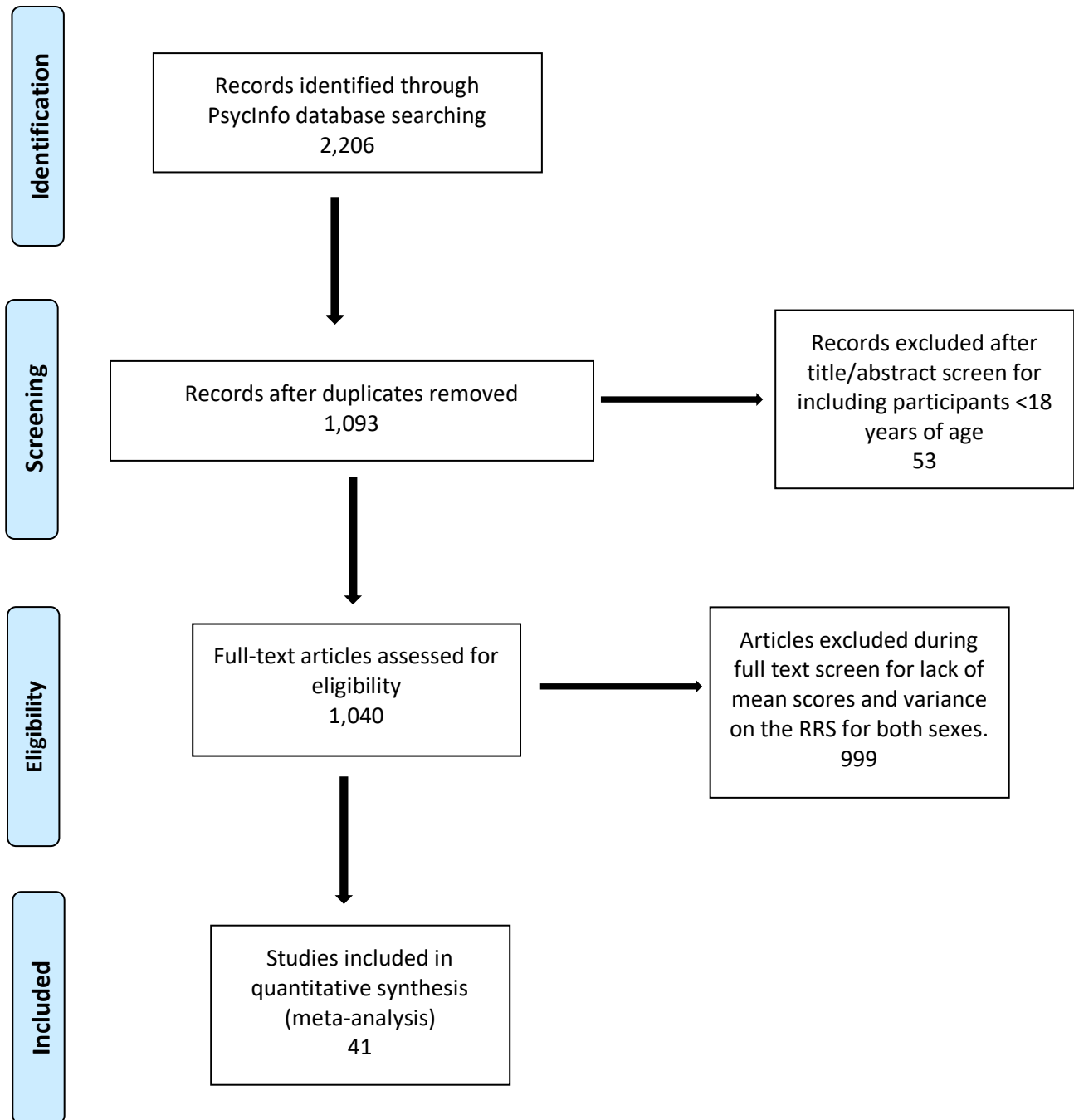
PRISMA flow diagram

Figure 2:

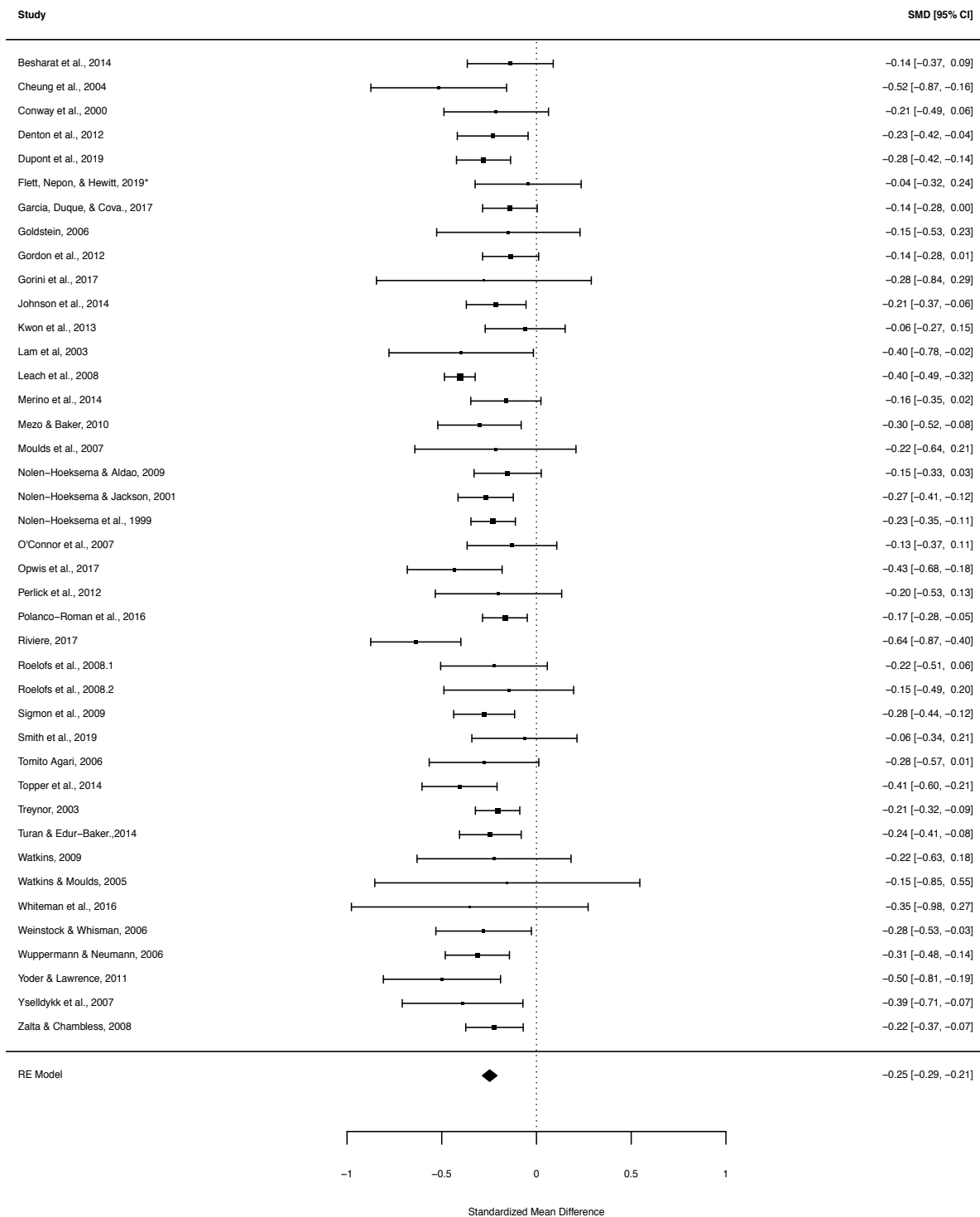
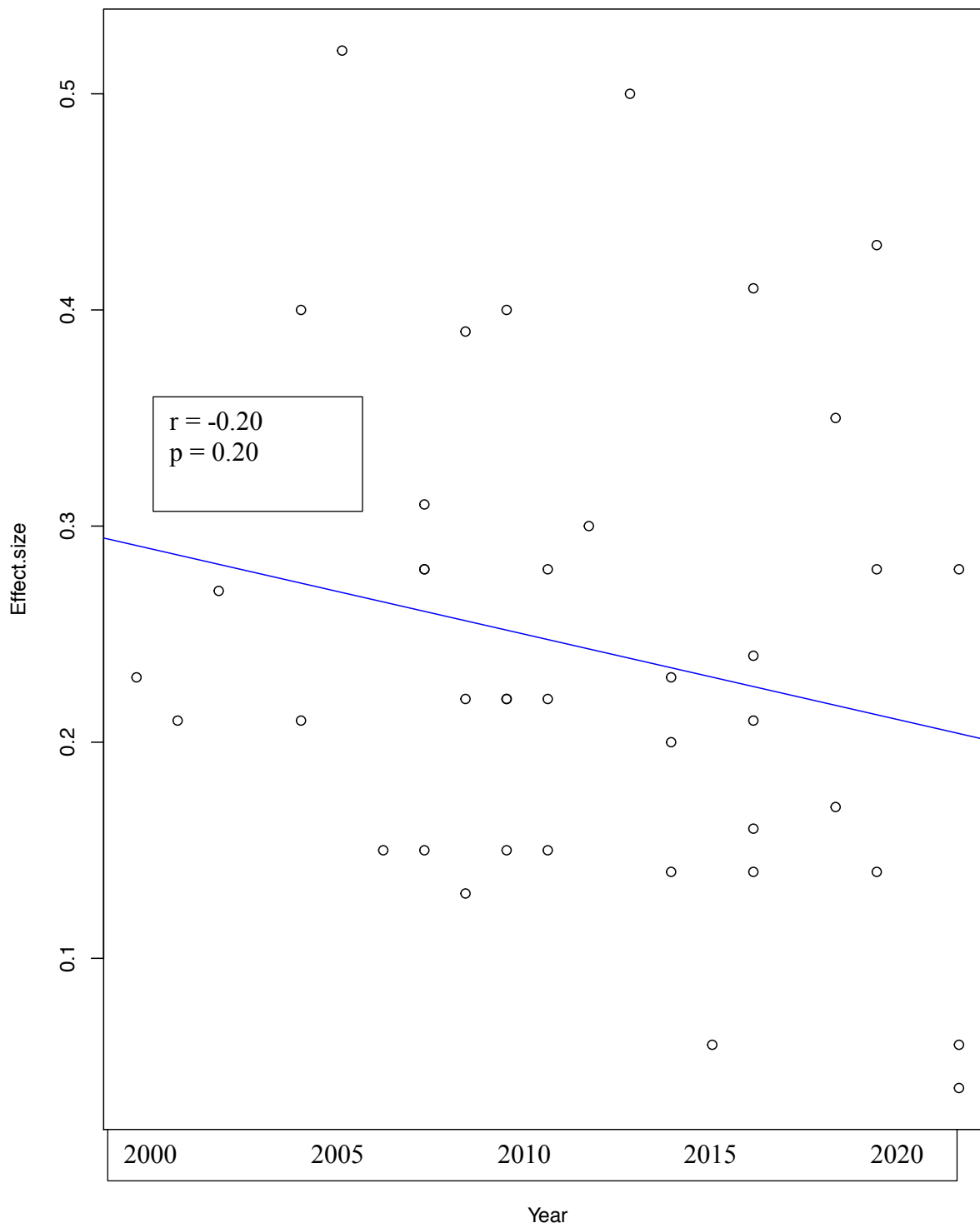
Forest plot of study effect sizes

Figure 3:

Scatterplot of study effect size by year



Messaging in Biological Psychiatry:

- *Spin* in biomedical literature
- The most misleading form of spin consists of an obvious inconsistency between the observations described earlier in the article and the conclusions drawn at the end of the article or in the summary. For example, a study reported that treating children with ADHD with a psychostimulant does not improve their reading performance and does not decrease their risk of early school dropout
- Less extreme forms of beautification are much more frequent in biomedical publications—in particular (again), in their summaries.³² A common form consists in highlighting a statistically significant effect without mentioning the figures that question its clinical significance.³¹ For example, 159 summaries asserted a statistically significant association between ADHD and the 7R allele of the gene coding for the dopamine D4 receptor, but only 25 summaries mentioned the size of this association,¹² which is actually weak:
- Many articles reporting a correlation between a pathology and a risk factor improperly suggest that it is a causal factor.^{32,35} When this improper interpretation also appears in the corresponding press release, it is likely to be found in the press articles covering the study
- We observed, on a sample of 5029 association studies, that newspapers favored initial studies (13% were covered) over subsequent studies (2.4%) and meta-analyses (1.6%).⁴⁴ As a result, half of the studies covered by newspapers were actually disconfirmed by subsequent studies
- Of these, only half resulted in subsequent publication in peer-reviewed journals. Among newspaper articles covering these conference communications, less than one in five informed the reader of their preliminary and uncertain nature.

- Dumas-Mallet, E., & Gonon, F. (2020). Messaging in Biological Psychiatry: Misrepresentations, Their Causes, and Potential Consequences. *Harvard review of psychiatry*, 28(6), 395–403.

Boutron, I., & Ravaud, P. (2018). Misrepresentation and distortion of research in biomedical literature. *Proceedings of the National Academy of Sciences of the United States of America*, 115(11), 2613–2619.

- Different types of spin, my focus on misinterpreting results
- This type of spin includes misinterpreting p value as a measure of effect
- Also extrapolating to a larger population
- Rhetoric, defined as language designed to have a persuasive or impressive effect, can be used by authors to interest and convince the readers (5). Any author can exaggerate the importance of the topic, unfairly dismiss previous work on it, or use persuasive words to convince the reader of a specific point of view
- Mentions a website that explains how journalists/scientists can use rhetoric to gloss over a nonsignificant result [https://mchankins.wordpress.com/2013/04/21/still-not-significant-](https://mchankins.wordpress.com/2013/04/21/still-not-significant-2/)

2/

a definite trend (p=0.08)
 a distinct trend toward significance (p=0.07)
 a marginal trend (p=0.09)
 a marginal trend toward significance (p=0.052)
 a marked trend (p=0.07)
 a mild trend (p<0.09)
 a moderate trend toward significance (p=0.068)
 a notable trend (p<0.1)
 a possible trend (p=0.09)
 a significant trend (p=0.09)
 difference was apparent (p=0.07)

Simmerling, A., & Janich, N. (2016). Rhetorical functions of a 'language of uncertainty' in the mass media. *Public Understanding of Science*, 25(8), 961–975.

- It is based on a number of qualitative hermeneutical studies and shows that at the syntactical level, the main indicators of uncertainty are tense, modality (subjunctive, conditional mood, modal verbs and words, questions) and expressions of negation.
- Words that refer prototypically to ignorance and uncertainty (including e.g. *error, ignorance, doubt, controversy, risk, uncertain,*
- Expressions that, on account of shared semantic features relating to context, may point to ignorance and uncertainty (such as *lack of data, unresolved issues, contested*).
- Rhetorical figures such as metaphors (including e.g. *unmapped terrain, knowledge gaps, stepping into new territory*), personifications (*poor cousin of [health] research*) and comparative constructions (*a kind of [x]*). Such figures also include hyperbole and irony, even if they are less easy to identify by pointing to a specific word.