REVIEW

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# Depression, But Not Dissociative Experiences, Predicts Overgeneral Memory: A Systematic Review and Meta-Regression Analysis

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## ABSTRACT

**Background:** Reduced memory specificity (i.e., overgeneral memory) is a characteristic of autobiographical memories widely studied in clinical populations, and it is explained by rumination, functional avoidance, and executive dysfunction. Though the relationship of autobiographical memory specificity with mood and anxiety disorders has been shown, how it relates to dissociation is not well-established. Thus, we aimed to investigate whether dissociative experiences are related to overgeneral memory while considering concurrent depression as a possible confounding factor.

**Methods:** We conducted a systematic review in compliance with The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines and searched PubMed and Web of Science databases using autobiograph* and dissoc* as our keywords.

**Results:** Of the 768 studies identified, 9 studies fulfilled the inclusion criteria. A meta-regression analysis was conducted to analyze the relationship between dissociative experiences and depression scores with autobiographical memory test scores. Our research revealed that depression scores, but not dissociative experiences, are significantly related to reduced memory specificity.

**Conclusion:** While the possible overlap between dissociation and depression should be considered in the interpretation of the findings, dissociative experiences do not seem to pose vulnerability for reduced specificity of autobiographical memory. The number of studies on the topic is limited, and they do not have longitudinal follow-ups. The heterogeneous reporting of memory scores and low scores of dissociative experiences in the samples are also limitations of the existing studies.

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## INTRODUCTION

Overgeneral autobiographical memory (OGM) is defined as the inability to recall specific details of an autobiographical memory (AM) in response to cue words of different valence.[1] Extant research established a link between OGM and psychopathology transdiagnostically. However, since studies looked at categorical diagnoses, we do not have much information on dimensional mechanisms associated with reduced memory specificity in clinical populations. Given the importance of memory integration in building a coherent self-concept,[2] we wanted to investigate how disruptions in the flow of consciousness (i.e., dissociative experiences) would affect memory characteristics. Some researchers suggested that dissociative individuals' avoidant information processing style would lead to recalling fewer specific memories. Others, however, expected that their heightened consolidation capacity might lead to recalling more specific memories. Evidence on this relationship is inconclusive due to the high heterogeneity of samples in studies investigating this phenomenon and the comorbidity of dissociation with depression. There is extensive evidence for a robust association between OGM and depression. However, these two pathological dimensions may overlap in many patients, making it difficult to distinguish the underlying etiopathogenesis.[3] Consequently, investigating dissociative experiences dimensionally might lead to more interpretable results. Motivated by the lack of knowledge in the literature, as a preliminary attempt to address such interplay, we aimed to conduct a systematic review and meta-regression analysis to address the relationship between dissociative experiences, depression, and OGM.

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There is a wealth of evidence investigating OGM in individuals suffering from disorders such as major depressive disorder (MDD), bipolar disorder, and post-traumatic stress disorder (PTSD). Little research has examined the features of retrieved personal memories such as specificity, episodic details, and phenomenological experience (i.e., vividness and vantage point) in dissociative disorders. A study conducted with non-clinical college students found that higher Dissociative Experiences Scale (DES) scores were associated with a more frequent observer perspective than a field perspective. Individuals with more dissociative experiences recalled personal memories as an onlooker rather than using the first-person perspective, facilitating retrieval of the scene through one's own eyes.[4] This finding points out that out-of-body experiences in dissociation are coupled with a similar experience during AM recall and that memory characteristics change for lifetime personal memories in non-clinical samples who experience dissociation, as well. Therefore, dissociative experiences might be linked to a decreased ability to reach specific AM, in other words, to OGM.

Dissociation is defined as "a disruption in the usually integrated functions of consciousness, memory, identity, or perception of the environment."[5] This definition includes forgetfulness of everyday events and personally relevant important information, such as traumatic instances.[6] This type of amnesia can be global or situational such that an individual experiencing dissociative amnesia can lose an entire identity and the memories associated with it (as in the case of dissociative identity disorder (DID) or forget specific events while retaining a unified sense of self.[7] The loss of memories can be time-limited in a fugue state where amnesia is temporary, and the memory is regained afterward, or focal where the individual loses access to them permanently.[8]

Existing literature on the relationship between autobiographical memory and dissociation clearly defines amnesia and fugue states. For example, we know that individuals who have dissociative experiences encounter episodic memory loss often (i.e., amnesia).[9] Additionally, generalized amnesia for life history may occur in dissociative disorders.[5] However, little research examined the features of memories from periods that fall outside of traumatic events, such as specificity, episodic details, and phenomenological experience (i.e., vividness and vantage point).

**MAIN POINTS**

- Memory specificity is associated with multiple psychiatric disorders.
- Our research revealed that depression scores, but not dissociative experiences, are significantly related to reduced memory specificity.
- Research on this topic is limited and the possible overlap between dissociation and depression should be considered in the interpretation of the findings.

Dissociative experiences are a common and transdiagnostic aspect of acute stress disorder,[10] PTSD,[11] borderline personality disorder (BPD),[12] MDD,[13] as well as in clinically undiagnosed individuals[14] even without traumatic exposure. Similarly, individuals with dissociative disorders frequently meet the diagnostic criteria for these disorders, showing comorbidities.[3]

According to the CaR-FA-X model, the inability to recall specific memories is linked with the capture of attention by emotionally relevant but task-irrelevant information, functional avoidance aimed at reducing the affective impact of emotional memories, and executive dysfunction.[15] High dissociation was found to be related to increased attention division facilitation in circumstances that require emotional engagement, and they recalled fewer emotional words than low dissociators.[16] On the other hand, high and low dissociators did not differ in their performance on a Think-No-Think task with neutral words, showing that dissociation did not correlate with suppressing task-irrelevant material in a non-clinical population.[17] Based on the evidence that high dissociators divide attention from emotionally engaging information,[16] it could be inferred that they might be employing functional avoidance.

Based on this current literature and hypothesis, we aimed to conduct a systematic review and meta-regression analysis to study the relationship between dissociative experiences and OGM. A growing body of evidence in favor of a dimensional approach to mental disorders (i.e., RDoC)[18] and hierarchical taxonomy of psychopathology[19] suggests that mental disorders and their symptoms are more overlapping than distinct. Studies measuring the relationship between OGM and specific endophenotypes would foster theoretical advances by illuminating the mechanisms by which autobiographical memories are encoded, stored, and retrieved. This would help improve the precision and efficacy of evidence-based treatments targeting apparent dysfunctions in such processes. Therefore, instead of making conclusions based on heterogeneous diagnostic criteria, highlighting the underlying symptom-specific neural and cognitive mechanisms is of greater importance. For this purpose, defining dissociative experiences as an endophenotype, we systematically searched for studies that had data on the DES, State Dissociation Questionnaire (SDQ), and Autobiographical Memory Task (AMT). Using these data, we conducted a meta-regression analysis to analyze the correlation between these measures. Also, we conducted a secondary meta-regression analysis by adding the Beck Depression Inventory (BDI) scores, which is a factor known to be related to OGM.[20] This secondary analysis is expected to clarify a possible positive finding in the context of the overlap between dissociation and depression in non-clinical and clinical populations.[3]

## METHODS

### Search Strategy

This study was conducted following The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA)[21] and Meta-Analysis of Observational Studies in Epidemiology (MOOSE)[22] guidelines. PubMed and Web of Science were searched using the keywords autobiograph* and dissoc* in all fields to reach articles that contain information on dissociative measures and autobiographical memory. The first search was completed on March 6, 2019, and it was updated using the same keywords on the same databases on March 28, 2020. We did not include the keywords "over general" or "specificity" to maximize the number of articles and ensure that articles that did not mention those terms were part of the article pool.

After the database search, duplicate articles were removed. A total of 580 (528 in the first search + 52 in the second search) articles were identified, and their abstracts were screened to determine the ones that would be included in the second stage for full-text reading. Studies were excluded if they were case reports, qualitative studies, books, book chapters, conference proceedings, not written in English, not reporting autobiographical memory outcomes. Articles about general memory deficits caused by either organic or functional causes (e.g., brain lesions, dementia, Alzheimer's disease, amnesia, or dissociative fugue) were also excluded.

Two authors (MAE and FA) screened all abstracts independently, and they resolved the disputes by discussing them until they agreed. AO served as the second coder for all screenings in both the first and the second stages. Eligibility criteria for inclusion were reporting both AMT and dissociation scores and being a peer-reviewed empirical study. Written or oral versions of AMT that used either verbal or pictorial cues were accepted. On the other hand, not reporting AMT or dissociation measurements as outcome variables or not representing original data (i.e., reviews/meta-an alyses, perspective papers) led to exclusion (Figure 1). Nine (9+0) of the eligible studies were used for data extraction. First coders (MAE and FA) extracted data, and the second coder (AO) double-checked the accuracy of the data. HYE checked all the steps of the search flow and the extracted data. Of the 9 studies included in this study, 3 of them were not used in the quantitative analysis because one reported median, instead of mean, scores,[23] one did not report the raw DES scores,[20] and another one used SDQ, instead of DES, as a measure of dissociation.[24] Findings from these studies are discussed in the qualitative synthesis section. In the meta-regression analyses, if an article contained multiple experimental sessions, only data from the first session were used to eliminate confounding effects of treatment.

### Autobiographical Memory Task and Extracted Autobiographical Memory Task Measures

Autobiographical Memory Task is the most used standardized measure of autobiographical memory specificity. In AMT, participants are asked to recall a specific memory in response to a cue word presented by the experimenter either verbally or by using flashcards with the words printed out. A specific memory is described as an event that happened at a particular place and time and lasted no longer than a day.[25] The standard AMT starts with a practice session to ensure the participant understands the procedure. Neutral cue words are used in the practice trials, and experimental trials begin only after the participant successfully reports a specific memory. Participants are allocated a time limit (ranging from 30 seconds to 120 seconds) within which they must come up with a specific memory. Then, the following cue word is presented, even if they cannot recall a memory. The experimenter gives prompts within the allocated time limit if the first event reported was not specific (e.g., "Can you remember an event that took place at a particular place and time?"). The reported events are then coded into one of the following categories: specific, categorical, extended, semantic associate, or omission.[25] A specific memory is one that meets the above criteria (e.g., taking the university entrance exam). Overgeneral memory categories include categorical and extended memories. Categorical memory refers to events that happened repeatedly (e.g., "every time I took a math test"), and extended memories are events that lasted longer than 1 day (e.g., "winter break last year"). Semantic associates are concepts rather than actual events (e.g., "my school"), and an omission is when participants fail to recall an event.[15] Cue words used in AMT can be positive (i.e., happy), negative (i.e., sad), or neutral (i.e., car). Autobiographical memory task measures extracted from the articles were specific, categorical, extended, semantic associates, and omission scores for each valence were based on their availability.

### Definitions of Dissociative Measures

Our study selected the DES as the main measure of dissociative experiences since it is the most commonly used one. Dissociative Experiences Scale is a 21-item self-report scale that measures dissociative experiences that might occur in daily life on a 100-point scale (e.g., "Some people find that they have no memory for some important events in their lives (e.g., a wedding or graduation). Select the number to show what percentage of the time this happens to you (0% never, 100% always)").[26] There are several items in the scale which measure various types of dissociative amnesia. Other items address experiences of depersonalization, derealization, absorption (i.e., narrowed consciousness and trance), and primary and secondary symptoms of identity fragmentation (i.e., hearing voices, alterations in the sense of self and

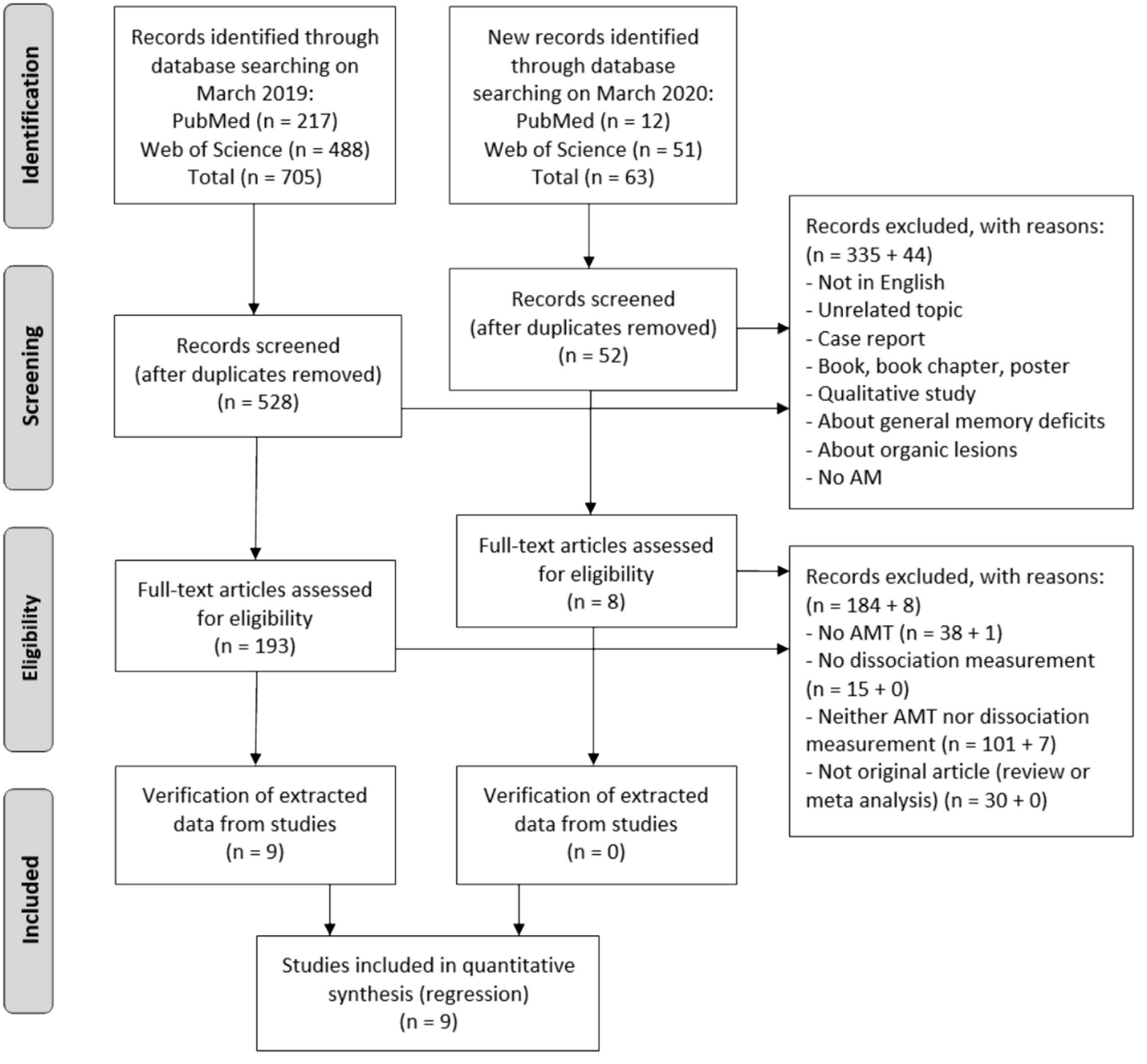



Figure 1. Study selection and inclusion flow diagram based on PRISMA guidelines.

agency). The participant is asked to consider the severity and frequency of these experiences during the last month. Thus, the DES covers the whole dimension/spectrum of dissociation, which does not necessarily include amnestic experiences in every incident. On the other hand, the sense of « ownership » of the experience may be affected by experiences of identity fragmentation/alteration and the estrangement to oneself and the environment (i.e., depersonalization and derealization).

Studies conducted using SDQ were also included for the qualitative review. State Dissociation Questionnaire measures dissociative experiences like depersonalization, derealization, altered sense of time, and detachment. Participants rate their experiences with each item on 3 levels (not at all, a little, a lot).[27] Only one of the studies included in our review used this scale. It was not included in the meta-regression analysis but was in the qualitative synthesis of this paper.

### Other Moderator Variables for Autobiographical Memory Task-Dissociation Relationship

Dissociation shares a significant part of its etiology and comorbidity with depressive disorders.[3] Also, depression is linked to disruptions in autobiographical memory formation and specificity.[28] Therefore, BDI scores were also extracted for analysis. One of the studies used BDI-II instead of BDI-I and was not included in the quantitative analyses.

**Table 1.** Descriptive Methodological Measures and Participant Characteristics of 8 studies That Used DES as A Dissociative Measure

| Reference | Sub-Group Within Study | Number of Cue Words in AMT | Valence Categories Screened | Response Window in AMT (in seconds) | Sample Size | Age (Mean ± SD) | Female/Male Ratio | DES (Mean ± SD) | BDI (Mean ± SD) |
|---|---|---|---|---|---|---|---|---|---|
| **Jones (1999)** | BPD | 18 (6 each) | Positive, negative, neutral | 30 | 23 | 31.1 ± 7.7 | 18/5 | 39.9 ± 17 | 35.2 ± 10.7 |
| | Control | | | | 23 | 31.2 ± 8.6 | 18/5 | 8.9 ± 7.3 | 4.7 ± 5.5 |
| **Wessel (2001)** | High dissociation (DES ≥30) | 10 (5 each) | Positive, negative | 30 | 23 | 19.3 ± - | 16/7 | 28.12 ± 12.01 | 5.65 ± 3.43 |
| | Low dissociation (DES <15) | | | | 25 | | 23/2 | 10.08 ± 6.71 | 2.76 ± 2.98 |
| **Gibbs (2004)*** | N/A | 15 (5 each) | Positive, negative, neutral | 30 | 89 | 21.23 ± 2.56 | - | - | 8.2 ± 6.31 |
| **Kremers (2004)** | Depressed BPD | 10 (5 each) | Positive, negative | 60 | 47 | 29.8 ± 8.1 | 44/3 | 23.4 ± 14 | 29.5 ± 9.4 |
| | Non-depressed BPD | | | | 36 | 31.8 ± 7.8 | 33/3 | 21.1 ± 12.1 | 23.1 ± 8.6 |
| | Depressed | | | | 26 | 46 ± 7.8 | 15/11 | | 23.6 ± 7.1 |
| | Control | | | | 30 | 34.7 ± 7.4 | 30/0 | 9.2 ± 9.7 | 3.9 ± 7.1 |
| **Renneberg (2005)** | BPD | 15 (5 each) | Positive, negative, neutral | 60 | 30 | 28.5 ± 9.1 | 30/0 | 23.9 ± 11.8 | 28.7 ± 11.1 |
| | Unipolar major depression | | | | 27 | 39.1 ± 8 | 27/0 | 18.8 ± 13.5 | 24.4 ± 8.8 |
| | Control group | | | | 30 | 28.4 ± 8.6 | 30/0 | 9.5 ± 6.9 | 3.9 ± 2.7 |
| **Spinhoven (2006)** | Depressed BPD | 10 (5 each) | Positive, negative | 60 | 37 | 29.8 ± 8.6 | - | 19.3 ± 14.2 | 30.5 ± 9.8 |
| | Non-depressed BPD | | | | 18 | 31.7 ± 7.9 | - | 18.6 ± 14.3 | 23.1 ± 8.7 |
| **Brennen (2010)**** | Bosnian war trauma | 15 (5 each) | Positive, negative, neutral | 120 | 40 | 17.9 ± 0.6 | 20/20 | 11.1 ± 7.4 | 13.7 ± 8 |
| | Norwegian control | | | | 49 | 18 ± 0.5 | 22/27 | - | 10.7 ± 7.6 |
| | High exposure to bombing | 10 (5 each) | Positive, negative | 120 | 50 | 19 ± 0.6 | 41/9 | 10.6 ± 7.8 | 5.3 ± 4.2 |
| | Low exposure to bombing | | | | 90 | 19.3 ± 0.7 | 80/10 | 11.4 ± 12.4 | 4.8 ± 5.3 |
| **Huntjens (2014)***** | DID | 10 (5 each) | Positive, negative | 60 | 12 | 41 ± - | 12/0 | 44.64 (range 21.85-66.43) | - |
| | PTSD | | | | 27 | 41 ± - | 27/0 | 20.36 (range 0.00-58.21) | - |
| | Control | | | | 29 | 39 ± - | 29/0 | 7.14 (range 1.07-17.50) | - |
| | DID simulator | | | | 26 | 46 ± - | 26/0 | 5.18 (range 1.07-26.07) | - |

AMT, autobiographical memory test; BDI, Beck's Depression Inventory; DES: Dissociative Events Scale; BPD, borderline personality disorder; DID, dissociative identity disorder; PTSD, post-traumatic stress disorder.
Note: Number of Cue Words in AMT for each valence is indicated in parentheses since studies differ in whether they included neutral cue words or if they only used positive or negative cue words.
*Gibbs et al., 2004 did not present raw DES scores but correlation between DES and AMT scores was reported
**Brennen et al., 2010 used BDI-II, instead of BDI-I.
***Huntjens et al., 2014 reported median, instead of mean, scores.

## Demonstration of Data and Statistics

In the 9 studies, samples comprised various patient groups (e.g., DID, BPD, traumatized individuals, and matched control groups). We did not distinguish between the groups based on their diagnoses. Instead, we focused on their AMT and DES scores as transdiagnostic dimensional variables. As DES and AMT scores were reported separately for different subgroups in each study, we chose to use subgroups' scores as an individual study data set in our analysis. Details about all the studies, their sub-variables, and related measures that we used in our analyses are in Table 1.

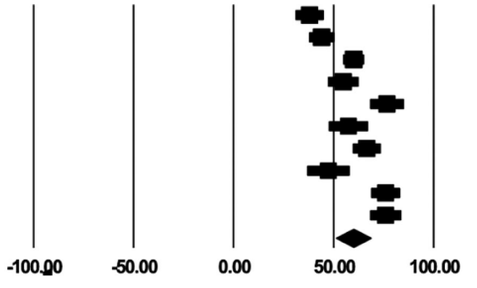
The primary outcome variables that were extracted were the means and standard deviations of AMT and DES scores. Although the current literature suggests that the AMT records are scored by categorizing the responses into 5 groups (specific, categorical, extended, semantic association, and omission), the papers included in our study used heterogeneous reporting strategies. Because of that heterogeneity, we conducted separate quantitative analyses for each of those categories with each group's available scores.

Because some studies reported AMT scores as mean numbers, some as percentages out of all answers, and others as percentages for within subgroups (i.e., positive specific), the first step we took was to convert all the scores into percentage values. This conversion represents the percentages of specific and categorical responses to all the words that the participants received for each valence.

The quantitative analyses were conducted on the Comprehensive Meta-Analysis software trial v.3.[29] Publication bias was assessed over the data from specific positive scores since that was the subgroup with the most data available, employing visualization of the Funnel plots and statistically analyzing by Egger's test[30] and Begg-Mazumdar Kendall's tau.[31] The risk of bias analysis was conducted on specific-positive AMT scores.

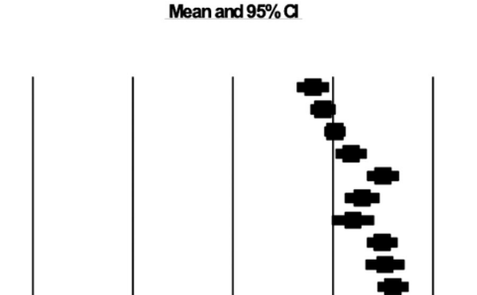
A

| Study name | Subgroup within study | Mean | Standard error | Variance | Lower limit | Upper limit | Z-Value | p-Value |
|---|---|---|---|---|---|---|---|---|
| Brennen 2010 | Bosnian war trauma | 38.000 | 3.637 | 13.225 | 30.872 | 45.128 | 10.449 | 0.000 |
| Brennen 2010 | High exposure to bombing | 44.000 | 3.253 | 10.580 | 37.625 | 50.375 | 13.527 | 0.000 |
| Brennen 2010 | Low exposure to bombing | 60.000 | 2.741 | 7.511 | 54.628 | 65.372 | 21.893 | 0.000 |
| Spinhoven 2006 | Depressed BPD | 54.800 | 3.978 | 15.828 | 47.002 | 62.598 | 13.774 | 0.000 |
| Spinhoven 2006 | Non-depressed BPD | 76.700 | 4.360 | 19.014 | 68.154 | 85.246 | 17.590 | 0.000 |
| Remeberg 2005 | BPD | 57.400 | 5.039 | 25.392 | 47.524 | 67.276 | 11.391 | 0.000 |
| Remeberg 2005 | Control group | 66.600 | 3.615 | 13.068 | 59.515 | 73.685 | 18.423 | 0.000 |
| Remeberg 2005 | Unipolar major depression | 47.400 | 5.466 | 29.873 | 36.688 | 58.112 | 8.672 | 0.000 |
| Wessel 2001 | High dissociation (DES = 30) | 76.000 | 3.753 | 14.087 | 68.644 | 83.356 | 20.249 | 0.000 |
| Wessel 2001 | Low dissociation (DES < 15) | 76.000 | 4.000 | 16.000 | 68.160 | 83.840 | 19.000 | 0.000 |
| | | 59.708 | 4.413 | 19.474 | 51.059 | 68.357 | 13.530 | 0.000 |




B

| Study name | Subgroup within study | Mean | Standard error | Variance | Lower limit | Upper limit | Z-Value | p-Value |
|---|---|---|---|---|---|---|---|---|
| Brennen 2010 | Bosnian war trauma | 40.000 | 4.111 | 16.900 | 31.943 | 48.057 | 9.730 | 0.000 |
| Brennen 2010 | High exposure to bombing | 45.000 | 3.253 | 10.580 | 38.625 | 51.375 | 13.835 | 0.000 |
| Brennen 2010 | Low exposure to bombing | 51.000 | 2.741 | 7.511 | 45.628 | 56.372 | 18.609 | 0.000 |
| Spinhoven 2006 | Depressed BPD | 59.100 | 3.995 | 15.959 | 51.270 | 66.930 | 14.794 | 0.000 |
| Spinhoven 2006 | Non-depressed BPD | 75.000 | 4.078 | 16.627 | 67.008 | 82.992 | 18.393 | 0.000 |
| Remeberg 2005 | BPD | 64.600 | 4.455 | 19.845 | 55.869 | 73.331 | 14.501 | 0.000 |
| Remeberg 2005 | Control group | 60.000 | 5.427 | 29.453 | 49.363 | 70.637 | 11.056 | 0.000 |
| Remeberg 2005 | Unipolar major depression | 74.600 | 3.944 | 15.552 | 66.871 | 82.329 | 18.917 | 0.000 |
| Wessel 2001 | High dissociation (DES = 30) | 76.000 | 5.004 | 25.043 | 66.192 | 85.808 | 15.187 | 0.000 |
| Wessel 2001 | Low dissociation (DES < 15) | 80.000 | 4.000 | 16.000 | 72.160 | 87.840 | 20.000 | 0.000 |
| | | 62.395 | 4.541 | 20.618 | 53.496 | 71.295 | 13.741 | 0.000 |




C

| Study name | Subgroup within study | Mean | Standard error | Variance | Lower limit | Upper limit | Z-Value | p-Value |
|---|---|---|---|---|---|---|---|---|
| Brennen 2010 | Bosnian war trauma | 39.000 | 3.004 | 9.025 | 33.112 | 44.888 | 12.982 | 0.000 |
| Brennen 2010 | High exposure to bombing | 45.000 | 2.687 | 7.220 | 39.734 | 50.266 | 16.747 | 0.000 |
| Brennen 2010 | Low exposure to bombing | 56.000 | 2.214 | 4.900 | 51.661 | 60.339 | 25.298 | 0.000 |
| Kremers 2004 | Control | 75.300 | 3.378 | 11.408 | 68.680 | 81.920 | 22.294 | 0.000 |
| Kremers 2004 | Depressed BPD | 59.000 | 2.859 | 8.174 | 53.397 | 64.603 | 20.637 | 0.000 |
| Kremers 2004 | Non-depressed BPD | 69.800 | 3.133 | 9.818 | 63.659 | 75.941 | 22.277 | 0.000 |
| Wessel 2001 | High dissociation (DES = 30) | 76.000 | 3.336 | 11.130 | 69.461 | 82.539 | 22.780 | 0.000 |
| Wessel 2001 | Low dissociation (DES < 15) | 78.000 | 3.200 | 10.240 | 71.728 | 84.272 | 24.375 | 0.000 |
| | | 62.174 | 5.062 | 25.627 | 52.252 | 72.096 | 12.282 | 0.000 |

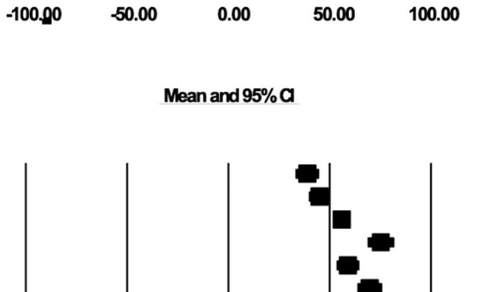



Figure 2. A-C. Autobiographical memory test (AMT) mean scores for each subgroup included in the study and the forest plot demonstration of the mean scores. (A) Specific-positive AMT mean scores for each subgroup included in the study and the forest plot demonstration of the mean scores. (B) Specific-negative AMT mean scores for each subgroup included in the study and the forest plot demonstration of the mean scores. (C) Specific total AMT mean scores for each subgroup included in the study and the forest plot demonstration of the mean scores.

The reported AMT mean scores, subgroups and total mean for AMT scores based on random effects models for the specific positive, specific negative, and total specific AMT scores are presented as forest plots in Figure 2. Heterogeneity for the studies included in these 3 analyses are also calculated and reported as the $I^2$ and Q statistic for each analysis.

Meta-regression analyses were conducted discretely for each cue valence of specific and categorical AMT scores in relation to BDI and DES scores. For regression, we ran Meta-regression 2 analysis for each of these score groups.

The relationship between DES scores and AMT measurements was calculated using random-effects univariate meta-regression. In case a sufficient number of studies were identified to include both BDI and DES scores, multivariate meta-regression was conducted to observe their interaction. Statistics for the test of the model and goodness of fit measures were recorded to observe if the variance is due to a true effect or a sampling error. Since it was not possible to run meta-regression for categories that contained fewer than 6 studies (i.e., omission), we discussed the results of those categories in the qualitative synthesis.

## RESULTS

### Description of the Included Studies

Following identification, screening, and eligibility steps, data from 9 studies were used. Available studies were published between 1999 and 2014. PRISMA flow diagram of these studies is in Figure 1. We included 8 studies using the mean of DES to measure dissociative symptoms[20,32-37] in quantitative analysis. The one study that used SDQ[24] was included in the qualitative synthesis. Descriptive methodological measures and participant characteristics of the studies and their reported subgroups are in Table 1.

### Risk of Bias and Quality Assessment

Risk of bias analysis was conducted by using the specific positive AMT scores of the 10 groups reported in 4 studies,[1-4] as this variable had the highest number of subgroups.

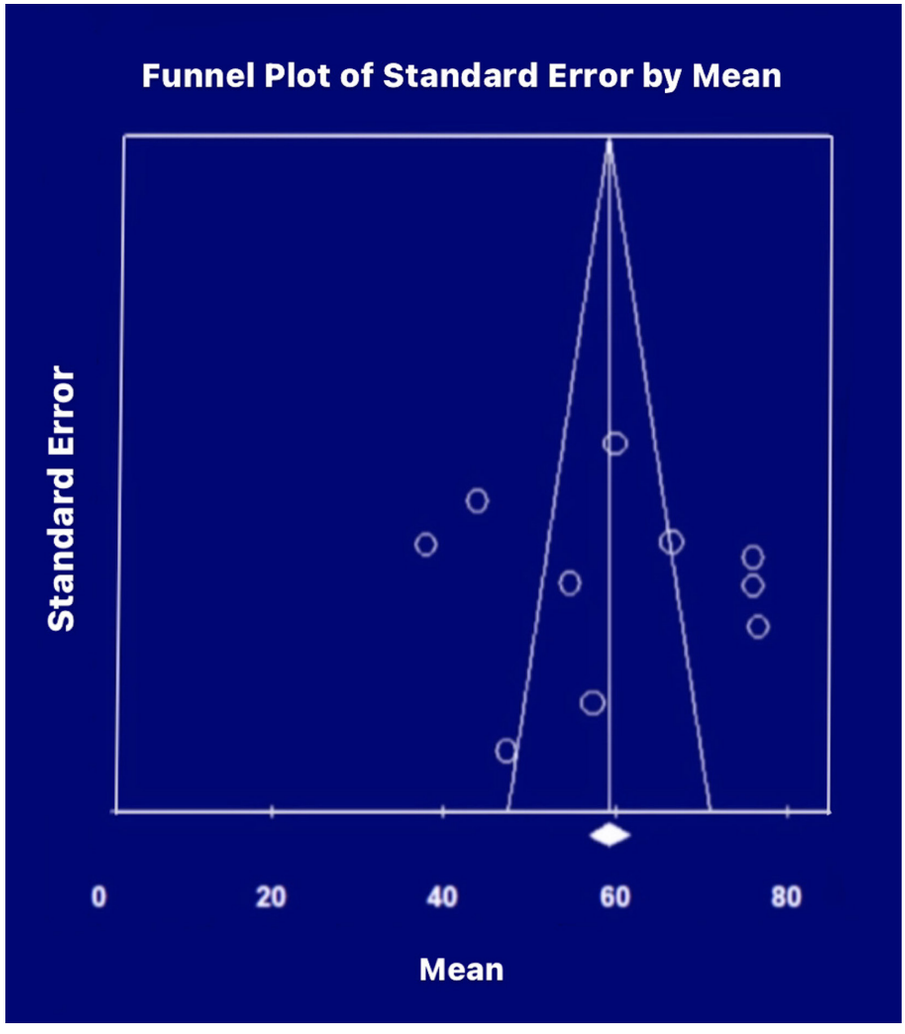



Figure 3. Funnel plot of standard error by mean showing no publication bias.

**Table 2.** Effects of DES and BDI Scores on AMT Measurements Based on the Meta-Regression Analysis

| a. | | | Scales (Coefficients and CIs) | | | | Model | | | Goodness of Fit Measures | | | | References |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-Score | N | n | | Coefficient | CI-Lower | CI-Upper | Q | *df* | *P* | $I^2$ | Tau | Q | *P* | |
| Specific-positive memories | 10 | 370 | DES | 0.592 | −0.792 | 1.975 | 0.700 | 1 | .402 | 92.400 | 13.302 | 105.310 | <.001 | Brennen, Renneberg, Spinhoven, Wessel |
| Specific-negative memories | 10 | 370 | | 0.703 | −0.722 | 2.128 | 0.930 | 1 | .334 | 92.390 | 13.602 | 105.070 | <.001 | Brennen, Renneberg, Spinhoven, Wessel |
| Specific-total memories | 8 | 341 | | 0.619 | −0.830 | 2.069 | 0.700 | 1 | .402 | 95.940 | 14.112 | 147.920 | <.001 | Brennen, Kremers, Wessel |
| Categorical-positive memories | 5 | 235 | | 0.051 | −2.130 | 2.232 | 0.000 | 1 | .964 | 92.040 | 9.065 | 37.680 | <.001 | Brennen, Spinhoven |
| Categorical-negative memories | 5 | 235 | | −0.035 | −2.698 | 2.629 | 0.000 | 1 | .980 | 92.760 | 11.247 | 41.410 | <.001 | Brennen, Spinhoven |
| Specific-positive memories | 7 | 190 | BDI | −0.628 | −1.217 | −0.040 | 4.380 | 1 | .036 | 78.290 | 8.064 | 23.030 | <.001 | Renneberg, Spinhoven, Wessel |
| Specific-negative memories | 7 | 190 | | −0.560 | −0.887 | −0.234 | 11.310 | 1 | .001 | 27.630 | 2.709 | 6.910 | .228 | Renneberg, Spinhoven, Wessel |
| Specific-total memories | 5 | 161 | | −0.598 | −0.841 | −0.355 | 23.240 | 1 | <.001 | 0.550 | 0.239 | 3.020 | .389 | Kremers, Wessel |
| **b.** | | | **DES and BDI (Coefficients and CIs)** | | | | **Model** | | | **Goodness of Fit Measures** | | | | |
| **Sub-Score** | **N** | **n** | | **Coefficient** | **CI-Lower** | **CI-Upper** | **Q** | ***df*** | ***P*** | **$I^2$** | **Tau** | **Q** | ***P*** | **References** |
| Specific-positive memories | 7 | 370 | | | | | 3.920 | 2 | .140 | 81.000 | 9.070 | 21.060 | .003 | Renneberg, Spinhoven, Wessel |
| | | | Intercept | 70.920 | 48.180 | 93.650 | | | | | | | <.001 | |
| | | | DES | 0.339 | −0.939 | 1.618 | | | | | | | .600 | |
| | | | BDI | −0.706 | −1.413 | 0.001 | | | | | | | .050 | |
| Specific-negative memories | 10 | 370 | | | | | 9.180 | 2 | .010 | 41.800 | 3.660 | 6.880 | .140 | Renneberg, Spinhoven, Wessel |
| | | | Intercept | 79.060 | 66.300 | 91.820 | | | | | | | <.001 | |
| | | | DES | 0.047 | −0.727 | 0.821 | | | | | | | .900 | |
| | | | BDI | −0.575 | −0.991 | −0.158 | | | | | | | .006 | |
| Specific-total memories | 8 | 341 | | | | | 15.030 | 2 | .005 | 33.150 | 2.220 | 2.990 | | Brennen, Kremers, Wessel |
| | | | Intercept | 78.750 | 69.500 | 87.980 | | | | | | | <.001 | |
| | | | DES | 0.037 | −0.503 | 0.577 | | | | | | | .890 | |
| | | | BDI | −0.604 | −0.955 | −0.254 | | | | | | | .001 | |

N, number of subgroups included from referenced articles.
n, number of total participants from the subgroups included.

Publication bias assessment by inspection of the funnel plot revealed symmetrical distribution for all sub-groups. Here, we include a funnel plot based on the analysis of the specificpositive sub-group since it had the highest number of studies (Figure 3). No publication bias emerged either in Egger's regression or Begg and Mazumdar rank correlation for the specific-positive subgroup (Egger's regression test [intercept: 2.02 (95% C.I.: −12.955, 17), *P*-value: .763] and Kendall's tau with continuity correction test (tau: 0.000, *P*-value: .500)). The results for analysis of heterogeneity for the included studies were as follows: specific-positive: $I^2=92.5$, Cochran Q=119.9, $P < .001$; specific-negative: $I^2=92.5$, Cochran Q=119.3, $P < .001$; specific-total: $I^2=95.8$, Cochran Q=168.3, $P < .001$. All subgroup analyses revealed high heterogeneity as defined by an $I^2$ value higher than 90%.

## Quantitative Synthesis Using Meta-Regression

Our meta-regression using scores from all these studies showed that none of the main scores (specific or categorical total scores) or sub-scores (specific- positive/negative/neutral or categorical-positive/negative/neutral) significantly correlated with DES scores of the groups ($P > .050$). The bivariate meta-regression we conducted using specific memory values indicated that the variance was better explained by BDI scores ($P < .050$). The results of meta-regression analyses are shown in Table 2 and visualization of these findings can be found in Figure 4.

## Qualitative Inspection of the Findings

In general, most studies failed to find significant correlations between dissociative experiences measured by DES and AM specificity.[20,32,34,35,37] Studies also used diverse approaches for calculating overgenerality: some used specific memories as their primary outcome variable, whereas others reported categorical or extended memories as a measure of reduced specificity. However, Huntjens et al[23] reported an overall negative significant correlation between trait dissociation and memory specificity, and Jones et al[33] found a significant effect only for negative cues. Furthermore, one of the papers reported DES and AMT scores, but not the correlation between them.[36]

## Specific Memories

The number of specific memories is one of the measures used to detect overgenerality. When the number of

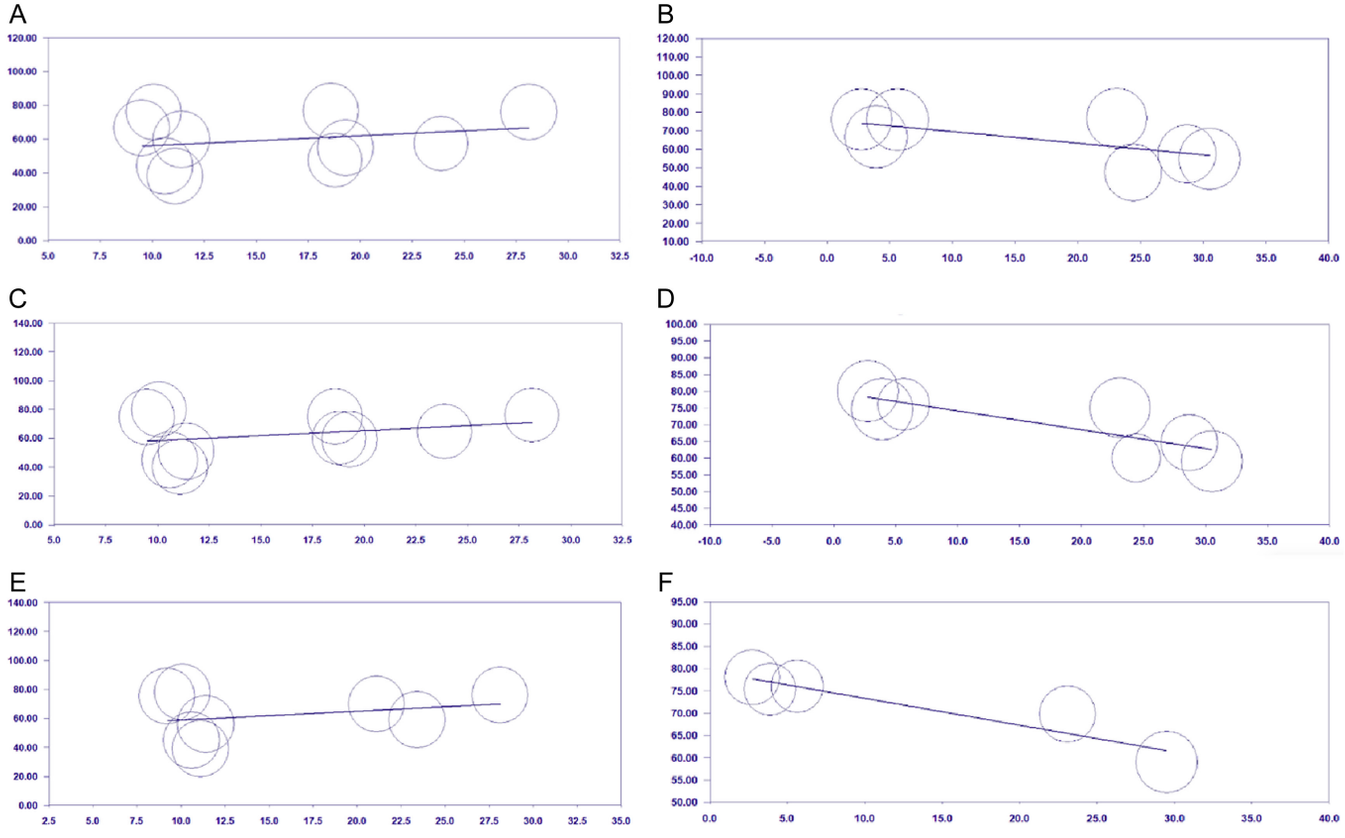



Figure 4. A-F. Scatterplots for regression of autobiographical memory test (AMT) specific scores on Dissociative Experiences Scale (DES) and Beck Depression Inventory (BDI). Specific-positive (A and B), -negative (C and D), and total scores (E and F) were used in the multivariate meta-regression analysis. Each circle demonstrates a specific subgroup included in the analysis. Dissociative Experiences Scale scores were not significantly related to AMT outcome variables whereas BDI scores significantly affected AMT scores for specific-negative and specific-total measurements.

specific memories reported decreases, it indicates reduced specificity (i.e., OGM). Brennen, Kremers, Spinhoven, Renneberg, and Wessel studies[34-37] reported that DES scores did not significantly correlate with the number of specific memories. Additionally, Huntjens et al[23] found that DID patients did not recall significantly fewer specific memories in trauma ("emotional") identity as opposed to the condition when they were in control of their "apparently normal" ("host" or "non-emotional") identity. Interestingly, the patients were even faster in retrieving specific memories when in control of the trauma identity.

### Categorical and Extended Memories

A combination of categorical and extended memories can be used as a measure of over-general memory. Huntjens et al[23] reported the number of categorical and extended memories in addition to specific responses. In their study, PTSD and DID patients who had higher DES scores compared to controls reported significantly more extended memories. However, the correlation between the number of categorical responses and DES scores remained marginally significant. Jones et al[33] used "generic" response as a measure of overgenerality. This term corresponds to a combination of categorical and extended memories in our methods, but it does not distinguish between the two. In this study, they reported that BPD patients with above-the-cut-off DES scores (>30/100)[38] produced significantly more generic memories in response to negative cue words but not to positive or neutral words. Additionally, Gibbs et al[20] used categorical memories as a measure of OGM without mentioning extended memories. In this study conducted with healthy participants, they found that DES scores positively correlated with the number of categorical memories in response to neutral cue words, and categorical responses to positive cue words approached significance.

### Semantic Associates

The only study that reported the number of semantic associates was Huntjens et al.[23] Their results showed that the PTSD group reported more semantic associates than the control group. However, there was no significant relationship between the respective scores and dissociative experiences.

### Omission

Jones et al[33] was the only study that reported omissions. According to their results, BPD group participants who scored above cut-off on DES had a higher number of omissions compared to control group participants, which may point to dissociative amnesia. However, they did not report the direct correlation between DES and AMT scores.

## DISCUSSION

The results of the meta-regression suggested that there was no correlation between DES scores and OGM. A recent network analysis study on a non-clinical population revealed that although DES scores present subdomains of trance, experiential disconnectedness, and segregated behaviors, dissociative amnesia was a common denominator of these 3 clusters.[39] Thus, although these subdomains may be related to distinct processes, this heterogeneity does not explain the lack of a direct relationship between DES and OGM. A further result of the meta-regression was that there was a correlation between OGM and depression scores. Despite the limitations of this preliminary study, this observation may point to important insights about future trans-diagnostic studies because dissociation and depression are interrelated in various ways in a neurobiological feedback loop of stress mechanisms.

One of the pathways leading to dissociative experiences is the traumatic experiences of early childhood.[40] In a recent study, low accessibility of self-referential representations moderated the relationship between childhood trauma and dissociation proneness.[41] Additionally, another study revealed that the trauma exposure by itself does not explain OGM, and it was instead the presence of PTSD and depression that accounted for the changes in AM.[42] It is possible that deficiencies intrinsic to depression are more relevant to OGM or that the distinct mechanisms of amnesia and OGM are manifested differently in dissociation and depression. In our meta-analysis, the largest number of available scores was in positive cue-related measures. This might be why the BDI scores associated with reward mechanism dysfunctions significantly predicted OGM, whereas DES scores did not. Since dissociation is thought to be a defense mechanism to avoid negative effects,[43,44] we would expect to see its effect more prominently on the negative cue-related memories.

On the other hand, dissociation, in Janet'ian understanding, cannot be considered as limited to avoidance only. The structural theory of dissociation[45] considers "positive symptoms," such as intrusive memories, thoughts, emotions, images, and even behavior ("enactment" related to traumatic memories) as a type of dissociation in an interplay with "negative symptoms" based on avoidance creating "parallel-district structures"[46] of mind. Neurobiological studies led to the separation of the avoidant type of experience as overmodulation, while intrusive phenomena represented the under modulation of emotions.[47] This "bimodal" character of trauma-related memory retrieval in dissociation would be a reason for the conflicting results in studies on dissociative disorders which do not consider the bimodal character of the condition.

Depersonalization, an avoidant type of dissociative experience, is characterized by the feeling of watching oneself from a distance. This is similar to the experience that individuals with MDD define while recalling AM. Namely, depressed patients who recall AM in an overgeneral way also report remembering their personal memories

from a third-person perspective.[15] Even when depressed individuals manage to retrieve positive memories, they cannot integrate them into their life script as if they experienced them first-hand.

Dissociative Experiences Scale items measure separate phases characterized by out-of-body experiences, seeing oneself from the observer perspective, and a disruption in the integration of consciousness, whereas BDI focuses on depressed mood, anhedonia, executive dysfunction, and negative thought content. That is, depressed individuals' inability to report specific memories might stem from their lack of motivation for rewarding experiences at the time of either encoding or retrieval. Neuroimaging studies underline that depressed individuals show hypoactivity in areas related to salience, self-referential processing, and executive function such as the insula, precuneus, and lateral prefrontal cortex (lPFC), in response to positive cue words.[48] Since one of the functions of AM is to regulate mood by remembering positive episodes, anhedonia might make this function underutilized.

In developing DSM-5, the Corticolimbic Inhibition Model of dissociation was proposed.[49] This model suggests that traumatic experiences have 3 stages of neurobiological activation that differ in the degree to which prefrontal and limbic regions are activated in response to emotional cues. In the first stage, re-experiencing and flashbacks are accompanied by the low medial PFC and high limbic (i.e., amygdala) activation. This failure of corticolimbic inhibition caused by low PFC activity is related to fragmented memories seen in PTSD. In depersonalization and derealization, which constitute the second stage, excessive corticolimbic inhibition by high mPFC activation leads to inhibited responses of the amygdala toward emotional stimuli. By the time an individual develops multiple identities in the third stage, high PFC activation characterized by hypoemotionality leads to inhibited sub-corticolimbic activity and, therefore, to blunted responses to traumatic cues. However, a recent systematic review finds that alterations observed in the amygdala and hippocampus are related to PTSD diagnosis instead of dissociative experiences.[50] Therefore, the Corticolimbic Inhibition Model might not be instrumental in explaining dissociative experiences dimensionally.

Decreased prefrontal activation seen in mood and anxiety disorders[51] would explain executive dysfunction that impairs successful specific AM retrieval. However, it was found that individuals with DID had better memory for trauma-related cues compared to non-traumatic cues.[52] It might be that the intact PFC activity in DID leads to a functional executive control that aids the successful retrieval of specific memories and, since the emotional overload does not strain the individual, the inhibition of sub-corticolimbic structures eliminates the need to use strategies to avoid negative affect. This neurobiological hypothesis may explain the absence of OGM and DES correlation. Neuroimaging studies investigating cognitive control of emotion and memory would illuminate these processes.

The current study has several limitations. We could only include 8 studies in our analysis due to a lack of publications in this field. We observed that DES scores in the groups were usually lower than the expected cut-off (Table 1), except for the DID group in Huntjens et al[23] and the BPD groups in Jones et al 1999.[33] The restricted variability due to low scores, in addition to low variance between sub-groups, might be the reason for the absence of a significant effect in our results. Further, we could not use the raw data. Instead, we conducted the meta-regression analysis on the statistical values in the articles, which may not have captured the variation.

Reporting strategies for AMT were highly heterogeneous. Studies differed in their use of specific, categorical, or extended memories as measures of overgenerality. We used any of these measures and pooled scores in all subgroups in our meta-regression. However, that did not compensate for the lack of homogeneity. Unfortunately, the number of sub-groups in the present study was barely sufficient to run bivariate mediator analyses using DES and BDI scores. Further, MDD comorbidity was not well-defined, except for Kremers et al[34] and Spinhoven et al[36] studies whose groups with and without depression did not significantly differ in DES scores.

If avoidance has a significant role, its relationship with characteristics of negative memories should be investigated more deeply. Since the more recent literature differentiates between categorical and extended memories, we also suggest that categorical and extended memory scores are reported separately even if their aggregation is used to measure over generality. Future studies would also benefit from reporting the scores according to valence instead of only reporting total scores. Besides, recent literature suggests that episodic details of personal memories could provide better information and higher discriminative validity than OGM, and future studies may use the coding of details for a better investigation.[53]

## CONCLUSION

Our research showed that there is significant heterogeneity in reporting AMT results. Studies followed different protocols and did not report all of the outcome measures. Additionally, the studies included in our analyses did not address the issue of comorbidity of dissociative experiences and depression. The meta-regression results show that depression scores, but not dissociative experiences, are correlated with reduced memory specificity. These findings highlight the importance of investigating these mechanisms

dimensionally and addressing possible comorbidity. Further research is needed to clarify the role of dissociation in memory characteristics.

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