

Research on Translational Psychological Treatment: A Comprehensive Bibliometric Analysis

André Bittermann¹, Claudiu Petrulă¹, Viktoria Ritter², Anke Haberkamp³, Stefan G. Hofmann³, Winfried Rief³, and the PsyChange Network⁴

¹Leibniz Institute for Psychology (ZPID), Trier, Germany

²Goethe-University of Frankfurt, Dept. of Psychology

³Philipps-University of Marburg, Dept. of Psychology

⁴Members of the PsyChange Network in alphabetical order:

Max Berg ^a, Hanna Christiansen ^a, Anke Haberkamp ^a, Christiane Hermann ^b, Stefan G. Hofmann ^a, Marcel A. Martin ^b, Christiane Pané-Farré ^a, Winfried Rief ^a, Viktoria Ritter ^c, Julian Rubel ^b, Christina Schwenck ^c, Ulrich Stangier ^c, Rudolf Stark ^b, Regina Steil ^c

^a Philipps-University of Marburg, Dept. of Psychology

^b Justus-Liebig University of Gießen, Dept. of Psychology

^c Goethe-University of Frankfurt, Dept. of Psychology

Author Note

André Bittermann:  <https://orcid.org/0000-0003-2942-9831>

Claudiu Petrulă:  <https://orcid.org/0000-0003-2068-1459>

Viktoria Ritter:  <https://orcid.org/0000-0002-3996-2077>

Anke Haberkamp:  <https://orcid.org/0000-0002-1774-1660>

Stefan G. Hofmann:  <https://orcid.org/0000-0002-3548-9681>

Winfried Rief:  <https://orcid.org/0000-0002-7019-2250>

Correspondence concerning this article should be addressed to André Bittermann, Leibniz Institute for Psychology (ZPID), Max-Planck-Straße 22, D-54296 Trier - Germany, abi@leibniz-psychology.org

Author Contributions

André Bittermann: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Visualization, Writing - Original Draft, Review & Editing

Claudiu Petrule: Formal analysis, Data curation, Investigation, Software, Visualization, Writing - Original Draft, Review & Editing

Viktoria Ritter: Conceptualization, Funding acquisition, Project administration, Validation, Writing - Original Draft, Review & Editing

Anke Haberkamp: Conceptualization, Funding acquisition, Writing - Review & Editing

Stefan G. Hofmann: Conceptualization, Funding acquisition, Writing - Review & Editing

Winfried Rief: Conceptualization, Funding acquisition, Project administration, Supervision, Writing - Review & Editing

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We have no competing interests to disclose.

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Electronic Supplementary Material (ESM)

We provide datasets, analysis code, and additional tables, on [\[https://drive.google.com/file/d/1fwU_1fQOyg_b3nQMbHGfCg-gH4pRSfFx/; final link included after review\]](https://drive.google.com/file/d/1fwU_1fQOyg_b3nQMbHGfCg-gH4pRSfFx/)

Abstract

Psychotherapy researchers have emphasized the importance of a paradigm shift towards translational psychological treatment. However, the publication landscape on this topic is uncharted. This makes it difficult to assess the state of translational psychotherapy research. Hence, we developed a workflow that leverages natural language processing and machine learning to find relevant studies. Based on this, we bibliometrically analyzed 7,146 publications to provide insights for the integration and development of the research field. Specifically, citation and network analyses were performed to examine the strengths and weaknesses of the research field. Five main findings emerged: 1. Machine learning proved valuable in finding eligible publications and generating an open dataset. 2. Regarding basic psychological subfields, translation comes primarily from physiological psychology/neuroscience, with a focus on fear, posttraumatic stress, and anxiety. 3. Translational research is characterized by international collaborations. 4. It has an impact within and beyond academia. 5. The lack of standardized terminology might threaten scientific progress. To foster a paradigm shift towards translational psychological treatment, a consistent terminology would greatly facilitate its development and dissemination.

Keywords: translational research, basic science, sentence embeddings, paper identification, terminology

Public Health Significance Statement

This study highlights the potential of a fruitful collaboration of basic psychological science and clinical science to improve psychological treatments.

Introduction

Translational psychological treatment is a complex research field that aims to translate or transfer current findings or principles from basic research into innovative psychological interventions by optimizing and/or further improving evidence-based treatments and/or creating new treatment approaches („from laboratory to everyday life and treatment“) (Blackwell & Woud, 2022; Ehring et al., 2022; Richter et al., 2017; Stice & Jansen, 2018). During the last decades, extensive basic research has been conducted in clinical psychology, biopsychology, neuroscience, cognitive science, and psychological therapy (e.g., Gennaro et al., 2019; Horn et al., 2020; Krampen & Perrez, 2015; Richter et al., 2021; van den Hout et al., 2017). However, bridging the translational gap between basic research and psychological treatments remains a challenge. Beyond different traditional approaches to psychological therapy, treatment research still lacks a comprehensive conceptual translational framework that brings together the wide variety of basic findings, different models, perspectives, core ingredients and mechanisms of change towards improved translation to intervention, improved efficacy and effectiveness of psychological therapy, and improved translation to routine care (Emmelkamp et al., 2014; Hayes et al., 2020).

Despite the confirmed effectiveness of psychological treatment, some patients with mental disorders benefit only to a limited extent or not at all from the established treatment approaches (e.g., Cuijpers et al., 2016; Grawe et al., 2001; Hofmann et al., 2012; Lambert, 2017). Approximately one-third to one-half of all patients in psychological treatment must be classified as nonresponders, and response rates for the most common disorders such as depression rarely exceed 50% (Lambert, 2017). Translational psychological treatment is driven by the vision that treatment can be optimized by incorporating findings from basic research (e.g., experimental psychopathology) and by focusing on the underlying psychological processes and mechanisms of change. Although there is still not enough

research on mediating and moderating factors (e.g. therapeutic alliance, nonspecific and specific factors) and their chronological sequence (Hofmann et al., 2020; Kazantzis et al., 2018; Kazdin, 2007), a more rigorous consideration of these factors and processes has the potential to improve treatment approaches (Rief et al., 2022). In addition, the transferability of the evidence-based findings to routine care, as well as dissemination and implementation into daily routine care, are issues that have hindered translational psychotherapy research to date and need to be addressed (Clark, 2018). Of note, the quality of the exchange between basic science and application can also be seen as a sign of maturity of a scientific field in general.

Therefore, psychotherapy researchers have emphasized the importance of a paradigm shift towards translational psychological treatment that takes into account the complexity of underlying individual psychological processes, etiological factors, and mechanisms, and allows for flexible, integrative evidence-based treatments beyond the orientation to different traditions of psychological therapy, but with general concepts of necessary treatment competencies (Grawe, 2004a; Hayes & Hofmann, 2018; Thoma & Abbass, 2022). Given the potential benefits of translational research for psychological treatment on the one hand, and its poor implementation in research practice on the other, the PsyChange Network has been established. This collaborative network is an association of clinical psychologists in Germany and encompasses several independent but interrelated projects such as enhancing networking between scientists in basic and treatment research as well as developing new paradigms of psychological treatment based on translational research.

Background

The term *translational research* has been widely used and applied in the scientific literature for more than two decades. A systematic review by Fort et al. (2017) indicated a consensus-based five-phase definition of translational research, which includes 1) processes of basic research in humans, 2) translation of basic research into pilot testing in humans, 3)

translation into effective treatments and clinical guidelines, 4) implementation and dissemination research and 5) outcome and effectiveness studies in populations. In (bio) medicine, translational research has become an important concept for the implementation of basic research into effective forms of treatment („from bench to bedside and back again“) (Drolet & Lorenzi, 2011). Since the turn of the 21st century, the number of publications has increased abruptly and translational research constitutes an established area in (bio) medical research (e.g., Butler, 2008; Krueger et al., 2019; Roberts et al., 2012; Rubio et al., 2010). In psychiatry, a similar trend to translational research can be observed (e.g., Fulford et al., 2014; Onitsuka et al., 2022), which is also documented by the founding of the journal *Translational Psychiatry*. In psychological treatment, translational research is proceeding more slowly compared to the dynamic development in psychiatry and other (bio)medical research (e.g., Butler, 2008; Rubio et al., 2010; Roberts et al., 2012; Krueger et al., 2019).

Translational research in clinical psychology investigates psychological processes underlying the development and maintenance of psychopathology to foster the development of innovative psychological interventions and evidence-based treatments for mental disorders (Ehring et al., 2022; Stice & Jansen, 2018). Translational psychological treatment can also be defined as *reciprocal* translation in which not only findings from basic research are translated into clinical practice, but also vice versa from clinical practice into (laboratory) experimental paradigms (Richter et al., 2017). Translational approaches to transfer basic findings from experimental studies or paradigms into clinical applications or interventions (e.g., interpretation training to target negative repetitive negative thinking) exist for various mental disorders (e.g., Glashouwer et al., 2018; Hirsch et al., 2018; Kessler et al., 2018).

However, only few overviews on the translation of principles from basic research to psychological treatments exist. Krampen and Perrez (2015) scientometrically analyzed the publication output of clinical psychology and treatment research between 1980 and 2014 in

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Anglo-American and German-speaking countries. Overall, clinical psychology publications dominated the total publication output of psychological research (> 40%). More similarities than differences between both country communities were evident. However, the relative proportion of publications on psychological treatments was considerably higher in German-speaking regions, whereas in Anglo-American countries more contributions on health psychology and behavioral medicine were found. The intradisciplinary integration of the clinical psychology literature was characterized by a high import from other subdisciplines of psychology (Krampen & Perrez, 2015).

A recent review by Ehring et al. (2022) examined the translation of basic clinical research (biological, cognitive, behavioral) into effective psychological treatments. Forty evidence-based psychological treatments recommended in the current APA's Division 12 and the clinical NICE guidelines for five major groups of mental disorders (depression, anxiety disorders, substance disorders: alcohol, drugs; schizophrenia) were considered. The strength of the link between basic research (i.e., evidence-based testing of theoretical models prior to treatment development) and treatment development was analyzed. Only 25% of treatments showed a very strong link between basic research and treatment development (e.g., behavioral activation for depression, exposure for specific phobias, cognitive-behavioral therapy for panic disorder), and further 20% showed a strong link (e.g., acceptance and commitment therapy, mindfulness-based cognitive therapy for depression, cognitive-behavioral therapy for social anxiety disorder). These findings suggest an insufficient translation from basic research into clinical innovation. Ehring et al. (2022) propose an increased attention to robust and replicable research findings, a stronger focus on experimental psychopathology, a stronger emphasis on mechanisms of change and moderators of clinical interventions, increased attention to clinical subgroups, and an emphasis on improving existing interventions rather than developing new ones.

One reason for the relative paucity of overviews on translational psychological treatment may be the difficulty of finding them. In a special issue on “Translating Basic Science into Clinical Practice” (edited by Stice & Jansen, 2018), only five of the eleven articles (including the editorial) use the term “translation” (or grammatical variants) in either title or abstract. The term “basic” is used in only two publications. A search for “basic” in the author keywords would have retrieved only one of the articles, while “translation” was included in none of the author keywords. From the perspective of information retrieval, this raises the questions 1) How can the status quo of research on translational psychological treatment be assessed if it is not clear how to find respective studies? and 2) How can the field move forward if the construct itself is not referred to in a consistent manner?

To the best of our knowledge, there has been no systematic approach to the exhaustive identification of translational psychological treatment publications. Furthermore, there is no comprehensive overview of the relevant research landscape. Therefore, a bibliometric topography is needed in order to assess the status quo of research on translational psychological treatment in terms of publication volume, terminology, research networks, fragmentation, and impact. This would help to identify barriers at the very beginning of the research cycle (“information phase / literature search”) and the very end (“publication phase”). Such a *structural* overview can provide useful insights for the integration and development of the research field and paves the way for subsequent in-depth literature reviews.

Aims

The aims of the current study are threefold:

1. To identify eligible papers on translational psychological treatment
2. To map the research landscape bibliometrically
3. To explore the strengths and weaknesses of the field from a bibliometric perspective

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To find relevant papers, we will make use of natural language processing and machine learning techniques and compare their performance to conventional data collection in bibliometrics, i.e. using database search. To map the research landscape, we will examine publication volume, journals, regional differences, subfields of psychological science, and study methodology. This will provide an overview of the size and main characteristics of the research field. Regarding strengths and weaknesses from a bibliometric point of view, we will analyze citation impact levels, altmetric attention, and research collaboration networks, as well as the terminology and similarity of the publications. The inspection of terminological consistency (e.g., “translational” vs. “using basic science to develop interventions” vs. other phrasings) will reveal potential barriers in the retrievability of publications. Derived from publication similarity networks, a potential fragmentation of the research field into different, independent realms are of further interest, as disciplinary fragmentation could hinder scientific progress (Baliatti et al., 2015).

Method

Transparency and Openness

All datasets and code scripts for reproducing the analyses, as well as detailed information on software versions, can be found in the ESM at [\[https://drive.google.com/file/d/1fwU_1fQOyg_b3nQMbHGfCg-gH4pRSfFx/; final repository link included after review\]](https://drive.google.com/file/d/1fwU_1fQOyg_b3nQMbHGfCg-gH4pRSfFx/). As we aimed to systematically search for eligible studies, we follow MARS and JARS guidelines for reporting (Cooper, 2018). This exploratory study’s design and its analysis were not pre-registered.

Methodological Rationale

We focused on publications that addressed the translation of knowledge from basic psychological science to psychological interventions. However, translational efforts are not always explicitly labeled as “translational research”, making database queries for finding

eligible studies challenging: Searching explicitly for “translational” will increase the proportion of eligible studies in the search results at the cost of missing many relevant publications. Conversely, a rather broad query (e.g., “psychological treatment AND social psychology”) will yield many irrelevant results that cannot be screened individually. Furthermore, translational research can refer to different phases (see Fort et al., 2017). Here, however, only translation from basic science to interventions is of interest (not dissemination or effectiveness in populations). Finally, the semantic relationships in the wording of study abstracts that actually reveal the translation of interest (e.g., “drawing upon Theory X from social psychology, we developed an intervention”) pose a further challenge to non-semantic literature database searches. To address this issue, we developed a paper identification workflow that leverages machine learning and language models. This workflow is illustrated in Figure 1 and described in the following.

Data

Inclusion and Exclusion Criteria

The current study’s subject of interest is the translation of basic science into psychological interventions. We included journal articles and dissertations providing

- evidence of a basic psychology construct (theory, model, concept) being used to (further) develop, apply, test, evaluate, or improve a psychological treatment, training, or intervention,
- evidence of psychotherapy research or clinical psychology (disorders) being used to (further) develop or test theories, models, or constructs of basic psychology, or
- general research methodological or theoretical considerations for translational research in psychology (including other subfields than clinical psychology).

Accordingly, we excluded publications that did not deal with psychological treatment or translation from basic science, false positives (e.g., translational abstracts, language translation), as well as comments, editorials, errata, preprints, reports, and books.

Paper Identification Workflow

As shown in Figure 1, our procedure for finding eligible papers consisted of three steps (see a full and detailed report in ESM/method_details). First, a training dataset is compiled through manual screening of literature search results for the term 'translational', supplemented by citation mining of the review paper by Ehring et al. (2022). To reduce the screening workload, we employed semi-automated literature screening (Burgard & Bittermann, 2023). Specifically, we curated a list of known papers and a reference list of pertinent authors (supplemented in ESM/additional_tables). This list was then utilized as input for the screening tool Rayyan (Ouzzani et al., 2016), which identifies similar papers within unscreened datasets based on this curated list. Rayyan has shown the best performance in preselecting relevant papers when compared to similar tools (dos Reis, 2023). A full report of the semi-automated screening approach can be found in ESM/method_details. It is essential to note that our paper selection process went beyond a specific literature search for translational studies. By expanding our pool of candidate papers and employing screening automation, we aimed to mitigate bias in the training data, thereby preventing the algorithm in Step 2 from solely learning established search terms as criteria for paper inclusion. Including only papers with known terms in the training data would have undermined the objective of identifying papers that utilize terminology outside of our current awareness.

Second, titles and abstracts of all 3,200 manually screened papers were transformed into numerical vectors using different language models for text embeddings. By doing so, the meaning of the text can be captured: The embedding vectors are close together if the texts (i.e., titles/abstracts of the studies) have similar meanings (Pilehvar & Camacho-Collados,

2020). Next, these vectors are used to train machine learning classifiers. We evaluated the performance of nine models (three embedding models, each combined with logistic regression, random forest, or extreme gradient boosting) on two test sets. The two main performance measures were precision (the number of true positives divided by the sum of true positives and false positives) and recall (the number of true positives divided by the sum of true positives and false negatives). To ensure that our dataset includes eligible papers, we favored precision over recall. This means that we prioritized minimizing false positives (i.e., incorrectly including irrelevant papers) over maximizing true positives (i.e., including all relevant papers), as the former can lead to noisy and inaccurate results. The trained models are provided in `ESM/trained_models`.

Third, the best performing model was used to classify unseen papers exported from three databases, i.e., the psychology-specific PsycInfo (produced by the American Psychological Association, APA) and PSYNDEX (produced by Leibniz Institute for Psychology, ZPID, Germany), and the interdisciplinary and freely accessible OpenAlex database (maintained by the nonprofit organization OurResearch.org), which has literature coverage comparable to Web of Science and Scopus (Culbert et al., 2024). After the exclusion of papers for formal reasons (e.g., preprints or no metadata available), all papers included by the classifier and the manually screened inclusions of the training data are combined for the final dataset. All databases were queried in March 2024.

As the papers in our final dataset came from different sources, we retrieved standardized metadata and citation information via the OpenAlex API in June 2024. As a proxy for impact outside academia, we analyzed altmetric attention. It is important to note that altmetric attention does not equal impact (Sugimoto, 2015). Nonetheless, in the field of translational medicine, Llewellyn and Nehl (2022) found that altmetric attention can serve as an indicator of potential impact and translational advancement. Unfortunately, at time of

metadata retrieval Twitter had changed its research access policies and prohibited the retrieval of altmetrics. However, we were able to collect altmetrics data for the 674 papers included in our screened dataset (Step 1) prior to this policy change, by the end of 2022. Hence, we present altmetrics for this subset. In addition to the metadata retrieved from OpenAlex, we collected “Methodology” and “APA PsycInfo Classification Code” (APA, 2024) from PsycInfo and PSYNDEX. The classification codes were used to assign publications to subfields of psychology.

Analytical Procedures

Regarding RQ1 (bibliometric mapping), all frequency analyses (publication volume, journals, regional differences, subfields of psychological science, study method) were carried out in the R programming language (R Core Team, 2023) and with the package *bibliometrix* (Aria & Cuccurullo, 2017). For network analysis, we used the free VOSviewer tool version 1.6.20 (van Eck & Waltmann, 2010) with default settings for network layout and clustering. VOSviewer allows for the construction and visualization of bibliometric networks. We analyzed three types of networks to address RQ2 (strengths and weaknesses):

First, we created a co-authorship network aggregated at the institutional level. In this way, the network reveals institutes that are both well connected (i.e., many collaborations) and impactful (i.e., large number of citations in our dataset). Second, we created a term co-occurrence network to get an overview of the publications’ contents. Specifically, we were interested in whether the term “translational” was rather central in the network and well connected to other terms (i.e., it frequently co-occurs with terms from different research areas), or whether “translational” only co-occurred within a specific semantic space. Third, we inspected publication similarity using bibliographic coupling (Kessler, 1963): Two publications are coupled if they both cite a third reference. The more common citations two publications have, the higher the probability that both address the same subject. We utilized

this approach to determine whether research on translational psychological treatment has a more homogeneous structure or is published in fragmented strands of literature.

Results

Automated Paper Identification

The best-performing model resulted from combining multilingual E5 embeddings (Wang et al., 2024) with a random forest classifier (Breiman, 2001), yielding a final dataset of 7,146 publications. In the first test set, this combination achieved a precision of .90 and a recall of .51, indicating a strong ability to accurately identify true positives (i.e., correctly included papers). Meanwhile, in the second test set, the model demonstrated a precision of .85 and a recall of .31, showcasing its robustness across different datasets (see Figure 2). A manual inspection of false positives revealed that most of these papers were related to translational research but did not meet our inclusion criteria. Given our goal of providing a general overview of the research field's structure, an estimated 10-15% of such false positives is considered acceptable. On the downside, it is fair to say that the number of false negatives (i.e., missed relevant papers) is rather high (1-recall = estimated 49% to 69% based on the test sets).

However, the baseline for our identification approach is a conventional literature search using database queries, the standard approach in bibliometrics (Donthu et al., 2021; Öztürk et al., 2024). Notably, our database search for “translational” in Step 1 yielded 1,847 records, of which 286 were relevant (see “Step 1_Screening” and Figure S1 in ESM/method_details). This equals a precision of .16. The literature search yielded 286 relevant papers, comprising only 4.7% of the total dataset volume, assuming a conservative estimate of 15% false positives. This translates to a recall rate of .05 for the search query approach, highlighting the challenges of identifying publications related to translational psychological treatment using search terms. Against this baseline, our approach of using text

embeddings and machine learning classifiers turned out to be superior to common literature search queries in bibliometrics.

Mapping the Landscape

The year of publication of the 7,146 publications in the dataset ranged from 1974 to 2024. The total publication volume by year is shown in Figure 3. The compound annual growth rate is 5.23%. The peak in 2018 can be explained by two special issues released in that year (Milton & Holmes, 2018; Stice & Jansen, 2018). The most common publication outlets for translational psychotherapy research are shown in Figure 4. *Behavior Research and Therapy* published 5.49% of the 7,146 publications in the corpus, followed by *Behavior Therapy* (2.62%) and the *Journal of Consulting and Clinical Psychology* (2.48%).

With regard to regional differences, Figure 5 shows the ten most productive countries. Most studies were published by authors from the United States (43.32%), followed by the United Kingdom (11.77%), Australia (6.07%), and Germany (5.98%). Among the top ten countries, Belgium has the largest share of multiple-country publications (70.73% of the studies by Belgian authors), while most studies by authors from the United States are single-country publications (83.73%). Overall, the average proportion of multiple-country collaborations is 50.89%, and 40.11% for the ten most productive countries.

The publication volume shares of the basic psychological subfields are depicted in Figure 6. Physiological psychology and neuroscience (4.11%), experimental psychology (2.25%), and personality psychology (1.44%) are the basic subfields from which knowledge is most often translated into psychological interventions. We manually checked a sample of respective studies (i.e., the screened dataset of Step 1) to confirm this direction of translation. A full table for all subfields of psychology can be found in ESM_additional_tables, showing that “physiological psychology and neuroscience” is also the overall most frequent subfield in

the dataset (besides clinical psychology). Regarding methodology, the majority of publications were quantitative studies (55.77%).

Strengths and Weaknesses

Research Impact and Collaborations

In order to examine the strengths and weaknesses of research on translational psychological treatment from a bibliometric perspective, we first examined the citation impact (with citation data from June 2024). Please note that we did not assess study quality, as its relation to citations is a controversial topic (see Pontika et al., 2022). As shown in Table 1, papers on translational psychological treatment were most frequently cited by scientific articles within clinical psychology and treatment research (median = 9 citations). However, 60.96% of the publications were cited at least once outside of psychology (median = 1), e.g., in medicine ($M = 4.26$ citations, $SD = 34.72$, $max = 2,602$), computer science ($M = 1.26$ citations, $SD = 7.25$, $max = 434$), and political science ($M = 0.45$ citations, $SD = 2.47$, $max = 129$). According to altmetrics, 13.97% of the 674 publications with available data (December 2022) were mentioned at least once in news outlets and 64.70% were mentioned at least once in tweets. The majority of tweets were posted by members of the public (81.09% of all tweets related to publications in the dataset).

The total citation impact and the collaboration patterns of involved institutes are shown in Figure 7: The larger the font size, the more citations of an institute (when correcting for the year of their publications). The highest (normalized for year) citation impact was observed for the University of Oxford (301.47 normalized citations; 20,166 total citations), followed by Boston University (262.10 normalized citations; 17,111 total citations) and KU Leuven (221.53 normalized citations; 9,918 citations).

As illustrated in Figure 7, the USA and Germany form two relatively large and separated clusters. While this indicates that in single country publications, many institutes of

these countries are involved, institutions from the USA exhibit fewer connections outside their cluster compared to Germany. This is consistent with the high proportion of single-country publications from the USA shown in Figure 5. The color scheme in Figure 7 represents the average publication year of each institution, highlighting that translational psychological treatment is a relatively recent research focus in the German cluster, although some exceptions exist.

The highest number of unique collaborations (i.e., *degree centrality* = the number of links in the network) was found for the Harvard University ($n = 172$), followed by King's College, London ($n = 151$). These two also had the highest betweenness centrality: By dividing the number of shortest paths that pass through an institute by the total number of shortest paths, high values of betweenness centrality indicate institutes that connect subnetworks. The institutes with the highest number of publications in the dataset are Boston University ($n = 148$), Harvard University ($n = 130$), University of Oxford ($n = 127$), and King's College London ($n = 126$) close behind. A full table for all institutes in Figure 7 is provided in the ESM/additional_tables.

Terminology

Figure 8 shows a term co-occurrence network as a clustered density plot: terms that frequently appear together in titles and abstracts of publications are located next to each other and in the same cluster (the colored clouds). The most frequent and connected terms are printed in larger font and positioned in the center of the network. The terms “translational research” and “translation” are located at the top right of the network. This indicates that they do not co-occur frequently with other terms in the network, which means they are not commonly used in studies on translational psychological treatment. In fact, only 287 (4.02%) of the 7,146 publications use the term “translational” in title, abstract or keywords. The

related terms “basic science” or “basic research” appear in 125 (1.75%) titles/abstracts/keywords of the publications.

Regarding the clusters in the network, “translational research” and “translation” are located on the border between the blue cluster and the red cluster. While the latter is composed of rather generic terms in psychotherapy research, the blue cluster refers to psychological and neuroscientific studies on fear treatment. This indicates that the term “translational research” is more common in this field of research. Indeed, a closer inspection of the journals that published the 287 papers that use “translational” in title or abstract revealed the *Journal of Behavior Analysis* ($n = 13$ of these 285 papers; 4.56%) and *Biological Psychiatry* ($n = 12$; 4.21%) as the most frequent outlets. Besides fear, posttraumatic stress (PTSD) and anxiety appear as the most frequent disorders. This is underscored by an analysis of the overall frequency of terms in the corpus, yielding 25,650 occurrences of terms related to anxiety disorders (“fear”, “ptsd”, “trauma”, “anxiety”), 7,390 related to affective disorders (“affective”, “depress”, “bipolar”, “manic”), and 1,052 related to psychotic disorders (“schizophrenic”, “psychotic”, “psychosis”).

Publication Similarity

Using bibliographic coupling, we inspected the similarity of the papers in our dataset. This helps to identify clusters of articles, which can represent conceptual common ground or thematic areas of research. On the contrary, a lack of connections between these clusters may indicate a lack of communication, collaboration, or knowledge transfer. In our case, we did not find distinct insular clusters in the network. This means that the research areas in our dataset are interconnected, suggesting a certain level of knowledge diffusion and collaboration among researchers across different thematic areas (see Figure S2 in ESM/figures).

Discussion

The aim of this study was to bibliometrically map the research field of translational psychological treatment in order to identify its strengths and weaknesses. The main challenge that we encountered was at the very beginning of this study project: the collection of eligible publications. Studies that translated knowledge from basic psychological science to psychological treatments could not be reliably identified in literature databases when searching for “translational”. Therefore, we presented a workflow that leverages machine learning to find relevant publications. In the end, our dataset comprised 7,146 studies that we analyzed using bibliometric and network analytic methods. There were five main findings:

1. Machine learning proved valuable for generating an open bibliographic dataset for translational psychological treatment

Our classification approach based on natural language processing and machine learning demonstrated superior performance compared to conventional literature searches, achieving higher precision and recall. Notably, it leverages open-source software, rendering it adaptable to various paper identification scenarios where traditional search methods fall short (see ESM/trained_models). Although our approach yielded a relatively low recall (i.e., not all papers related to translational psychological treatment were captured), this limitation is largely attributed to the challenging starting point of heterogeneous terminology. The translational nature of certain papers often only becomes apparent after full-text screening, which poses a fundamental constraint on automated classification based on title and abstract alone. We provide our dataset of translational psychological treatment publications, along with metadata, as open data via

[https://drive.google.com/file/d/1fwU_1fQOyg_b3nQMbHGfCg-gH4pRSfX/; final

repository link after review]. The dataset can be used to reproduce our results or for further research.

2. Translation comes primarily from physiological psychology/neuroscience, with a focus on fear, posttraumatic stress, and anxiety

Regarding basic psychological subfields, most studies in our dataset were labeled by PsycInfo or PSYNDEX as “physiological psychology and neuroscience”, indicating that this is the subfield where translation into psychological treatments occurs most frequently (see Figure 6). A dominance of physiological and neuroscientific research input was also found by Krampen and Perrez (2015) for the German-speaking countries. This is in line with the recent high prevalence of neuroscientific topics in psychological treatment research and clinical psychology (Gennaro et al., 2019; Richter et al., 2021). Moreover, the term co-occurrence network in Figure 8 and term frequency analysis revealed that the treatment of fear, posttraumatic stress, and anxiety disorders is a very common topic in the dataset. Many articles on this topic have a strong focus on the underlying physiological and neuroscientific processes (e.g., Kindt, 2018; Milad et al., 2014).

3. Translational psychotherapy research is characterized by international collaborations

About half of the papers in our dataset were the result of international collaborations. In recent years, international research collaboration has grown steadily in general science (e.g., Hsiehchen et al., 2018) as well as in psychology (Coccia & Bozeman, 2016; Kliegl & Bates, 2011). In psychotherapy research, international collaborations with samples from different countries promise cross-cultural insights and greater generalizability of findings (e.g., Orlinsky et al., 1999). At a more abstract level, one of the benefits of international collaborations may be higher quality and more impactful research projects. Recent studies indicate that the level of economic development of the collaborating countries has a positive impact on the quality of the internationally co-authored journal articles (Thelwall et al., 2022). A closer look at the top ten countries in translational psychotherapy research reveals

that all these countries show “very high human development” according to the Human Development Index (Human Development Reports, n.d.). Collaborations led by authors from developed countries were also found to have a positive effect on citation impact, potentially attributable to disparities in national research funding (Zhou et al., 2020). This might indicate that the research field of translational psychological treatment is not only well connected internationally, but also of high quality and impact. While study quality was outside the scope of this study and remains to be examined, the impact is discussed in the next section.

The analysis of collaboration networks (see Figure 7) revealed the USA and Europe as two relatively large and separated clusters, indicating that in case of single country publications, many institutes from these countries are involved. However, the total share of single country publications is significantly larger in the USA than in Germany (see Figure 5). Regarding the mean publication year, German institutes have only relatively recently begun to publish on translational psychological treatment, but with notable output.

The delay in translational psychotherapy research in Germany may be explained by the historical proximity and integration of psychological treatment into the disease model of medicine, the demarcation/delimitation of basic and applied disciplines in psychology, and the dominance of neurobiological research, which complicates the translation from basic psychological disciplines (e.g., Grawe, 2004b; Kanning et al., 2007; Wampold, 2001). In German-speaking countries, however, the call for psychological treatment to relate to basic research is associated with Klaus Grawe. In the 1990s, Grawe outlined a "general psychotherapy" (Grawe, 2004a) that is no longer oriented towards treatment theories of traditional schools with weak empirical evidence, but to the current state of scientific psychology (Lutz et al., 2021). The establishment of outpatient clinics at universities in Germany in the course of the Psychotherapists Act of 1999 was the first step towards creating the required structures for comprehensive psychological treatment research (Fydrich &

Unger, 2013). However, in Germany, the basic position of deriving psychological treatment research from psychology as the "parent science" (Wittchen & Rief, 2015) was only recently confirmed by the Science Council in 2018 (Wissenschaftsrat, 2018).

4. Translational psychotherapy research has impact – beyond clinical psychology and beyond academia

We analyzed the impact of translational psychotherapy research within academia in terms of citations. The mean number of citations for the studies in our dataset was 58.51, although the distribution was heavily skewed by some high-impact publications (max = 6,123). Nevertheless, even the median of 18 citations is comparable to the mean for translational medicine ($M = 20.35$) and general clinical psychology and psychological treatment research ($M = 18.91$)¹. Thus, even after correcting for extreme cases with high citations, translational psychotherapy research has a comparably high citation impact.

Not surprisingly, translational research was most often cited within the field of clinical psychology and psychological treatment. However, we found that 60.95% of the publications were cited at least once outside of psychology. This was most often the case in the fields of medicine, computer science, and political science. While medicine has an expected overlap with psychological treatment (e.g., psychiatry), the reception in computer science seems surprising. This could be explained by the interest and recent developments in artificial intelligence, focusing on the development of artificial neural networks that mimic human behavior (van de Ven et al., 2020), measurement tools based on psychological constructs (Xiao et al., 2016), and online or virtual platforms for therapy and healthcare (Langrial et al., 2014). The field of political science seems to be interested in political

¹ We queried www.LENS.org in February 2023 for the same period of publication years and document types as described in the methods section, and OpenAlex fields of study "Clinical Psychology / Psychotherapist" and "Translational Medicine" (see ESM/method_details for full search queries).

information processing as a general theoretical framework for conceptualizing the cognitive processes that underlie the use of information to make political judgments (Wyer & Ottati, 1993) or more recently in the intersection between psychology, human rights and politics (e.g. how fear and hope shaped the universal declaration of human rights, Black & Cooper, 2020) or issues related to governance interventions for climate change adaptation (Termeer et al., 2016).

As a proxy for impact outside academia, we inspected mentions on Twitter and in news outlets. Elon Musk's 2022 acquisition of Twitter led to a revised research access policy, which curtailed our collection of Twitter-based altmetrics. However, we were able to analyze the subset of 674 translational papers that were included in our training data. Most Twitter mentions were made by members from the public. As researchers tend to use Twitter for promoting their research findings or share interesting publications with their peers (e.g., Côté & Darling, 2018), one would expect them to mention translational psychotherapy research the most. In part, this can be explained by research articles with topics that attract the attention of a wide audience. By far the most Twitter mentions by members of the public (8,252 mentions of James et al., 2015) and in the news (95 mentions of Iyadurai et al., 2018) related to research on the reducing effects of computer games on intrusive memories. Video gaming – and especially its effects on psychological properties and social behavior – has been a controversial topic in recent years (see Greitemeyer, 2022) and has thus received a lot of attention. However, there are other topics of public interest on Twitter that are addressed in translational psychotherapy research, such as exposure therapy augmentation (Weisman & Rodebaugh, 2018; 90 mentions), process-based therapy (Hayes & Hofmann, 2017; 71 mentions), or MDMA-assisted psychological treatment for PTSD (Feduccia & Mithoefer, 2018; 55 mentions).

5. The lack of standardized terminology hampers findability which might hinder scientific progress

The ideal research cycle begins with a review of the current state of knowledge by finding and reading the literature. In the case of translational psychological treatment, this is a particularly challenging task: the lack of a standardized terminology makes it difficult to formulate search queries, which in turn hampers findability. In the current study, a term co-occurrence network (see Figure 8) revealed that the terms “translational” and “basic science/research” are not very common in translational psychotherapy research, at least in titles and abstracts. Furthermore, these terms are not well connected in the term network, i.e., many studies of translational research in psychological treatment use different descriptions (e.g., process-based) or no explicit label at all. The phrase “translational research” was most associated with psychological and neuroscientific studies on the treatment of fear. This was in particular the case for behavior analysis, which means that this area of research is overrepresented when performing a literature search using the term “translational”. The co-occurrence network did not reveal any commonly used and translation-related terms.

In conclusion, translational psychotherapy research needs to employ a consistent terminology to improve the identification of relevant research outputs. Without a common terminology, researchers may not be aware of models and approaches already discussed in the literature and may “reinvent the wheel”. Inconsistent terminology can further affect research synthesis, communication within and outside the field, collaborations, and the translation of research findings in diverse settings (Colquhoun et al., 2014).

Inconsistent terminology and the need for a common nomenclature are not specific to translational psychological treatment. Haeny et al. (2021) report the same issue in the field of anti-racist clinical research. The authors argue that “using a shared nomenclature will result in more effective and equitable health care” (ibid., p. 891). In the context of Internet-

delivered interventions, Smoktunowicz et al. (2020) emphasize the negative effects of inconsistent terminology on the communication between researchers, students, clinicians, the general public, the media, and policy makers. They propose a common glossary and list three factors for its successful dissemination: 1) influential researchers adopting and using the terms, 2) recommendation of terms by publication outlets, and 3) establishing a single information source for reference. The APA's *Thesaurus of Psychological Index Terms* (Tuleya, 2007) could be such an information source, and the addition of the term "translational research" seems desirable. Nevertheless, even the use of "translational research" as an author keyword would significantly improve findability. In any case, the research community of translational psychological treatment needs to agree on common terms and adhere to a consistent labeling of their studies, and influential researchers and journals could take the lead in that matter.

Note that the issue of inconsistent terminology can also be addressed through ontological approaches. For example, in the behavioral and social sciences, Michie and colleagues (Davis et al., 2015) argue that interventions for health-related behaviors should be more effective if they are grounded in appropriate theories. However, the use of different terminology across the plethora of relevant theories makes it difficult to synthesize evidence and knowledge across these theories. Accordingly, the authors suggest representing theories in ontologies that can serve as hubs for evidence aggregation (Hastings et al., 2020). The *Behaviour Change Intervention Ontology*, in particular, helps researchers to accurately specify key constructs in their studies and papers (for more information, see BCIO; <https://www.bciontology.org/>). A similar approach could be taken in the area of translational research, so that the term 'translational research' is defined as a key construct and used by researchers in this particular area of research to facilitate bibliographic retrieval.

At the same time, however, the establishment of nomenclature and ontology within the behavioral sciences comes with significant challenges (Sharp et al., 2023). For example, many established constructs within the discipline have yet to be precisely defined, which can lead to 'jingle-jangle fallacies'. The jingle fallacy describes the wrongful assumption that two (different) constructs with similar names are indeed the same (Thorndike, 1904), while the jangle fallacy describes the wrongful assumption that two (almost identical) constructs with different names are indeed different (Kelley, 1927). This can hinder scientific progress in the field. For example, imprecise definitions of constructs can lead to problems in operationalization (e.g. of psychological treatments) and replication of findings under different conditions. Ideally, ontologies are not static and not enforced top-down but rather dynamic and designed to facilitate communication (Sharp et al., 2023). In the field of translational research, there is yet no single conceptual model of translational psychological treatments that is used consistently by researchers.

Limitations and future research

A first limitation of the current study is its reliance on database metadata – without analyzing full texts. For future studies, the automated retrieval and integration of full texts into the paper identification workflow might be promising to increase the number of correctly identified papers. Ideally, full texts could be collected via DOI and screened by the machine learning classifier. More desirable, however, would be a standardized terminology for finding publications with concise search queries – thus making research on translational psychological treatment more accessible (see Andrews et al., 2016).

A second limitation refers to the limited insights on *content* level. The goal of our bibliometric analysis is to provide an overview at the level of publication processes. This aims at an assessment of the *structure* and impact of the research field. An analysis of the content of publications (via literature review) would be the next step to delve deeper into the

research landscape. This would help to untangle different stages, methodologies, and designs in studies on translational psychological treatment and may empirically inform the development or testing of a conceptual model of translation (see Ehring et al., 2022).

A third limitation lies in the coarse granularity of database metadata, which hinders the accurate identification of basic research. While the APA classification system for psychology literature (APA, 2024) offers a comprehensive topical scope, allowing for the categorization of papers into basic and applied subfields such as experimental psychology or clinical psychology, it has its drawbacks. Notably, the system struggles to reliably distinguish basic research within clinical psychology from applied or evaluative research. Furthermore, our keyword analysis revealed that the terms "basic research" or "basic science" are employed in fewer than 2% of the studies. To overcome this limitation, a targeted literature review focusing on the content of publications is necessary to gain a deeper understanding of the areas of basic research involved in translational psychological treatment.

Conclusion

The importance and visibility of translational psychotherapy research may be increased by addressing it as an exchange between different research areas in psychology and using standardized terminology and common nomenclature – or at least a common keyword for better visibility and findability of studies. Currently, machine learning-assisted literature screening and classification appears to be the only way to discover the research landscape. The open publication dataset provided in this study can be the starting point for future in-depth analyses such as a literature review or empirically informed conceptual considerations.

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Table 1

Citations and Mentions

	Citations*				Twitter Mentions**				News Mentions	
	all	Clinical Psychology & Psychological Treatment	Psychology	Non-Psychology	all	research scientists	science communicators	practitioners	members of the public	
Median	18	9	2	1	2	0	0	0	1	0
M	58.11	34.88	12.07	7.05	20.67	2.07	0.65	1.18	16.76	0.80
SD	186.52	122.09	44.24	47.54	341.99	11.36	10.87	6.79	316.62	5.07
max	6,123	3,737	1,294	3,497	8,901	263	283	122	8,252	95

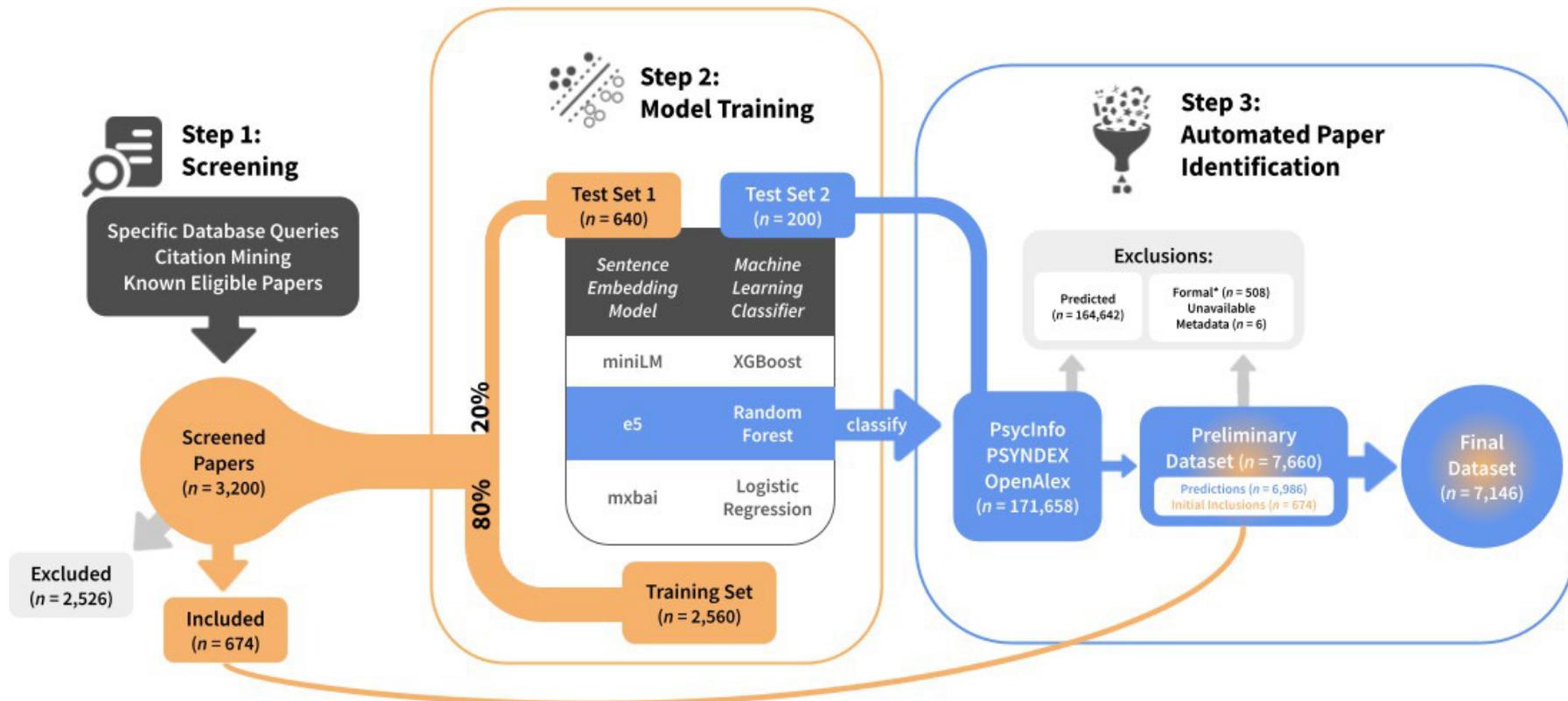
TRANSLATIONAL PSYCHOLOGICAL TREATMENT BIBLIOMETRIC ANALYSIS

Note. *The citations are corrected for authors, i.e., self-citations were removed. A table including self-citations can be found in ESM/additional_tables. For every publication in the dataset, the citing papers were assigned to one of three categories. **The groups of Twitter users are according to altmetrics. Due to changes in Twitter's research access policy during our study, we could only retrieve Twitter and news mentions for a subset of 674 translational papers in December 2022.

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Figure 1

Paper identification workflow

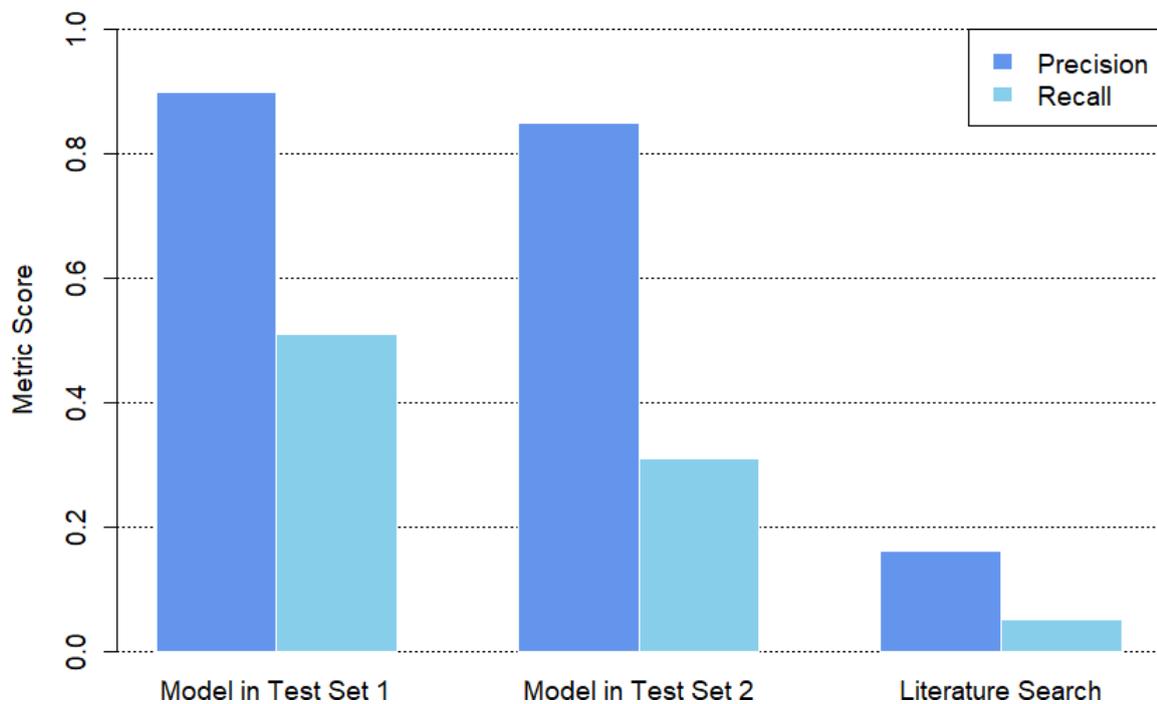


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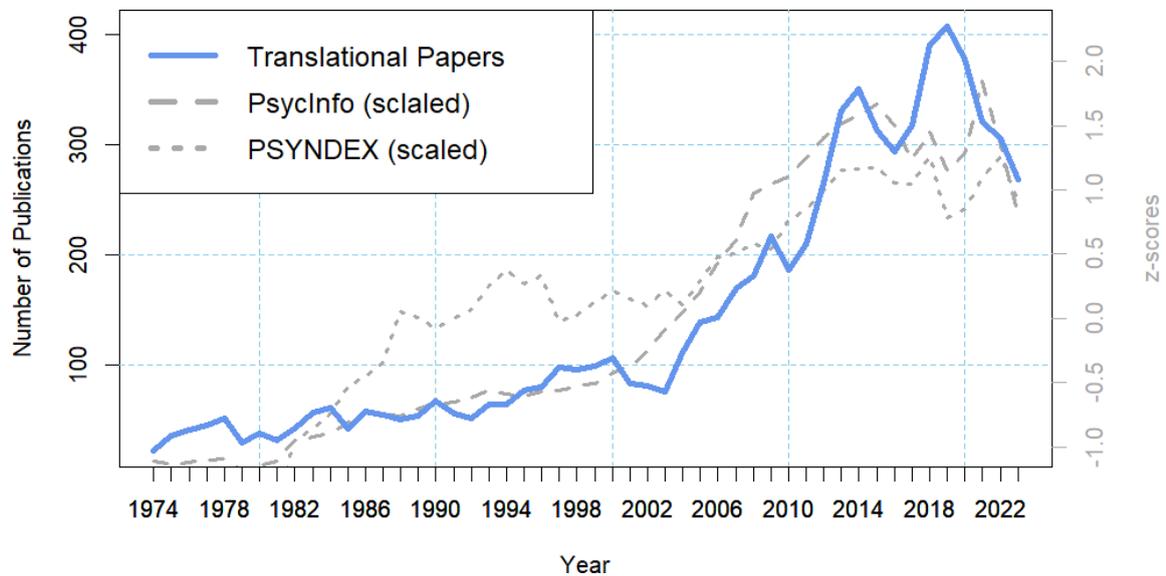
Note. *Formal exclusion are preprints, books, etc. (see inclusion criteria). How to find papers on translational psychological treatment when a database query is either too specific or returns too many irrelevant results? Our paper identification workflow consists of three steps. First, a dataset of relevant and irrelevant papers is created based on known examples and semi-automated screening of a specific search for “translational” and the results of citation mining. In the second step, this screened dataset is used as training data for combinations of sentence embedding models and machine learning classifiers. All resulting nine variants were evaluated on two test sets (held out from the training data vs. completely new). In the third step, the best performing model is used to predict eligible papers in a large pool of database records from three different databases. All details and performance metrics for machine learning and sentence embedding models can be found in the [ESM/method_details](#).

Figure 2

Performance of our best classification model compared to conventional literature search



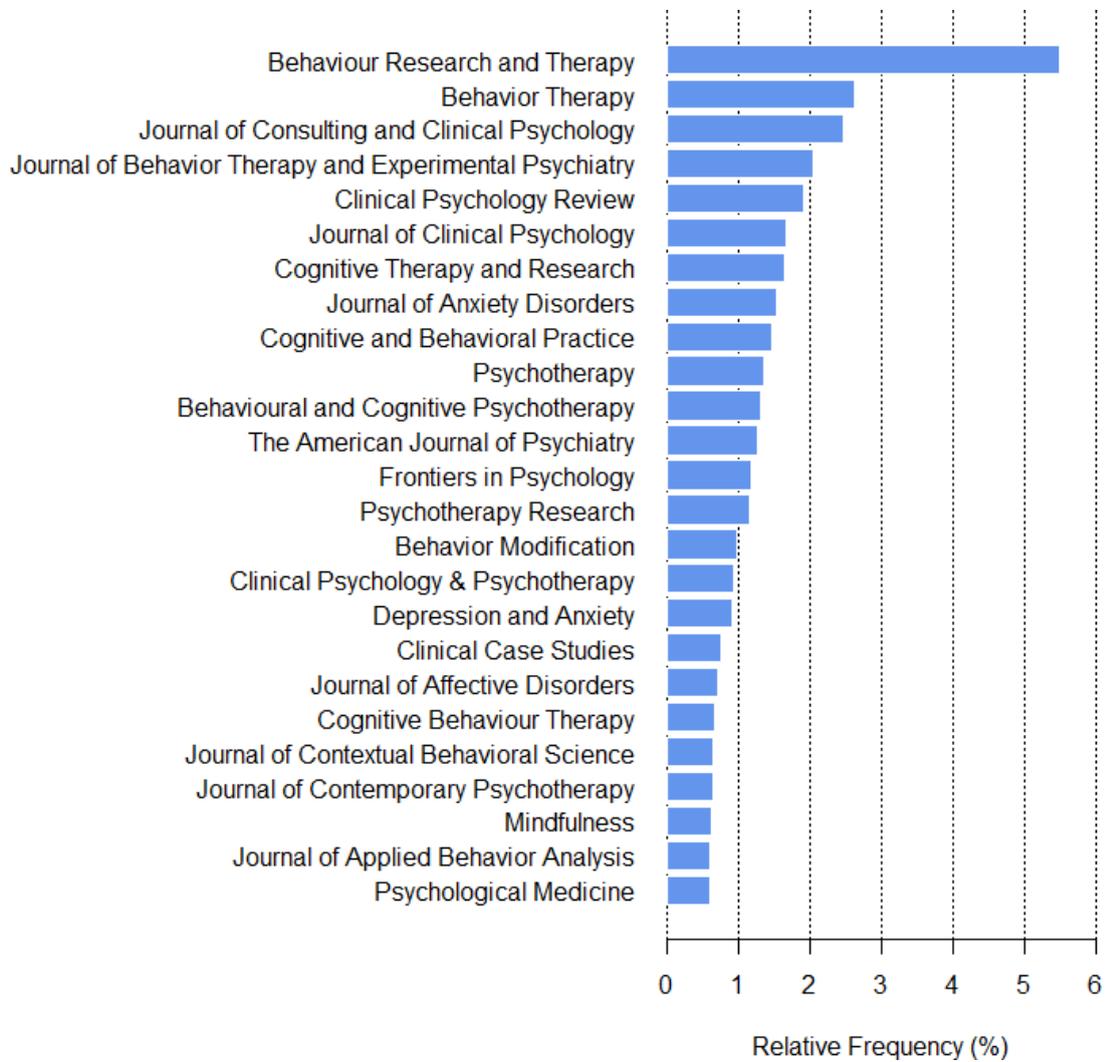
Note. The test sets were constructed as follows. Test Set 1 was deliberately withheld from the dataset generated through semi-automated screening (Step 1 in Figure 1). In contrast, Test Set 2 was randomly selected from database exports that were not utilized in Step 1. Furthermore, the literature search employed the specific term "translational".

Figure 3*Number of publications per year*

Note. To compare the publication volume of all translational papers in our dataset with the general trend in psychology literature, the gray lines depict z-scores of PsycInfo and PSYINDEX publication numbers (gray axis matched with z-scores of translational papers; black line). The correlation between translational publications per year and all database records is $r = .94$ for PsycInfo and $r = .76$ for PSYINDEX. Especially from 2017 to 2020, the increase in translational publication volume is higher than in general psychology literature. This is partly due to the publication of two special issues in 2018.

Figure 4

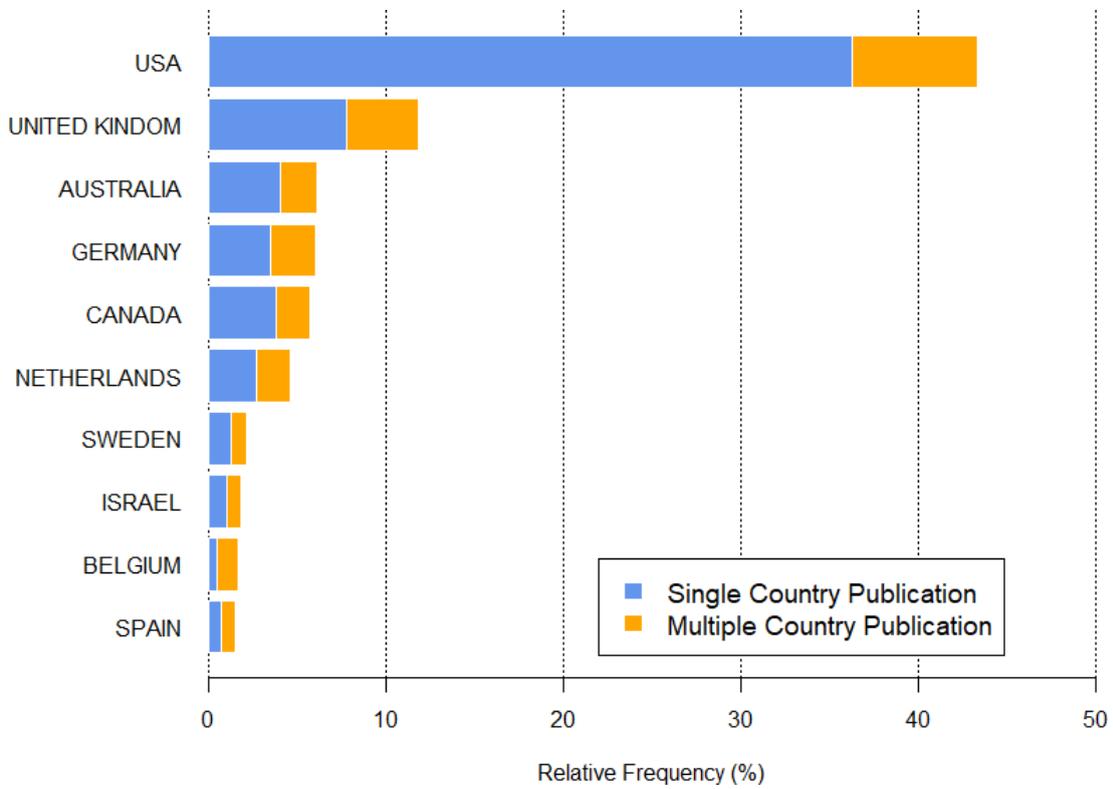
Most common journals



Note. Frequencies relate to the total number of publications in the dataset ($N = 7,146$).

Figure 5

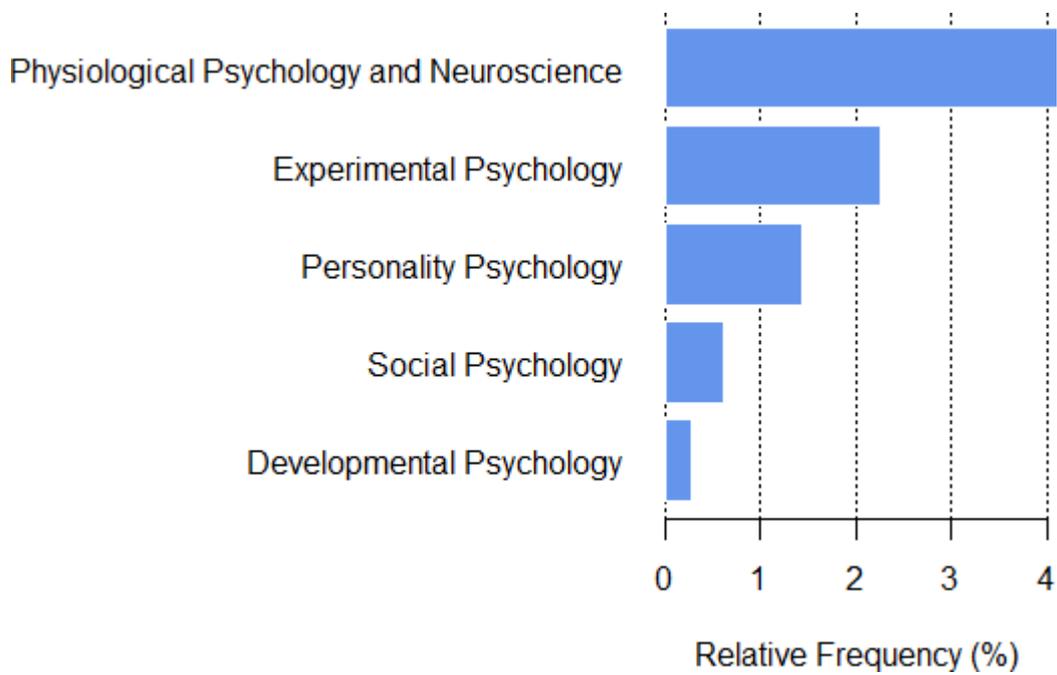
Most productive countries



Note. Frequencies relate to the total number of publications in the dataset ($N = 7,146$).

Figure 6

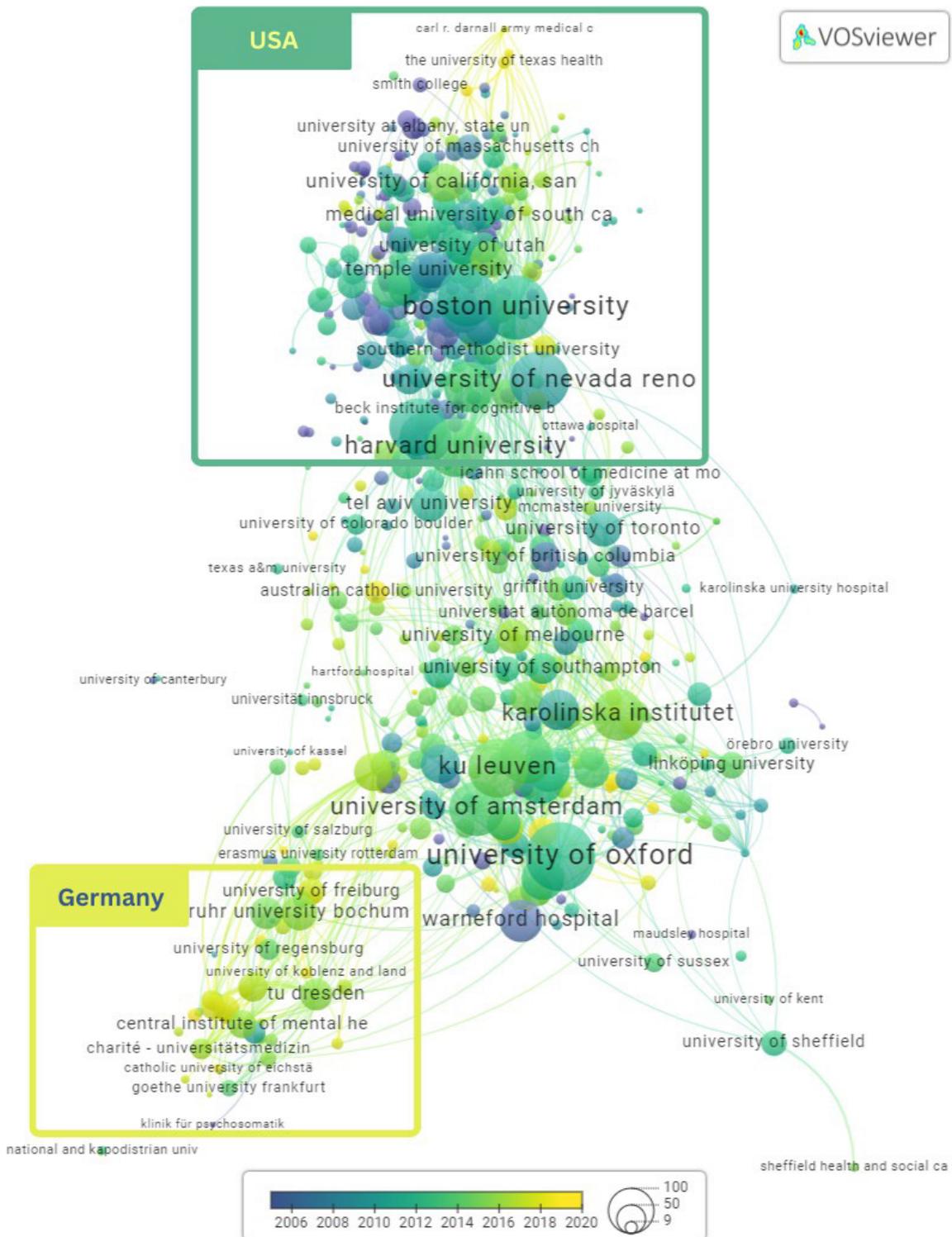
Publication volume shares of the basic psychological subfields



Note. Subfield information was available for 6,234 publications. Relative frequencies for applied subfields are not shown. A full table for all subfields can be found in [ESM/additional_tables](#).

Figure 7

Collaboration network of institutes

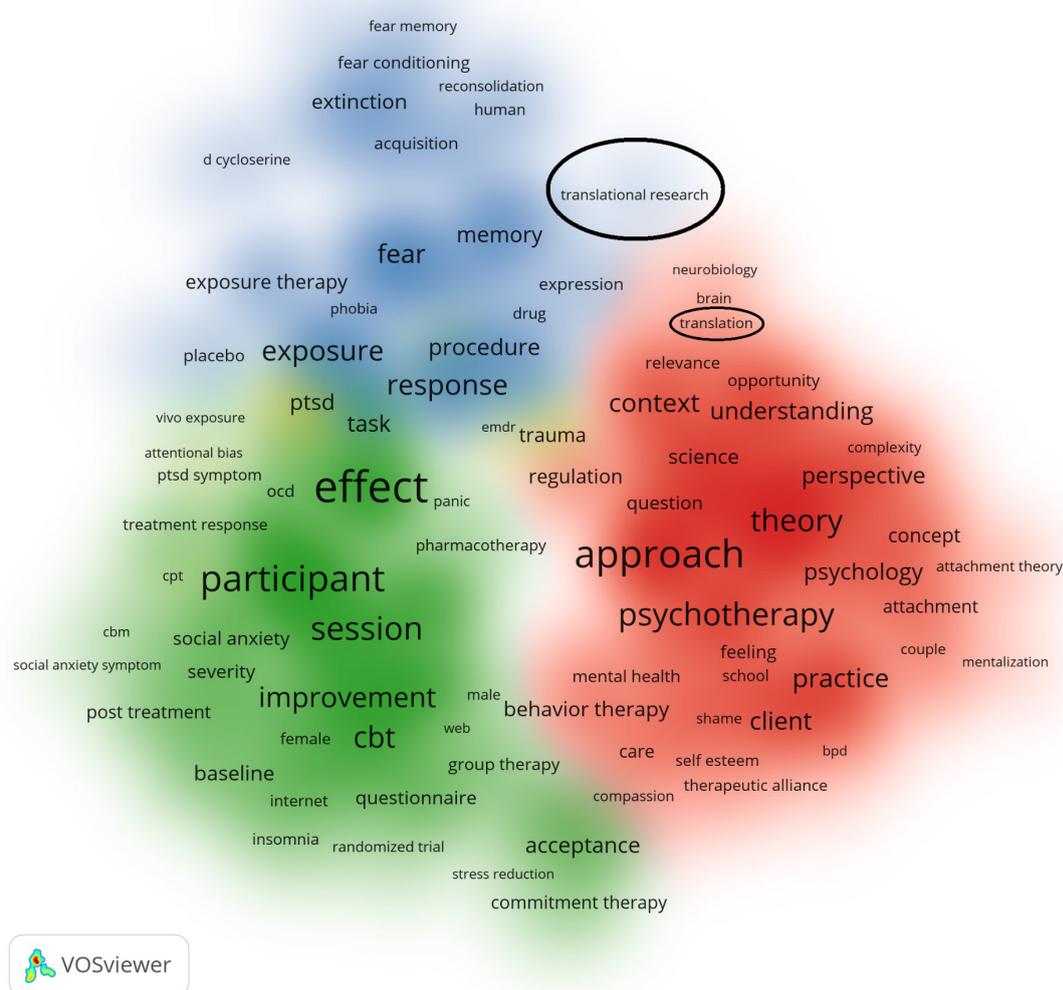


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Note. Font size is proportional to the number of citations of an institute corrected for publication year (normalized to take account for older publications naturally having a longer period to be cited). Connections refer to pairwise co-authorships: The more publications with authors from two institutes, the stronger the connection between these institutes. USA and Germany result as two relatively large and separated clusters, indicating frequent collaboration among different institutes in their countries. The colors refer to an institute's publications average publication year: Yellow indicates institutes that published rather recently on translational psychological treatment (especially German institutes). To improve visibility, only institutes with a minimum of five publications are shown (586 of 2,902 institutes). A table with the number of publications, citations, and number of collaborations by institute is provided in the ESM/additional_tables. An interactive and zoomable version of this network can be accessed via https://t1p.de/collaboration_network .

Figure 8

Term co-occurrence network (density plot), indicating non-standardized terminology



Note. Colors indicate clusters of co-occurring terms. Font size is proportional to term frequency and the location of a term represents its connectedness: Terms that co-occur with many other terms are located in the center (e.g., “effect”, “approach”). Notably, “translational research” and “translation” are located at the top right of the network, indicating that they do not co-occur frequently with other terms in the network. The rather small font indicates that only few publications use these two terms explicitly in title or abstract. An interactive version of this network can be accessed via https://t1p.de/term_network .