Applications and Limitations of LLMs in Psychology

While LLMs facilitate psychological research through literature reviews, hypothesis generation, and data analysis, they are constrained by computational limitations and inability to replicate human psychological constructs.

Abstract

Large language models (LLMs) assist psychological research methods by streamlining literature reviews, supporting hypothesis generation, and aiding experimental design. For example, studies note that LLMs efficiently summarize research and process large volumes of text, facilitating data annotation and analysis. These capabilities extend to contexts such as mental health, psychiatry, and cognitive psychology.

At the same time, challenges remain. Multiple reports indicate that LLMs struggle to replicate human variance and established psychological constructs. They face computational limitations that affect model interpretability and demand significant resources, while reliance on training data of uneven quality also constrains performance. In addition, ethical considerations emerge, with efforts to develop robust guidelines, validation protocols, and integration standards cited as critical for safe application.

Paper search

Using your research question "What are the potential applications and limitations of large language models (LLM) in psychological research methodology?", we searched across over 126 million academic papers from the Semantic Scholar corpus. We retrieved the 50 papers most relevant to the query.

Screening

We screened in papers that met these criteria:

- **Research Focus**: Does the study examine the use or potential applications of LLMs specifically in psychological research methods?
- **Methodological Application**: Does the study evaluate LLMs' performance in psychological data analysis or assessment tasks?
- **Comparative Analysis**: Does the study compare LLMs with traditional psychological research methods OR provide a systematic review/meta-analysis of LLM applications in psychology?
- **Ethical Considerations**: Does the study address ethical considerations relevant to LLM use in psychological research?
- **Psychological Context**: Does the study focus on psychological research applications rather than solely on general AI applications?
- **Study Type**: Is the study an empirical investigation or systematic analysis rather than an opinion piece or commentary?

We considered all screening questions together and made a holistic judgement about whether to screen in each paper.

Data extraction

We asked a large language model to extract each data column below from each paper. We gave the model the extraction instructions shown below for each column.

- **Study Design Type**:

  Identify the type of study design used. Possible categories include:

- Systematic review
- Scoping review
- Narrative review
- Theoretical analysis
- Empirical study

Look in the methods or introduction section. If multiple design elements are present, list all that apply. If the design is not explicitly stated, carefully infer from the study's methodology and approach.

- **Research Approach to LLMs**:

  Describe the primary approach used to examine large language models:

- Theoretical exploration
- Empirical analysis
- Methodological assessment
- Critical review
- Practical application evaluation

Examine the objectives, methods, and conclusions sections to determine the primary approach. If multiple approaches are used, list them in order of prominence.

- **Specific Applications of LLMs**:

  List all specific applications of large language models identified in the study, such as:

- Diagnostic support
- Therapy assistance
- Patient engagement
- Research methodology enhancement
- Text analysis
- Academic writing

Extract from results, discussion, and conclusion sections. Be precise and use the exact terminology from the paper. If an application is mentioned but not fully explored, note this in brackets.

- **Identified Limitations of LLMs**:

  Catalog all limitations of large language models discussed in the study, including:

- Methodological limitations
- Ethical concerns
- Technical constraints
- Bias issues
- Data reliability problems

Prioritize limitations explicitly stated in the discussion or conclusion sections. If limitations are implied but not directly stated, carefully paraphrase the underlying concern. Use direct quotes where possible to capture the nuanced critique.

- **Ethical and Methodological Recommendations**:

  Identify specific recommendations for:

- Ethical use of LLMs
- Methodological improvements
- Risk mitigation strategies
- Future research directions

Extract from conclusion, discussion, or recommendations sections. Distinguish between direct recommendations and suggested potential improvements. If recommendations are implicit, carefully interpret the authors' suggestions.

Results

Characteristics of Included Studies

Study Focus	Methodology Type	Research Context	Key Findings	Full text retrieved
Limitations and potential of Large Language Models (LLMs) in psychological research	Theoretical analysis and Empirical study	General psychological research	LLMs show potential in task automation and text annotation but have limitations in replicating human variance and established nomological networks	Yes
Applications and limitations of LLMs in psychology	Theoretical analysis	General psychological research	LLMs have potential in psychological measurement, experimentation, and practice, but are not yet ready for transformative applications	Yes
Use of LLMs in mental health	Systematic review	Mental health research and practice	LLMs show effectiveness in detecting mental health issues but have limitations in clinical use due to ethical and technical concerns	Yes

Study Focus	Methodology Type	Research Context	Key Findings	Full text retrieved
Applications of LLMs in mental health	Systematic review	Mental health research and practice	LLMs demonstrate potential in early screening and digital interventions but face challenges in accuracy, reliability, and ethical considerations	No
Applications and challenges of LLMs in mental health care	Scoping review	Mental health care	LLMs show promise in various mental health care applications but face challenges in data quality, bias, and ethical considerations	Yes
Utility of LLMs in psychiatric research	Narrative review	Psychiatric research	LLMs have potential in enhancing psychiatric research processes but require careful oversight and validation	No
Applications of LLMs in psychiatry	Systematic review	Psychiatry	LLMs show diverse applications in psychiatry but have limitations in complex case management and high-risk scenarios	Yes
Impact of LLMs on psychological sciences	Systematic review	Cognitive psychology	LLMs demonstrate impressive performance in cognitive tasks but have limitations in causal cognition and planning	Yes

Study Focus	Methodology Type	Research Context	Key Findings	Full text retrieved
Potential of LLMs in behavioral healthcare	Theoretical analysis	Psychotherapy	LLMs have potential to support psychotherapy but require careful development and evaluation to address ethical and clinical concerns	Yes
Opportunities and challenges of LLMs in psychiatry	Narrative review	Psychiatry	LLMs offer opportunities in psychiatric applications but face challenges related to biases, explainability, and privacy	No

The review identified 10 papers focusing on various aspects of Large Language Models (LLMs) in psychology and related fields, including both primary studies and reviews.

Study focus varied widely, with no single focus appearing in more than one study. Topics included limitations and potential, applications, challenges, utility, impact, and opportunities of LLMs in psychological and psychiatric contexts.

Regarding methodology:

- The review identified 4 systematic reviews
- The review identified 2 narrative reviews
- The review identified 2 theoretical analyses
- The review identified 1 scoping review
- The review identified 1 study combining theoretical analysis and empirical study

Research contexts included:

- Mental health (3 studies)
- General psychological research (2 studies)
- Psychiatry (2 studies)
- The review identified one study each in psychiatric research, cognitive psychology, and psychotherapy

The included studies reported on applications of LLMs in psychology or closely related fields, with varying emphases on potential benefits, limitations, and challenges according to their abstracts or full texts.

Thematic Analysis

LLM Applications in Psychological Research Methods

Theme	Key Findings	Supporting Evidence	Implementation Challenges
Research Design Support	LLMs can assist in literature review, hypothesis generation, and experimental design	Sartori and Orrú (2023) report LLMs' ability to summarize literature and generate hypotheses; Hua et al. (2025) discuss LLMs' potential in study design	Ensuring the reliability and validity of LLM-generated research designs; potential for bias in literature selection
Data Analysis Applications	LLMs show promise in text analysis and processing large amounts of data	Abdurahman et al. (2024) highlight LLMs' potential in text annotation; Guo et al. (2024) mention LLMs' effectiveness in analyzing mental health-related text	Addressing potential biases in data analysis; ensuring transparency and reproducibility of LLM-based analyses
Literature Review Enhancement	LLMs can efficiently summarize and synthesize large volumes of research	Sartori and Orrú (2023) discuss LLMs' ability to enhance literature review processes; Hua et al. (2025) mention LLMs' utility in literature review	Ensuring comprehensive coverage and avoiding bias in literature selection; validating the accuracy of LLM-generated summaries

The review identified three main themes related to the application of Large Language Models (LLMs) in research methods:

1. Research Design Support
2. Data Analysis Applications
3. Literature Review Enhancement

Key findings across these themes include:

- Two of the three themes reported that LLMs can assist with literature review
- LLMs show potential in hypothesis generation and experimental design
- LLMs demonstrate capabilities in text analysis and processing large amounts of data
- LLMs can efficiently summarize and synthesize research

The review found supporting evidence from a total of 6 cited studies across the three themes.

Implementation challenges were identified for each theme:

- Bias was the most frequently mentioned challenge (3/3 themes)
- Other challenges include:
  - Ensuring reliability and validity of LLM-generated research designs
  - Maintaining transparency and reproducibility in LLM-based analyses
  - Ensuring comprehensive coverage in literature reviews

– Validating the accuracy of LLM-generated summaries

The review did not identify any quantitative measures of LLM performance or effectiveness in these applications from the available abstracts or full texts.

Technical and Methodological Limitations

Theme	Key Findings	Supporting Evidence	Implementation Challenges
Reliability and Validity Issues	LLMs struggle to replicate human variance and established nomological networks	Abdurahman et al. (2024) report on LLMs' limitations in replicating human-like variance; Demszky et al. (2023) discuss LLMs' inability to predict language based on psychological standards	Developing methods to validate LLM outputs against established psychological constructs; ensuring LLMs do not introduce artificial patterns
Computational Challenges	LLMs face issues with interpretability and computational demands	Volkmer et al. (2024) mention concerns about explainability; Hua et al. (2025) note computational demands as a limitation	Balancing the need for complex models with interpretability; addressing resource constraints in research settings
Data Quality Concerns	LLMs are limited by the quality and representativeness of their training data	Guo et al. (2024) highlight the lack of multilingual datasets annotated by experts; Hua et al. (2024) emphasize data availability and reliability issues	Developing high-quality, diverse datasets for training LLMs in psychological contexts; ensuring data privacy and ethical use

The review identified three main themes related to challenges in implementing LLMs for psychological research:

1. Reliability and Validity Issues:

   - Key finding: LLMs struggle to replicate human variance and established nomological networks
   - This finding was supported by evidence from 2 studies
   - Implementation challenge: Developing methods to validate LLM outputs against established psychological constructs

2. Computational Challenges:

   - Key findings: Issues with interpretability and computational demands
   - These findings were supported by evidence from 2 studies

- Implementation challenge: Balancing the need for complex models with interpretability

3. Data Quality Concerns:

- Key finding: LLMs are limited by the quality and representativeness of their training data
- This finding was supported by evidence from 2 studies
- Implementation challenge: Developing high-quality, diverse datasets for training LLMs in psychological contexts

In total, the review found evidence cited from 6 different studies across the three themes. Each theme had one associated implementation challenge.

Implementation Considerations

Theme	Key Findings	Supporting Evidence	Implementation Challenges
Ethical Framework Requirements	Need for comprehensive ethical guidelines for LLM use in psychology	Guo et al. (2024) emphasize the absence of a comprehensive, benchmarked ethical framework; Stade et al. (2024) stress the importance of addressing ethical concerns in LLM development	Developing consensus on ethical standards across diverse psychological applications; balancing innovation with ethical safeguards
Validation Protocols	Necessity of rigorous validation processes for LLM outputs	Omar et al. (2024) suggest the need for prospective, real-world evidence studies; Hua et al. (2025) emphasize the importance of rigorous validation	Establishing standardized validation protocols across different psychological domains; ensuring validation processes keep pace with rapid LLM advancements
Integration Guidelines	Need for clear guidelines on integrating LLMs into existing psychological research and practice	Stade et al. (2024) propose a roadmap for LLM integration in psychotherapy; Volkmer et al. (2024) discuss the need for guidelines in psychiatric applications	Developing flexible yet robust guidelines that can adapt to diverse psychological contexts; ensuring guidelines address both research and clinical applications

The review identified three main themes related to the implementation of LLMs in psychology:

1. Ethical Framework Requirements:

- Key finding: Need for comprehensive ethical guidelines for LLM use in psychology

- Supporting evidence found from 2 studies
- Implementation challenges include developing consensus on ethical standards and balancing innovation with ethical safeguards

2. Validation Protocols:

- Key finding: Necessity of rigorous validation processes for LLM outputs
- Supporting evidence found from 2 studies
- Implementation challenges include establishing standardized validation protocols and ensuring validation processes keep pace with rapid LLM advancements

3. Integration Guidelines:

- Key finding: Need for clear guidelines on integrating LLMs into existing psychological research and practice
- Supporting evidence found from 2 studies
- Implementation challenges include developing flexible yet robust guidelines that can adapt to diverse psychological contexts and ensuring guidelines address both research and clinical applications

The review found a total of 6 supporting studies cited across all themes. Each theme had unique implementation challenges, with a total of 6 distinct challenges identified across the three themes.

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