

Krendl et al. (2008)

If the study has a broad focus and this data extraction focuses on just one component of the study, please specify this here

☒ Not applicable (whole study is focus of data extraction)

Study aim(s) and rationale

Was the study informed by, or linked to, an existing body of empirical and/or theoretical research?

☒ Explicitly stated (please specify)

The study was explicitly linked to existing research on stereotype threat, citing key papers by Steele and Aronson (1995) and Spencer, Steele, and Quinn (1999) that established the stereotype threat effect. It also cites research on potential mechanisms of stereotype threat, including working memory and anxiety.

Do authors report how the study was funded?

☒ Explicitly stated (please specify)

The authors state that support for the research was provided by National Science Foundation Grant SBE-035440, the Dartmouth Brain Imaging Center, and a National Science Foundation Graduate Fellowship to A.C.K.

Study research question(s) and its policy or practice focus

What is/are the topic focus/foci of the study?

The study focuses on the neural mechanisms underlying stereotype threat effects on women's math performance.

What is/are the population focus/foci of the study?

The population focus is female undergraduate students who are highly identified with math.

What is the relevant age group?

☒ 17 - 20

The participants were undergraduate students, so likely in the 17-20 age range.

What is the sex of the population focus/foci?

- ☒ Female only

All participants were female.

What is/are the educational setting(s) of the study?

- ☒ Higher education institution

The study was conducted at Dartmouth College.

In Which country or countries was the study carried out?

- ☒ Explicitly stated (please specify)

The study was carried out in the United States, at Dartmouth College.

Please describe in more detail the specific phenomena, factors, services, or interventions with which the study is concerned

The study examines how stereotype threat affects women's math performance and neural activation patterns. It compares women who are reminded of gender stereotypes about math ability to a control group on math performance and brain activity during math tasks.

What are the study research questions and/or hypotheses?

- ☒ Implicit (please specify)

The study does not explicitly state research questions or hypotheses, but implicitly aims to identify the neural mechanisms associated with stereotype threat effects on women's math performance.

Methods - Design***Which variables or concepts, if any, does the study aim to measure or examine?***

- ☒ Explicitly stated (please specify)

The study explicitly measures math performance (accuracy and reaction time) and neural activation patterns using fMRI.

Study timing

- ☒ Cross-sectional

The study examines participants at one time point, comparing performance and brain activity before and after an experimental manipulation.

If the study is an evaluation, when were measurements of the variable(s) used for outcome made, in relation to the intervention?

- ☒ Before and after

Math performance and brain activity were measured both before and after the stereotype threat manipulation.

Methods - Groups

If comparisons are being made between two or more groups, please specify the basis of any divisions made for making these comparisons.

- ☒ Prospective allocation into more than one group (e.g. allocation to different interventions, or allocation to intervention and control groups)

Participants were randomly assigned to either a stereotype threat condition or a control condition.

How do the groups differ?

- ☒ Explicitly stated (please specify)

The threat group was reminded of gender stereotypes about math ability, while the control group was not.

Number of groups

- ☒ Two

There was a stereotype threat group and a control group.

Was the assignment of participants to interventions randomised?

- ☒ Random

Participants were randomly assigned to conditions.

Where there was prospective allocation to more than one group, was the allocation sequence concealed from participants and those enrolling them until after enrolment?

- ☒ Not stated/unclear (please specify)

The paper does not specify if allocation was concealed.

Apart from the experimental intervention, did each study group receive the same level of care (that is, were they treated equally)?

- ☒ Yes

Both groups completed the same tasks, with only the stereotype threat manipulation differing between groups.

Study design summary

This was a randomized experimental study comparing a stereotype threat condition to a control condition. Female undergraduates completed math tasks while undergoing fMRI scanning. The threat group was reminded of gender stereotypes about math ability, while the control group was not. Math performance and neural activation were compared between groups and from pre- to post-manipulation.

Methods - Sampling strategy

Are the authors trying to produce findings that are representative of a given population?

☒ Implicit (please specify)

The authors do not explicitly state they are aiming for representative findings, but implicitly aim to understand stereotype threat effects in female college students highly identified with math.

Which methods does the study use to identify people or groups of people to sample from and what is the sampling frame?

☒ Not stated/unclear (please specify)

The sampling frame and recruitment methods are not clearly specified.

Which methods does the study use to select people or groups of people (from the sampling frame)?

☒ Not stated/unclear (please specify)

The specific selection methods are not described.

Planned sample size

☒ Explicitly stated (please specify)

The total sample size was 28 participants (14 per condition).

Methods - Recruitment and consent

Which methods are used to recruit people into the study?

☒ Not stated/unclear (please specify)

The recruitment methods are not described.

Were any incentives provided to recruit people into the study?

☒ Explicitly stated (please specify)

Participants received partial course credit or \$20 remuneration for participating.

Was consent sought?

☒ Not stated/unclear (please specify)

The consent process is not described.

Are there any other details relevant to recruitment and consent?

☒ No

Methods - Actual sample***What was the total number of participants in the study (the actual sample)?***

☒ Explicitly stated (please specify)

28 participants total (14 per condition)

What is the proportion of those selected for the study who actually participated in the study?

☒ Not stated/unclear (please specify)

The proportion of those selected who participated is not reported.

Which country/countries are the individuals in the actual sample from?

☒ Explicitly stated (please specify)

United States (Dartmouth College undergraduates)

What ages are covered by the actual sample?

☒ Not stated/unclear (please specify)

The exact ages are not specified, but participants were undergraduates.

What is the socio-economic status of the individuals within the actual sample?

☒ Not stated/unclear (please specify)

Socioeconomic status is not reported.

What is the ethnicity of the individuals within the actual sample?

☒ Not stated/unclear (please specify)

Ethnicity is not reported.

What is known about the special educational needs of individuals within the actual sample?

☒ Not stated/unclear (please specify)

Special educational needs are not reported.

Is there any other useful information about the study participants?

☒ Explicitly stated (please specify no/s.)

Participants were all highly identified with math, scoring 4 or higher on a 7-point scale for the statement “It is important to me that I am good at math.”

How representative was the achieved sample (as recruited at the start of the study) in relation to the aims of the sampling frame?

☒ Unclear (please specify)

There is not enough information provided to determine representativeness.

If the study involves studying samples prospectively over time, what proportion of the sample dropped out over the course of the study?

☒ Not applicable (not following samples prospectively over time)

For studies that involve following samples prospectively over time, do the authors provide any information on whether and/or how those who dropped out of the study differ from those who remained in the study?

☒ Not applicable (not following samples prospectively over time)

If the study involves following samples prospectively over time, do authors provide baseline values of key variables such as those being used as outcomes and relevant socio-demographic variables?

☒ Not applicable (not following samples prospectively over time)

Methods - Data collection

Please describe the main types of data collected and specify if they were used (a) to define the sample; (b) to measure aspects of the sample as findings of the study?

☒ Details

- (a) To define the sample: Math identification score
- (b) To measure aspects of the sample: Math performance (accuracy and reaction time), fMRI brain activation data

Which methods were used to collect the data?

- ☒ Self-completion questionnaire
- ☒ Practical test
- ☒ Other (please specify)

Functional magnetic resonance imaging (fMRI)

Details of data collection methods or tool(s).

- ☒ Explicitly stated (please specify)

Math identification was measured with a single item. Math performance was measured using arithmetic and modular arithmetic problems. Brain activation was measured using fMRI while participants completed math tasks.

Who collected the data?

- ☒ Researcher

Do the authors describe any ways they addressed the reliability of their data collection tools/methods?

- ☒ Details

The authors do not explicitly address reliability of data collection methods.

Do the authors describe any ways they have addressed the validity of their data collection tools/methods?

- ☒ Details

The authors do not explicitly address validity of data collection methods.

Was there concealment of study allocation or other key factors from those carrying out measurement of outcome – if relevant?

- ☒ Yes (please specify)

The male experimenter who recruited participants and put them in the scanner was blind to condition.

Where were the data collected?

- ☒ Explicitly stated (please specify)

Data were collected at the Dartmouth Brain Imaging Center.

Are there other important features of data collection?

- ☒ Details

Participants completed tasks while in an fMRI scanner.

Methods - Data analysis***Which methods were used to analyse the data?***

- ☒ Explicitly stated (please specify)

Behavioral data were analyzed using ANOVA. fMRI data were analyzed using Statistical Parametric Mapping software, including preprocessing steps and general linear model analysis.

Which statistical methods, if any, were used in the analysis?

☒ Details

ANOVA, t-tests, general linear model analysis of fMRI data, region of interest (ROI) analyses

What rationale do the authors give for the methods of analysis for the study?

☒ Details

The authors do not provide an explicit rationale for their analysis methods.

For evaluation studies that use prospective allocation, please specify the basis on which data analysis was carried out.

☒ 'Intention to intervene'

Analysis was based on the original group allocation.

Do the authors describe any ways they have addressed the reliability of data analysis?

☒ Details

The authors do not explicitly address reliability of data analysis.

Do the authors describe any ways they have addressed the validity of data analysis?

☒ Details

The authors do not explicitly address validity of data analysis.

Do the authors describe strategies used in the analysis to control for bias from confounding variables?

☒ Details

The authors do not explicitly describe strategies to control for confounding variables.

Please describe any other important features of the analysis.

☒ Details

The authors conducted region of interest (ROI) analyses to examine functional dissociations between brain regions.

Please comment on any other analytic or statistical issues if relevant.

☒ Details

No other major analytic issues noted.

Results and Conclusions

How are the results of the study presented?

☒ Details

Results are presented in text, tables, and figures including brain activation maps and graphs of signal change in key regions of interest.

What are the results of the study as reported by authors?

☒ Details

The stereotype threat group showed decreased math performance over time, while the control group improved. The threat group showed increased activation in the ventral anterior cingulate cortex (vACC), while the control group showed increased activation in regions associated with mathematical learning (angular gyrus, left parietal and prefrontal cortex).

Was the precision of the estimate of the intervention or treatment effect reported?

- CONSIDER:
 - Were confidence intervals (CIs) reported?

☒ No

Confidence intervals were not reported.

Are there any obvious shortcomings in the reporting of the data?

☒ Yes (please specify)

Confidence intervals and effect sizes are not reported for key results.

Do the authors report on all variables they aimed to study as specified in their aims/research questions?

☒ Yes (please specify)

The authors report on math performance and neural activation patterns as intended.

Do the authors state where the full original data are stored?

☒ No

What do the author(s) conclude about the findings of the study?

☒ Details

The authors conclude that stereotype threat leads to increased activation in brain regions associated with social and emotional processing (vACC) and failure to recruit regions associated with mathematical learning, resulting in poorer math performance.

Quality of the study - Reporting***Is the context of the study adequately described?***

☒ Yes (please specify)

The authors provide adequate context on stereotype threat research and the need to understand its neural mechanisms.

Are the aims of the study clearly reported?

☒ Yes (please specify)

While not explicitly stated, the aims to identify neural mechanisms of stereotype threat are clear from the introduction.

Is there an adequate description of the sample used in the study and how the sample was identified and recruited?

☒ No (please specify)

Details on recruitment and sampling are limited.

Is there an adequate description of the methods used in the study to collect data?

☒ Yes (please specify)

The math tasks and fMRI procedures are described in detail.

Is there an adequate description of the methods of data analysis?

☒ Yes (please specify)

The fMRI analysis methods are described in detail.

Is the study replicable from this report?

☒ No (please specify)

Some key details on recruitment and procedures are missing.

Do the authors avoid selective reporting bias?

☒ Yes (please specify)

The authors report on all key outcomes mentioned in the introduction.

Quality of the study - Methods and data***Are there ethical concerns about the way the study was done?***

☒ No concerns

Were students and/or parents appropriately involved in the design or conduct of the study?

☒ No (please specify)

There is no indication of student/parent involvement in study design.

Is there sufficient justification for why the study was done the way it was?

☒ Yes (please specify)

The authors justify the use of fMRI to examine neural mechanisms of stereotype threat.

Was the choice of research design appropriate for addressing the research question(s) posed?

☒ Yes (please specify)

The experimental design with fMRI was appropriate for examining neural mechanisms of stereotype threat.

To what extent are the research design and methods employed able to rule out any other sources of error/bias which would lead to alternative explanations for the findings of the study?

☒ A little (please specify)

Random assignment helps control for some biases, but small sample size and lack of details on recruitment limit ability to rule out alternative explanations.

How generalisable are the study results?

☒ Details

Generalizability is limited by the small, homogeneous sample of female undergraduates at one university.

Weight of evidence - A: Taking account of all quality assessment issues, can the study findings be trusted in answering the study question(s)?

☒ Medium trustworthiness (please specify)

The experimental design and fMRI methods are strong, but small sample size and lack of details on recruitment/sampling limit trustworthiness.

Have sufficient attempts been made to justify the conclusions drawn from the findings so that the conclusions are trustworthy?

☒ Medium trustworthiness

The authors' conclusions are generally justified by the data, but some limitations are not fully addressed.

References

- Krendl, A. C., Richeson, J. A., Kelley, W. M., & Heatherton, T. F. (2008). The negative consequences of threat: A functional magnetic resonance imaging investigation of the neural mechanisms underlying women's underperformance in math. *Psychological Science*, *19*(2), 168–175. <https://doi.org/10.1111/j.1467-9280.2008.02063.x>