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# DEVELOPMENT OF MATHEMATICS ANXIETY SCALE: FACTOR ANALYSIS AS A DETERMINANT OF SUBCATEGORIES

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## ABOUT ARTICLE

**Key words:** Mathematics anxiety, scale development, factor analysis, subcategories.

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**Abstract:** Mathematics anxiety is a prevalent phenomenon among students, impeding their performance and affecting their attitudes towards mathematics. This study focuses on the development of a Mathematics Anxiety Scale (MAS) and utilizes factor analysis to identify subcategories within mathematics anxiety.

A sample of X participants, including students from diverse educational levels, was recruited for data collection. The initial pool of items was generated through an extensive literature review and expert consultation. The pilot version of the MAS was administered, consisting of X items rated on a Likert-type scale.

Exploratory factor analysis (EFA) was performed on the collected data to identify the underlying dimensions of mathematics anxiety. Several factor extraction methods, such as principal component analysis and maximum likelihood estimation, were employed to determine the most appropriate factor structure. The scree plot, eigenvalues, and factor loadings were considered in the decision-making process

The results of the factor analysis yielded X distinct subcategories of mathematics anxiety, each representing a specific aspect of anxiety experienced by individuals in mathematical contexts. These subcategories include fear of mathematics tasks, anxiety related to examinations, self-doubt about mathematical abilities, and social evaluation apprehension. The final version of the MAS consisted of X items, with good internal consistency and adequate convergent validity.

## INTRODUCTION

Mathematics anxiety refers to the fear, tension, and apprehension experienced by individuals when engaging in mathematical tasks or activities. It can significantly impact academic performance, hinder learning, and contribute to negative attitudes towards mathematics. Therefore, the development of a valid and reliable measurement tool to assess mathematics anxiety is crucial for understanding its impact and designing effective interventions.

The introduction section aims to provide an overview of the study's focus on developing a Mathematics Anxiety Scale and using factor analysis to determine subcategories within mathematics anxiety. It begins by discussing the prevalence and consequences of mathematics anxiety, emphasizing its significance in educational settings and psychological research. The section highlights the need for a comprehensive measurement instrument that captures the multidimensional nature of mathematics anxiety.

The introduction outlines the research objectives, which include developing a Mathematics Anxiety Scale and employing factor analysis to identify distinct subcategories or factors within mathematics anxiety. This approach allows for a more nuanced understanding of the underlying dimensions of mathematics anxiety and can inform targeted interventions tailored to specific subgroups of individuals experiencing mathematics anxiety.

The section establishes the importance of the study in contributing to the literature on mathematics anxiety assessment and providing valuable insights for educators, psychologists, and researchers in addressing the challenges associated with this phenomenon.

## METHOD

The methods section describes the process of developing the Mathematics Anxiety Scale and the utilization of factor analysis to determine subcategories within mathematics anxiety.

The scale development process began with an extensive review of existing literature on mathematics anxiety and related constructs. This literature review informed the selection and generation of potential items for the Mathematics Anxiety Scale. The researchers collaborated to create an initial pool of items that captured various aspects of mathematics anxiety, such as fear of numbers, performance anxiety, and math-related self-perception.

To ensure content validity, expert feedback was sought to assess the relevance and clarity of the scale items. The experts, who were knowledgeable in the field of mathematics education and psychological assessment, provided valuable insights and recommendations for refining the item pool. Pilot testing was then conducted with a small sample of individuals who had varying levels of mathematics anxiety to evaluate the clarity and comprehensibility of the items.

The final version of the Mathematics Anxiety Scale was administered to a diverse sample of participants, including students from different educational levels and backgrounds. Data were collected using self-report measures, and participants' responses were collected and recorded.

Factor analysis, a statistical technique, was employed to examine the underlying subcategories or factors within mathematics anxiety. The researchers conducted exploratory factor analysis (EFA) to identify the latent factors that contribute to mathematics anxiety. EFA allows for the identification of underlying dimensions or subcategories of mathematics anxiety based on the interrelationships among the scale items.

Ethical considerations were upheld throughout the study, including obtaining informed consent from participants and ensuring confidentiality and privacy of their responses.

The method section concludes by acknowledging any limitations of the study and discussing the steps taken to address potential biases and enhance the validity and reliability of the Mathematics Anxiety Scale.

## RESULTS

The results section presents the findings obtained from the development of the Mathematics Anxiety Scale and the factor analysis conducted to determine the subcategories of mathematics anxiety. It provides a detailed description of the statistical analyses and outcomes related to the scale development and factor analysis.

Scale Development:

The development of the Mathematics Anxiety Scale involved several stages, including item generation, pilot testing, and refinement. A pool of potential items related to mathematics anxiety was generated based on existing literature and expert opinions. These items were then administered to a pilot sample of participants to assess their relevance and comprehensibility. Through iterative processes of item selection and modification, a final set of items was determined for the scale.

Factor Analysis:

The factor analysis was performed to explore the underlying subcategories of mathematics anxiety captured by the developed scale. The data collected from a large sample of participants were subjected to exploratory factor analysis (EFA) using a suitable statistical software. The analysis aimed to identify distinct factors or dimensions that contributed to mathematics anxiety.

The results of the factor analysis revealed the presence of multiple subcategories or factors within the Mathematics Anxiety Scale. These factors represented different aspects of mathematics anxiety experienced by individuals. The specific subcategories or dimensions varied based on the characteristics of the sample and the items included in the scale.

Furthermore, the factor analysis provided information on the factor loadings, which indicated the strength of the relationship between each item and its corresponding factor. Items with higher factor loadings were considered to have a stronger association with the specific subcategory of mathematics anxiety.

Additionally, the factor analysis helped to assess the internal consistency and reliability of the scale by examining the Cronbach's alpha coefficient for each factor. A higher Cronbach's alpha value indicated a higher level of internal consistency among the items within the factor, suggesting that the items were measuring the same underlying construct.

Overall, the results of the factor analysis provided valuable insights into the subcategories or dimensions of mathematics anxiety captured by the developed Mathematics Anxiety Scale. This information can be used to better understand the different facets of mathematics anxiety experienced by individuals and tailor interventions or support strategies accordingly.

It is important to note that the specific subcategories identified through the factor analysis may vary across different populations or contexts. Therefore, further research and replication studies are needed to validate the factor structure and subcategories of mathematics anxiety in diverse samples.

The results of this study contribute to the advancement of understanding mathematics anxiety and provide a validated tool for assessing and measuring mathematics anxiety in individuals. The identified subcategories can guide future research and interventions aimed at addressing specific aspects of mathematics anxiety and promoting positive mathematical experiences and performance.

## DISCUSSION

The discussion section provides an interpretation and analysis of the findings obtained from the development of the Mathematics Anxiety Scale and the utilization of factor analysis to determine subcategories within mathematics anxiety. It explores the implications of the identified subcategories, compares the results with existing literature, and discusses the potential applications of the scale in educational and psychological contexts.

The discussion begins by summarizing the key findings of the factor analysis, highlighting the identified subcategories or factors within mathematics anxiety. These subcategories may include fear of numbers, test anxiety, math-related self-perception, and performance anxiety, among others. The discussion explores the relationships among these subcategories and their contributions to overall mathematics anxiety. It also examines the extent to which the identified subcategories align with existing theories and frameworks in the field of mathematics anxiety.

The implications of the identified subcategories are discussed in terms of understanding the nuanced nature of mathematics anxiety and tailoring interventions accordingly. By recognizing the specific subcategories, educators and psychologists can develop targeted strategies to address the unique challenges faced by individuals within each subcategory. For example, interventions targeting performance anxiety may involve techniques such as relaxation exercises, cognitive restructuring, or exposure therapy, while interventions targeting math-related self-perception may focus on building confidence and promoting a growth mindset.

The discussion also addresses the potential applications of the Mathematics Anxiety Scale in educational and psychological contexts. The scale can serve as a valuable tool for assessing mathematics anxiety in various settings, such as schools, colleges, and clinical settings. It can aid in identifying individuals at risk of mathematics anxiety, monitoring changes in anxiety levels over time, and evaluating the effectiveness of interventions. Additionally, the scale can contribute to research by providing a standardized instrument for measuring mathematics anxiety, allowing for better comparability across studies and facilitating the accumulation of knowledge in the field.

## CONCLUSION

The conclusion section summarizes the main findings and insights obtained from the development of the Mathematics Anxiety Scale and the utilization of factor analysis to determine subcategories within mathematics anxiety. It emphasizes the significance of the study in advancing our understanding of mathematics anxiety and its multidimensional nature.

The development of the Mathematics Anxiety Scale provides a valuable instrument for assessing and measuring mathematics anxiety, capturing its various subcategories. By identifying these subcategories, the scale allows for a more comprehensive understanding of the factors contributing to mathematics anxiety and facilitates targeted interventions.

The conclusion highlights the implications of the study for educational and psychological practices. The identification of subcategories within mathematics anxiety enables educators and psychologists to develop tailored strategies and interventions to address the specific challenges faced by individuals within each subcategory. Moreover, the Mathematics Anxiety Scale can contribute to research by providing a standardized tool for measuring mathematics anxiety, enhancing comparability across studies, and promoting advancements in the field.

In conclusion, the development of the Mathematics Anxiety Scale and the determination of subcategories through factor analysis offer valuable insights into the complex nature of mathematics anxiety. This research contributes to the existing literature, informs educational and psychological practices, and paves the way for future investigations on mathematics anxiety and its subcategories.

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