Dyscalculia

Dyscalculia affects approximately 8% of the global population, roughly 5 million people in the United States (Butterworth, Varma & Laurillard, 2011; Horowitz, Rawe, & Whittaker, 2017). Dyscalculia is an inability to learn, remember, and recall mathematical information (Geary, 2011). Around the world, people naturally count objects, understand having more or less, and recognize patterns. For some children, mathematical thinking develops slowly for these children because the parietal lobe of the brain has weak neurological connections (Price & Ansari, 2013; Butterworth, Varma & Laurillard, 2011). Children with dyscalculia have trouble learning how to tell time, estimate amounts, or remember basic math facts (Shalev & Gross-Tsur, 2001).

Other dyscalculia-related problems are remembering or following formulas and learning "backward" math, such as subtraction, division, or finding the roots of a number (Kaufmann & von Aster, 2012). Many researchers, including Cherasaro, Reale, Haystead, and Marzano (2015) think this is due to coding issues between Arabic numerals, written word form, and objects. Dr. Brian Butterworth proposed a core deficit model but other researchers feel the culprit is poor working memory and visuo-spatial skills (Amirian, 2014; Anderson & Wagovich, 2010). Dyscalculia causes a loss of math information over time. Students learn a topic in class, do well on classwork and homework assignments, perform poorly on a quiz, and have forgotten the information by the time they take a test (Gibbs, Hinton, & Flores, 2018; Grabner et al., 2007; Piazzi et al., 2010).

- Honora Wall, 2021. *Parts of this position paper were rephrased from the author's dissertation for an Ed.D. program.*

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Endnotes

[1] Intrinsic cognitive load refers to the inherent difficulty of a task; for example, tying shoelaces generally requires less cognitive load than building a weight-bearing bridge (Sweller, 2011). However, an engineer with limited fine motor control may find the load reversed. This study does not explore intrinsic cognitive load, although future research into the discrepancies of intrinsic cognitive load between students with and without learning disabilities would be very useful. Germane cognitive load explains the process of developing schemas, our mental representation of a whole concept (Sweller, 2011). Germane cognitive load is the experiences and learning events that create a baker's knowledge of making cupcakes, for instance. This study does not examine germane cognitive load, although this would be an appropriate lens to study the ways in which students with learning disabilities conceptualize mathematical ideas. Through extraneous cognitive load, test design can create either a positive or negative assessment experience. For instance, vocabulary choices can be a door opener or a deterrent for students (Cheung, 2017). Using active voice, affirmative constructions, and simple sentences are all shown to decrease cognitive load and allow the reader more time to determine the relevance of text to problem solving (Cheung, 2017). Conversely, lengthy explanations, negative question construction (i.e., Which of these is not a prime number), or separating the subject and predicate all add to cognitive load and decrease comprehension and information recall (Cheung, 2017). This may reduce test performance.

Appendix A

Recruitment Form

August 2021

Nancy Harvey
Harvey Academy
1 Main Street
Tequesta, FL 33469

Hello Nancy,

I am writing to request your participation in a research study I am conducting as part of my Ed.D. program at Concordia University Chicago. This exploratory study will examine whether a relationship exists between test presentation and test performance for students with dyscalculia.

Participation includes sending home a request and consent form to parents in your 3rd through 7th grade classes, having teachers distribute, grade, and return tests I have modified by adding extra white space to the page, and sharing demographic information including age, gender, grade level, any known learning disabilities, and past math scores on standardized tests (if known).

Inclusion criteria in the study will be a diagnosis of dyscalculia, performance below the 30th percentile on a standardized math test, or class performance two grade levels below peers. All students who wish to participate and who meet these criteria will be accepted in the study; an equal number of students who do not meet these criteria will also be included in the study to strengthen the data results.

Participants will be randomly assigned a test format. Classroom teachers will be asked to distribute the test formats without remark, to grade all tests in their usual manner, and to return copies of all participants' tests to me for analysis. For questions about the rights of research participants, please contact the Concordia University Chicago Institutional Review Board at: IRB@CUChicago.edu.

Thank you for considering this study. A copy of the research proposal can be shared with you upon request. Feel free to contact me or my dissertation committee chair, Dr. Valerie Jones at Valerie.Jones@cuchicago.edu, should you have any other questions.

Thank you,

Honora Wall

Appendix B

Parental Notification Form Regarding Participation in a Research Study

Principal Investigator: Honora Wall
Faculty Advisor: Dr. Valerie Jones, Concordia University Chicago
Study Title: The Efficacy of Test Accommodations for Students with Dyscalculia

Dear Parents and Guardians,

I am an Ed.D. candidate at Concordia University Chicago conducting a research study of elementary and middle school children to assess the ways their math performance might be related to the format of a test. I am researching whether the format and design of a test is a barrier for students with learning disabilities; students both and without learning disabilities are needed to ensure the study has the proper data.

Your school is familiar with this study and has given me permission to conduct this research at the school, and is facilitating this communication to you to tell you about the study and give you an opportunity to decide if you would like your child to participate. If you allow your child to participate, I will provide them with either a regular classroom test, or a modified version containing more white space on the page Test formats will be randomly assigned to students by the researcher and no one may request a specific type of test.

All students in the class, regardless of whether they participate in the study, will take the same number of math tests this school year, answering the same questions. The research study will utilize regular classroom tests in the regular math program and tests will be graded by your child's regular classroom teacher. Your child's grades will not be impacted by this study in any way. For questions about the rights of research participants, please contact the Concordia University Chicago Institutional Review Board at: IRB@CUChicago.edu.

This research is anonymous. Data collection will include age, grade, gender, any known learning disabilities, and test performance. Participant names will not be collected. Results of the study will be made available to the school and to any interested parents or stakeholders. If a report of this study is published or presented at a professional conference, only group results will be communicated. The research team is happy to answer any questions you have about the study. Please contact Honora Wall at educalclearning@gmail.com, or 561-800-6881. Feel free to contact me or my dissertation committee chair, Dr. Valerie Jones at Valerie.Jones@cuchicago.edu, should you have any other questions.

Not all students in the class will take part in the research study. An equal number of students will be randomly chosen from a pool of those who meet the criteria for learning disabilities and those who do not meet the criteria. Please complete the attached CONSENT/DO NOT CONSENT form and return it to your child's teacher by September 30, 2021.

Thank you,

Honora Wall, M. A.
561-800-6881
educalclearning@gmail.com

Appendix C

Parent Informed Consent Form

I am doing a study to find out if the way a math test is written could change the score a person gets on that test. I am asking your child to help because we don't know very much about whether test format helps or hurts a person's math test scores.

If you agree to let your child participate in this study, they will be randomly assigned to a certain type of math test: a regular test, or one that has some changes to the way it looks, like having extra white space on the page.

No one knows which student will get a certain kind of test design. No one can choose a certain test. No matter what the test design is, all test questions will be exactly the same as the questions on every other test given to the rest of the class.

Participants in this study will have their test scores sent to the researcher. I will conduct an analysis of the test scores for each design to determine whether test presentation and format is related to student performance.

There are no foreseeable risks or benefits to being involved in this study. Confidentiality will be maintained as student names will not be obtained. Participants will be labeled by number, i.e., P1234, and this code will be used to track test type and performance, as well as demographic information including age, gender, and any known learning disabilities This information will be confidential and stored on a secure computer.

The results of this research study will be published as part of my dissertation. I am a candidate for an Ed.D. in Education, Curriculum & Instruction. My research focus area is the math learning disorder, dyscalculia. Results from this study will be kept on file for a period of three (3) years.

Involvement in this research study is completely voluntary. Your child's math grade will not be affected because you say yes or no to this study. For questions about the rights of research participants, please contact the Concordia University Chicago Institutional Review Board at: IRB@CUChicago.edu. Feel free to contact me or my dissertation committee chair, Dr. Valerie Jones at Valerie.Jones@cuchicago.edu, should you have any other questions.

Your signature: _____ Date _____

Your printed name: _____ Date _____

Your child's name: _____ Teacher: _____

Signature of person obtaining consent: _____ Date _____

Printed name of person obtaining consent: _____ Date _____

Appendix D

Student Informed Consent Form

I am doing a study to find out if the way a math test is written could change the score a person gets on that test. I am asking you to help because we don't know very much about whether test format helps or hurts a person's math test scores.

If you agree to be in our study, we are going to assign to a certain type of math: a regular test, or one that has some changes to the way it looks, like having extra white space on the page. No one knows which student will get a certain kind of test design. No one can choose a certain test. No matter what test design you get, all of the test questions will be exactly the same as the questions on every other test.

You can ask questions about this study at any time. If you decide at any time not to finish, you can ask to stop being part of the study and you will have only regular math tests. For questions about the rights of research participants, please contact the Concordia University Chicago Institutional Review Board at: IRB@CUChicago.edu.

If you sign this paper, it means that you have read this and that you want to be in the study. If you don't want to be in the study, don't sign this paper.

Being in the study is up to you, and no one will be upset if you don't sign this paper or if you change your mind later. Feel free to contact me or my dissertation committee chair, Dr. Valerie Jones at Valerie.Jones@cuchicago.edu, should you have any other questions.

Your math grade will not be affected in any way because you say yes or no to this study.

Your signature: _____ Date _____

Your printed name: _____ Date _____

Signature of person obtaining consent: _____ Date _____

Printed name of person obtaining consent: _____ Date _____

Appendix E

Publisher Consent Request

Dear Editor,

I am an Ed.D. candidate at Concordia University Chicago. For my dissertation, I am conducting a research study of elementary and middle school children to assess the ways math performance might be related to the format of a test. I am researching whether the amount of white space on a test is a barrier for students with learning disabilities; I am asking for permission to use the chapter tests included in your textbook, which is used at one of my sample school sites.

If you allow me to use your tests, I will make a version that increases the white space on each page. No directions, questions, or graphics will be changed in any way. Test formats will be randomly assigned to students by the researcher, and no one may request a specific type of test. The results of this research study will be published as part of my dissertation. I am a candidate for an Ed.D. in Education, Curriculum & Instruction and my research focus area is the math learning disorder, dyscalculia. Results from this study will be kept on file for a period of three (3) years.

All students in the class, regardless of whether they participate in the study, will take the same number of math tests this school year, answering the same questions. The research study will utilize regular classroom tests in the regular math program and tests will be graded by your child's regular classroom teacher. Student work will be graded by their classroom teachers and student grades will not be impacted by this study in any way. Feel free to contact me or my dissertation committee chair, Dr. Valerie Jones at Valerie.Jones@cuchicago.edu, should you have any other questions. For questions about the rights of research participants, please contact the Concordia University Chicago Institutional Review Board at: IRB@CUChicago.edu.

Thank you for considering my request,

Honora Wall, M.A.
561-800-6881
educalcmath@gmail.com