ISSN 2618-2238

MEMORIAS

XV Congreso Internacional de Investigación y Práctica Profesional en Psicología

XXX Jornadas de Investigación

XIX Encuentro de Investigadores en Psicología del MERCOSUR

V Encuentro de Investigación de Terapia Ocupacional

V Encuentro de Musicoterapia

29 DE NOVIEMBRE AL 1° DE DICIEMBRE DE 2023

Neuropsicología y Psicología Experimental

TOMO 2

.UBA 40 AÑOS DE DEMOCRACIA

.UBA PSICOLOGÍA
Facultad de Psicología

LA RELACIÓN ENTRE LAS HABILIDADES MATEMÁTICAS SIMBÓLICAS Y NO SIMBÓLICAS EN NIÑOS

Gomez, Brenda; Formoso, Jesica
Universidad de Buenos Aires. Facultad de Psicología. Buenos Aires, Argentina.

RESUMEN

Introducción: Una amplia gama de estudios proponen una relación entre el sistema numérico aproximado (encargado de representar magnitudes no simbólicas) y el sistema numérico simbólico (especializado en representar cantidades precisas). La evidencia sobre las características de esta relación, sin embargo, es heterogénea. Objetivo: Investigar la asociación entre medidas del sistema numérico aproximado y el sistema numérico simbólico. Método: Se realizó un metaanálisis siguiendo la declaración PRISMA. Se realizo una búsqueda sistemática en las bases de Wiley, APA-Psycnet y PubMed de artículos publicados entre 2012 y 2022, con participantes de entre 3 y 13 años de edad, que incluyeran al menos una tarea de estimación de cantidades no simbólicas y una asociada al conocimiento del sistema numérico arábigo. Resultados: El conjunto de datos está compuesto por 35 tamaños de efecto, reportados por 27 estudios correspondientes a 5994 participantes, con un promedio de edad de 80.6 meses (DE=24.7). El efecto global estimado fue 0.36 ($z = 9.62$, $p < .001$, IC95% = 0.29, 0.43), indicando asociación entre las variables de intensidad moderada, y la variabilidad entre los estudios fue alta ($I2 = 86.34\%$). Discusión: El análisis realizado sugiere que hay una asociación entre el procesamiento del sistema numérico aproximado y el sistema numérico simbólico.

Palabras clave

Sistema simbólico - Sistema aproximado - Código arábigo - Línea numérica

ABSTRACT

THE ASSOCIATION BETWEEN SYMBOLIC AND NON-SYMBOLIC SKILLS IN CHILDREN

A wide variety of studies has proposed an association between the approximate number system (in charge of representing non-symbolic magnitudes) and the symbolic number system (specialized in representing exact quantities). However, the evidence regarding this association's properties is contrasting. In this study, we examined the relationship between measures of the symbolic and approximate number systems. A meta-analysis was performed in line with the PRISMA declaration. The databases Wiley, APA-Psycnet, and PubMed were researched for articles published between 2012 y 2022 with participants between the ages of 3 and 13 years, including at least one non-symbolic magnitude estimation task and one task associated with the Arabic numeral system knowledge. Data consisted of 35 effect sizes, reported by 27 studies corresponding to 5994 participants, with an age average of 80.6 months (SD=24.7). The estimated global effect was 0.36 ($z = 9.62$, $p < .001$, IC95% = 0.29, 0.43), indicating the variables' association was of moderate intensity, and the variability between studies was high ($I2 = 86.34\%$). The analysis of this data suggests that there is an association between the symbolic number system and the approximate number system.

Keywords

Approximate number system - Symbolic number system - Arabic numerals - Mental number line

BIBLIOGRAFÍA

Anobile, G., Arrighi, R., Castaldi, E., Grassi, E., Pedonese, L., Moscoso, P. A. M., & Burr, D. C. (2018). Spatial but not temporal numerosity thresholds correlate with formal math skills in children. *Developmental Psychology*, *54*(3), 458-473. https://doi.org/10.1037/dev0000448

Bartelet, D., Vaessen, A., Blomert, L., & Ansari, D. (2014). What basic number processing measures in kindergarten explain unique variability in first-grade arithmetic proficiency? *Journal of Experimental Child Psychology*, *117*, 12-28. https://doi.org/10.1016/j.jecp.2013.08.010

Cai, D., Zhang, L., Li, Y., Wei, W., & Georgiou, G. K. (2018). The Role of Approximate Number System in Different Mathematics Skills Across Grades. *Frontiers in Psychology*, *9*, 1733. https://doi.org/10.3389/fpsyg.2018.01733

Caviola, S., Colling, L. J., Mammarella, I. C., & Szucs, D. (2020). Predictors of mathematics in primary school: Magnitude comparison, verbal and spatial working memory measures. *Developmental Science*, *23*(6). https://doi.org/10.1111/desc.12957

Chu, F. W., vanMarle, K., & Geary, D. C. (2015). Early numerical foundations of young children's mathematical development. *Journal of Experimental Child Psychology*, *132*, 205-212. https://doi.org/10.1016/j.jecp.2015.01.006

Dietrich, J. F., Huber, S., & Nuerk, H.-C. (2015). Methodological aspects to be considered when measuring the approximate number system (ANS) â€“a research review. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.00295

Fazio, L. K., Bailey, D. H., Thompson, C. A., & Siegler, R. S. (2014). Relations of different types of numerical magnitude representations to each other and to mathematics achievement. *Journal of Experimental Child Psychology*, *123*, 53-72. https://doi.org/10.1016/j.jecp.2014.01.013

Feigenson, L., Dehaene, S., & Spelke, E. (2004). Core systems of number. *Trends in Cognitive Sciences*, *8*(7), 307-314. https://doi.org/10.1016/j.tics.2004.05.002

Geary, D. C., & vanMarle, K. (2016). Young children's core symbolic and nonsymbolic quantitative knowledge in the prediction of later mathematics achievement. *Developmental Psychology*, *52*(12), 2130-2144. https://doi.org/10.1037/dev0000214

Hornung, C., Schiltz, C., Brunner, M., & Martin, R. (2014). Predicting first-grade mathematics achievement: The contributions of domain-general cognitive abilities, nonverbal number sense, and early number competence. *Frontiers in Psychology*, *5*. https://doi.org/10.3389/fpsyg.2014.00272

Hutchison, J. E., Ansari, D., Zheng, S., De Jesus, S., & Lyons, I. M. (2020). The relation between subitizable symbolic and non-symbolic number processing over the kindergarten school year. *Developmental Science*, *23*(2). https://doi.org/10.1111/desc.12884

Jordan, N. C., Hansen, N., Fuchs, L. S., Siegler, R. S., Gersten, R., & Micklos, D. (2013). Developmental predictors of fraction concepts and procedures. *Journal of Experimental Child Psychology*, *116*(1), 45-58. https://doi.org/10.1016/j.jecp.2013.02.001

Lau, N. T. T., Merkley, R., Tremblay, P., Zhang, S., De Jesus, S., & Ansari, D. (2021). Kindergarteners' symbolic number abilities predict nonsymbolic number abilities and math achievement in grade 1. *Developmental Psychology*, *57*(4), 471-488. https://doi.org/10.1037/dev0001158

Liu, Y. (2018). Fraction magnitude understanding and its unique role in predicting general mathematics achievement at two early stages of fraction instruction. *British Journal of Educational Psychology*, *88*(3), 345-362. https://doi.org/10.1111/bjep.12182

Lonnemann, J., Linkersdörfer, J., Hasselhorn, M., & Lindberg, S. (2013). Developmental changes in the association between approximate number representations and addition skills in elementary school children. *Frontiers in Psychology*, *4*. https://doi.org/10.3389/fpsyg.2013.00783

Lyons, I. M., Price, G. R., Vaessen, A., Blomert, L., & Ansari, D. (2014). Numerical predictors of arithmetic success in grades 1-6. *Developmental Science*, *17*(5), 714-726. https://doi.org/10.1111/desc.12152

Malone, S. A., Pritchard, V. E., & Hulme, C. (2021). Separable effects of the approximate number system, symbolic number knowledge, and number ordering ability on early arithmetic development. *Journal of Experimental Child Psychology*, *208*, 105120. https://doi.org/10.1016/j.jecp.2021.105120

Matejko, A. A., & Ansari, D. (2016). Trajectories of Symbolic and Nonsymbolic Magnitude Processing in the First Year of Formal Schooling. *PLOS ONE*, *11*(3), e0149863. https://doi.org/10.1371/journal.pone.0149863

Mou, Y., Zhang, B., & Hyde, D. C. (2023). Directionality in the interrelations between approximate number, verbal number, and mathematics in preschool-aged children. *Child Development*, *94*(2). https://doi.org/10.1111/cdev.13879

Mussolin, C., Nys, J., Content, A., & Leybaert, J. (2014). Symbolic Number Abilities Predict Later Approximate Number System Acuity in Preschool Children. *PLoS ONE*, *9*(3), e91839. https://doi.org/10.1371/journal.pone.0091839

Negen, J., & Sarnecka, B. W. (2015). Is there really a link between exact-number knowledge and approximate number system acuity in young children? *British Journal of Developmental Psychology*, *33*(1), 92-105. https://doi.org/10.1111/bjdp.12071

O'Connor, P. A., Morsanyi, K., & McCormack, T. (2018). Young children's non-numerical ordering ability at the start of formal education longitudinally predicts their symbolic number skills and academic achievement in maths. *Developmental Science*, *21*(5), e12645. https://doi.org/10.1111/desc.12645

O'Connor, P. A., Morsanyi, K., & McCormack, T. (2019). The Stability of Individual Differences in Basic Mathematics-Related Skills in Young Children at the Start of Formal Education: Stability of Basic Mathematics-Related Skills. *Mind, Brain, and Education*, *13*(3), 234-244. https://doi.org/10.1111/mbe.12190

Odic, D., Lisboa, J. V., Eisinger, R., Olivera, M. G., Maiche, A., & Halberda, J. (2016). Approximate number and approximate time discrimination each correlate with school math abilities in young children. *Acta Psychologica*, *163*, 17-26. https://doi.org/10.1016/j.actpsy.2015.10.010

Ouyang, X., Yang, Y., Zhang, X., & Zhang, Q. (2021). Longitudinal relations between the approximate number system and symbolic number skills in preschool children. *Journal of Experimental Child Psychology*, *212*, 105254. https://doi.org/10.1016/j.jecp.2021.105254

Praet, M., Titeca, D., Ceulemans, A., & Desoete, A. (2013). Language in the prediction of arithmetics in kindergarten and grade 1. *Learning and Individual Differences*, *27*, 90-96. https://doi.org/10.1016/j.lindif.2013.07.003

Sasanguie, D., De Smedt, B., Defever, E., & Reynvoet, B. (2012). Association between basic numerical abilities and mathematics achievement: Association between basic numerical abilities and mathmatics achievement. *British Journal of Developmental Psychology*, *30*(2), 344-357. https://doi.org/10.1111/j.2044-835X.2011.02048.x

Sasanguie, D., Defever, E., Maertens, B., & Reynvoet, B. (2014). The Approximate Number System is not Predictive for Symbolic Number Processing in Kindergarteners. *Quarterly Journal of Experimental Psychology*, *67*(2), 271-280. https://doi.org/10.1080/17470218.2013.803581

Sasanguie, D., Göbel, S. M., Moll, K., Smets, K., & Reynvoet, B. (2013). Approximate number sense, symbolic number processing, or number-space mappings: What underlies mathematics achievement? *Journal of Experimental Child Psychology*, *114*(3), 418-431. https://doi.org/10.1016/j.jecp.2012.10.012

Shusterman, A., Slusser, E., Halberda, J., & Odic, D. (2016). Acquisition of the Cardinal Principle Coincides with Improvement in Approximate Number System Acuity in Preschoolers. *PLOS ONE*, *11*(4), e0153072. https://doi.org/10.1371/journal.pone.0153072

Spelke, E. S. (2017). Core Knowledge, Language, and Number. *Language Learning and Development*, *13*(2), 147-170. https://doi.org/10.1080/15475441.2016.1263572

Vanbinst, K., Ghesquière, P., & De Smedt, B. (2012). Numerical Magnitude Representations and Individual Differences in Children's Arithmetic Strategy Use. *Mind, Brain, and Education*, *6*(3), 129-136. https://doi.org/10.1111/j.1751-228X.2012.01148.x

vanMarle, K., Chu, F. W., Mou, Y., Seok, J. H., Rouder, J., & Geary, D. C. (2018). Attaching meaning to the number words: Contributions of the object tracking and approximate number systems. *Developmental Science*, *21*(1). https://doi.org/10.1111/desc.12495

Yuan, L., Prather, R., Mix, K. S., & Smith, L. B. (2020). Number Representations Drive Number-Line Estimates. *Child Development*, *91*(4). https://doi.org/10.1111/cdev.13333