Curriculum Vitae

Zachary Hawes

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Lab Website: https://www.mathematicalthinkinglab.com/
ResearchGate: https://www.researchgate.net/profile/Zachary_Hawes
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Education

2015 - 2019	PhD Cognitive, Developmental, and Brain Sciences University of Western Ontario Advisor: Daniel Ansari
2009 - 2011	MA Child Studies and Education Applied Psychology & Human Development Ontario Institute for Studies in Education (OISE) University of Toronto
2008	Post-degree studies in Psychology Wilfrid Laurier University
2002 - 2006	BKin Honours Kinesiology Faculty of Sciences Wilfrid Laurier University

Academic Positions

2019 - present	Assistant Professor Department of Applied Psychology & Human Development Ontario Institute for Studies in Education/University of Toronto

2011 - 2015 Research Officer
The Robertson Program for Inquiry-Based Teaching in Mathematics and Science
Dr. Eric Jackman Institute of Child Study
Department of Applied Psychology & Human Development
Ontario Institute for Studies in Education/University of Toronto

Refereed Journal Publications

O'Connor, R., Gattas, S.U., Blakey, E., Brough, C., Cook, K., **Hawes, Z.**, Howard, S., Korell, C., Loveridge, T., Merkley, R., O'Reilly, F., Simms, V., von Spreckelsen, M., Sylva, K., Scerif, G. (2025). Engaging educators in the co-design, feasibility, and implementation quality of early years interventions: The ONE programme. *Mind, Brain, and Education*

Yang, X., & **Hawes, Z.** (2025). Inspiring combinatorial thinking through spatial heuristics. *Mathematics Teacher: Learning and Teaching Pre-K-12*.

Youmans, A., **Hawes, Z**., Merkley, R., Gunning, S., Savelson , Z., Chisholm, L., Collins, M., Black, C., Godden, L., Montgomery, C., Tellos, A., & Lacelle, K. (2025). Co-constructing professional development: A framework for fostering educators' professional growth. *Canadian Journal of Science, Mathematics, and Technology Education.*

Munoz-Rubke, F., **Hawes, Z**., Castillo, R.D., Avendano, K., Zamorano, V., & Soto, J. (2025). Understanding the link between spatial skills and mechanical reasoning. *Thinking Skills and Creativity*, *58*, 1-16, https://doi.org/10.1016/j.tsc.2025.101936

Scerif, G., Sučević, J., Andrews, H., Blakey, E., Gattas, S., Godfrey, A., **Hawes, Z.**, Howard, S.J., Kent, L., Merkley, R., O'Connor, R., O'Reilly, F., & Simms, V. (2025). Enhancing children's numeracy and executive function skills via explicit integration. *npj Science of Learning*, *10*, 8, https://doi.org/10.1038/s41539-025-00302-9

Hawes, Z., Whitehead, H.L, & Cai, Y., & Mussio, C. (2025). How language influences thought: The case of multiplying fractions. *Journal of Cognition and Development*, 1-25, https://doi.org/10.1080/15248372.2025.2521258

Abreau-Mendoza, R.A.,… **Hawes, Z.**, et al. (registered report; accepted in principle). ManyNumbers 1: A multi-lab international study of early number knowledge. *Developmental Science*

Whitehead, H.L., & **Hawes, Z.** (2023). Cognitive foundations of early mathematics: Investigating the unique contributions of numerical, executive function, and spatial skills. *Journal of Intelligence*, *11*(12), 1-18. https://doi.org/10.3390/jintelligence11120221

Scerif, G., Blakey, E., Gattas, S., **Hawes, Z.**, Howard, S., Merkley, R., O'Connor, R., & Simms, V. (2023). Making the executive 'function' for the foundations of mathematics: The need for

explicit theories of change for early interventions. *Educational Psychology Review*, *35*(110), 1-27. https://doi.org/10.1007/s10648-023-09824-3

Gilligan-Lee, K., **Hawes, Z.**, Williams, A.Y., Farran, E.K., & Mix, K.S. (2023). Hands-on: Investigating the role of physical manipulatives in spatial training. *Child Development*, 94(5), 1205-1221. https://doi.org/10.1111/cdev.13963

Bruce, C.D., Flynn, T., Yearley, S., **Hawes, Z**. (2023). Leveraging number lines and unit fractions to build student understanding: Insights from a mixed methods study. *Canadian Journal of Science, Mathematics, and Technology Education*, 1-18, https://doi.org/10.1007/s42330-023-00278-x

Sokolowski, H. M., **Hawes, Z**., & Ansari, D. (2023). The neural correlates of retrieval and procedural strategies in mental arithmetic: A functional neuroimaging meta-analysis. *Human Brain Mapping*, *44*(1), 229-244, https://doi.org/10.1002/hbm.26082

Sokolowski, H. M., **Hawes, Z.**, Leibovich-Raveh, T., & Ansari, D. (2022). Number symbols are processed more automatically than nonsymbolic numerical magnitudes: Findings from a Symbolic-Nonsymbolic Stroop task. *Acta Psychologica*, *228,* https://doi.org/10.1016/j.actpsy.2022.103644

Gilligan-Lee, K.A., **Hawes, Z.C.K.**, & Mix, K.S. (2022). Spatial cognition as the missing piece of mathematics curricula. *npj Science of Learning, 7*(10), 1-4, https://doi.org/10.1038/s41539-022-00128-9

Lau, N., **Hawes, Z.**, Tremblay, P., & Ansari, D. (2022). Disentangling the individual and contextual effects of math anxiety: A global perspective. *Proceedings of the National Academy of Sciences*, 119(*7*), https://doi.org/10.1073/pnas.2115855119

Hawes, Z.C.K., Gilligan-Lee, K.A., & Mix, K.S. (2022). Effects of spatial training on mathematics performance: A meta-analysis. *Developmental Psychology*, 58(*1*), 112-137 http://doi.org/10.1037/dev0001281

Sokolowski, H. M., **Hawes, Z.**, Peters, L., & Ansari, D. (2021). Symbols are special: An *f*MRI adaptation study of symbolic, nonsymbolic and non-numerical magnitude processing in the human brain. *Cerebral Cortex Communications,* 2*(3),* tgab048 https://doi.org/10.1093/texcom/tgab048

Hawes, Z., Merkley, R., Stager, C. L., & Ansari, D. (2021). Integrating numerical cognition research and mathematics education to strengthen the teaching and learning of early number. *British Journal of Educational Psychology*, 91(4), 1073-1109 https://doi.org/10.1111/bjep.12421

Muñoz-Rubke, F., Will, R., **Hawes, Z.**, & James, K. (2021). Enhancing spatial skills through mechanical problem solving. *Learning and Instruction,* 75, 1-12. https://doi.org/10.1016/j.learninstruc.2021.101496

McDonald, J., Merkley, R., Mickle, J., Collimore, L., **Hawes, Z**., & Ansari, D. (2021). Exploring the implementation of early math assessments in kindergarten classrooms: A research-practice collaboration. *Mind, Brain, and Education*, 15(4), 311-321. https://doi.org/10.1111/mbe.12293

Wilcox, G., Morett, L.M., **Hawes, Z.**, & Domett, E. (2021). Why educational neuroscience needs educational and school psychology to effectively translate neuroscience to educational practice. *Frontiers in Psychology*, 11:618449. https://doi.org/10.3389/fpsyg.2020.618449

Woolcott, G., Chamberlain, D., **Hawes, Z.**, Drefs, M., Bruce, C. D., Davis, B., ... & Mulligan, J. (2020). The central position of education in knowledge mobilization: Insights from network analyses of spatial reasoning research across disciplines. *Scientometrics*, *125*(3), 2323-2347. https://doi.org/10.1007/s11192-020-03692-2

Hawes, Z., Moss, J., Caswell, B., Seo, J., Thomson, M., Thomson, N., Bailey, C. (2020). Effects of a teacher-designed and teacher-led number board game intervention: A randomized controlled trial with 4- to 6- year-olds. *Mind, Brain, and Education, 14*(1), *71-80.* https://doi.org/10.1111/mbe.12215

Hawes, Z., & Ansari, D. (2020). What explains the relationship between spatial and mathematical skills? A review of evidence from brain and behavior. *Psychonomic Bulletin & Review*, *27, 465-482.* https://doi.org/10.3758/s13423-019-01694-7

Hawes, Z., Sokolowski, H. M., Ononye, C. B., & Ansari, D. (2019). Neural underpinnings of spatial and numerical cognition: An *f*MRI meta-analysis of brain regions associated with symbolic number, arithmetic, and mental rotation. *Neuroscience & Biobehavioral Reviews*, *103*, 316-336. https://doi.org/10.1016/j.neubiorev.2019.05.007

Hawes, Z., Moss, J., Caswell, B., Seo, J., & Ansari, D. (2019). Relations between numerical, spatial, and executive function skills and mathematics achievement: A latent-variable approach. *Cognitive Psychology*, *109*, 68-80. https://doi.org/10.1016/j.cogpsych.2018.12.002

Sokolowski, H. M., **Hawes, Z.**, & Lyons, I. M. (2019). What explains sex differences in math anxiety? A closer look at the role of spatial processing. *Cognition*, *182*, 193-212. https://doi.org/10.1016/j.cognition.2018.10.005

Hawes, Z., Nosworthy, N., Archibald, L., & Ansari, D. (2019). Kindergarten children's symbolic number comparison skills predict 1st grade mathematics achievement: Evidence from a two-minute paper-and-pencil test. *Learning and Instruction*, *59*, 21-33. https://doi.org/10.1016/j.learninstruc.2018.09.004

Hawes, Z., Moss, J., Caswell, B., Naqvi, S., & MacKinnon, S. (2017). Enhancing children's spatial and numerical skills through a dynamic spatial approach to early geometry instruction: Effects of a 32-week intervention. *Cognition and Instruction*, *35*(3), 236-264. https://doi.org/10.1080/07370008.2017.1323902

Bruce, C.D., Davis, B., Sinclair, N., McGarvey, L., Hallowell, D., Drefs, M., Francis, K., **Hawes, Z.**, Moss, J., Mulligan, J. & Okamoto, Y. (2017). Understanding gaps in research networks: Using "spatial reasoning" as a window into the importance of networked educational

research. *Educational Studies in Mathematics*, *95*(2), 143-161. https://www.jstor.org/stable/45184558

Francis, K., Bruce, C., Davis, B., Drefs, M., Hallowell, D., **Hawes, Z.**, McGarvey, L., Moss, J., Mulligan, J., Okamoto, Y. & Sinclair, N. (2017). Multidisciplinary perspectives on a video case of children designing and coding for robotics. *Canadian Journal of Science, Mathematics and Technology Education*, *17*(3), 165-178. https://doi.org/10.1080/14926156.2017.1297510

Hawes, Z., Moss, J., Caswell, B., & Poliszczuk, D. (2015). Effects of mental rotation training on children's spatial and mathematics performance: A randomized controlled study. *Trends in Neuroscience and Education*, *4*(3), 60-68. https://doi.org/10.1016/j.tine.2015.05.001

Hawes, Z., LeFevre, J.-A., Xu, C., & Bruce, C. (2015). Mental rotation with tangible three-dimensional objects: A new measure sensitive to developmental differences in 4- to 8-year-old children. *Mind, Brain, and Education*, *9*(1), 10-18. https://doi.org/10.1111/mbe.12051

Moss, J., **Hawes, Z.**, Naqvi, S., & Caswell, B. (2015). Adapting Japanese Lesson Study to enhance the teaching and learning of geometry and spatial reasoning in early years classrooms: A case study. *ZDM – The International Journal on Mathematics Education*, *47*(3), 377-390. https://doi.org/10.1007/s11858-015-0679-2

Bruce, C. D., & **Hawes, Z.** (2015). The role of 2D and 3D mental rotation in mathematics for young children: What is it? Why does it matter? And what can we do about it? *ZDM – The International Journal on Mathematics Education*, *47*(3), 331-343. https://doi.org/10.1007/s11858-014-0637-4

Hawes, Z., Moss, J., Finch, H., & Katz, J. (2013). Choreographing patterns and functions. *Teaching Children Mathematics*, *19*(5), 302-309. https://doi.org/10.5951/teacchilmath.19.5.0302

Book Chapters

Comay, J., Lam, L., Pedersen, Z., & **Hawes, Z.** (2024). Pathways to equitable mathematics: Learning from our work with communities. In A. Eizadirad and P. Trifonas (Eds.) *International handbook of anti-discriminatory education*. Springer Nature Publishing.

Flynn, T., **Hawes, Z.**, & Bruce, C. (2024). Paying attention to spatial reasoning in early years mathematics: Empowering children's learning through a playful, spatial approach. In S. Youmans and L. Colgan (Eds.) *Beyond 1, 2, 3: Early mathematics education in Canada*. CSP Books Inc.

Hawes, Z., Gilligan-Lee, K.A., & Mix, K.S. (2023). Infusing spatial thinking into elementary and middle school mathematics: What, why, and how? In K.M. Robinson, D. Kostopoulos, and A. Dubé (Eds.), *Mathematical cognition and understanding: Perspectives on mathematical minds in the elementary and middle school years* (pp. 13-33). Springer Nature Publishing

Sinclair, N., Moss, J., **Hawes, Z.**, & Stephenson, C. (2019). Learning through and from drawing in early years geometry. In K. Mix and M. Battista (Eds.), *Visualizing mathematics: The role of spatial reasoning in mathematical thought* (pp. 229-252). New York, NY: Springer Nature Publishing.

McGarvey, L., Luo, L., **Hawes, Z.,** & Spatial Reasoning Study Group. (2018). Spatial skills framework for young engineers. In L. English and T. Moore (Eds.), *Early engineering learning* (pp. 53-81). Singapore: Springer Nature Publishing

Hawes, Z., Tepylo, D., & Moss, J. (2015). Developing spatial thinking: Implications for early mathematics education. In B. Davis and Spatial Reasoning Study Group (Eds.), *Spatial reasoning in the early years: Principles, assertions and speculations* (pp. 29-44). New York, NY: Routledge.

Bruce, C., Sinclair, N., Moss, J., **Hawes, Z.**, & Caswell, B. (2015). Spatializing the mathematics curricula. In B. Davis and Spatial Reasoning Study Group. (Eds.), *Spatial reasoning in the early years: Principles, assertions and speculations* (pp. 85-106). New York, NY: Routledge

Books

Moss, J., Bruce, C.D., Caswell, B., Flynn, T. & **Hawes, Z.** (2016). *Taking shape: Activities to develop geometric and spatial thinking.* Toronto, ON: Pearson

Davis, B., & Spatial Reasoning Study Group (2015). *Spatial reasoning in the early years: principles, assertions and speculations.* New York, NY: Routledge

Educational Policy and Government Publications

Hawes, Z., Flynn, T., (co-lead authors) (2014). *Paying attention to spatial thinking: K-12; Support document for paying attention to mathematical education.* Toronto, ON: Queen's Printer for Ontario. **Note:** Over 10, 000 copies in print; every school in Ontario received a copy

Hawes, Z. (2013). *Capacity Building Series: Inquiry-based learning*. Toronto, ON: Queen's Printer for Ontario. **Note:** Over 5, 000 copies in print; every school in Ontario received a copy

Hawes, Z., Gibson, A., Mir, S., & Pelletier, J. (2012). Children's experiences in full-day programs for 4-and 5-year-olds: Play and self-regulation. In Corter, C., Janmohamed, Z., & Pelletier, J. (Eds.), *Toronto First Duty Phase 3 Report* (pp. 31-55). Toronto, ON: Atkinson Centre for Society and Child Development, OISE/University of Toronto.

Editorials

Wilcox, G., Morett, L.M., **Hawes, Z.**, & Domett, E. (2022). The role of educational psychology as a bridge between neuroscience and education. *Frontiers in Education*. https://doi.org/10.3389/feduc.2022.962930

Papers Under Review or in Preparation

Atit, K., Petersen, E.G., Gilligan-Lee, K., & **Hawes, Z.** (revise and resubmit). Examining the relations between spatial skills and science achievement: A meta-analysis. *Psychological Bulletin*

Gilligan-Lee, K., Mix, K., & **Hawes, Z.** (under review, invited submission). The role of spatial skill in mathematics. In J. Bahnmueller, K. Cipora, C. Gilmore, K. Morsanyi, F. Sella, & I. Xenidou-Dervou (Eds.). *Routledge Handbook of Mathematical Cognition*. Routledge.

Yang, X., & **Hawes, Z**. (under review). Visualizing combinatorial structure: Graph-based approaches to the counting principles. *Journal of Mathematical Behavior*

Hawes, Z., Rosenbaum, L., Whitehead, H., D'Silva, I., Turco, J., Crawford, M., Birrell, M., & (under review). From setbacks to renewal: Factors that shape teachers' mathematics identities. *Journal for Research in Mathematics Education*.

Cutting, C. Harris, D., **Hawes, Z**. (under review). From theory to practice and back: The intertwined nature of spatial thinking and fraction learning. *Journal of the Learning Sciences*

Merkley, R., Douglas, H., Kozak, A., Chitranshi, A., Gandhi, A., **Hawes, Z**., Houle, J., Kahwaji, L., McDonald, J. A., Maloney, E. A., Osana, H. P., Primeau, B., Rice, J., Rodrigues, M. L., Skwarchuk, S.-L., Youmans, A., Yu, S., & LeFevre, J.-A. (under review). The AIM Collective: Connecting research and practice in Canadian early mathematics education. *Mind, Brain, and Education*

Díaz-Simón, N.,…**Hawes, Z**.,…Ansari, D. (submitted). Understanding cross-national similarities and differences in foundational numeracy skills: Meta-analytical evidence from the Numeracy Screener. *Developmental Psychology*

Hawes, Z., King, V., Sokolowski, H. M. (submitted). The mind's eye(s): A neuroimaging meta-analysis of spatial versus object imagery. *Neuroscience & Biobehavioral Reviews*

Shapiro, J., Gilligan-Lee, K., Farran, E., & **Hawes, Z**. (in preparation; invited submission). Spatial reasoning and mathematics learning difficulties: Insights from brain, behavior, and genetics. *Topics in Cognitive Science*

Hawes, Z., (in preparation). Why should we care about spatial thinking? An evidence-based argument for the 'spatialization' of education

Yee, G., Masterciyan, H., Whitehead, H., Langburt, D., Talwar, T. K., Jasińska, K. Sokolowski, H. M., & **Hawes, Z**. (in preparation). Is fNIRS a useful tool for studying numerical cognition? A critical review.

Shapiro, J., Musthafa, Z.A., & **Hawes, Z**. (in preparation). The role of spatial thinking in mathematics learning difficulties: A meta-analysis

Musthafa, Z.A., Lam, L., Pedersen, Z. Comay, J., Shapiro, J., Pucci, D., Xie, J. H., Naylor, J., Talwar, T. K., & **Hawes, Z**. (in preparation). Building foundational fraction knowledge through gameplay

Yao, Y., **Hawes, Z**., Sokolowski, H. M., Feng, Z., & Lee, K. (in preparation). The mind-body divide: Math anxiety has distinct psychological and physiological stress responses

Roe, A., **Hawes, Z**., Bower, C., Mix, K., Gilligan-Lee, K. (in preparation). Investigating the association between spatial skills and mathematics using a dual-task paradigm.

Hawes, Z., Moss, J., Caswell, B., Seo, J., Thomson, M., Thomson, N., Bailey, C. & Sinclair, N. (in preparation). Learning to see geometrical relationships: Effects of a teacher-led drawing intervention for 4- to 6- year-olds.

Refereed Conferences and Proceedings

Cheung, P., Poon, M., Ling, S.M., Ng, E., Munez, D., Sun, B., Hawes, Z., Khng, K., Ratnam, C. (2025). *Supporting preschool teachers in numeracy lessons: A professional development approach.* Paper presented at the Mathematical Cognition and Learning Society (MCLS) conference, Hong Kong.

Rosenbaum, L., Whitehead, H., D'Silva, I., Turco, J., Crawford, M., Birrell, M., & **Hawes, Z.** (2025). *What's your relationship with math? An investigation into teachers' mathematics identity.* Poster presented at the Mathematical Cognition and Learning Society (MCLS) conference, Hong Kong.

Whitehead, H., Cai, Y., D'Silva, I., Turco, J., Crawford, M., & **Hawes, Z.** (2025). *How language influences thought: The case of multiplying fractions.* Paper presented at the Mathematical Cognition and Learning Society (MCLS) conference, Hong Kong.

Shapiro, J., Lam, L., Pedersen, Z. Musthafa, Z.A., **Hawes, Z.** (2025). *Learning fractions through an interactive online game intervention*. Paper presented at the Mathematical Cognition and Learning Society (MCLS) conference, Hong Kong.

Yu, S., McDonald, J., **Hawes, Z.**, Merkley, R., Youmans, A., & FeFevre, J.-A. (2024). Canadian educator's beliefs, training, and practices in early math assessment and instruction. Poster presented at the *Canadian Psychological Association (CPA) 85th Annual National Convention*, Ottawa, Canada.

Atit, K., Peterson, E.G., Gilligan-Lee, K., & **Hawes, Z.** (2024). Relations between spatial skills and science achievement: A meta-analysis. Poster presented at *Cognitive Development Society* conference, Pasadena, California, U.S.A.

Munoz-Rubke, F., **Hawes, Z**., Castillo, R.D., Melipillán, K., Zamorano, V., & Soto, J. (2022). What's the relationship between mechanical reasoning and different types of spatial skills? In J.

Culbertson, A. Perfors, H. Rabagliati & V. Ramenzoni (Eds.), *Proceedings of the 44th Annual Conference of the Cognitive Science Society* (pp. 3875). Toronto, Canada.

Gilligan-Lee, K., **Hawes, Z**., Williams, A., Farran, E., & Mix, K. (2022). *Hands-on: Investigating the role of physical manipulatives in spatial training and transfer to mathematics*. Paper presented at the Mathematical Cognition and Learning Society (MCLS) conference, Antwerp, Belgium.

Lau., N.T.T., **Hawes, Z**., Tremblay, P., Ansari, D. (2022). Disentangling the individual and contextual effects of math anxiety: A global perspective. Paper presented at the Mathematical Cognition and Learning Society (MCLS) conference, Antwerp, Belgium.

Bruce, C., **Hawes, Z**., & Flynn, T. (2021). *Supporting the development of young children's spatial reasoning: Insights from the Math for Young Children (M4YC) project*. Paper presented (virtually) at the 14th International Congress on Mathematics Education (ICME), Shanghai, July 2021.

Hawes, Z., Gilligan, K., & Mix, K. (2020). *Can mathematics performance be improved through spatial training? A meta-analysis*. Accepted poster at Mathematical Cognition and Learning Society conference, Dublin, Ireland. Note: Cancelled due to COVID-19

Hawes, Z., Sokolowski, H. M., Ononye, C., & Ansari, D. (2019). *Where and under what conditions do spatial and numerical cognition converge and diverge in the brain? An fMRI meta-analysis.* Poster presented at the Mathematical Cognition and Learning Society conference, Carleton University, ON, Canada.

Sokolowski, H. M., **Hawes, Z.**, Peters, L., & Ansari, D. (2019). *Symbols are special: An fMRI adaptation study of symbolic, nonsymbolic, and non-numerical magnitude processing in the human brain*. Poster presented at the Mathematical Cognition and Learning Society conference, Carleton University, ON, Canada.

Hawes, Z., Moss, J., Caswell, B., Seo, J., & Ansari. (2018). *Relations between Numerical, Spatial, and Executive Function Skills and Mathematics Achievement: A Latent-Variable Approach.* Poster presented at the Mathematical Cognition and Learning Society conference, Oxford University, UK.

Lyons, I.M., Daker, R.J., Sokolowski, H.M., **Hawes, Z**., Ramirez, G., Maloney, E.A., Rendina D.N., Levine, S.C., & Beilock, S.L. (2018). *Spatial Anxiety – A novel tool with applications for STEM education*. Paper presentation at the Mathematical Cognition and Learning Society conference, Oxford University, UK.

Merkley, R., **Hawes, Z.**, & Ansari, D. (2018). What are the barriers to MBE? Insights from conversations and collaborations with early maths educators and researchers. Paper symposium at *International Mind, Brain, and Education Society* conference. Los Angeles, California.

Hawes, Z., Merkley, R., Stager, C., & Ansari, D. (2018). Bridging the gap: Integrating developmental cognitive research and educational practice to strengthen students' number

knowledge. Presentation at *7th Latin American School for Education, Cognitive, and Neural Sciences* (LA School) (June), Aconcagua Valley, Chile, 2018.

Ansari, D., & **Hawes, Z.** (2017). Do students benefit when teachers learn about the science of learning? Evidence from an early math professional development program. Talk presented at *ResearchEd* Toronto 2017, Toronto, ON, Canada.

Moss, J., Caswell, B., **Hawes, Z.**, & Jones, J. (2017). Prioritizing visual spatial mathematical approaches in first nation early years classrooms. In A. Chronaki's (Ed.), *Mathematics Education and Life at Times of Crisis*; *Proceedings of the 9th International Mathematics Education and Society Conference* (pp. 728-738). Volos, Greece.

Flynn, T., Bruce, C., **Hawes, Z.**, Moss, J., & Caswell, B. (2017). Math for Young Children: A classroom-based spatial reasoning intervention. Paper presented at the *Biennial Meeting of the Society for Research in Child Development.* Austin, TX.

Sokolowski, H. M., **Hawes, Z.**, Leibovich, T., & Ansari, D. (2017). The interference of symbolic and nonsymbolic numbers in a novel enumeration Stroop task. Poster presented at the 29th annual *American Psychological Association* convention. Boston, MA.

Hawes, Z., Moss, J., Caswell, B., Cain, M., Thomson, N., Bruce, C., Flynn, T., & Le Duc, P. (2016). Integrating Mind, Brain, and Education through teacher-researcher collaborations. Paper symposium at the *International Mind, Brain, and Education Society* conference. Toronto, ON.

Hawes, Z., Moss, J., Caswell, B., & MacKinnon, S. (2016). Enhancing children's spatial and numerical skills through a dynamic spatial approach to early geometry instruction: Effects of a 32-week intervention. Poster presented at the *6th Latin American School for Education, Cognitive and Neural Sciences* (LA School) (March), Buenos Aires, Argentina, March, 2016.

Moss, J., **Hawes, Z.**, & Caswell, B. (2016). Infusing spatial reasoning into early years mathematics: A year-long K-2 intervention. Paper presented at the *National Council for Teachers of Mathematics Conference*, San Francisco, CA, April, 2016.

Moss, J., **Hawes, Z.**, & Caswell, B. (2016). A spatial approach to early years geometry: Effects of a year-long teacher-led intervention. Part of symposium entitled: Lessons learned about increasing mathematics achievement through spatial instruction. Paper presented at the *American Educational Research Association* Conference, Washington, DC.

Hawes, Z., Moss, J., Caswell, B., Naqvi, S., Bruce, C., & Flynn, T. (2015). A 'spatial' approach to early Mathematics instruction: Effects of a yearlong intervention. Paper presented at the *Biennial Meeting of the Society for Research in Child Development.* Philadelphia, PA.

Hawes, Z., Moss, J., Caswell, B., Naqvi, S., & Poliszczuk, D. (2015). Effects of computerized spatial training on children's spatial and mathematical thinking: A randomized, controlled study. Poster presented at the *Biennial Meeting of the Society for Research in Child Development.* Philadelphia, PA.

Hawes, Z., Moss, J., Caswell, B., & Poliszczuk, D. (2015). To what extent is spatial thinking malleable: Examining near and far transfer effects of computerized mental rotation training. Paper presented at the *45th Annual Jean Piaget Society Conference*. Toronto, Canada.

Tookenay, B., Caswell, B., Jones, J., Moss, J., MacKinnon, S., Snowball, R., Jones, S., **Hawes, Z.**, & Kabatay, T. (2015). Equitable access to quality mathematics for First Nation children. Paper presented at the World Indigenous Research Alliance Symposium, *World Indigenous Nations Higher Education Consortium*, Nanicoste, ON, August, 2015.

Moss, J., **Hawes, Z.**, Naqvi, S., Caswell, B., Bruce, C., Flynn, T. (2014). Changing perceptions of young children's geometry and spatial reasoning competencies: Lessons from the 'Math for Young Children' (M4YC) project. In Liljedahl, P., Nicol, C., Oesterle, S., & Allan, D. (Eds.). Proceedings of the 38th Conference of the International Group for the Psychology of Mathematics Education and the 36th Conference of the North American Chapter of the Psychology of Mathematics Education (Vol. 1; pp. 79-81). Vancouver, Canada: PME.

Moss, J., Tepylo, D., & **Hawes, Z.** (2014). The malleability of spatial reasoning. In Liljedahl, P., Nicol, C., Oesterle, S., & Allan, D. (Eds.). Proceedings of the 38th Conference of the International Group for the Psychology of Mathematics Education and the 36th Conference of the North American Chapter of the Psychology of Mathematics Education (Vol. 1; pp. 87-89). Vancouver, Canada: PME.

Hawes, Z., & Bruce, C. (2014). A misnomer no more: Using tangible cube-figures to measure 3D mental rotation in young children. In Liljedahl, P., Nicol, C., Oesterle, S., & Allan, D. (Eds.). Proceedings of the 38th Conference of the International Group for the Psychology of Mathematics Education and the 36th Conference of the North American Chapter of the Psychology of Mathematics Education (Vol. 1; pp. 95-97). Vancouver, Canada: PME.

Hawes, Z., Chang, D., Naqvi, S., Olver, A., & Moss, J. (2013). Uncovering the processes of young children's 3D mental rotation abilities: Implications for lesson design. In Martinez, M. & Castro Superfine, A (Eds.), *Proceedings of the 35th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Chicago, IL: University of Illinois at Chicago.

Hawes, Z., Chang, D., Olver, A., & Moss, J. (2013). Investigating spatial reasoning in young children: Developing a new measure to inform curriculum design. Paper presented at *Fields MathEd Forum Meeting,* Toronto, ON: The Fields Institute for Research in Mathematical Sciences, University of Toronto.

Hawes, Z., Mancini, M., Morris, J., Olver, A., & Moss, J. (2013). Mental and physical rotations of 3D cube figures in 4-to 11-year olds: Differences in gender, age, and mathematical ability. Paper presented at the *Biennial Meeting of the Society for Research in Child Development.* Seattle, WA.

Hawes, Z., McManus J., Naqvi S., Martinussen R., Pelletier J. (2013). Improving children's ability to self-regulate through computerized cognitive training: a randomized controlled study. Poster presented at the *Biennial Meeting of the Society for Research in Child Development.* Seattle, WA.

Hawes, Z., Moss, J., Chang, D., & Naqvi, S. (2013). Math for Young Children: A professional development model that bridges cognitive science and mathematics education. In Martinez, M. & Castro Superfine, A (Eds.), *Proceedings of the 35th annual meeting of the North American Chapter*

of the International Group for the Psychology of Mathematics Education. Chicago, IL: University of Illinois at Chicago.

Naqvi, S., **Hawes, Z.**, Chang, D., & Moss, J. (2013) Exploring pentominoes in 7 diverse Pre-k/K classrooms. In Martinez, M. & Castro Superfine, A (Eds.), *Proceedings of the 35th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Chicago, IL: University of Illinois at Chicago.

Moss, J., **Hawes, Z.**, Chang, D., Tepylo, D. (2013). From mental rotation task design to lesson planning: The case of the polyomino challenge. Paper presented at *Fields MathEd Forum Meeting,* Toronto, ON: The Fields Institute for Research in Mathematical Sciences, University of Toronto.

Invited Papers and Talks

Hawes, Z. (2025). Enhancing mathematics learning and motivation through spatial reasoning. Invited talk to London District Catholic School Board (LDCSB) Grades 4-6 teachers. London, Ontario, Canada.

Hawes, Z. (2025). Why are fractions so hard? And what can we do about it? Invited talk to London District Catholic School Board (LDCSB) Grades 4-6 teachers. London, Ontario, Canada.

Hawes, Z. (2024). Paying attention to spatial reasoning into early years mathematics. Presented talk and facilitated working group at the *Assessment and Instruction (AIM) for Mathematics* Summit Conference, Ottawa, Canada.

Hawes, Z. (2024). Why should we care about spatial thinking? An argument for the 'spatialization' of mathematics education. Invited talk at the *Jacobs Foundation* meeting, Barranquilla, Columbia.

Hawes, Z. (2022). Improving mathematics teaching and learning through an increased focus on spatial thinking. Invited talk to France's Ministry of National Education and Youth, International Conference of the Scientific Council of National Education (CSEN), Collège de France, Paris.

Hawes, Z. (2021). Paying attention to spatial reasoning in the early years mathematics. Invited video presentation for the *Mathematics Knowledge Network*.

Moss, J., & **Hawes, Z.** (2015). Learning to visualize through "quick image" activities: Building spatial and numerical reasoning for students of all ages. Presentation at *Ontario Association for Mathematics Educators* (OAME). Toronto, ON.

Caswell, B., Moss, J., & **Hawes, Z.**, & Naqvi, S. (2013). Math for Young Children (M4YC) project: A no ceiling approach to math learning in an urban school. *Centre for Urban Schooling*, *1*(1),1-4.

Hawes, Z., Rohel. M, Chang, D., & Naqvi (2013). Tapping into symmetry: Young children's understanding of geometry and spatial reasoning. Presentation at *Ontario Literacy and Numeracy math forum: Creativity and innovation in mathematics*. Toronto, ON.

Bruce, C., Moss, J., Flynn, T., & **Hawes, Z.** (2013). A model of teacher professional development: Math for young children (M4YC). Presentation at *Ontario Ministry of Education Far and Northern Boards Meeting.* Toronto, ON.

Flynn, T., & **Hawes, Z.** (2013). Young children's spatial reasoning. *Ontario Association for Mathematics Education* (OAME). Toronto, ON.

McLaughlin, J., **Hawes, Z.**, & Ellingson, P. (2012). Research-based educational games: Good for the brain? Presentation at *Brainpower*. Toronto, ON: University of Toronto.

Funding

2025 — Social Sciences and Humanities Research Council (SSHRC) Connection Grant (SIG)
CAD: **$24,984**
Connecting Research and Practice in Early Math: Sharing Successes and Forging New Ground
Role: Co-Applicant (PI: Helena Osana)

2024 – 2026 — Social Sciences and Humanities Research Council (SSHRC) Insight Development Grant
Supporting Mathematics Learning and Engagement Through Game-Based Spatial Instruction
CAD: **$67,433**
Role: Primary Investigator (PI)

2024 – 2029 — Natural Sciences and Engineering Research Council of Canada (NSERC) Discovery Grant
Mechanisms Underlying Spatial and Mathematical Cognition
CAD: **$237,500**
Role: Primary Investigator (PI)

2024 – 2026 — Jacobs Foundation Research Fellowship
Maximizing Human Potential Through Spatial Learning
CAD: **$255,000**
Role: Primary Investigator (PI)

2023 – 2025 — Connaught New Researcher Award
How Language Influences Thought: The Case of Multiplying Fractions
CAD: **$19,978**

Role: Primary Investigator (PI)

2023 – 2025 Social Sciences and Humanities Research Council (SSHRC) Partnership Engage Grant (PEG)
Leveraging Children's Interest in Basketball to Improve Access, Understanding, and Attitudes Towards Mathematics
CAD: **$24,948**
Role: Primary Investigator (PI)

2023 – 2025 Education Endowment Foundation (EEF) and Stronger Practice Hubs
Embedding Executive Challenge into Early Maths: A Randomized Controlled Trial (abbreviated title: The ONE Project)
CAD: **$1,667,644.48**
Role: Co-Investigator (PI: Gaia Scerif)

2023 Social Sciences and Humanities Research Council (SSHRC) Connection Grant (SIG)
CAD: **$24,966**
Connecting Advance Assessment and Intervention in Math Education: The AIM Summit
Role: Co-Applicant (PI: Rebecca Merkley)

2023 Social Sciences and Humanities Research Council (SSHRC) Institutional Grant (SIG)
CAD: **$6,864**
What's Your Relationship with Math? Uncovering the Factors that Influence Elementary Teachers' Mathematical Identities
Role: Primary Investigator (PI)

2023 – 2025 Education Research Funding Program (ERFP); Ministry of Education, Singapore
CAD: **$290,699.07**
A Study on Early Mathematics Professional Development (PD)
Role: Co-Principal Investigator (PI: Pierina Cheung)

2022 – 2024 Social Sciences and Humanities Research Council (SSHRC) Partnership Development Grant
CAD: **$198,980**
Assessment and Intervention for Mathematics (AIM)
Role: Co-Applicant (PI: Jo-Anne LeFevre)
Ranked #1 out of 52 applications

2021 – 2023 National Institute of Education (NIE) Singapore
CAD: **$111,810.40**
Early Foundations of Place Value
Role: Co-Principal Investigator (PI: Pierina Cheung)

2021 – 2023 Nuffield Foundation

CAD: **$299,772.40**
Fostering Resilience by Injecting Executive Challenge into Early Maths
Role: Co-Investigator (PI: Gaia Scerif)
Link: https://www.nuffieldfoundation.org/project/fostering-resilience-executive-challenge-early-maths

2021 – 2023 The British Academy Leverhulme Small Research Grants (SRG20\201210)
CAD: **$17,161**
Hands-On: Investigating the Role of Physical Manipulatives in Spatial Training.
Role: Co-Applicant (PI: Katie Gilligan-Lee)

2019 - 2021 Chilean Commission for Scientific and Technological Research (CONICYT). Fund for Promotion of Scientific and Technological Development (FONDEF IDeA I+D)
CAD: **$367,678.66.**
Relations between Spatial Skills and Mathematics Performance in Elementary School Children.
Role: Co-Investigator/International Collaborator (PI: Felipe Munoz-Rubke)

2019 - 2021 Chilean Commission for Scientific and Technological Research (CONICYT). Scientific and Technological Development Fund for Early Career Researchers (FONDECYT de Inciación)
CAD: **$105,100.96**
An Investigation of Causal Relations between Mechanical Reasoning and Spatial Skills.
Role: Co-Investigator/International Collaborator (PI: Felipe Munoz-Rubke)

2014 - 2015 TVOntario (TVO) technology grant
CAD: **$9,004.80**
Examining the Effects of Computerized Spatial Training
Role: Co-Principal Investigator with Joan Moss

2011 - 2012 TVOntario (TVO) technology grant
CAD: **$31, 280**
Computerized Learning
Role: Co-Principal Investigator with Janette Pelletier

Scholarships and Awards

2024 Association for Psychological Sciences Rising Star Award

2024 – 2026 Jacobs Fellow, Jacobs Foundation Research Fellowship Program ($255,000)

2023 Award for Excellence in Initial Teacher Education, Ontario Institute for Studies in Education, University of Toronto

2016 - 2019	University of Western Ontario Doctoral Excellence Research Award ($5000/year)
2015 - 2019	Western Graduate Research Scholarship ($ ~ 5,900/year)
2015 - 2019	Social Sciences and Humanities Research Council of Canada (SSHRC) Doctoral Fellowship ($80,000 over 48 months)
2018	Latin American School for Education, Cognition, and Neural Sciences Fellowship. Aconcagua Valley, Chile. June 17th – 23rd.
2016	Latin American School for Education, Cognition, and Neural Sciences Fellowship. Buenos Aires, Argentina. March 7th – 18th.
2015 - 2016	Ontario Graduate Scholarship (declined)
2011	Dr. Eric Jackman Graduate Studies Researcher Award, University of Toronto ($500)

Consulting

2013 - present	Independent educational consulting for the Ontario Ministry of Education, New Brunswick Ministry of Education, TVOntario (TVO), Branksome Hall, My Oral Village, EvidenceB

Editorial Service

2023 – present	Associate Editor, *Mind, Brain, and Education*

Ad Hoc Journal Reviews

Developmental Science / Psychonomic Bulletin & Review / Psychological Bulletin / Educational Studies in Mathematics / ZDM – International Journal for Mathematics Education / Child Development / Journal of Educational Psychology / Journal of Experimental Child Psychology / Frontiers in Psychology / Intelligence / Cognitive Research: Principles and Implications Scientific Reports / Learning and Individual Differences / Learning and Instruction / Cognition and Instruction / Developmental Psychology / Mind, Brain, and Education / Mathematical Thinking and Learning / Journal of the Learning Sciences / Journal of Cognition and Development / Mathematics Education Research Journal / Journal of Mathematical Behavior / Digital Experiences in Mathematics Education / British Journal of Educational Psychology / Nature Reviews Psychology / Journal of Research in Mathematics Education / Journal of Numerical Cognition / Mathematics Teacher: Learning and Teaching PK-12 / Journal of Intelligence / Journal of Experimental Psychology: General / International Journal of STEM Education / British Journal of Developmental Psychology / Canadian Journal of Experimental Psychology / Child Development Perspectives / Quarterly Journal of Experimental Psychology /

Cognition / Trends in Neuroscience and Education / Open Mind: Discoveries in Cognitive Science / Canadian Journal of Science, Mathematics, and Technology Education / Teaching and Teacher Education / Journal of Experimental Psychology: Human Perception and Performance