



## 2021 FELLOW NOMINATION FORM

### DEADLINE:

Nomination Form and accompanying materials must be received October 31 of the year prior to that in which consideration is requested. Late nomination forms and/or those without the required materials will not be reviewed.

**(Nominations for 2021 Fellows must be received by October 31, 2020)**

### SUBMISSION INSTRUCTIONS:

#### HOW TO SUBMIT:

The nominating Fellow should submit ALL materials electronically by e-mail to the Research Council office at: [research@shapeamerica.org](mailto:research@shapeamerica.org). If an e-mail confirmation of receipt is not received within three business days, please call the RC office to confirm at: 703-476-3455.

#### SUBMISSION CHECKLIST:

Materials should be sent as e-mail attachments as follows:

1. This completed nomination form; including Areas I, II, III and IV
2. Electronic copy of the publications as described in Area I
3. Electronic copy of the abstracts documenting the presentations as described in Area II

It is preferable to submit items **in as few documents as possible; please combine where possible**. As committee members will have a high volume of information to review, **please do not send materials other than those requested**. *Thank you!*

### Research Fellow of SHAPE America (RFSA)/Nominator:

**By submitting the nomination materials, I affirm that the contributions listed herein are significant and to the best of my knowledge, are accurate. Additionally, I have affirmed with the nominee that if elected to Fellow status, they will commit to continuing their active interest in SHAPE America research, present research at Research Council's convention sessions, and cooperate in the work of SHAPE America.**

Name: Justin Haegele, Ph.D.

Email: [jhaegele@odu.edu](mailto:jhaegele@odu.edu)

### NOMINEE INFORMATION:

Name: Andrew M. Colombo-Dougovito, Ph.D., C.A.P.E.

Institution of Doctoral Degree: University of Virginia

Year of Degree Conferred: 2017

Mailing Address: 1155 Union Circle #310769, Denton, TX, 76203-5017

Area(s) of Research Interest: Adapted Physical Education & Activity, Autism & Developmental Disabilities

Phone: (w) 940-565-3403; (h) 810-338-2558

Email: [andrew.colombo-dougovito@unt.edu](mailto:andrew.colombo-dougovito@unt.edu)

Seven-digit SHAPE America Membership Number: 2252075

*Criteria Reminder: member must have at least five years membership in SHAPE America at time of nomination.*

*Criteria Reminder: Publication of a minimum of 10 separate original research articles in nationally recognized peer-reviewed journals with an Impact Factor and a minimum of 5 as lead author – since doctoral degree was conferred. If you include in-press publications for these 10 papers, please provide a letter of acceptance from the editor.*

1. **Authors** (as they appear on paper): **Colombo-Dougovito, A.M., & Lee, Ji.**

**If not first author, explain your role in the research:**

**Title:** Social skill outcomes following physical activity-based interventions for individuals on the autism spectrum: A scoping review spanning young childhood through young adulthood.

**Year & Full Citation:** **Colombo-Dougovito, A.M., & Lee, Ji.** (in press). Social skill outcomes following physical activity-based interventions for individuals on the autism spectrum: A scoping review spanning young childhood through young adulthood. *Adapted Physical Activity Quarterly*. Accepted April 28, 2020.

2. **Authors** (as they appear on paper): Weiller, K. A., Everbach, T., & **Colombo-Dougovito, A. M.**

**If not first author, explain your role in the research:** I was involved with each element of the project from the design to the data collection and analysis, as well as the creation of the manuscript.

**Title:** She's a lady; he's an athlete; they have overcome: Portrayals of gender and disability in the 2018 Paralympic Winter Games.

**Year & Full Citation:** Weiller, K. A., Everbach, T., & **Colombo-Dougovito, A. M.** (in press). She's a lady; he's an athlete; they have overcome: Portrayals of gender and disability in the 2018 Paralympic Winter Games. *Journal of Sports Media*. Accepted April 1, 2020.

3. **Authors** (as they appear on paper): **Colombo-Dougovito, A. M.,** Blagrove, A. J., & Healy, S.

**If not first author, explain your role in the research:**

**Title:** A grounded theory of adoption and maintenance of physical activity among autistic adults.

**Year & Full Citation:** **Colombo-Dougovito, A. M.,** Blagrove, A. J., & Healy, S. (2020). A grounded theory of adoption and maintenance of physical activity among autistic adults. *Autism*. Advanced Online Publication. DOI: 10.1177/1362361320932444.

4. **Authors** (as they appear on paper): McNamara, S. W. T., **Colombo-Dougovito, A. M.,** Weiner, B., & Ahearn, C.

**If not first author, explain your role in the research:** Was involved in the conception and development of the project, data collection, data analysis, and the manuscript generation.

**Title:** Adapted physical educators perceptions of educational research.

**Year & Full Citation:** McNamara, S. W. T., **Colombo-Dougovito, A. M.,** Weiner, B., & Ahearn, C. (2020). Adapted physical educators perceptions of educational research. *Research Quarterly for Exercise and Sport*. Advance Online Publication. DOI: 10.1080/02701367.2020.1732858

5. **Authors** (as they appear on paper): **Colombo-Dougovito, A. M.,** Block, M. E., Zhang, X., & Strehli, I.

**If not first author, explain your role in the research:**

**Title:** A multiple method review of accommodations to standardized assessments commonly used with children and adolescents on the autism spectrum.

**Year & Full Citation:** **Colombo-Dougovito, A. M.,** Block, M. E., Zhang, X., & Strehli, I. (2020). A multiple method review of accommodations to standardized assessments commonly used with children and adolescents on the autism spectrum. *Autism*, 24(3), 693-706. DOI: 10.1177/1362361319884400

6. **Authors** (as they appear on paper): **Colombo-Dougovito, A. M.**, Kelly, L. E., & Block, M. E.

**If not first author, explain your role in the research:**

**Title:** The effect of task modifications on the fundamental motor skills of boys on the autism spectrum.

**Year & Full Citation:** **Colombo-Dougovito, A. M.**, Kelly, L. E., & Block, M. E. (2019). The effect of task modifications on the fundamental motor skills of boys on the autism spectrum. *Journal of Developmental and Physical Disabilities*, 31(5), 653-668. DOI: 10.1007/s10882-019-09666-4

7. **Authors** (as they appear on paper): Blagrove, A. J., & **Colombo-Dougovito, A. M.**

**If not first author, explain your role in the research:** Played a key role in the data analysis and manuscript development.

**Title:** Community barriers to physical activity for families with a child with autism spectrum disorder.

**Year & Full Citation:** Blagrove, A. J., & **Colombo-Dougovito, A. M.** (2019). Community barriers to physical activity for families with a child with autism spectrum disorder. *Advances in Neurodevelopmental Disorders*, 3(1), 72-84. DOI: 10.1007/s41252-018-0094-0.

8. **Authors** (as they appear on paper): **Colombo-Dougovito, A. M.**, & Reeve, R. E.

**If not first author, explain your role in the research:**

**Title:** Exploring the interaction of motor and social skills with autism severity using the SFARI dataset

**Year & Full Citation:** **Colombo-Dougovito, A. M.**, & Reeve, R. E. (2017). Exploring the interaction of motor and social skills with autism severity using the SFARI dataset. *Perceptual and Motor Skill*, 124(2), 413-424.

9. **Authors** (as they appear on paper): **Colombo-Dougovito, A. M.**

**If not first author, explain your role in the research:**

**Title:** Exploring the effect of gender and disability on gross motor performance in kindergarten children.

**Year & Full Citation:** **Colombo-Dougovito, A. M.** (2017). Exploring the effect of gender and disability on gross motor performance in kindergarten children. *The Physical Educator*, 74(2), 183-197.

10. **Authors** (as they appear on paper): **Colombo-Dougovito, A. M.**

**If not first author, explain your role in the research:**

**Title:** ). The roll of dynamic systems theory in motor development research: How does theory inform practice and what are the implications for autism spectrum disorder?

**Year & Full Citation:** **Colombo-Dougovito, A. M.** (2017). The roll of dynamic systems theory in motor development research: How does theory inform practice and what are the implications for autism spectrum disorder? *International Journal on Disability and Human Development*, 16(2), 141-156. DOI: 10.1515/ijdh-2016-0015

*Criteria Reminder: Presentation of a minimum of three separate research papers at the SHAPE America National Conventions on the Research program – within the past 5 years. **NOTE: This is for the 2016-2020 conventions.***

1. **SHAPE America National Presentation**

**Authors** (as they appear on paper): McNamara, S., **Colombo-Dougovito, A. M.**, Ahrens, C., & Weiner, B.

**If not first author, explain your role in the research:** Presented research at conference. Was involved in each element of the research project from conceptualization to data collection to data analysis to dissemination.

**Title:** *Adapted Physical Educators' Views Toward Educational Research.*

**Year/Location of Presentation:** 2020/Salt Lake City, UT (Remote)

2. **SHAPE America National Presentation**

**Authors** (as they appear on paper): **Colombo-Dougovito, A. M.**, & Block, M. E.

**If not first author, explain your role in the research:** Unable to present in person due to weather issues.

**Title:** *Task modifications to improve motor performance in children with ASD*

**Year/Location of Presentation:** 2017/Boston, MA

3. **SHAPE America National Presentation**

**Authors** (as they appear on paper): **Colombo-Dougovito, A. M.**, & Kelly, L.

**If not first author, explain your role in the research:**

**Title:** *Developing modifications for assessment in children with ASD: Preliminary Results.*

**Year/Location of Presentation:** 2016/Minneapolis, MN.

4. **SHAPE America National Presentation**

**Authors** (as they appear on paper): **Colombo-Dougovito, A. M.**, Alexander, M., Douglas, M., Healy, S., & O'Neil, K.

**If not first author, explain your role in the research:**

**Title:** *Practical strategies to successfully assess children with autism spectrum disorder..*

**Year/Location of Presentation:** 2016/Minneapolis, MN.

### AREA III – SERVICE

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1. **Minimum of one service activity with the Research Council (e.g., Research convention abstract reviewer, *RQES* manuscript reviewer, Research council grant review committee) or within SHAPE America in the past 5 years.**

***NOTE: This is for 2016-2020.***

Year(s): 2016 through 2020.

Activitie(s): Convention abstract reviewer (2014-Present); Reviewer of Tommy Wilson Grant (2020) Member of the Annual Conference Program Committee (2017-Present); Chair-elect of APE/A SIG (2019-2020); Chair of APE/A SIG (2020-Present)

2. **Participate at three or more SHAPE America National Conventions – in the past 5 years. *NOTE: This is for the 2016-2020 conventions.***

Years: 2016, 2017, 2020.

### AREA IV – ADDITIONAL FELLOW NOMINEE DOCUMENTATION

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- A. Description of Established Lines of Scholarship (Research and Creative Activity) – *limit 1/2 page, single spaced*

**Please clearly describe your focused program of scholarship supported by your publications, presentations and vita.**

My research focuses on the physical activity behaviors and motor skill development of autistic individuals across their lifespan. This work has focused on examining the socio-environmental barriers that autistic individuals, and their families, face when trying to be physically active. Additionally, I have focused on the instructional practices and the assessment procedures that have been used with autistic individuals to explore their effectiveness. This has also included examining the training of future teachers and examining the continued development of teachers regarding to their ability to include students with disabilities. As a program, I use my expertise of mixed methods within participatory frameworks to co-create solutions with the stakeholders that are most impacted by my work.

- B. Description of Service to SHAPE America, the Research Council and other related national/international organizations – *limit 1/2 page, single spaced*

I have been a SHAPE member since 2009, first as an educator, then as a researcher starting in 2013. Since the 2014 conference, I have served as a reviewer for conference presentation and have been a member of the Annual Convention Program Committee since 2017. Additionally, I have served as a reviewer for the Tommy Wilson Grant applications. Presently, I serve as the Chair of the Adapted Physical Education and Activity (APE/A) special interest group for SHAPE America.

Outside of SHAPE, I have been an engaged member of the National Consortium for Physical Education for Individuals with Disabilities (NCPEID), the North American Federation for Adapted Physical Activity (NAFAPA), the International Federation for Adapted Physical Activity (IFAPA), the American Educational Research Association (AERA), as well as state level SHAPE/AHPERD organizations. I have served as a student representative on the Board of Directors for NAFAPA and as a Member-at-large for NCPEID. Currently, I serve as the Historian on the Board of Directors for NCPEID. Additionally, I have served as the chair of the membership committee for NCPEID and currently serve on the advocacy committee for NCPEID.

- C. Vita –

- D. Letter of Nomination from Research Council Fellow – *limit 1 page*

## CURRICULUM VITA

# ANDREW M. COLOMBO-DOUGOVITO, PhD, CAPE

Assistant Professor of Motor Behavior & Sport Pedagogy

## CONTACT

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1155 Union Circle #310769  
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## AREA OF EXPERTISE

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My specific area of research interest focuses on understanding the motor development and physical activity behaviors of individuals on the autism spectrum across their lifespan. Through a radical pragmatic lens, I use my expertise in mixed methodology to employ both qualitative and quantitative methods in the search of high-quality intervention, assessment, and teaching strategies to reduce systemic barriers to physical activity and healthy behaviors. Through participatory research frameworks, I am interested in co-producing research that closely aligns with actual community need to ensure equal opportunity is provided to autistic individuals and their families.

## EDUCATION

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Year	Degree	Major	Institution
2017	Ph.D.	<b>Kinesiology</b> , focus in Adapted Physical Education	University of Virginia Charlottesville, VA
<i>Dissertation:</i> A mixed methods analysis of the effects of a fundamental motor skill intervention for children with autism spectrum disorder. <a href="https://doi.org/10.18130/V3HW66">https://doi.org/10.18130/V3HW66</a> <i>Committee:</i> Drs. Martin Block (chair), Luke Kelly, B. Ann Boyce, & Nancy Deutsch.			
2011	M.A.	<b>Special (Adapted) Physical Education</b>	Western Michigan University Kalamazoo, MI
<i>Thesis:</i> Comparison of physical fitness performance between elementary-age students with and without attention deficit hyperactivity disorder <i>Advisor:</i> Dr. Jiabei Zhang.			
2009	B.S.	Major: <b>Physical Education</b> Minors: Health, History	University of Michigan Ann Arbor, MI

## PROFESSIONAL EXPERIENCE


Years	Rank/Job Title	Place of Employment
2017 — Present	Assistant Professor	<i>Dept. of Kinesiology, Health Promotion, &amp; Recreation</i> University of North Texas Denton, TX
2016 — 2017	Graduate Researcher	<i>Motivation Intervention Design Lab</i> Curry School of Education University of Virginia Charlottesville, VA
2014 — 2017	University Supervisor	<i>Dept. of Kinesiology</i> University of Virginia Charlottesville, VA
2013 — 2017	Doctoral Research & Teaching Assistant	<i>Dept. of Kinesiology</i> University of Virginia Charlottesville, VA
2012 — 2013	Assistant Researcher	<i>Curriculum &amp; Instruction Lab</i> School of Kinesiology University of Michigan Ann Arbor, MI

## HONORS & AWARDS

2020	Awarded “Top Faculty Paper” <i>Commission on the Status of Women, Association for Education in Journalism and Mass Communication (AEJMC)</i>
2019	Elly D. Friedmann Young Professional Award <i>International Federation for Adapted Physical Activity (IFAPA)</i>
2019 — 2020	Mentoring Micro-grant (\$1,500) <i>Office for the Provost and VP for Academic Affairs, University of North Texas</i>
2019	Travel Support (\$1,000) <i>Office of the Provost, University of North Texas</i>
2017	Connect Learning Grant and Course Development Program (\$750) <i>Career Connect, University of North Texas</i>
2017	Mary Catherine Ellwein Award <i>Curry School of Education, University of Virginia</i>
2017	Adapted Physical Education/Activity Graduate Student of the Year <i>SHAPE America</i>
2016	Linda K. Bunker Scholarship <i>Department of Kinesiology, University of Virginia</i>
2010	Golden Key International Honor Society <i>Nominated &amp; Inducted, Western Michigan University</i>

## CREDENTIALS & CERTIFICATIONS

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- Certification in Mixed Methods Research, University of Michigan School of Social Work (2019), *30 CEU coursework in mixed methods research.*
- Collaborative Institutional Training (CITI) (2018), *Social & Behavioral Research.*
- Apple Teacher  Certification (2017), *Apple Teacher Program.*
- Certified Adapted Physical Educator (CAPE) (2015), *nationally certified as an expert in adapted physical education.*

## OTHER RELEVANT PROFESSIONAL INFORMATION & DEVELOPMENT

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2020 — Present	<b>Editor/Contributor</b> , <i>The Radical Pragmatist</i> Newsletter
2020	Mixed Methods International Research Association MOOC Professional Learning Courses
2019	<b>Co-host</b> , #SaludTues twitter chat. Topic: #NationalDisabilityEmploymentAwareness
2019	<b>Organizer</b> , Community Movie Event (DAMN Good Time!) in collaboration with Texas Woman's University.
2018 — 2019	<b>Editor/Contributor</b> , <i>Meet Me in the Gym</i> (Blog)
2018	Early Career Mentoring Workshop, <i>International Society for Autism Research</i>
2018	NIH K-Award Workshop
2018 — 2019	UNT College of Education, Research Development Fridays
2017 — Present	National Center for Faculty Development & Diversity
2014 — 2016	Tomorrow's Professor Today, University of Virginia Center for Teaching Excellence



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## RESEARCH

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### SCHOLARLY PUBLICATION RECORD

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#### Data-Based or Theoretically Refereed Papers

19 total.

+Mentorship of Student.

1. **Colombo-Dougovito, A.M., & Lee, Ji.** (in press). Social skill outcomes following physical activity-based interventions for individuals on the autism spectrum: A scoping review spanning young childhood through young adulthood. *Adapted Physical Activity Quarterly*. Accepted April 28, 2020.  
*JIF: 1.11; Scimago H-index: 51; SJR: Q2 in Physical Therapy, Sports Therapy and Rehabilitation*
2. Weiller, K. A., Everbach, T., & **Colombo-Dougovito, A. M.** (in press). She's a lady; he's an athlete; they have overcome: Portrayals of gender and disability in the 2018 Paralympic Winter Games. *Journal of Sports Media*. Accepted April 1, 2020.  
*ResearchGate IF: 0.21; Professional Affiliation: Official journal of the Sports Communication Interest Group of the Association for Education in Journalism & Mass Communication*
3. **Colombo-Dougovito, A. M.,** Blgrave, A. J., & Healy, S. (2020). A grounded theory of adoption and maintenance of physical activity among autistic adults. *Autism*. Advanced Online Publication. DOI: 10.1177/1362361320932444.  
*JIF: 4.367; Scimago H-index: 89; SJR: Q1 in Developmental and Educational Psychology*
4. McNamara, S. W. T., **Colombo-Dougovito, A. M.,** Weiner, B., & Aheans, C. (2020). Adapted physical educators perceptions of educational research. *Research Quarterly for Exercise and Sport*. Advance Online Publication. DOI: 10.1080/02701367.2020.1732858  
*JIF: 2.268; Scimago H-index: 82; SJR: Q2 in Medicine*
5. **Colombo-Dougovito, A. M.,** Block, M. E., +Zhang, X., & +Strehli, I. (2020). A multiple method review of accommodations to standardized assessments commonly used with children and adolescents on the autism spectrum. *Autism*, 24(3), 693-706. DOI: 10.1177/1362361319884400  
*JIF: 4.367; Scimago H-index: 82; SJR: Q1 in Developmental and Educational Psychology*
6. **Colombo-Dougovito, A. M.** (2019). Building rapport: Improve interviews to capture detailed responses from parents of children with disabilities. *PALAESTRA*, 33(4), 10-19.  
*Professional Affiliation: Adapted Physical Activity Council of the SHAPE America; US Paralympics, a division of the US Olympic Committee; & the Education Committee of the North American Riding for the Handicapped Association*
7. **Colombo-Dougovito, A. M.,** Kelly, L. E., & Block, M. E. (2019). The effect of task modifications on the fundamental motor skills of boys on the autism spectrum. *Journal of Developmental and Physical Disabilities*, 31(5), 653-668. DOI: 10.1007/s10882-019-09666-4  
*JIF: 0.954; Scimago H-index: 38; SJR: Q2 in Physical Therapy, Sports Therapy and Recreation*
8. **Colombo-Dougovito, A. M., & Block, M. E.** (2019). Fundamental motor skill interventions for individuals with autism spectrum disorder: A literature review. *Review Journal of Autism and Developmental Disabilities*, 6(2), 159-171. DOI: 10.1007/s40489-019-00161-2  
*JIF: 1.407; Scimago H-index: 12; SJR: Q2 in Psychiatry and Mental Health*

9. Blagrove, A. J., & **Colombo-Dougovito, A. M.** (2019). Community barriers to physical activity for families with a child with autism spectrum disorder. *Advances in Neurodevelopmental Disorders*, 3(1), 72-84. DOI: 10.1007/s41252-018-0094-0.

*2018 Journal Metrics currently being updated*

10. Healy, S., **Colombo-Dougovito, A.**, Judge, J., Kwon, E., Strehli, I., & Block, M. (2017). A practical guide to the development of an online course in adapted physical education. *PALAESTRA*, 31(2), 48-54.

*Professional Affiliation: Adapted Physical Activity Council of the SHAPE America; US Paralympics, a division of the US Olympic Committee; & the Education Committee of the North American Riding for the Handicapped Association*

11. **Colombo-Dougovito, A. M.**, & Reeve, R. E. (2017). Exploring the interaction of motor and social skills with autism severity using the SFARI dataset. *Perceptual and Motor Skill*, 124(2), 413-424.

*JIF: 1.049; Scimago H-index: 60; SJR: Q4 in Experimental and Cognitive Psychology*

12. **Colombo-Dougovito, A. M.** (2017). Exploring the effect of gender and disability on gross motor performance in kindergarten children. *The Physical Educator*, 74(2), 183-197.

*Professional Affiliation: Phi Epsilon Kappa*

13. **Colombo-Dougovito, A. M.** (2017). The roll of dynamic systems theory in motor development research: How does theory inform practice and what are the implications for autism spectrum disorder? *International Journal on Disability and Human Development*, 16(2), 141-156. DOI: 10.1515/ijdhhd-2016-0015

*JIF: 0.33; Scimago H-index: 22; SJR: Q2 in Advanced and Specialized Nursing*

14. Chen, W., Zhu, W., Mason, S., Hammond-Bennett, A., & **Colombo-Dougovito, A.** (2016). Effectiveness of quality physical education in improving students' manipulative skill competency. *Journal of Sport and Health Science*, 5(2), 231-238.

*JIF: 3.644; Scimago H-index: 22; SJR: Q1 in Orthopedics and Sports Medicine*

15. **Colombo-Dougovito, A. M.**, & Block, M. (2016). Make task constraints work for you: Teaching object control skills to students with autism spectrum disorder. *Journal of Physical Education, Recreation, and Dance*, 87(1), 32-37.

*Professional Affiliation: SHAPE America*

16. **Colombo-Dougovito, A. M.** (2015). "Try to do the best you can": How pre-service APE specialists experience teaching students with Autism Spectrum Disorder. *International Journal of Special Education*, 30(3), 160-176.

*JIF: 0.15; Scimago H-index: 20; SJR: Q4 in Education*

17. Wilson, W. J., & **Colombo-Dougovito, A.** (2015). Inclusive and effective adapted physical education: Meeting the needs of each student. *Strategies: A Journal for Physical and Sport Educators*, 28(4), 50-52.

*Professional Affiliation: SHAPE America*

18. **Colombo-Dougovito, A. M.** (2015). Successful intervention strategies for autism spectrum disorder and their use for the development of motor skills in physical education. *PALAESTRA*, 29(2), 34-41.

*Professional Affiliation: Adapted Physical Activity Council of the SHAPE America; US Paralympics, a division of the US Olympic Committee; & the Education Committee of the North American Riding for the Handicapped Association*

19. **Colombo-Dougovito, A.** (2013). Comparison of physical fitness performance between elementary-age students with and without attention deficit hyperactivity disorder. *The Physical Educator*, 70(3), 262-280.

*Professional Affiliation: Phi Epsilon Kappa*

## **Data-Based or Theoretically Refereed Papers in Review or Preparation**

*13 total (5 in review; 8 in preparation).*

20. Blagrove, A. J., **Colombo-Dougovito, A. M.**, & Healy, S. (in review). "Just invite us": Autistic adults' recommendations for developing more accessible physical activity opportunities.
21. **Colombo-Dougovito, A. M.**, Kelly, L. E., & Bishop, J. C. (in review). A pilot investigation of potential modifications to gross motor assessment for children with autism spectrum disorder.
22. **Colombo-Dougovito, A. M.**, McNamara, S. W. T., Kumferstein, H., & Blagrove, A. J. (in review). 'Not everybody enjoys physical activity': A qualitative Twitter study of the barriers experienced by autistic adults.
23. **Colombo-Dougovito, A. M.**, Block, M. E., & MacDonald, M. (in review). Including children and adolescents on the autism spectrum in kinesiology research: Strategies to navigate the gray area of informed consent.
24. McNamara, S., Lieberman, L., Wilson, K., & **Colombo-Dougovito, A. M.** (in review). "I mean I hate to say it's sink or swim, but...": College course instructors' perceptions of the adapted physical education content that they prioritize and teach.
25. **Colombo-Dougovito, A. M.**, Healy, S., & Block, M. E. (in preparation). Dynamic systems approach to building motor skills in children on the autism spectrum.
26. **Colombo-Dougovito, A. M.**, Blagrove, A. J., & Block, M. E. (in preparation). Family perspectives of autistic child behaviors during a fundamental motor skills intervention.
27. **Colombo-Dougovito, A. M.**, Dillon, S., & Block, M. E. (in preparation). Mixed methods analysis of a fundamental motor skill intervention for children on the autism spectrum.
28. **Colombo-Dougovito, A. M.** (in preparation). Make motor learning more accessible for children on the autism spectrum through task modifications.
29. **Colombo-Dougovito, A. M.**, Blagrove, A. J., & Healy, S. (in preparation). The self-identified social network of autistic adults and their importance to physical activity engagement.
30. Bishop, J. C., **Colombo-Dougovito, A. M.**, & Grabowsky, A. (in preparation). A systematic review of objective measures for physical activity in populations on the autism spectrum.
31. **Colombo-Dougovito, A. M.**, Blagrove, A. J., Bremer, E., & Gassner, D. (in preparation). Physical activity and individuals on the autism spectrum: Report from the first "physical activity" special interest group meeting at the 2019 INSAR annual meeting.
32. **Colombo-Dougovito, A.M.**, Abel, T., & +Kersala, R. (in preparation). Socially-assistive robots and physical activity engagement among autistic youth: The possibilities and limitations.

## Book Chapters

3 total.

1. Lourenço, C., Esteves, D., & **Colombo-Dougovito, A. M.** (in preparation). Methodological strategies, planned motor activities and motor assessment in children and young people with autism spectrum disorder. In D. Esteves (Ed.), *Exercise: Physical, Physiological and Psychological Benefits*, Hauppauge, NY: Nova Science Publishers, Inc.
2. **Colombo-Dougovito, A. M.**, Dillon, S. R., & Mpofu, E. (in press). Neurodiverse people. In E. Mpofu (Ed.), *Sustainable Community Health: Systems and Practices in Diverse Settings*, Basingstoke, United Kingdom: Palgrave Macmillan.
3. Kelly, L. E., Block, M., & **Colombo-Dougovito, A.** (2017). Physical education. In Kauffman, J. M., Hallahan, D. P., & Pullen, P. C. (Eds.), *Handbook of Special Education (2nd ed.)*, New York: Routledge.

## Non-traditional Publications (Non-referred)

4 total (1 print; 3 audio).

1. Martin, R. (Editor), & **Colombo-Dougovito, A. M.** (Contributor). (2020, Oct. 20). *Adapted physical educators perceptions of educational research [Audio podcast]*. Retrieved from <https://anchor.fm/PwRHPE/episodes/125-APE-Teachers-Perspectives-of-Educational-Research-ejppgg/a-a3jacui>.
2. Block, M. E., Judge, J., Nichols, C., & **Colombo-Dougovito, A. M.** (2020, Sept.). How physical activity can benefit your child with autism. *Autism Parenting Magazine*, 107, 11-18.
3. McNamara, S. (Editor), **Colombo-Dougovito, A. M.** (Contributor), Aherns, C. (Contributor), & Weiner, B. (Contributor). (2020, July 15). *Adapted physical educators' perspectives of educational research [Audio podcast]*. Retrieved from <https://mrmmcnamaras.blogspot.com/2020/07/adapted-physical-educators-perspectives.html>.
4. McNamara, S. (Editor), **Colombo-Dougovito, A. M.** (Contributor), Blagrove, A.J. (Contributor), & Vanderbom, K. (Contributor). (2019, July 17). *Social justice in adapted physical education [Audio podcast]*. Retrieved from <http://mrmmcnamaras.blogspot.com/2019/07/social-justice-in-adapted-physical.html>.

## GRANTS & CONTRACTS

### External Grants

5 total. 1 active; 1 completed; 2 submitted; 1 in preparation.

#### Research Grants/Contracts (Awarded, Active)

- Lee, J., **Colombo-Dougovito, A. M.** (Co-I), & Zhang, T. Examining service providers' perspectives toward physical activity in children on the autism spectrum. 11/2018 — 11/2019. (\$500). Association for Applied Sport Psychology Student Seed Fund. Products: On-going.

#### Research Grants/Contracts (Awarded, Completed)

- **Colombo-Dougovito, A. M.** (PI, 100%). Dynamic systems approach to build motor skills in children with autism spectrum disorder. 01/2015 — 12/2015. (\$1,000). Golden Key International Honor Society - 2014 Research Grant. Products: 1 published article, 5 presentations.

**Research Grants/Contracts (Submitted)**

- McNamara, S., & **Colombo-Dougovito, A. M. (co-PI; 50%)**. An examination of physical educators' views towards educational research. 06/2020 — 02/2022. (\$50,000; subaward: \$8,642). Spencer Foundation Small Grant.
- **Colombo-Dougovito, A. M. (PI)**. ADAPTED: The pursuit for access and opportunity for individuals with disabilities to be physically active. 08/2020 — 07/2021. (\$60,000). National Endowment for the Humanities, Fellowship

**Research Grants/Contracts (in preparation)**

- **Colombo-Dougovito, A. M. (Lead PI; 100%)**, & Dillon, S. R. Physical activity of autistic adults (PA3). 01/2021 — 12/2023. (\$299,428). National Institute of Health — R15 Mechanism.

**Research Grants/Contracts (select unfunded)**

- Mpofu, E., Holloway, L., Zhong, X., Ludi, S., Zhou, Z., Prybutok, G., Connors, P, Catalano, D., **Colombo-Dougovito, A. M. (co-PI; 10%)**, Carey, C., & Sanford, J. Smart Technologies for Inclusive Living Aging With Autism Spectrum Disorder (STILAS). 01/2020 — 12/2023. (\$1,500,000). U.S. Department of Health and Human Services.
- **Colombo-Dougovito, A. M. (Lead PI; 100%)**, & Dillon, S. R. Physical activity of autistic adults (PA3). 07/2020 — 06/2022. (\$299,428). National Institute of Health — R15 Mechanism.

**Internal Grants**

*4 total. 1 active; 3 completed.*

**Research Grants/Contracts (Awarded, Active)**

- Savage, M., & **Colombo-Dougovito, A. M. (co-PI; 50%)**. A mixed methods analysis on the effects of fitness classes on physical fitness performance outcomes for adults with intellectual disability. 10/2019 — 09/2020. (\$10,000). UNT College of Education Collaborative Grant. Products: On-going.

**Research Grants/Contracts (Awarded, Completed)**

- **Colombo-Dougovito, A. M. (PI)**. Physical activity experiences of autistic adults. 02/2018 — 11/2018. (\$7,150). UNT Office of Research and Economic Development. Products: 1 manuscript submission and 4 presentations.
- **Colombo-Dougovito, A. M. (PI)**. Summer Research. 05/2018 — 08/2018. (\$5,000). UNT Provost's Office. Products: 2 published articles and 2 presentations.
- **Colombo-Dougovito, A. M. (PI)**. A mixed methods analysis of a fundamental motor skill intervention for children with ASD. 06/2015 — 05/2017. (\$972.50). University of Virginia Curry School of Education IDEA Dissertation Grant. Products: 1 dissertation, 2 publications and 6 presentations.

## PAPERS PRESENTED

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### Invited Presentations

4 total.

1. **Colombo-Dougovito, A. M.** (2021, March 12). *Navigating access: Modifying the environment to leverage the strengths of autistic youth*. Oral presentation for the Binghamton Regional Center for Autism Spectrum annual conference, Binghamton, NY [Remote].
2. **Colombo-Dougovito, A. M.** (2018, Sept. 1). *Task Modification to effectively build gross motor skills in autistic youth*. Paper presented at the Northern California Autism Symposium, Chico, CA.
3. **Colombo-Dougovito, A. M.** (2018, July 24). *Inclusion of autistic voices: Strategies to navigate the grey area of informed consent*. Paper presented as a part of a panel at the 9th International Conference on Applied Human Factors and Ergonomics and the Affiliated Conferences, Orlando, FL.
4. **Colombo-Dougovito, A. M.** (2016, June 28). *Working with Students with Autism Spectrum Disorder*. Oral presentation at the Content Teaching Academy. James Madison University, Harrisonburg, VA

### Webinars

1 total.

1. **Colombo-Dougovito, A. M.** (2020, Oct. 7). *We are in this together: Improving research outcomes by including key stakeholders*. Building session presented to the AERA Research on Learning & Instruction in Physical Education special interest group (SIG93).

### Peer-Reviewed Abstract Presentations

45 total.

+Mentorship of Graduate Student; ^Mentorship of Undergraduate Student; \*Inclusion of Stakeholder.

\*Presenting author.

### International

16 total

1. **\*Colombo-Dougovito, A. M.,** McNamara, S., Blagrove, A. J., & Kumferstein, H. (2020, May). *A conversation on Twitter: Autistic adults perspectives on physical activity*. Poster presented at the International Society for Autism Research (INSAR) 2020 annual meeting, Seattle, WA. [Conference canceled due to COVID-19]
2. +Stutts, S., ^Kesala, R., Abel, T., & **\*Colombo-Dougovito, A. M.** (2020, May). *Using a Socially Assistive Robot to Engage Children in Physical Activity: An Analysis of "What's Possible" Using a Participatory Design Framework*. Poster at the International Society for Autism Research (INSAR) 2020 annual meeting, Seattle, WA. [Conference canceled due to COVID-19]
3. **\*Colombo-Dougovito, A. M.,** Blagrove, A. J., & Healy, S. (2019, June). *Lifetime physical activity experiences of autistic adults: A grounded theory study*. Paper presented at the 2019 International Symposium of Adapted Physical Activity (ISAPA), Charlottesville, VA.
4. **\*Colombo-Dougovito, A. M.,** Block, M. E., +Zhang, X., & +Strehli, I. (2019, June). *Common modifications for youth on the autism spectrum during motor and physical fitness assessment*. Paper presented at the 2019 International Symposium of Adapted Physical Activity (ISAPA), Charlottesville, VA.

5. **\*Colombo-Dougovito, A. M.**, Blagrove, A. J., Vanderbom, K., & McNamara, S. (2019, June). *Participatory research: Improving adapted physical activity outcomes by including key stakeholders*. Building session presented at the 2019 International Symposium of Adapted Physical Activity (ISAPA), Charlottesville, VA.
6. **\*Colombo-Dougovito, A. M.**, Blagrove, A., & Healy, S. (2019, May). *A new grounded theory of physical activity participation in autistic adults: Preliminary findings*. Paper presented at the International Society for Autism Research (INSAR) 2019 annual meeting, Montreal, Canada.
7. **\*Blagrove, A., & Colombo-Dougovito, A. M.** (2019, March). *Experiences participating in community physical activity by families who have an autistic child: Findings and recommendations*. Poster presented at the 2019 Pac Rim International Conference on Disability and Diversity, Manoa, HI.
8. **\*Colombo-Dougovito, A. M.**, & Block, M. E. (2018, August). *A mixed methods analysis of a fundamental motor skill intervention for children with autism spectrum disorder*. Paper presented at the MMIRA International Conference 2018, Vienna, Austria.
9. **\*Colombo-Dougovito, A.** & Block, M. E. (2018, May). *A fundamental motor skill intervention using a dynamic systems approach*. Paper presented at the International Society for Autism Research (INSAR) 2018 annual meeting, Rotterdam, Netherlands.
10. **Colombo-Dougovito, A.**, & **\*Block, M. E.** (2017, June). *Task modifications to improve motor performance in children with ASD: A pilot study using a dynamic systems approach*. Paper presented at the International Symposium for Adapted Physical Activity (ISAPA) biannual conference, Daegu City, South Korea.
11. **\*Blagrove, A. J.**, & **Colombo-Dougovito, A.** (2017, May). *Facilitators and barriers to physical activity in the community in families with children who have autism spectrum disorder*. Poster presented at the International Meeting for Autism Research, San Francisco, CA.
12. **\*Colombo-Dougovito, A.**, & Block, M. E. (2016, September). *Parent perceptions of the physical ability of children with ASD: An excerpt from a mixed methods dissertation of a FMS intervention*. Paper presented at the North American Federation of Adapted Physical Activity (NAFAPA) biannual conference, Alberta, Canada.
13. **\*Colombo-Dougovito, A.**, & Kelly, L. E. (2016, September). *When we assess, do they understand? A pilot study to make assessments more accessible for children with ASD*. Paper presented at the North American Federation of Adapted Physical Activity (NAFAPA) biannual conference. Alberta, Canada.
14. **\*Colombo-Dougovito, A.**, & Reeve, R. (2016, May). *Analyzing how autism severity affects motor and social skills: An exploration using the SFARI Base dataset*. Poster presented at the International Meeting for Autism Research (IMFAR), Baltimore, MD.
15. **\*Colombo-Dougovito, A.** (2014, October). *Preservice adapted physical education teacher challenges when teaching motor skills to children with autism spectrum disorder*. Poster presented at the North American Federation of Adapted Physical Activity (NAFAPA) biannual conference, Ann Arbor, MI.
16. **\*Colombo-Dougovito, A.** (2014, October). *Effect of gender and disability on gross motor performance in kindergarten children*. Poster presented at the North American Federation of Adapted Physical Activity (NAFAPA) biannual conference, Ann Arbor, MI.

## National

18 total.

17. \*Everbach, T., Weiller-Abels, K., & **Colombo-Dougovito, A.** (2020, August). *She's a Lady; He's an Athlete; They have overcome: Portrayals of Gender and Disability in the 2018 Paralympic Winter Games*. [Virtual] Paper presented at the Association for Education in Journalism and Mass Communication (AEJMC) conference organized by the Commission on the Status of Women, San Francisco, CA.
18. \***Colombo-Dougovito, A. M.**, Blagrove, A., Vanderbom, K. & McNamara, S. (2020, April). *We Are in This Together: Improving Research Outcomes by Including Key Stakeholders* [Pre-Conference Mentoring Session]. American Educational Research Association (AERA) Annual Meeting, San Francisco, CA <http://tinyurl.com/qlhx5hw> (Conference Canceled)
19. McNamara, S., \***Colombo-Dougovito, A. M.**, Ahrens, C., & Weiner, B. (2020, April). *Adapted Physical Educators' Views Toward Educational Research*. Digital paper presentation for the 2020 SHAPE America National Convention & Expo, Salt Lake City, UT.
20. \*Blagrove, A. J., & **Colombo-Dougovito, A. M.** (2018, November). *What autistic adults say about their physical activity experiences and why we should listen*. Paper presented at the 47th National Adapted Physical Education (APE) Conference (NAPEC), San Diego, CA.
21. Bishop, J., & \***Colombo-Dougovito, A. M.** (2018, October). *Measurement of physical activity of young adults on the autism spectrum*. Paper presented at the North American Federation of Adapted Physical Activity 2018 bi-annual meeting, Corvallis, OR.
22. \***Colombo-Dougovito, A. M.**, & Lee, Ji. (2018, October). *A systematic review of social skills common to physical activity-based interventions for individuals on the autism spectrum*. Paper presented at the North American Federation of Adapted Physical Activity 2018 bi-annual meeting, Corvallis, OR.
23. Blagrove, A. J., & \***Colombo-Dougovito, A. M.** (2018, October). *Barriers to physical activity participation in the community for families with a child on the autism spectrum*. Paper presented at the North American Federation of Adapted Physical Activity 2018 bi-annual meeting, Corvallis, OR.
24. \***Colombo-Dougovito, A.**, & Blagrove, A (2018, July). *"Nothing about us, without us": A building session for using participatory design frameworks in adapted physical activity research*. Paper presented at the National Consortium for Physical Education for Individuals with Disabilities (NCPEID) annual meeting, Arlington, VA.
25. \*+Lee, Jo., **Colombo-Dougovito, A.**, & Zhang, T. (2018, July). *Examining physical activity in children on the autism spectrum from service provider's perspective*. Paper presented in the Emerging Scholars Symposium at the National Consortium for Physical Education for Individuals with Disabilities (NCPEID) annual meeting, Arlington, VA.
26. \***Colombo-Dougovito, A.** (2017, March). *Task modifications to improve motor performance in children with ASD*. Paper presented at SHAPE America annual national convention, Boston, MA.
27. \***Colombo-Dougovito, A. M.**, Kelly, L. E., & Block, M. E. (2016, August). *The effect of task modifications on fundamental motor skills of children with ASD: Preliminary results of a pilot study*. Paper presented in the Emerging Scholars Symposium at the National Consortium for Physical Education for Individuals with Disabilities (NCPEID) annual meeting, Tyson's Corner, VA.



28. **\*Colombo-Dougovito, A.**, Alexander, M., Douglas, M., Healy, S., & O'Neil, K. (2016, April). *Practical strategies to successfully assess children with autism spectrum disorder*. Paper presented at SHAPE America annual national convention, Minneapolis, MN.
29. **\*Colombo-Dougovito, A.**, & Kelly, L. (2016, April). *Developing modifications for assessment in children with ASD: Preliminary Results*. Paper presented at SHAPE America annual national convention, Minneapolis, MN.
30. **\*Colombo-Dougovito, A.**, & Block, M. (2016, February). *Making task constraints work for you: Teaching motor skills to children with autism spectrum disorder*. Paper presented at SHAPE America - Southern District annual convention, Williamsburg, VA.
31. **\*Colombo-Dougovito, A.** (2015, July). *Utilizing a dynamic systems approach to building functional motor skills in children with ASD*. Paper presented in the Emerging Scholars Symposium at the National Consortium for Physical Education for Individuals with Disabilities (NCPEID) annual meeting, Tyson's Corner, VA.
32. **\*Healy, S.**, & **Colombo-Dougovito, A.** (2015, March). *Evaluating fidelity in online professional development for physical educators*. Paper presented at SHAPE America annual national conference, Seattle, WA.
33. **\*Colombo-Dougovito, A.** (2014, June). *Developing a protocol for use of the Test of Gross Motor Development, TGMD-2, with children with autism spectrum disorder*. Paper presented in the Emerging Scholars Symposium at the National Consortium for Physical Education for Individuals with Disabilities (NCPEID) annual conference, Tyson's Corner, VA.
34. **\*Colombo-Dougovito, A.** (2013, April). *Comparison of fitness performance between children with and without ADHD*. Poster presented at the AAHPERD National Convention Poster Session, Charlotte, NC.

## Regional

11 total.

35. **\*Mpofu, E.**, Holloway, L., Zhong, X., Ludi, S., Shou, Z., ... **Colombo-Dougovito, A.**, ... & Berhadsky, J. (2019, May). *Smart technologies for inclusive living aging with autism spectrum disorder (STILAS)*. Poster presented at Enabling Health Technologies meeting, Denton, TX.
36. **\*Colombo-Dougovito, A. M.**, & Blagrove, A. J. (2019, March). *"Unless you deal with the sensory stuff, nothing else matters": Autistic adult's experiences with physical activity and recommendation for better inclusion*. Paper presented at second annual Able, Active, and Adaptive Conference, College Station, TX.
37. **\*Colombo-Dougovito, A.** (2017, November). *Improving motor performance in children with ASD using task modifications*. Paper presented at Texas Association of Health, Physical Education, Recreation, & Dance's 94th Annual Conference, Fort Worth, TX.
38. **\*Colombo-Dougovito, A.** (2017, July). *Importance of gross motor skill programming for children and adolescents with autism spectrum disorder and strategies to be effective*. Paper presented at the 9th Annual Adventures in Autism Intervention and Research Conference, Denton, TX.

39. \***Colombo-Dougovito, A.** (2016, November). *Designing Purposeful Task Modification to Improve the Success of Children with Autism Spectrum Disorder in P.E.* Paper presented at VAHPERD annual conference, Midlothian, VA.
40. \***Colombo-Dougovito, A.** (2016, February). *The roll of dynamic systems theory in motor development research: How does theory inform practice and what are the implications for autism spectrum disorder?* At Curry Research Conference, Charlottesville, VA.
41. \***Colombo-Dougovito, A.**, Healy, S., Wilson, J., & Jackson, T. (2015, March). *Building a protocol for utilizing the TGMD-3 with children with autism spectrum disorder: Preliminary results.* Paper presented at the Curry Research Conference, Charlottesville, VA.
42. \***Colombo-Dougovito, A.**, & Healy, S. (2014, November). *Utilizing evidence-based practices to teach motor skills to children with autism spectrum disorder (ASD).* Paper presented at VAHPERD annual conference, Virginia Beach, VA.
43. \***Colombo-Dougovito, A.** (2014, February). *Evidence-based autism intervention strategies and their potential to develop motor skills.* Paper presented at the Curry Research Conference, Charlottesville, VA.
44. \*Jackson, T., Healy, S., Hwan Koh, Y., **Colombo-Dougovito, A.**, Judge, J, and Wang, B. (2014, February). *Comparing selected international K-12 physical education programs.* Poster presented at Curry Research Conference, Charlottesville, VA.
45. \***Colombo-Dougovito, A.**, & Healy, S. (2013, October). *Theory to Practice: inclusive practices for physical education teachers.* Paper presented at University of Virginia Curry Cup, Charlottesville, VA.

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## TEACHING

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### INSTRUCTIONAL ACTIVITIES

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My instructional areas of expertise include: adapted physical education/activity, teaching pedagogy, disabilities (specific focus on developmental disabilities and autism spectrum disorders), measurement and assessment in teaching and physical education, motor development, and research methods (specific focus on qualitative and mixed methods). I am trained and proficient in providing instruction in-person, hybrid, and online.

#### Course Enrollment Totals (credit)

*\*updated existing course, \*\*re-designed existing course, \*\*\*designed new course*

*UG = undergraduate level; G = graduate level*

Course #	Course Title	Level	Semesters	Enrollment	Location
KINE 3020*	<b>Movement for Individuals with Disabilities (hybrid)</b>	UG	8	560	UNT

**Course Description:** Comprehensive practical approach to conducting physical activity programs for individuals with disabilities. Course is delivered in a blended format (online and in person), and includes legal entitlement and relevant procedures that conform with state and federal legislative mandates. Procedures on integrating individuals with disabilities, as well as procedures for assessment, programming and facilitation of learning are presented. Classroom discussions and activities will revolve around understanding the movement needs of a variety of disabilities and how to best modify programs to meet those needs. In addition to classroom-based lectures and discussions, students will gain hand-on experiences working with a child(ren) with disabilities; this allows for both a theoretical and practical understanding of the concepts presented in class.

**Student Evaluations** (Summative Rating [5.0 highest], Challenge & Engagement Index [7.0 highest]):

Summer 2020: 4.4, 4.0 (Online)

Spring 2020: 4.8, 5.0

Fall 2019: 4.7, 5.2

Summer 2019: 4.7, 5.0

Spring 2019: 4.9, 5.4

Fall 2018: 4.3, 5.6 [Sec. 1], 3.8, 5.2 [Sec. 2]

Summer 2018: 4.8, 4.8

Spring 2018: 4.4, 5.3 [Sec. 1], 4.5, 5.1 [Sec. 2]

Fall 2017: 4.1, 4.9 [Sec. 1], 3.6, 4.7 [Sec. 2]

Course #	Course Title	Level	Semesters	Enrollment	Location
KINE 3550	<b>Elementary Teaching Methods</b>	UG	1	68	UNT

**Course Description:** Effective use of communication and pedagogical skills and strategies to enhance student engagement and learning. Focuses on developmentally appropriate physical education at the EC-6 level, highlighting movement education theory and application. Candidates are provided with opportunities to learn and implement effective demonstrations, explanations and instructional cues and prompts, linking physical activity concepts to appropriate learning experiences. Candidates are afforded both peer teaching and field based applications of content.

**Student Evaluations** (Summative Rating [5.0 highest], Challenge & Engagement Index [7.0 highest]):  
Spring 2020: 4.7, 4.8

KINE 5100**	<b>Research Perspectives in Kinesiology, Health Promotion, and Recreation</b>	G	1	30	UNT
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**Course Description:** The study of human movement is a complex and ever evolving science. To appropriately understand how we move, why we move certain ways, and how we can move better, a research scientist must design and employ a diverse array of research methodologies. Unfortunately, there is no one “right” way to conduct a research study; instead, we must ensure that there is cohesion between what is being asked and what is being analyzed. To that end, it is essential that researchers have a foundational understanding of how to design a study from conception through analysis. Further, competency in research methods is more than a technical understanding of statistics and measurement; it requires the development skills so as to critically analyze questions, methods, uses of research data and inferences based on evidence. The foundations of useful kinesiology- based research, therefore, relies on a solid understanding of the connections among research questions, methods for gathering and analyzing evidence, inference from evidence, and links between inference and use. These connections will be the foci and driving force of this course.

**Student Evaluations** (Summative Rating [5.0 highest], Challenge & Engagement Index [7.0 highest]):  
Fall 2020: On-going [online]  
Fall 2019: 4.8, 5.8

KINE 2900	<b>Special Problems Research</b>	UG	1	1	UNT
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**Course Description:** This course is a collaborative effort of myself and a Freshman or Sophomore level undergraduate student. This course is designed to give students an in depth focus into a specific topic of interest. Projects are highly independent and self-driven.

Spring 2019: Rishin Kersala

Course #	Course Title	Level	Semesters	Enrollment	Location
KINE 4900	<b>Special Problems Research</b>	UG	1	1	UNT

**Course Description:** This course is a collaborative effort of myself and a Junior or Senior level undergraduate student. This course is designed to give students an in depth focus into a specific topic of interest. Projects are highly independent and self-driven. Typically course outcomes are submitted for publication or presentation at a state or national conference.

Spring 2019: Zoë Alderman

KINE 5900	<b>Special Problems Research</b>	G	1	1	UNT
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**Course Description:** This course is a collaborative effort of myself and a graduate student. This course is designed to give students a research intensive focus into a specific topic of interest. Projects are highly independent and self-driven. Course projects are submitted for publication or presentation at a state, national, or international conference.

Summer 2020: Zaquavia Bluitt

INST 3150*	<b>CavEd Seminar</b>	UG	2	26	UVA
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**Course Description:** This pedagogy seminar provides Student-Instructors the theoretical underpinnings of teaching in higher education, addressing questions such as: What do you want your students to know, be able to do, or find value in now and later? How will you engage your students in the learning process? How will you know if students are learning? Practical suggestions on ways to implement the ideas and address specific challenges are explored. The first third of the course will involve reading and discussion. The second third of the course will involve course proposal development. The final third of the course will involve implementing ideas discussed in the first two-thirds into daily lesson plans for your potential course, and practice teaching. Students should expect to average about two hours of outside coursework weekly for a 1-credit course, and to actively participate on the class forum and in class. Workload fluctuates, with some weeks lighter than others.

**Student Evaluations** (Summative Rating [5.0 highest]):

Fall 2016: 4.5

Spring 2015: n/a

KINE 5000***	<b>PE for Children with ASD (online)</b>	UG/G	1	11	UVA
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**Course Description:** The online class is designed for practicing physical education teachers and adapted physical education specialists who want to learn more about the specific challenges and best practices when teaching children with autism. Students taking this class should currently work with children with autism in a physical education/physical activity setting, as most of the assignments require hands-on work with children with autism.

**Student Evaluations:**

Fall 2016: n/a

## Invited Lectures and Symposia

19 total.

1. **Colombo-Dougovito, A.** (2020, November). *Examining our presumptions: How society influences our presumption of “ability” and its influence on disabled people.* PEMES 4152: Adapted Physical Education, University of Northern Iowa. [Remote lecture]
2. **Colombo-Dougovito, A.** (2020, April). *“We live in a disabling society”: Artificial limitations, major barriers, and social injustice in the US as a result of ableism.* KINE 2050: Sociology of Sport, University of North Texas. [Lecture recorded for future semesters]
3. **Colombo-Dougovito, A.** (2019, October). *Age and Ability: Social Barriers: Participation and Inclusion.* KINE 2050: Sociology of Sport, University of North Texas.
4. **Colombo-Dougovito, A.** (2019, April). *Motor Development of Children on the Autism Spectrum.* EDSP 3410: Developmental Disabilities and Autism, University of North Texas.
5. **Colombo-Dougovito, A.** (2019, March). *Adapted Careers.* KHPRos Student Meeting, University of North Texas.
6. **Colombo-Dougovito, A.** (2015, February). *Working with Individuals on the Spectrum.* AutismSpeaks Club, University of Virginia.
7. **Colombo-Dougovito, A.** (2015, November). *Autism Spectrum Disorders.* KINE 3210: Kinesiology for Individuals with Disabilities, University of Virginia.
8. **Colombo-Dougovito, A.** (2015, November). *Learning Disabilities.* KINE 3210: Kinesiology for Individuals with Disabilities, University of Virginia.
9. **Colombo-Dougovito, A.** (2015, October). *Dynamic Systems and Task Constraints.* Graduate Seminar in APE, University of Virginia.
10. **Colombo-Dougovito, A.** (2015, October). *Regression.* KINE 5100: Assessment in Kinesiology, University of Virginia.
11. **Colombo-Dougovito, A.** (2015, October). *Data Collection.* KINE 5100: Assessment in Kinesiology, University of Virginia.
12. **Colombo-Dougovito, A.** (2015, March). *Locomotor Skills.* EDHS 3040/5040: Motor Development, University of Virginia.
13. **Colombo-Dougovito, A.** (2015, March). *Object Control Skills.* EDHS 3040/5040: Motor Development, University of Virginia.
14. **Colombo-Dougovito, A.** (2014, November). *Behavior Management Strategies.* KINE 5110: Elementary Teaching Methods, University of Virginia.
15. **Colombo-Dougovito, A.** (2014, November). *Youth Fitness.* KINE 5110: Elementary Teaching Methods, University of Virginia.
16. **Colombo-Dougovito, A.** (2014, March). *Research Introduction.* EDHS 2000: Intro to Kinesiology, University of Virginia.
17. **Colombo-Dougovito, A.** (2014, March). *Data Collection.* EDHS 2000: Intro to Kinesiology, University of Virginia.

18. **Colombo-Dougovito, A.** (2014, March). *Evidence-based Practice*. EDIS 5500: Survey of Autism Spectrum Disorders: Birth to Five, University of Virginia.
19. **Colombo-Dougovito, A.** (2014, March). *Teaching Children with ASD*. EDIS 5500: Survey of Autism Spectrum Disorders: Birth to Five, University of Virginia.

## Workshops

2 total.

1. **Colombo-Dougovito, A.** (2019, June). *Task modifications for building motor skills of autistic children*. Practitioners and Researcher at ISAPA conference, University of Virginia, Charlottesville, VA. 1.5 hour training.
2. **Colombo-Dougovito, A.** (2019, January). *Gross motor assessment and goal development*. Administration and Behavioral Specialist at Kristin Farmer Autism Center, University of North Texas, Denton, TX. 4 hour training.

## Graduate Teaching Assistant (UVA)

- Practicum in Kinesiology	Spring 2016, Fall 2016
- Kinesiology for Individuals with Disabilities	Fall 2015
- Assessment in Kinesiology	Fall 2015
- Motor Development	Spring 2015, 2016, 2017
- Secondary Teaching Methods	Spring 2015
- Elementary Teaching Methods	Fall 2014
- Introduction to Kinesiology	Fall 2013, Spring 2014

## K-12 Teaching Experience

Years	Job Title	Place of Employment
2012 — 2013	Physical Education & Water Safety Instructor (K-8)	Honey Creek Community School Ann Arbor, MI
2011 — 2012	Physical Education Instructor (K-5)	Alsup IB World Elementary School Commerce City, CO
2009 — 2011	Itinerant Physical Education Instructor (PK-6)	Lapeer Community Schools Lapeer, MI
2008 — 2009	Substitute Teacher	Washtenaw County Schools Southeast Michigan

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## GRADUATE & UNDERGRADUATE STUDENTS ADVISED

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### UNT Graduate Student Research

*\*Intended graduation.*

#### Doctorate Students — Dissertation (Chair or Committee Member)

- \*2021 Caroline Henry-Packer, Ph.D. in Early Childhood  
**Committee Member** (4 semester)  
Proposal: TBD  
Title: TBD
- \*2020 Joonyoung Lee, Ph.D. in Educational Psychology,  
(focus *Sport Pedagogy & Motor Behavior*)  
**Committee Member** (3 semester)  
Proposal: October 2019 Defense: TBD  
Title: “Fundamental Motor Skills Competence On Undeserved  
Preschool Children’s Health Outcomes: A Mixed-Methods Approach”
- 2020 Kay Shurtlieff, Ph.D. in Gifted Education  
**Committee Member** (3 semester)  
Proposal: August 2019; Defense: March 2020  
Title: “Teachers’ Attitudes toward Professional Development”
- 2018 Noel Jett, Ph.D. in Gifted Education  
**Committee Member** (2 semesters)  
Proposal: June 2018; Defense: October 2018  
Title: “Radically early college entrants on radically early college  
entrance: A heuristic exploration”

#### Master’s Students — Thesis (Chair or Committee Member)

- \*2021 Geetha Sama, M.S. in Kinesiology  
**Chair** (1 semester)
- \*2021 Mansi Patel, M.S. in Kinesiology  
**Chair** (1 semester)
- \*2021 Medhavi Joshi, M.S. in Kinesiology  
**Chair** (1 semester)
- \*2021 Tylar Smith, M.S. in Kinesiology  
**Chair** (1 semester)

#### Master’s Students — Advising

- \*2021 Zaquavia Bluitt, M.S. in Kinesiology  
**Advisor** (3 semesters)



\*2020 Carlos (Daniel) Martinez, M.S. in Kinesiology  
**Advisor** (2 semesters)

2019 Georgina Vint, M.S. in Interdisciplinary Studies  
(3 semester)

### Master's Students — Individual Research Project Advisor

2020 — 2021 Carlos (Daniel) Martinez, M.S. in Kinesiology

2020 Zaquavia Bluitt, M.S. in Kinesiology

2019 — 2020 Sarah Stutts, M.S. in Anthropology

### UNT Undergraduate Student Research

*\*Intended end date of project.*

#### Special Projects Advisor

2020 Zoe Alderman (2 semesters)

*Title:* Impact of equine therapy on individuals diagnosed with PTSD: A systematic review

#### TAMS Research Project Advisor

2019 — Present Rishin Kesarla (on-going, 3 semesters)

*Title:* Robot-use to increase PA in autistic children

**Awards:** 1st place poster award, Sigma Xi Student Research Conference (Human Behavioral and Social Science category), 1st place, Senior Division, Forth Worth Science and Engineering Fair.

### Students Advised at Other Institutions

*\*Intended end date of project.*

2019 — 2020 Victoria Lagous (Highland Park High School — AP Research Project)

*Title:* Autism, Sign Language, and Sensory Processing

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## SERVICE

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### JOURNAL ACTIVITIES

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#### Editorial Board

2019 — Present	<i>Revista de Sobama: Journal of the Brazilian Assoc. of Adapted Motor Activity</i>
2017 — Present	<i>PALAESTRA</i>

#### Reviewer

2020 — Present	Frontiers Psychology
2020 — Present	Research in Autism Spectrum Disorder
2019 — Present	Autism Research
2019 — Present	Journal for the Measurement of Physical Behaviour
2019 — Present	Journal of Advanced Academics
2019 — Present	Research Quarterly for Exercise and Sport
2018 — Present	Autism
2018 — Present	Exceptional Children
2018 — Present	Journal of Autism and Developmental Disorders
2018 — Present	Perceptual and Motor Skills
2017 — Present	Research in Developmental Disabilities
2016 — Present	Adapted Physical Activity Quarterly
2014 — Present	PALAESTRA
2018	Journal of Teaching in Physical Education
2017	Journal of Motor Learning and Development
2016	British Journal of Visual Impairment

### MEMBERSHIP & SERVICE IN PROFESSIONAL ORGANIZATIONS

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#### International Society for Autism Research (INSAR)

2019	<b>Co-leader</b> , Special Interest Group: “Building on existing strengths and lessening current barriers to physical activity for autistic individuals across the lifespan”
2017 — Present	<b>Member</b>

#### Mixed Methods International Research Association (MMIRA)

2017 — Present	<b>Member</b>
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#### International Federation of Adapted Physical Activity (IFAPA)

2017 — Present	<b>Member</b>
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**National Consortium for PE for Individuals with Disabilities (NCPEID)**

2019 — 2021	<b>Historian</b> (Board of Directors)
2019 — 2022	<b>Member</b> , Legislative Committee
2018 — 2019	<b>Chair</b> , Membership Committee
2017 — 2019	<b>Member-at-large</b> (Board of Directors)
2018	<b>Reviewer</b> , Annual convention proposal abstracts
2018	<b>Moderator</b> , Annual convention
2014 — Present	<b>Member</b>

**North American Federation of Adapted Physical Activity (NAFAPA)**

2016 — 2018	<b>Student Representative</b> (Board of Directors)
2018	<b>Reviewer</b> , Annual convention proposal abstracts
2018	<b>Moderator</b> , Annual convention
2014 — Present	<b>Member</b>

**Society for Health and Physical Education in America (SHAPE America)**

2020	<b>Reviewer</b> , Tommy Wilson Grant Applications
2020 — 2021	<b>Chair</b> , Special Interest Group: "Adapted Physical Education/Activity"
2019 — 2020	<b>Chair-elect</b> , Special Interest Group: "Adapted Physical Education/Activity"
2017 — Present	<b>Member</b> , Annual Convention Program Committee
2014 — Present	<b>Reviewer</b> , Annual convention proposal abstracts
2009 — Present	<b>Member</b>

**American Educational Research Association (AERA)**

2020	<b>Reviewer</b> , 2021 Annual Meeting
2019 — Present	<b>Member</b> <i>SIG Membership</i> : Research on Learning and Assessment in Physical Education, Disability Studies in Education

**Texas Assoc. for Health, Physical Ed., Recreation & Dance (TAHPERD)**

2017 — 2019	<b>Member</b>
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**Virginia Assoc. for Health, Physical Ed., Recreation & Dance (VAHPERD)**

2015 — 2017	<b>Member</b>
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**Society for Health and Physical Education in Colorado (SHAPE Colorado)**

2011 — 2012	<b>Member</b>
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**Michigan Assoc. for Health, Physical Ed., Recreation & Dance (MAHPERD)**

2009 — 2011	<b>Member</b>
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## SERVICE TO THE UNIVERSITY

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### University

2019 — 2021 **Member**, Neurodiversity Committee (Invitation, UNT)

### College

2020 — 2023 **Member**, Academic Affairs Committee (Elected, UNT)  
 2019 — 2021 **Member**, Scholarship Committee (Chair-nomination, UNT)  
 2016 **Affiliate Mentor**, Summer Undergraduate Research Program (UVA)

### Department

2020 **Member**, Adhoc Kinesiology Curriculum Subcommittee (Volunteer, UNT)s  
 2019 — 2022 Americans with Disabilities Act Representative (Elected, UNT)  
 2019 — 2021 **Member**, Graduate Curriculum Committee (Elected, UNT)  
 2018 — 2021 **Member**, Activity Program Committee (Elected, UNT)  
 2018 — 2020 **Member**, Undergraduate Curriculum Committee (Elected, UNT)  
 2019 — 2020 **Chair**, Scholarship Committee (Elected, UNT)  
 2017 — 2020 **Member**, Scholarship Committee (Elected, UNT)  
 2020 — Present **Director**, Disability & Movement Research Collective (UNT)  
 2017 — Present **Member**, Pediatric Movement & Physical Activity Lab (UNT)

## COMMUNITY SERVICE

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2010 — Present **Member**, International Mountain Biking Association (IMBA)  
 2020 — Present **Member**, Climbing Access Fund  
 2020 — Present **Volunteer**, Protect Our Winters (POW)  
 2019 **Volunteer**, Clean up Denton  
 2014 **Volunteer**, Special Olympics, Swimming  
 2013 **Volunteer**, Move2Health.org

# Social Skill Outcomes Following Physical Activity–Based Interventions for Individuals on the Autism Spectrum: A Scoping Review Spanning Young Childhood Through Young Adulthood

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Researchers posit that physical activity (PA) settings may provide an increased opportunity for social interaction. However, little consensus exists regarding the construct of social skills ~~and~~ what type or amount of PA is ~~needed to improve the quality of social functioning of~~ individuals on the autism spectrum. Thus, this scoping review synthesized the components (e.g., design, participants, independent and dependent variables, etc.) and findings of PA-based interventions that included social skill components to identify how interventions have incorporated these skills within different settings. Based on a review of 25 articles, this review revealed a great deal of variability in the types of PA, social skills, and instruments studied as well as the intensity of published findings. No longitudinal studies were identified as a part of the search. These results provide a foundation for the designing of effective PA-based interventions that may have an increased impact on the social skills of individuals on the autism spectrum. Future research should employ longitudinal designs to capture the relationship between social skills and PA as well as to increase the likelihood of capturing change.

Q1

**Keywords:** autism spectrum disorder, human development, social functioning

Q2

As a core identified area of need in individuals on the autism spectrum, past research has resulted in several evidence-based practices that focus on developing social communication skills through intervention (Wong et al., 2015). Yet, these evidence-based practices, despite having the potential for modified use in a physical activity (PA) space (Colombo-Dougovito, 2015), have not been designed or validated for these PA settings. Furthermore, multiple definitions of social skills are used interchangeably to describe an individual's overall social functioning (Cordier et al., 2015), and because no current unifying definition of social skills exists, the construct tends to be misunderstood (Merrell & Gimpel, 2014).

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Q3

As a construct, social skills are a complex set of behaviors that vary based on setting; currently, no gold standard for measurement exists for this particular construct (Dowd, Rinehart, & McGinley, 2010). Broadly, social skills could include an individual's ability to initiate interactions, make meaningful verbal or nonverbal reactions to others, maintain eye contact, share enjoyment and interests, and understand nonverbal cues (American Psychiatric Association, 2013). The social communication differences found in individuals on the autism spectrum are considered to be derived from inherent neurological impairments in tandem with reduced opportunity to acquire skills (e.g., social withdrawal and social exclusion; American Psychiatric Association, 2013) and differences in social expectations (Perepa, 2014). Regardless of origin, the social difficulties of an individual can increase their vulnerability in other areas, such as social play skills with peers (Lee & Haegele, 2016) or quality of life (Barnhill, 2007).

## PA as Intervention

Among the myriad behavioral intervention strategies, PA has been considered as a beneficial intervention component for individuals on the autism spectrum because of its role in promoting mental and physical health as well as naturalistic opportunities for social interactions (Lee & Vargo, 2017). Thus, researchers often address sedentary lifestyles (e.g., Pan & Frey, 2006; Tyler et al., 2014) and delayed movement skills (Liu, Hamilton, Davis, & ElGarhy, 2014; Lloyd, MacDonald, & Lord, 2013) as a rationale for the use of PA in behavioral interventions for individuals on the autism spectrum. Evidence (Bremer, Crozier, & Lloyd, 2016; Dillon, Adams, Goudy, Bittner, & McNamara, 2017; Healy, Nacario, Braithwaite, & Hopper, 2018; Lang et al., 2010; Rapp & Vollmer, 2005) supports the use of PA-based interventions to encourage social skill development, though the "active ingredient" (O'Haire, 2013, p. 1618) remains elusive.

Despite demonstrated improvements in the measured social skills of participants, captured improvements are often not universal across or, even, within studies and are often not assessed in natural environments. Typically, in many intervention studies, behaviors are observed in controlled settings and focus on nonreciprocal (e.g., echoic verbal behavior or an imitation of movement) behaviors rather than interactive actions. Moreover, social skills in these studies are narrowly defined to one aspect, such as "stereotypic behaviors" and "on-task behaviors." In many instances, the social skills that are being measured with each study vary greatly and capture only one aspect of social skills and not the broader construct (Cordier et al., 2015). Thus, it is unclear that demonstrated changes in social communicative behaviors would have a meaningful, generalizable impact on the social skills that are utilized in day-to-day social interaction.

## Interconnected Domains

Coupled with differences in social skills, research has shown that individuals on the autism spectrum are more likely to exhibit significant fundamental motor skill delays (Berkeley, Zittel, Pitney, & Nichols, 2001) as well as poor gait, posture, and rhythm (Provost, Lopez, & Heimerl, 2007). In particular, individuals may be more likely to have delayed motor skill development (Liu et al., 2014; Lloyd et al., 2013;

Staples & Reid, 2010), potentially leading to increased rates of physical inactivity (MacDonald, Esposito, & Ulrich, 2011; Pan & Frey, 2006; Stanish et al., 2017), especially when participating in PA programs such as physical education and community-based programs (Todd & Reid, 2006). Furthermore, most types of PA require not only motor abilities and skills but also some elements of social function (Eime, Young, Harvey, Charity, & Payne, 2013; Leonard & Hill, 2014). In a 2016 systematic review of the behavioral outcomes of exercise interventions, Bremer, Balogh, and Lloyd (2015) observed the most benefit from activities such as martial arts, horseback riding, and jogging; benefits were shown to be more limited in yoga, dance, and swimming interventions. However, due to a large variability in intervention frequency, intensity, type, and dosage, as well as methodological design, the relative benefits remain unclear.

Despite varying definitions, environment has been shown to be influential in the development of social skills (Cordier et al., 2015). Age-appropriate motor skills and activity, therefore, may provide an environment conducive to more social opportunities for individuals to practice (Barnett & Weber, 2008; Hawks, Constantino, Weichselbaum, & Marrus, 2019; Lee & Vargo, 2017). MacDonald, Lord, and Ulrich (2013) postulated that by improving an individual's motor skills, there may also be an effect on the individual's social skills (p. 278), although an increase in one construct does not necessarily result in a direct, equal immediate change in the other (e.g., Colombo-Dougovito, 2017), despite a seemingly bidirectional relationship (e.g., Reinders, Branco, Wright, Fletcher, & Bryden, 2019). Yet, for young children to young adults, the participation in PA—including games and sports—could be viewed as a more natural environment where social interactions occur with a lower barrier for engaging with others. In this setting, individuals may have a greater opportunity to develop physical, cognitive, and communication skills as well as to make friendships (Hoogsteen & Woodgate, 2010).

Therefore, due to limited consensus, a scoping review was used to “map” current literature in pursuit of how social skills have been defined and measured, either primarily or secondarily, within PA-based interventions for individuals on the autism spectrum. The following research questions were used to guide this review: (a) What types of PA are used in PA-based interventions that have social skills outcomes? (b) What focal social skills are included and how are they measured? (c) How, if at all, are the unique social communication needs of the participants determined? (d) What are the protocols and components of the interventions, such as the duration, frequency, delivering agent, and location of the interventions? and (e) What overall impact do PA-based interventions have on social skills?

## Methods

According to Peters et al. (2015), scoping reviews aim for “mapping the key concepts” from a body of literature to answer a broader research question than systematic reviews. Due to a limited understanding of how social skills are defined or incorporated within PA-based interventions, it was believed that the purpose of this review was well aligned with that of a scoping review. Therefore, the Preferred Reporting

Items for Systematic Reviews and Meta-Analyses (~~PRISMA~~) extension for scoping reviews (Tricco et al., 2018) protocol was used to guide this scoping review.

Q13

## Literature Search

The authors ( $n = 2$ ) identified key terms relevant to the search, and the following databases were selected: ERIC, PsycINFO, SPORTDiscuss, and PubMed. The search strategy included three lines of search words, truncated whenever possible, as follows:

("autism" OR asd OR "autism spectrum disorder" OR "pervasive disorder" OR "pervasive developmental disorder\*" OR asperger\*) AND ("physical activity" OR "physical education" OR "adapted physical education" OR "motor skill" OR "gross motor" OR "fundamental motor" OR dance OR yoga OR horseback OR sport\* OR aquatic\* OR swimming) AND ("social skill\*" OR "social interaction" OR "social behavior" OR conversation OR compliment\* OR cooperation OR communication OR "social response" OR play OR "eye contact" OR reciprocity OR "peer initiation" OR pragmatic\* OR "play skill\*" OR "challenging behavior" OR affect OR routine\* OR verbalization\*).

Q14

As the authors screened each search output, review articles that were found were filtered to conduct a hand search of the references for these articles to locate any potential additional articles not ~~be~~ retrieved by the initial database search. The search protocol was reviewed by a university librarian and verified for adherence to ~~PRISMA extension for scoping reviews~~ protocol.

## Operational Definitions

Physical activity is often used interchangeably with exercise (Taylor, 1983) and, indeed, the two share many defining characteristics (Caspersen, Powell, & Christenson, 1985, p. 127). For this review, *PA*—presented by Ross et al. (2016)—was defined as “experiences in physically demanding movement, sport, game, or recreational play that results in energy expenditure and perceptions of communal involvement” (p. 8).

Q15

Similar to *PA* and exercise, social skills have been broadly defined in the literature with varying terms that are used interchangeably (Cordier et al., 2015). Without an accepted guiding definition, for this review, the concept of *social skills* was operationally defined by the authors as interactive behavior demonstrated or observed between two or more individuals.

## Inclusion and Exclusion Criteria

The inclusion and exclusion criteria for this study were used as “limiters” for the database searches and served as a filtering mechanism to capture all relevant studies for the present scoping review.

Q16

The inclusion criteria were that studies had to be (a) published empirical studies, (b) written in the English language, (c) published within peer-review



journals, (d) available in full-text format, and (e) published between January 1990 and August 2019. This time range was set for the review as studies focusing on motor skills, PA, and exercise were not prevalent until recently (see Case & Yun, 2019; Colombo-Dougovito, Block, Zhang, & Strehli, 2020; Healy et al., 2018; Sowa & Meulenbroek, 2012). As a part of the inclusion criteria, articles needed to have a clearly defined intervention that included PA; this may have encompassed leisure-time PA, weight training, martial arts, yoga, horseback riding, swimming, or any other type of sport or fitness or motor skill programs. In addition, each article needed to measure an element of social skills as a primary or secondary measure. The authors also accepted social skill interventions conducted in a PA environment, such as a play skill intervention or social skill training using sports.

**Q17** The exclusion criteria applied to studies that focused on one aspect, such as including a PA measure but no social skills measures. Also, studies that used a PA intervention to affect noninteractive social behavior only, such as reducing the frequency or duration of stereotypic behaviors as a sole purpose, were excluded.

**Q18** Exclusion criteria also extended to unpublished theses or dissertations, studies published as conference proceedings, and review or conceptual articles. Furthermore, this review did not consider studies using animal models or solely qualitative analyses.

## Article Extraction

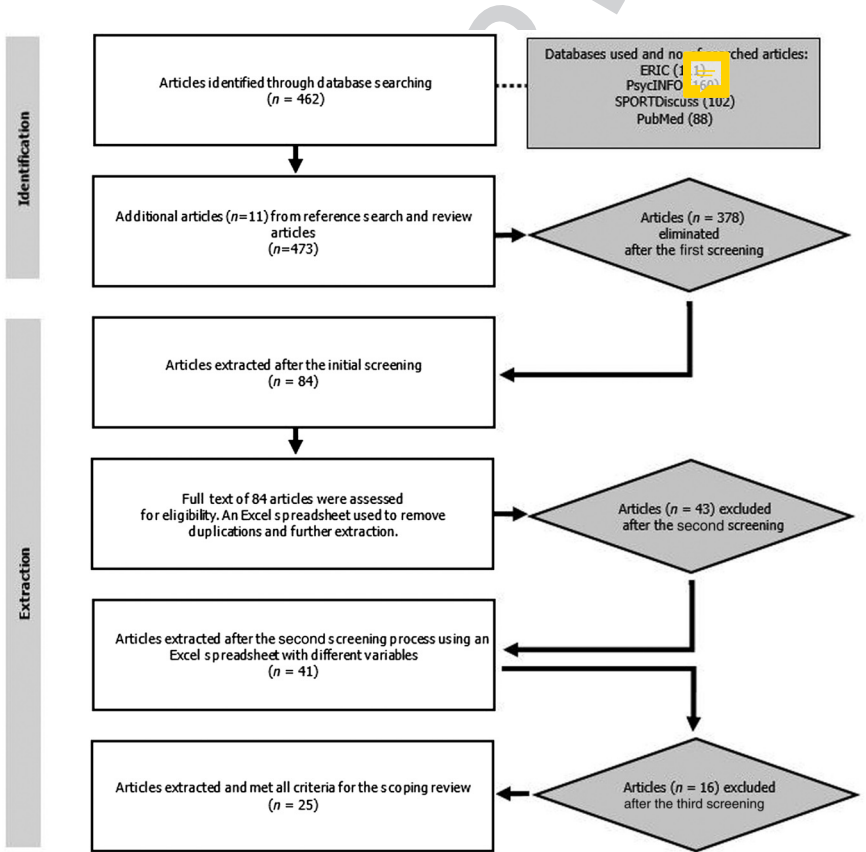
The initial database search produced 462 articles. Additional hand searching of reference lists identified an additional 11 articles. Each of the authors screened the searched articles ( $n = 473$ ) while applying the inclusion and exclusion criteria. As a result, articles that did not meet the inclusion criteria were eliminated; common reasons for exclusion included publication in languages other than English, the type of paper (i.e., conference proceedings, theses or dissertations, and nonempirical articles such as reviews, editorials, or conceptual papers), lack of intervention components (i.e., contextual factors, structural elements, or intervention practices), or lack of a movement or PA component in the intervention. If an article's title and/or abstract did not provide sufficient information to make the eligibility decision, the full text was screened.

After the initial screening, 84 articles were identified. A full-text screening of these articles was completed using the inclusion and exclusion criteria. Initial agreement between the authors was above 80% and discussions continued until 100% agreement was reached. After discussions, the authors excluded an additional 43 articles. Common reasons for exclusion in this second extraction process included participants without a diagnosis and PA or social skills being the sole focus of the study. An example of an excluded article was Duronjić and Válková (2010); although the article had a dedicated PA-based intervention, Duronjić and Válková did not include a social skills measure.

The authors, then, went through a final review of the remaining 41 articles, focusing on the method of intervention and dependent variables. Common reasons for exclusion in this final extraction process included definitions of social skills or PA that deviated from the operational definitions developed for this scoping review. Through this process, 25 articles were identified that met the inclusion criteria with 100% agreement by all authors. Examples of excluded articles were

Rosenblatt et al. (2011), Stahmer (1995), and Yilmaz, Birkan, Konukman, and Erkan (2005). Rosenblatt et al. (2011) focused on “mood” instead of social interaction or functional social skills. They considered mood as a status of feeling or emotion and that does not directly represent an individual’s social competence or ability. Stahmer (1995) used “play” as an intervention environment in the study; however, play used in the context of this study did not involve any identifiable PA. Yilmaz et al. (2005) included age-appropriate water play skills. Although the water orientation skills used in the study were considered by the authors as appropriate water play skills, they were not considered to fit the definition of social skills used for this review.

**Q19** With the final 25 articles, the authors used an Excel spreadsheet to chart relevant data using a coding scheme similar to Hansen et al. (2014); this included study design, participants (age and number), outcome measures, and major findings. Additionally, the authors identified indicators related to the rigor of **Q20** the methods and findings of each study, such as procedural fidelity, delivery agent,



**Q21** Figure 1 — Article search process.

intervention setting, and participant characteristics (i.e., diagnosis), based on recommendations from Reichow and Volkmar (2010) and Pereplechikova and Kazdin (2005). Both authors independently reviewed each of the identified articles; using Google Drive, the authors compared the coded results and discussed any discrepancies. Interrater agreement (100%) was reached on the identification of the indicators.

## Results

### Intervention-Related Variables

Table 1 shows the essential characteristics extracted from each study, including study design, demographic information (age and number), independent and dependent variables, social skills targeted, and findings. Of the 25 articles, six (24%) used single-subject research designs, 12 (48%) used quasi-experimental designs (with and without a comparison group), four (16%) used experimental designs, two (8%) used a descriptive design, and one (4%) used a wait-list control group design. The ages of participants were screened with respect to the mean age and the age range of the participants. There was a large age range among the included studies that spanned from young childhood (e.g., 3 years old) to young adulthood (e.g., 24 years old), though the mean age from calculatable data was around 8.09 years old ( $SD = 2.99$ ). Typically, studies focused on school age populations between 5 and 16 years old, or “adolescent” years. No studies were identified during the search that focused on participants older than 24 years.

**Types of PA.** There was considerable variance among the 25 included articles regarding the type of PA within the intervention. Of the 25 articles, five (20%) used an animal-assisted intervention (i.e., therapeutic horseback riding); four (16%) included either yoga or karate; ~~four~~ (12%) used fundamental motor skill practice (i.e., kicking, rolling, etc.); ~~three~~ (12%) used aquatics; ~~two~~ (8%) used group or individual sports components such as gymnastics, golf, soccer, or handball; and ~~one~~ (4%) incorporated fitness exercises.

**Targeted Social Skills.** Similar to the types of PA, there was no uniform focus or set of social skills across the included studies. Of the 25 articles reviewed, researchers attempted to gather insight into appropriate play, engagement, social interaction, speech/communication, attention, joint engagement, turn taking, compliments, adaptive behaviors, parallel play, and social functioning. The most common social skill variable among the studies was verbal and nonverbal communication; approximately 60% ( $n = 15$ ) of the reviewed studies fully or partially identified the intended social skill as such. Beyond assessing social behavior using the chosen social skills assessment, little to no information was provided to determine how researchers accounted for the differing social behaviors of participants or how researchers identified the unique social needs of each participant. All studies, though, reported that baseline social behavior was measured either through administered questionnaires or behavioral observations, yet it was not apparent how—or if—this information was used to guide instruction during the intervention. Some accommodations for limited social communication

Table 1 Essential Characteristics Extracted From Each Study

Study	Location	Design	Participant	IV	DV	Social skills	Results (#NI)
Alexander, Dummer, Snelzer, and Denton (2011)	United States	SS (ABCA)	N = 4 (all males; one with ASD); 14–24 years (M = 17.4 and SD = 2.57)	14-week social skills and sports program (Alexander, 2008, 90 min/week, 2 days/week). Sports: soccer (13–27 sessions, 74 min/session)	Parent Skill Rating Form using Alexander adaptation (2008) of Baker's Skill Rating Form (2003). Observation Skill Rating Form to judge social interactions while playing soccer	Turn taking, relevant information, and eye contact	After the intervention, participant with ASD (Jeff) showed significant improvement (increase more than 5%) on the three target skills: turn taking, relevant information, and eye contact. However, the results also showed a significant increase in the percentage of "did not attempt" for turn taking and eye contact. Q25
Bahrami, Movahedi, Marandi, and Sorensen (2016)	Iran	Ex with Cont	N = 30 (four females); 5–16 years (M = 9.13 and SD = 3.27)	14-week Karate (4 days/week, 30–90 min/session, 56 sessions) #Heian-Sho-dan-Kata	The communication subscale of GARS-2	Communication	Karate significantly improved communication based on communication subscale of the GARS-2. In maintenance period, communication deficit in the Ex group remained significantly decreased compared with postintervention. Q26
Bass, Duchowny, and Liabre (2009)	United States	QEx with Cont	N = 34 (five females); 4–10 years (Ex: M = 6.95 and SD = 1.67; Con: M = 7.73 and SD = 1.65)	12-week therapeutic horseback riding (1 hr/week). Riding skills, mounted games, and horsemanship activities	SRS and SP	Social functioning (sensory and autism severity, social awareness, social cognition, social communication, social motivation, and autistic mannerisms)	The intervention significantly increased sensory profile overall score compared with Cont. Interaction effects for four out of the five subscales were significant for the Ex; no significant interaction for the fine motor/perceptual subscale. Q27
Battaglia, Agró, Cataldo, Palma, and Alesi (2019)	Italy	Descriptive study using baseline and posttest data	N = 3 (one female); 11–15.11 years	12-week Caputo et al., implemented multisystemic aquatic therapy (2 days/week, 45–50 min/session) using three stages: emotional adaptation phase, swimming adaptation phase, and social integration phase.	An observation schedule adapted by Venuti (2001) for eight social behaviors; TGMD	Eight social skills (four for the interaction including joint attention, joint play, searching others' presence, and comply ones turn and four for contact including sensitivity to other's presence, loneliness, eye contact, and observation of other's behaviors)	Participants showed different levels of improvement in social behaviors (i.e., the sensitivity of other's presence, eye contact, and the comply one's turn), motor skills (locomotor and object control skills), and fine motor skills. Higher proportion of increases in social behavior in the sensitivity of other's presence, eye contact, and turn taking; increases were from ranking of "rarely" to "sometimes" or "sometimes" to "often." Q28 Q29

(continued)

Table 1 (continued)

Study	Location	Design	Participant	IV	DV	Social skills	Results (#NI)
Bremer et al. (2015)	Canada	Wait-list control experimental design (Group 1: 12-week intervention [12 hr]; Group 2: waited then received 6-week intervention [12 hr])	$N = 9$ (one female); 4 years (Ex: $M = 4.3$ and $SD = 0.25$ ; Con: $M = 4.3$ and $SD = 0.22$ )	12-week fundamental motor skills intervention (1 hr/week)	Anthropometric measurements (height and weight), motor proficiency assessed by the Peabody Developmental Motor Scales-2, adaptive behavior assessed by the VABS-2, and social skills assessed by the SSIS	Adaptive behavior and social skills	Significant differences in motor scores from preintervention to postintervention between Ex and Con groups on the PDMS-2. No significant differences between two groups on the VABS-2 and SSIS. When Groups 1 and 2 were used, all PDMS-2 variables showed significant differences between the pre, post, and 6-week follow-up assessments, while no social behavior variables showed such changes. At individual level, six participants showed increased appropriate play and verbal response and decreased inappropriate play and out of frame findings based on behavioral coding.
Bremer et al. (2016)	Canada	Descriptive	$N = 5$ (one female); 3–7 years. Four with ASD	Two 6-week blocks (total 12 weeks) of the fundamental motor skills intervention (3 days/week, 45 min/day), 27 hr of direct instruction for 12 weeks using teaching strategies suggested by Breslin & Liu (2014): Visual prompts, the name of skills to be completed, examples of the skill, verbal instructions, and physical prompts	Motor-skill proficiency assessed by the TGMD-2 and social skills assessed by the SSIS teacher	Social skills (communication, cooperation, assertion, responsibility, empathy, engagement, and self-control), problem behaviors (internalizing, externalizing, bullying, and hyperactivity) and autism spectrum profile behavior	Participants with ASD showed some improvement in raw scores for most of the items in the TGMD-2 and the SSIS from Assessment 1 (baseline) to Assessment 2 (Block 1) to Assessment 3 (Block 2).

(continued)

Table 1 (continued)

Study	Location	Design	Participant	IV	DV	Social skills	Results (#NI)
Gabriels et al. (2012)	United States	QEx with Cont	N = 42 (six females); M = 8.7 years	10-week therapeutic horseback riding (1 day/week, 45 min to 1 hr/session)—Routine: (a) put riding helmet on, (b) sit and wait on the bench, (c) mount horse, (d) THR activities, (e) dismount horse, (f) groom horse, and (g) put away equipment	The ABC-C; VABS-2—interview edition, survey form ; BOTMP-2, short form and SIPT	Self-regulation and adaptive skills	Significant improvements (i.e., decreased prevalence) on the ABC-C irritability, lethargy, stereotypic behavior, hyperactivity, and inappropriate speech; significant improvements on raw social scores, raw communication scores, raw daily scores, and adaptive total scores; scores are based on ranking of 0 ( <i>never a problem</i> ) to 3 ( <i>severe problem</i> ). Significant improvements were seen on the BOT-2 and verbal and postural subscales of the SIPT.
García-Gómez, Risco, Rubio, Guerri, and García-Peña (2014)	Spain	QEx with Cont	N = 16 (three females); 7–16 years	3-month therapeutic horseback riding (2 days/week, 24 sessions, 45 min to 1 hr/session)	A horse-riding program BASC-T or teachers	Social, affective, and emotional variables	Ex group showed significant differences in the aggressiveness subscale as reported by the “teacher.” Subscales are reported as aggregate of yes/no response and scales. Reduction of about 1 point based on the scale was deemed significant, though large overlap is present.
Guest, Ba-logh, Sogra, and Lloyd (2017)	Canada	QEx with Cont	N = 13 (all females); 8–11 years (M = 9.76 and SD = 1)	Five full-day multisport camp (based on Special Olympics Fundamentals program)	TGMD-2, pedometer, physical self-perception (CY-PSPP), SSIS, and the VABS-2	Adaptive behaviors, problem behaviors, and general social skills	Motor skills, physical self-perception, and the social skills domain significantly improved. Positive correlation between TGMD-2 motor quotient and CSAPPA adequacy, enjoyment, and total scores at the follow-up test. Improvements were seen in the overall social domain, as measured by the SSIS; no raw data were reported for social scores.
Holm et al. (2014)	United States	SS (multiple baseline, multiple case, and reversal)	N = 3 (all males); 6–8 years	Therapeutic horseback riding with dose control (1, 3, and 5 days/week) during B-phase	Parent-identified target behaviors, ABC-C, SRS, and SP-CQ	Social awareness, communication, and speech	Therapy helped significantly improve target behaviors at home and community; observed behavior changes consisted of frequency counts that were standardized (no raw frequencies were provided). Little change between phases on ABC-C, SRS, and SP-CQ

(continued)

Table 1 (continued)

Study	Location	Design	Participant	IV	DV	Social skills	Results (#NI)
Jam et al. (2018)	Iran	QEx with Cont	N = 30 (13 females) 8–12 years (Ex: M = 10.2; Con: M = 10.12)	16-week gymnastic exercise program (total 48 sessions, 3 days/week, 45 min/session)	Motor skill development assessed by the short form of BOTMP-2, short form; neuropsychological skills assessed by Conners Neuropsychological Questionnaire (2007)	Neuropsychological skills: Attention, executive functions, sensory and motor functions, language functions, and memory and learning functions in two forms for parents and teachers	The Ex group showed higher scores for all motor development subsets except strength, running speed and agility, and reaction time. The Ex group showed higher scores for all neuropsychological skills subsets except language functions; subscale scores reported as aggregate means. No information is provided on units of measurement for the neuropsychological skills.
Ketcheson, Hauck, and Ulrich (2016)	United States	QEx with Cont	N = 20 (five females); 4–6 years	8-week motor skill instruction (4 hr/day, 5 days/week) through CPRT framework	TCMD-2, ActiGraph (GT3X+; ActiGraph LLC, Pensacola, FL) (PA), and playground observation of peer engagement	Joint engagement, solitary, proximity, parallel aware, parallel play, and onlooking	Significant difference between Ex and Cont groups. No effects were found for social measures other than decreasing time in <del>solidarity</del> (measured in minutes).
Koenig, Buckley-Reen, and Garg (2012)	United States	QEx with Cont	N = 46 (nine females); 5–12 years (Ex: M = 9.7; Con: M = 8.7)	16 weeks (5 days/week) GRTL yoga program	Aberrant behavior checklist—community and VABS-2	Communication, ADL, adaptive behavior, and social skills	Yoga program demonstrated significant difference between Ex and Cont in teacher-reported ABC, but not parent-reported. A large effect size ( $d = 1.19$ ) was reported between teacher-reported changes between the Ex and Cont groups.
MacDonald, Clark, Garrigan, and Vangala (2005)	United States	SS (multiple baseline- <del>and</del> AB)	N = 2 (all males); 4 and 7 years	Specific play scripts for each set of materials (town, ship, and house); each script had 16 verbalizations and 14 coordinated actions	Scripted verbalizations = social statements that matched the video, scripted play actions = motor responses that match video, and unscripted play actions = not modeled but appropriate	Verbalizations appropriate to the contexts	Video modeling increased scripted play across three commercially available play-sets. <del>Verbalizations were frequency-recorded</del> . Verbalizations increased from a low level (0–2) per session to a mastery level (15–17) after the addition of a video model. No reversal was included; effect size and percent overlap were not reported.
Macpherson, Charlop, and Miltenberger (2015)	United States	SS	N = 5 (one female); 9.5–11.2 years	Video modeling using a video clip of a ball rolling and then being kicked with a compliment and then making a gesture	Participants' verbal compliments and compliment gestures when being instructed to play kickball	Compliments and gestures	All participants increased from baseline (0–5) to intervention (30–50) on their use of verbal compliments and compliment gestures during intervention, but these behaviors were not well generalized across activities.

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Table 1 (continued)

Study	Location	Design	Participant	IV	DV	Social skills	Results (#NI)
Magnusson, Cobham, and Mel eod (2012)	New Zealand	QEx	N = 6 (two females); 9–15 years	8-week fitness exercise (total 16 sessions, 2 days/week, two “testing” session). Sessions include warm-up, high-intensity interval training, aerobic exercises, plyometric training, resistance training, a warm-down, and stretches.	Modified Bruce protocol (cardiorespiratory fitness), 1RM bench press, 1RM leg press, maximal curl-up test, sit and reach test, and modified Romber test (balance)- <del>measured pre-and post</del> . Parents filled out surveys on behaviors	Social, attention, and behavior	All participants increased fitness measures. All positive and negative behavior measures improved. Improvements in social skills were not statistically significant, though parents reported an increase of 2 points (4.5–6.5); however, no information is provided as to how this construct was measured or how to infer what a 2-point gain means.
Martin and Farnum (2002)	United States	QEx within-subject, repeated-measures across three conditions	N = 10 (two females); 3–13 years	15-week AAT (total 45 sessions, 3 days/week, 15 min/session)	Frequency of interactions; durations were coded in terms of seconds per minute	Behaviors and verbalizations	Tentative support for the efficacy of AAT for children with PDD. Behaviors of the children varied as a function of experimental condition, and interaction with dogs appeared to have some positive benefits. For example, participants were more likely to talk about the dog and for longer duration than within the other conditions.
Miltenberger and Charlop (2014)	United States	SS (multiple baseline)	N = 3 (one female); 6, 9, and 9 years	Athletic skill and rules training session: Handball and Four square (duration and frequency were not clear)	Appropriate group play and speech; measured by percent of opportunity (interval coding; 10-s durations)	Independent play and speech	All three children increased group play, demonstrated gains in speech, and mastered the targeted athletic skills. Therapists reported significant changes in observed behavior pre and post; specifically, social skills increased between 1 and 2 points on a 7-point scale.
Movahedi, Bahrami, Marandi, and Abedi (2013)	Iran	Ex with Cont	N = 30 (four females); 5–16 years (M = 9.13 and SD = 3.27)	14-week Heian Shodan Kata (Karate) (total 56 sessions, 1 hr/session, 4 days/week) based on the TARGET model (Ames, 1992)	The social interaction subscale of GARS-2	Social interaction/dysfunction	A significant decrease in “social dysfunction” severity scores in the Ex at postintervention compared with the baseline and maintenance period (30 days after) using the aggregate score from the GARS-2.

(continued)



Table 1 (continued)

Study	Location	Design	Participant	IV	DV	Social skills	Results (#NI)
Najafabadi et al. (2018)	Iran	Ex with Cont	$N = 28$ (Ex = 12; Con = 14), 5–12 years (Ex: $M = 7.08$ and $SD = 2.06$ ; Con: $M = 8.07$ and $SD = 2.23$ )	12-week SPARK program (3 days/week, 40 min/ session)	The social interaction subscale of GARS-2, the sociability subscale ATEC, and balance and coordination subsets of BOTMP	Social interaction and sociability	Only the Ex group showed a significant improvement in the static and dynamic balance as well as bilateral coordination compared with the Con group. Only the Ex group's social interaction subscale of GARS-2 and sociability subscale of ATEC showed a significant improvement after the intervention, though a large overlap was present.
Pan (2010)	Taiwan	QEx within-participant repeated measures (baseline, WESP or regular treatment, and after 10 weeks)	$N = 16$ (all males); 6–9 years (Ex: $M = 7.27$ and $SD = 1.25$ ; Con: $M = 7.2$ and $SD = 0.89$ )	10-week water exercise swimming program (floor activities, one-to-two instruction, group activities, and cooldown) based on the HAAR and TEACCH	Aquatic skills—The HAAR checklist; social behaviors—the SSBS-2 completed by classroom teachers	School social behaviors (social competence and antisocial behavior)	WESP improved aquatic skills and antisocial behaviors (but not in social competence) as measured by the SSBS-2. Raw scores were not reported, though ranges were reported demonstrating a large difference among participants. Social competence and antisocial behavior scores ranged from 32 to 160.
Rosenblatt et al. (2011)	United States	QEx within-subject pre-treatment to posttreatment	$N = 24$ (two females); 3–16 years ( $M = 8.9$ and $SD = 3.6$ )	8-week yoga (total eight sessions, 45 min/week). Sessions included breathing skills, yoga postures, music and dance, and yoga relaxation.	BCSC-2 and ABC	Problematic behaviors	Yoga had significant impact on the BSI of the BASC-2 and atypicality subscale; although demonstrated significance, change was highly variable between subjects. A change in $T$ score of 3.17 and 5.40 was reported on the BSI and atypicality, respectively. While significant, postscores of the BSI fall within the 90% CI of normative data (94th percentile).
Schleien, Rynders, Mustonen, and Fox (1990)	United States	SS (alternating treatment)	$N = 17$ (one female); 5–12 years	6-week play sessions (30 min/session, 2 days/week); four play categorizations (isolated, dyadic, group, and team)	Appropriate play behavior—"engaging in goal directed rec. activity including appropriate use of materials and/or equipment in age-appropriate measures"	Appropriate play and peer engagement	Appropriate behaviors were observationally recorded and reported as percentages of time. Isolation produced lowest percentage of appropriate play. Carefully structured integrated activities involving higher levels of social play elicited a sig. higher frequency of appropriate play behavior in school-age learners with autism.

(continued)

Table 1 (continued)

Study	Location	Design	Participant	IV	DV	Social skills	Results (#NI)
Shanok, Sotelo, and Hong (2019)	United States	QEx within-subject pre-treatment to posttreatment	N = 46 (nine females); 6–24 years (M = 11.46 and SD = 6.21)	6-week golf-training program (12 session, 45 min/ session using The Ernie Els #GameON Autism) focusing on communication skills, regulatory skills, motor skills, and social skills using visual cues	Communication skills, regulatory skills, motor skills, and social skills were observed and measured by raters using scores on a (1–5) Likert scale, with 1 being the lowest motor skills and 5 the highest motor skills	Receptive communication skills, expressive communication skills, social skills, and regulatory skills	There were significant increases in all behavioral skills from preassessment to postassessment. All subdomains were measured using a 5-point Likert scale (1–5). Responses to questions were reported as averages of the summed total. Receptive comm. increased from 6.0 to 7.37 out of a possible 10. Expressive comm. increased from 10.22 to 11.26 out of a possible 15. Social skills increased from 13.11 to 15.02 out of a possible 20. Regulatory skills increased from 9.65 to 11.33 out of a possible 15.
Zhao and Chen (2018)	China	Ex with Cont (this study used a random assignment but it said QEx in their study)	N = 41 (12 females); 5–8 years (Ex: M = 6.14 and SD = 0.96; Cont: M = 6.1 and SD = 0.98)	12-week structured PA program (60 min/ session, total 24 sessions), using the TEACCH model	ABLLS-R and SSIS-RS	Social interaction and communication skills	The social skills (in the communication, cooperation, and self-control subdomains) of the Ex group measured by SSIS were significantly improved compared with the Cont group (mean change from T1 to T3 of 7.621 vs. 1.2, respectively). The intervention improved the Ex group's overall social interaction scores in ABLLS-R compared with the Cont group (mean change from T1 to T3 of 9.429 vs. 1.8, respectively).

Q239

Note. ASD = autism spectrum disorder; Location = the location of data collection; SS = single-subject design; QEx = quasi-experimental; Ex = experimental; Cont = control; AAT = animal-assisted therapy; HAAR = Humphries assessment of aquatic readiness; WESP = water exercise safety program; PA = physical activity; ADL = activities of daily living; GARS-2 = Gilliam Autism Rating Scale—second edition; SRS = Social Responsiveness Scale; SP = sensory profile; TGMD-2 = test of gross motor development—second edition; VABS-2 = Vineland Adaptive Behavior Scales; SSIS = Social Skills Improvement System; ABC = Aberrant Behavior Checklist-community; BOTMP-2 = Bruininks-Oseretsky Test of Motor Proficiency; SIPT = Sensory Integration and Praxis Test; BASC-T = Behavior Assessment System for Children; CPRT = classroom pivotal response treatment; GRITL = Get Ready to Learn; ATEC = autism treatment evaluation checklist; TEACCH = Treatment and Education of Autistic and Communication Handicapped Children; SBS-2 = School Social Behavior Scales; BCSC-2 = Behavioral Assessment System for Children, second edition; BSI = behavioral symptom index; ABLLS-R = Assessment of Basic Language and Learning; SSIS-RS = Social Skills Improvement System Rating Scales.

were mentioned, such as a picture schedule (Gabriels et al., 2012), an enlarged Picture Exchange Communication System (Bremer et al., 2015), extra prompts (Macpherson et al., 2015), or incorporation of elements of the Treatment and Education of Autistic and Communication Handicapped Children method (Zhao & Chen, 2018); yet, no rationale was given as to why the particular strategy was chosen or if that accommodation was necessary.

**Dosage/Frequency.** The administered interventions varied from 3 to 5 times/week for 15–45 min and from 6 to 16 weeks. The type of sport had little noticeable effect on the dosage or frequency of the intervention. Of the included studies, those that used equine therapy ranged between 10 and 12 weeks of delivery, providing 45 min to 1 hr of instruction per week. ~~Those that used yoga ranged from 8 to 16 weeks and from one 45-min period of instruction per week to 5 days/week.~~ Interventions that focused on sports skills or motor skills appeared to be longer in duration overall. Schleen et al. (1990) provided the shortest amount of instruction, which was over 6 weeks with each session lasting 30 min and occurring twice per week. In contrast, Ketcheson et al. (2016), while only providing an additional 2 weeks of instruction, provided instruction 5 days/week for 4 hr/day. ~~Ketcheson et al. suggested that future research be provided the intervention for a greater length of time.~~

## Rigor-Related Variables

The authors further examined study variables, as shown in Table 2, including the diagnostic tools used in the studies, the delivery agent, procedural fidelity, completion rates, and the formation and setting of the interventions. All these variables are considered relative to the rigor of the studies and show the commonalities of PA-based intervention studies that may inform future research.

**Diagnosis and Severity.** The reviewed studies utilized various diagnostic tools to identify the target population or as part of their measurement tools to examine the effectiveness of the intervention. Two studies (8%) (Gabriels et al., 2012; Ketcheson et al., 2016) used the Autism Diagnostic Observation Schedule, second edition (Lord, Luyster, Gotham, & Guthrie, 2012; Lord, Rutter, et al., 2012) to confirm autism spectrum disorder diagnoses within their sample population. Several studies used parent-report screening tools, such as the Gilliam Autism Rating Scale—second edition (three studies), the Childhood Autism Rating Scale (two studies), Social Responsiveness Scale (two studies), Social Skills Improvement System Rating Scales (three studies), and the Vineland Adaptive Behavior Scales—second edition (four studies), as a confirmatory measure of autism spectrum disorder or as a measure of social skills. One study (i.e., Jam et al., 2018) used intelligence quotient and the high-functioning Autism Spectrum Screening Questionnaire to identify participants ~~with high-functioning autism~~. Seven studies (29.1%) referred to the Diagnostic and Statistical Manual–5 definition, or a previous version of the Diagnostic and Statistical Manual, when describing their participants. Ten studies (40%) did not include any confirmatory information or defaulted to a physician's or psychologist's diagnosis.

Table 2 Additional Variables in Studies

Study	Sampling method	Diagnosis	Diagnostic tool	Facilitator	Fidelity check, attendance	Instructional formation	Setting
Alexander et al. (2011)	Conv.	AU (selected for review)	None	Intervention staff	No fidelity check, but attendance was tracked	G	Community
Bahrani et al. (2016)	Conv.	AU	DSM-IV and GARS-2	Certified trainers	No fidelity check, but attendance was tracked	Mixed	Not mentioned
Bass et al. (2009)	Conv.	ASD	DSM-IV and SRS	Trained THR instructors	Neither was mentioned	I	A horse-riding center
Battaglia et al. (2019)	Conv.	ASD	None	Therapists	No fidelity check, but attendance was tracked	I	Community
Bremer et al. (2015)	Conv.	ASD	VABS-2 and SSIS	Researcher with trained graduate students	No fidelity check, but attendance was tracked	G	Local therapeutic center
Bremer et al. (2016)	Conv.	AU (selected for review)	None (ASD diagnosis provided by a family physician, pediatrician, psychiatrist, psychologist, or psychological associate)	Research assistants, the special education teacher, classroom educational assistants, and Grade 8 peer buddies from the school	Neither was mentioned	I	School

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Table 2 (continued)

Study	Sampling method	Diagnosis	Diagnostic tool	Facilitator	Fidelity check, attendance	Instructional formation	Setting
Gabriels et al. (2012)	Conv.	AP and AU	SCQ, ADOS, nonverbal intelligence using the Leiter-R Brief IQ, and VABS-2	Trained THR instructors and trained volunteers	No fidelity check, but attendance was tracked	I	A horse-riding center
García-Gómez et al. (2014)	Conv.	Mild AU	CARS	Trained THR instructors	Neither was mentioned	G	A horse-riding center
Guest et al. (2017)	Conv.	PDD-NOS, DCD, and ASD	DSM-5 and VABS-2	Researchers and trained staff	Neither was mentioned	G	Summer camp
Holm et al. (2014)	Conv.	ASD	CARS and SRS	Researcher (trained graduate students)	No fidelity check, but attendance was tracked	I	A horse-riding center
Jam et al. (2018)	Conv.	High-functioning autism	IQ $\geq 70$ and high-functioning ASSQ	Not mentioned	Neither was mentioned	Not mentioned	Not mentioned
Ketcheson et al. (2016)	Conv.	ASD	ADOS	Trained instructors	Neither was mentioned	Mixed	Summer camp
Koenig et al. (2012)	Conv.	ASD	VABS-2	Trained classroom teachers (2.5 hr of training)	Fidelity check was done. No attendance reported	G	School

(continued)

Table 2 (continued)

Study	Sampling method	Diagnosis	Diagnostic tool	Facilitator	Fidelity check, attendance	Instructional formation	Setting
MacDonald et al. (2005)	Conv.	PDD and AU	None	Researchers	No fidelity check, but attendance was tracked	I	School
Macpherson et al. (2015)	Conv.	AU	None	Therapists	Both were done	G	School
Magnusson et al. (2012)	Purposive	AU, AP, ASD, and PDD-NOS	None	Researcher	No fidelity check, but attendance was tracked	I	Not mentioned
Martin and Farnum (2002)	Conv.	PDD, PDD-NOS, AP, and AU	None	Therapists	No fidelity check, but attendance was tracked	I	School
Miltenberger and Charlop (2014)	Conv.	AU	DSM	Therapists	Neither was mentioned	G	Outdoor areas of behavioral treatment center
Movahedi et al. (2013)	Conv.	ASD	GARS-2	Certified trainers	No fidelity check, but attendance was tracked	Mixed	Not mentioned
Najafabadi et al. (2018)	Conv.	ASD	DSM-IV-TR and GARS-2	Trained coaches with physical education teacher background	Neither was mentioned	G	An indoor complex

(continued)

Table 2 (continued)

Study	Sampling method	Diagnosis	Diagnostic tool	Facilitator	Fidelity check, attendance	Instructional formation	Setting
Pan (2010)	Conv.	ASD and AP	DSM	Research assistants	Neither was mentioned	I	Not mentioned
Rosenblatt et al. (2011)	Conv.	ASD	None	First author, who was licensed clinician with added cert. in yoga and dance therapy	No fidelity check, but attendance was tracked	G	Hospital
Schleien et al. (1990)	Purposive	AU	None	APE teacher and trained peer tutor	Neither was mentioned	Mixed	School
Shanok et al. (2019)	Conv.	ASD	None	Trained golf instructors	Neither was mentioned	Mixed	Various golf courses (multiple locations)
Zhao and Chen (2018)	Conv.	ASD	DSM-V and SSIS	Teachers	Neither was mentioned	Group	School

**Q42** *Note.* Conv. = convenience; IQ = intelligence quotient; ASD = autism spectrum disorder; AU = autism; PDD = pervasive developmental disorder; PDD-NOS = pervasive developmental disorder-not otherwise specified; ASSQ = Autism Spectrum Screening Questionnaire; AP = Asperger; DCD = developmental coordination disorder; DSM = Diagnostic and Statistical Manual; GARS = Gilliam Autism Rating Scale; CARS = Childhood Autism Rating Scale; ADOS = Autism Diagnostic Observation Schedule; SCQ = Social Communication Questionnaire; SSIS = Social Skills Improvement System Rating Scales; SRS = Social Responsiveness Scale; VABS = Vineland Adaptive Behavior Scales; G = Group; I = Individual.

**Delivery Agent.** Of the 25 studies, three studies (12%) used interventions delivered by trained teachers and peers. Bremer and Lloyd (2016), in addition to teachers (special education and classroom) and peer buddies, used trained research staff to deliver the intervention. In all other studies, specialists, such as the researchers or therapists, delivered the intervention components. In general, the ~~facilitator of the PA-based interventions to teach social skills~~ was directly linked to the types of PA, rather than the type of social skills or types of the settings where the learned skills to be generalized. **Q44** No studies identified “why” or gave a reason for the selected delivery agent.

**Procedural Fidelity and Intervention Completion Rate.** Few studies provided both fidelity and completion rates. One study (Macpherson et al., 2015) reported both a fidelity measure and attendance rates. Macpherson et al. (2015) assessed 40% of sessions for procedural integrity (p. 3840); in addition, attendance was tracked for each session. Koenig et al. (2012) measured fidelity using a checklist covering the environment, organization, teacher implementation, student support, and program conclusion (p. 541); attendance was not recorded. Eleven studies (44%) reported attendance rates but not fidelity. The remaining 12 studies (48%) did not report either fidelity check information or attendance rates. When studies that reported attendance rates were screened, it was revealed that participants in those studies showed 84% or higher attendance rates on average. Two studies (Gabriels et al., 2012; Holm et al., 2014) applied an attendance-related inclusion criterion for their participants, such as “someone who attended at least 80% of the sessions” instead of reporting attendance rates. Single-subject studies reported a number of sessions because they used a visual representation of data. Thus, these studies were considered as studies that tracked the attendance rather than reported attendance rates. These studies used a varying number of sessions across participants depending on the design (e.g., a multiple baseline design with probes).

**Group- or Individual-Based Format.** Ten (40%) studies used group-based sessions (e.g., one instructor to three or more participants), whereas nine (36%) used individual-based sessions (e.g., one instructor to one or two participants). Five (20%) studies provided instruction in various formations, including individual, small group, and large group sessions. One study (Jam et al., 2018) did not provide enough information to determine the format that was chosen. Little to no rationale was provided for why the particular format was chosen.

**Settings (School, After School, Home, etc.).** Eight (32%) studies reported that the intervention took place within the community, such as at a community-based horse-riding center, an indoor complex, or a golf course (it was not specified whether the course was public or private). Seven (28%) took place at the participants’ school, two (8%) were done at a summer camp, and three (12%) were completed at a treatment center or hospital. Four (16%) studies did not provide any information on the setting. None of the studies reported that the intervention took place in the participant’s home.

## Major Article Findings

All of the included studies reported “improvements” in social skill outcomes; however, the areas in which the outcomes improved were not universal.



Furthermore, the improvements reported were often not statistically significant. While statistical significance should not be the only measure of meaning or importance in a research finding, in looking at studies in aggregate, no clear determinations as to the findings can be made without it. Effect size is another output measure that can be valuable in determining the magnitude of change; however, this information was not consistently reported within the identified articles. Guest et al. (2017) and Bremer et al. (2015) used effect size to demonstrate changes in the motor domain but not the social domain; both expressed moderate effects ranging from 0.5 to 0.675. Koenig et al. (2012) used effect size to show differences between the experimental and control groups on their social measures, the largest being demonstrated in decreased “challenging behaviors” ( $d = 1.19$ ). Similarly, García-Gómez et al. (2014) used effect size with their social measures, showing small differences ( $d = 0.22$ ) in aggressiveness as a result of their intervention. Ketcheson et al. (2016) used effect size to show differences in the experimental and control groups prior to intervention, but did not report effect size as a part of the analysis of the intervention. Jam et al. (2018) reported high effect size differences ( $\geq 0.9$ ) uniformly between the control and experimental groups, but how these values were calculated was indeterminable.

Studies that used broad measures of “social skills” and focused on clearly defined motor or PA-based outcomes (i.e., Bremer et al., 2015; Bremer & Lloyd, 2016; Guest et al., 2017; Ketcheson et al., 2016) were more likely to see “improvement.” In Guest et al. (2017), in addition to improvements in motor outcomes, participants showed significant improvements in adaptive skills and overall social domain scores measured by the Social Skills Improvement System and the Vineland Adapted Behavior Scales, second edition. Ketcheson et al. (2016) did not observe overall social skill improvements, yet did show a reduction in time spent in solidarity. Q45 Bremer et al. (2015), again, did not see overall social skill improvement, despite significant changes in motor skill performance, though participants showed improvements in “appropriate play” (p. 987). Bremer and Lloyd (2016) saw improvements in social skills as measured by the Social Skills Improvement System, as well as in reported problem behaviors. In the other reviewed studies, although social skills showed significant improvements, they may have been reported by teachers but not parents (Koenig et al., 2012), or in one setting but not another (Macpherson et al., 2015).

## Discussion

This review demonstrates substantial variability among the published literature regarding the type of PA provided and the identified social skills. As mentioned previously, while social skills and motor skills have a demonstrated relationship (MacDonald et al., 2013), recent research that has sought to improve motor skills has shown either no direct change in social skills (Colombo-Dougovito, 2017) or nonsignificant improvement (Bremer et al., 2015). In this review, overall, the findings provide confirmatory support that PA settings may provide an environment conducive to social skill development—similar to the findings of Reinders et al. (2019). However, in looking in depth at how social skills have been measured during the PA-based interventions, it is clear that there is limited consensus on the

appropriate social skills to measure in the PA setting and that there is presently no single measure of social skills that has been applied to the PA environment. In addition, the social skill components that were embedded in the PA-based interventions were not uniform, potentially contributing to the limited consensus regarding the impact of PA-based interventions on social skill development.

## No Clear Set of Social Skills

Historically, improvements have been, and continue to be, challenging to identify due to limited consensus of the social skills construct and no gold standard assessment for social skills (Dowd et al., 2010). As “social skills” are, themselves, socially constructed, it could be assumed that the expectations of social communication may vary from setting to setting and assessor to assessor. Currently, social skill assessments are not developed for specific use in motor or PA-based interventions, nor are they designed with consideration for the potential differences that may be present in these environments or the sensitivity to capture change within the present interventions. Furthermore, the construct of social skills has had little feedback from the autistic community about what is relevant or needed. In order to determine the interconnectedness of the social and motor domain within individuals on the autism spectrum, there must be a better understanding of the social skills present in PA settings and which social skills are “important.” In this review, the studies that demonstrated the greatest improvements had clearly defined social skills constructs and used closely aligned measures. Furthermore, studies with demonstrated improvements, significant or not, had innate opportunities to practice.

Though the PA setting may provide a sizable opportunity and lower barrier to practice social skills (Colombo-Dougovito, 2017; Hawks et al., 2019; Lee & Vargo, 2017; MacDonald et al., 2013), these skills may take longer to become perceivable on standardized assessments, even if researchers are using the appropriate measure for the given situation. Furthermore, given the wide variety of measured skills, it is difficult to claim universal benefits from PA interventions, even though meaningful improvements may exist. For example, across the included studies, evidence suggests that there was meaningful impact, but it was (a) widely variable among participants (Rosenblatt et al., 2011); (b) a selective impact (e.g., an effect on some behaviors, but not all) (Pan, 2010); (c) short lasting, meaning significant changes at the end of the intervention, but not at a maintenance measurement (Movahedi et al., 2013); (d) no significant effect (Holm et al., 2014; Magnusson et al., 2012); (e) a significant impact, but was not generalizable (Macpherson et al., 2015); (f) inconsistently reported by different assessors, such as teachers versus parents (Koenig et al., 2012); and (g) a significant impact across all areas of measurement (Bremer & Lloyd, 2016; Gabriels et al., 2012; Guest et al., 2017). This highlights the necessity, as a field, to define the social skills construct, determine which elements would be most related to PA settings, and develop a measure sensitive enough to capture meaningful changes. Within the present, aggregated findings, it is difficult to determine whether (a) inconclusive impacts are related to the indiscernible impact that PA has on the social skill domain; (b) the measures used are not accurately capturing change; or (c) measurement improvements are due to the intervention itself, maturation, measurement error, chance, or some combination thereof.

## How Much or How Often?

- Q48** Romanczyk, Callahan, Turner, and Cavalari (2014) identified high-intensity interventions (e.g., 30 hr/week) as being potentially more beneficial than low-intensity interventions (e.g., about 10 hr/week). Based on the recommendations of Romanczyk et al., however, none of the reviewed studies in this review met the standard for high intensity; Ketcheson et al. (2016) was the closest to obtaining this intensity at 20 hr/week. When it comes to intervention duration, Romanczyk et al. showed that, on average, behavioral interventions ~~sustained~~ **Q49** 21 months, with a range from 3 to 52 months. If this standard is applied, the majority of studies in this review used a relatively short duration as the longest duration of the included studies was 4 months (i.e., 16 weeks; e.g., Jam et al., 2018; Koenig et al., 2012), although a few studies (Bremer et al., 2015; Ketcheson et al., 2016) suggested that future research be conducted for a longer duration (e.g., 18 weeks or beyond).

Considering the elements of a PA-based intervention, one must consider whether high intensity (e.g., 30 hr/week) or duration (e.g., 21 months) is appropriate or feasible. Though not a new issue in PA interventions—Colombo-Dougovito and Block (2019) highlighted this area as a needed focus of further motor skill intervention research—~~limitations of study findings~~ will continue to ~~occur~~ without an understanding of the appropriate frequency and dosage needed to enact or achieve change. PA outcomes may not need as intense a frequency and dosage as other developmental areas; however, when other domains use far greater durations and intensities for similarly measured behavior (i.e., social skills), it could be assumed that this may be why inconsistent results are reported in the present findings.

## Differences Across Ages

- Q50** Another difference that might provide insight into a lack of consensus is the wide range of ages in the included studies, as participants ranged from 3 to 24 years of age. This range covers multiple, vastly different stages of development from young childhood to adolescence to young adulthood, and the social expectations vary greatly at each stage (Hartup, 1989). Differences within studies covering similar ages and in similar settings further confound this issue as little similarity was shown in the measured social skills construct. For example, although Movahedi et al. (2013) and Koenig et al. (2012) covered similar ages (5–16 and 5–12 years, respectively) and individual sports (karate and yoga, respectively), there was no similarity in the social skills measured. Movahedi et al. measured social interaction/dysfunction, while Koenig et al. measured social communication, activities of daily living, adaptive behavior, and general social skills. Without a unified construct of which social skills are present during similar ages and in certain PA contexts (e.g., physical education), it becomes difficult to gather supporting evidence or make broader comparisons. Despite the increased likelihood for practice (Barnett & Weber, 2008) and a potential bidirectional relationship (Reinders et al., 2019), social skills, like motor skills, may need to be taught and practice experiences may need to be constructed.

## The Autism Constellation

Another area that may be contributing to the limited congruence of findings is the lack of a confirming diagnostic assessment or, even, detailed sample characteristics in reference to autistic characteristics. A large number (42%) of the reviewed studies did not include a confirmatory measure of the participant's diagnosis or provide characteristic information about the exact needs of the sample. Without this information, comparisons become very difficult as it is hard to determine if the intervention, or the modifications thereof, would be beneficial.

As autism spectrum disorder may be more of a constellation than a spectrum (Hendren, Beroglio, Ashwood, & Sharp, 2009; Mumper, 2012), it is essential to recognize that presenting characteristics, daily needs, and strengths in PA settings, as well as affinity for certain social skills, may be vastly different, despite the same or similar diagnostic label. Notably, there is a dearth of research that includes those with co-occurring conditions, such as epilepsy or attention deficit hyperactivity disorder, or that ~~limits participation to those~~ with an intelligence quotient ~~above~~ 70, in spite of high rates of reported co-occurring conditions among the broader populations of those on the autism spectrum (Simonoff et al., 2008; Sundelin et al., 2016). With limited sample data, it is hard to generalize findings for the use of a particular intervention.

In a rare example, Ketcheson et al. (2016) provided a comprehensive examination of their sample population by conducting the Autism Diagnostic Observation Schedule, second edition (Lord, Luyster, et al., 2012; Lord, Rutter, et al., 2012). In doing so, Ketcheson et al. offered information that allows future research to situate and compare the study's findings within their own sample. Functioning labels—such as “high functioning” or “low functioning”—have been shown to be of little value and potentially stigmatizing (Gillespie-Lynch, Kapp, Brooks, Pickens, & Schwartzman, 2017). Therefore, research should use actual measures and provide detailed information about the participant's actual abilities to allow a clearer comparison.

## Uneven Recruitment

Overwhelmingly, the included studies recruited far more male participants than female participants. Of the reviewed studies, 79% of the participants were male (357/452) and 21% were female (95/452). Although this represents the generally agreed-upon breakdown in the current understanding of the prevalence of autism (Baio et al., 2018), it also further demonstrates the vast overrepresentation of male participants on the autism spectrum in current research and the necessity for actively recruiting female participants. In the only study to include a ~~predominant sample population~~ of females on the autism spectrum, Guest et al. (2017) provided one of the few ~~accounts of an intervention~~ that ~~had~~ a higher likelihood of working for ~~females on the autism spectrum~~. Many studies did not include *any*, or a highly disproportionate number of, female participants, therefore limiting findings to only males on the autism spectrum. One study (Najafabadi et al., 2018) did not report whether the participants were male or female. Future research must actively seek female participants to ensure the universality of ~~the PA~~ intervention.

**Q51**

## Limited Fidelity Measures

Another limiting factor of the reviewed studies was the lack of indicators to evaluate procedural fidelity, though this seems to be a common issue among PA and exercise studies (Dillon et al., 2017). Without fidelity measures, findings are limited due to limited assurance that the intervention components were delivered consistently and as planned. Some types of indicators, such as lesson-by-lesson adherence rates, can be calculated simply by the facilitator or through observer logs. Similar to procedural fidelity, attendance or completion rates can be an indicator of the actual exposure or dose that the participants received. This analysis yielded many PA-based interventions that did not provide indicators for procedural fidelity or attendance rates. Intervention success, above all other measures discussed, might be dependent upon the level of treatment integrity, as a high level of integrity with rigorous methodology can increase the likelihood of changed outcomes (Pereplechikova & Kazdin, 2005). Similar to treatment integrity, attendance rates of the participants should be reported to assure that the participants were exposed to the intervention dose as planned. Future research should incorporate such indicators to ensure procedural integrity and completion rates.

Finally, when providing interventions for individuals, it is vital to incorporate sustainability (and social validity) for any of the given skills to ensure that development can be maintained once the research is completed. In many of the included studies, trained personnel, such as the horse trainers or the researchers, directly provided the intervention, even though intervention settings were relatively authentic, such as schools and community-based facilities. While encouraging appropriate treatment fidelity, limiting intervention delivery agents to trained instructors or researchers will limit the potential continued benefits of a study. Future research should explore parents, caregivers, siblings, or peers within the individual's social sphere. By doing so, this would increase the potential benefits from the study and allow for a higher likelihood of continued practice. Peers, for example, may provide for a more naturalistic opportunity to work on age-appropriate social skills and may create more opportunities to build relationships that will last.

## Limitations

Like many reviews, the inclusion criteria outlined by the authors limit this analysis. The selection criteria may have inadvertently excluded studies that were not present during the search process. To combat this, the authors used inclusive language and search terms while conducting the initial searches. Furthermore, references of review studies were searched for studies that were not present during the search. Regardless, despite comprehensive search terms used, this analysis may have captured studies that worked on social skills as an outcome but did not overtly define the study's presentation mode as being PA. An additional limitation of this review due to the scope of the analysis was the omission of other criteria related to the rigor of the studies, such as (a) inclusion of a generalization phase or maintenance phase and (b) social validity measures. Finally, it was unclear exactly how much each PA intervention afforded the opportunity for social interaction between participants. One could argue that the results of this scoping review are too

varied to allow for a clear picture; however, the varying evidence is the critical result highlighted through this review. Thus, the ~~researchers~~ recommend that future reviews include these variables to evaluate further the quality of PA-based interventions.

## Conclusion and Future Recommendations

Overall, the outcomes yielded from this scoping review suggest that the PA environment may provide a beneficial setting to engage in building social skills, suggesting—similar to Reinders et al. (2019)—that PA may have some influence on social outcomes of individuals on the autism spectrum. However, little consensus exists about which social skills are present or which may benefit from a PA-based intervention. While the PA environment may provide social opportunities that are more natural and have a lower barrier for entry for autistic persons to work on social skills, it may also be true that intentional, structured opportunities to build social skills are needed. Furthermore, without a gold standard measurement and ~~different~~ conceptions of what composes “social skills,” ~~research findings~~ will continue to be limited. Future research should seek to identify how the definition of social skills is constructed in different PA settings and at different ages and by different people (e.g., individuals, parents, instructors). Furthermore, future research should look at how to identify differences in growth among the heterogeneous samples of individuals on the autism spectrum as well as how this may differ in individuals not typically included (e.g., females or people of color). Finally, future research of PA-based interventions needs to include appropriate fidelity measures and provide justifications for dosages and frequencies of the intervention, which may prove to be different between settings.

**Q52**

Overall, there appears to be evidence to suggest the potentially positive association of PA and social skills. However, a lack of consensus on how to define social skills hinders the ability to make definitive statements regarding this relationship or, even, to measure it appropriately. Clearly, moving one's body affords a naturalistic opportunity to work on social skills, yet these opportunities may need to be constructed to ensure maximal benefits. Furthermore, individuals on the autism spectrum should be included in the construction of this construct. If an “expert” developed construct has little relevance, there will be little motivation to engage in such skill practice. Until a consensus of the composition of social skills and PA-specific social skills is reached, the implications of this body of research will continue ~~to be limited~~.

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**Q56**

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**Q57**

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Q59

# Queries

REVISED

12:47 pm, Jul 15, 2020

Please confirm that changes made to the sentence beginning “Based on a review . . .” preserve the intended meaning.

REVIEWED

By Andrew Colombo-Douglass at 12:43 pm, Jul 15, 2020

As per journal style, repeats of words in the article or journal title are not allowed in keywords. Hence, the keywords "physical activity" and "intervention" were deleted. Please check.

REVIEWED

By Andrew Colombo-Douglass at 12:43 pm, Jul 15, 2020

Please ensure author information is listed correctly here and within the byline.

REVISED

1:26 pm, Jul 15, 2020

Please provide the complete reference details for “Tyler et al., 2014” to be included in the reference list.

APPROVED

By Andrew Colombo-Douglass at 12:43 pm, Jul 15, 2020

Please check that changes made to the sentence beginning “Typically, in many . . .” preserve the intended meaning.

REVISED

1:26 pm, Jul 15, 2020

Please provide the complete reference details for “Berkeley et al., 2001” to be included in the reference list.

REVISED

1:26 pm, Jul 15, 2020

Please provide the complete reference details for “Provost et al., 2007” to be included in the reference list.

REVISED

2:23 pm, Jul 15, 2020

The year of publication for the reference “Bremer et al., 2014” cited here has been changed to "2015" to match with the reference in the list. Please verify.

REVISED

12:41 pm, Jul 15, 2020

Please clarify the sentence beginning “Age-appropriate motor skills . . .”.

REVIEWED

By Andrew Colombo-Douglass at 12:43 pm, Jul 15, 2020

Please provide the complete reference details for “Hawks et al., 2019” to be included in the reference list.

APPROVED

By Andrew Colombo-Douglass at 12:43 pm, Jul 15, 2020

Please check that changes made to the sentence beginning “What are the protocols . . .” preserve the intended meaning.

REVISED

1:29 pm, Jul 15, 2020

Please provide the complete reference details for “Peters et al., 2015” to be included in the reference list.

REVISED

1:30 pm, Jul 15, 2020

Please provide the complete reference details for “Tricco et al., 2018” to be included in the reference list.

REVISED

12:41 pm, Jul 15, 2020

Please rephrase the sentence beginning “As the authors screened . . .” for clarity.

REVIEWED

By Andrew Colombo-Douglass at 12:43 pm, Jul 15, 2020

Please ensure that the quotation beginning “experiences in physically demanding . . .” in the sentence beginning “For this review . . .” is reproduced correctly, especially the subject-verb disagreement between “experiences” and “results.”

REVIEWED

By Andrew Colombo-Douglass at 12:43 pm, Jul 15, 2020

The sentence beginning “The inclusion criteria . . .” has been rephrased for structural continuity. Please check that changes preserve the intended meaning.

REVIEWED

By Andrew Colombo-Douglass at 12:43 pm, Jul 15, 2020

Please confirm that changes made to the sentence beginning “The exclusion criteria . . .” preserve the intended meaning.

**REVIEWED**  
By Andrew Coleman-Douglass at 11:43 am, Jul 13, 2020

Please confirm that changes made to the sentence beginning "Exclusion criteria also extended to . . ." preserve the intended meaning.

**REVISED**  
12:41 pm, Jul 13, 2020

Please provide manufacturer name and location details (city, state [if US], and country) for "Excel spreadsheet."

**REVISED**  
11:28 am, Jul 13, 2020

Please check if "n" vales in Figure 1 are correct (as the total of 111+160+102+88 equals 461 not 462)."

**REVISED**  
12:41 pm, Jul 13, 2020

Please provide in-text citation for Figure 1.

**REVISED**  
12:41 pm, Jul 13, 2020

Please note that only 19 articles (instead of 25) are mentioned in the sentence "#Of the 25 articles, five (20%) used . . ." Please check.

**REVISED**  
12:41 pm, Jul 13, 2020

Please check Table 1 for consistency in usage of "Con" and "Cont" in reference to control group.

**REVISED**  
1:32 pm, Jul 13, 2020

Please provide the complete reference details for "Alexander, 2008" to be included in the reference list.

**REVISED**  
1:33 pm, Jul 13, 2020

Please provide complete reference details for "Baker (2003)" to be included in reference list.

**REVISED**  
12:41 pm, Jul 13, 2020

Please provide significance of "\*" in Table 1.

**REVISED**  
12:41 pm, Jul 13, 2020

Please confirm whether "GARS-2" or "GAR-2" is correct and ensure consistent usage throughout.

**REVISED**  
11:40 am, Jul 13, 2020

Please check the phrase "12-week Caputo et al. implemented multi-systemic aquatic therapy" for clarity. Also provide complete details of "Caputo et al." to be included in reference list.

**REVISED**  
1:51 pm, Jul 13, 2020

Please provide the complete reference details for "Venuti (2001)" to be included in the reference list.

**REVISED**  
1:53 pm, Jul 13, 2020

Please provide the complete reference details for "Breslin & Liu (2014)" to be included in the reference list.

**REVISED**  
11:41 am, Jul 13, 2020

Please assess the phrase "short form of BTMP-2, short form" for redundancy.

**REVISED**  
2:02 pm, Jul 13, 2020

Please provide complete reference details for "Conners Neuropsychological Questionnaire (2007)" to be included in reference list.

**REVIEWED**  
By Andrew Coleman-Douglass at 11:42 am, Jul 13, 2020

Please check if the manufacturer name and location details added for "ActiGraph" are correct.

**REVISED**  
11:43 am, Jul 13, 2020

Please check whether "solidarity" is the intended word in the sentence beginning "No effects were found . . ." rather than "solitary" or "solitude."

**REVISED**  
11:46 am, Jul 13, 2020

Please clarify the sentence beginning "Video modeling using . . ."

**REVISED**  
11:51 am, Jul 13, 2020

Please check if "modified Romber test (balance)-measured pre- post-Parents filled out surveys" is correct.

**Q37.** Please provide the complete reference details for "Ames, 1992" to be included in the reference list.

**REVISED**  
12:01 pm, Jul 13, 2020

Please provide an end quotation mark to the quoted phrase "engaging in goal . . ."

REVISED  
12:27 pm, Jul 13, 2020

Please provide expansion for "IV, DV, I/NI, ABCA, GAR-2, Con, PDMS-2, THR, BOT-2, CY-PSPP, CSAPPA, SS, B phase, SP-CQ, AB, PDD, TARGET, SPARK, rec., sig., and comm." in Table 1.

REVISED  
12:28 pm, Jul 13, 2020

Please rephrase the sentence beginning "Those that used yoga . . ." for clarity.

REVISED  
12:35 pm, Jul 13, 2020

Please rephrase the sentence beginning "Ketcheson et al. suggested . . ." for clarity.

REVISED  
12:40 pm, Jul 13, 2020

Please provide expansion for "THR, cert., DSM-IV-TR, and APE."

REVIEWED  
By Andrew Colombo-Dougiovito at 12:41 pm, Jul 13, 2020

Please note that "ID, DS, and ADHD" expansions deleted from footnote in Table 2 as they are not mentioned in the table.

REVISED  
12:43 pm, Jul 13, 2020

Please clarify the meaning of the sentence beginning "In general, the facilitator . . .".

REVISED  
12:44 pm, Jul 13, 2020

Please confirm that the word "solidarity" is used intentionally in the sentence beginning "Ketcheson et al. (2016) did not observe . . ." rather than "solitude" or "solitary."

REVISED  
12:46 pm, Jul 13, 2020

Please check if the phrase "widely variable among participants" is correct.

REVISED  
12:46 pm, Jul 13, 2020

Please check if "no significant effect" can be changed to "not a significant effect."

REVISED  
12:49 pm, Jul 13, 2020

Please provide the complete reference details for "Romanczyk et al., 2014" to be included in the reference list.

REVISED  
12:51 pm, Jul 13, 2020

Please check the sentence beginning "When it comes to intervention duration . . ." for clarity.

REVIEWED  
By Andrew Colombo-Dougiovito at 1:02 pm, Jul 13, 2020

The sentence beginning "Another difference that night . . ." has been reworded for clarity. Please check that the intended meaning is preserved.

REVISED  
12:59 pm, Jul 13, 2020

Please revise the sentence beginning "In the only study . . ." for clarity.

REVISED  
1:01 pm, Jul 13, 2020

Please clarify whether you mean "with different conceptions" or "without different conceptions" in the sentence beginning "Furthermore, without a gold standard . . .".

REVIEWED  
By Andrew Colombo-Dougiovito at 1:06 pm, Jul 13, 2020

The publication year has been updated for the reference "García-Gómez et al. 2014". Please check for accuracy.

REVIEWED  
By Andrew Colombo-Dougiovito at 1:07 pm, Jul 13, 2020

Please provide issue number for the reference "Gillespie-Lynch et al., 2017."

REVIEWED  
By Andrew Colombo-Dougiovito at 1:08 pm, Jul 13, 2020

The year of publication for the reference "Reichow & Volkma, 2009" here has been changed to "2010" to match with the in-text citation. Please verify.

REVIEWED  
By Andrew Colombo-Dougiovito at 1:09 pm, Jul 13, 2020

Please provide issue number for the reference "Reinders et al., 2019."

REVIEWED  
By Andrew Colombo-Dougiovito at 1:07 pm, Jul 13, 2020

Please provide issue number for the reference "Ross et al., 2016."

REVISED  
1:08 pm, Jul 13, 2020

Please provide in-text citation for the reference "Sorensen & Zarrett, 2014"

REVIEWED  
By Andrew Colombo-Dougiovito at 1:07 pm, Jul 13, 2020

Please provide issue number for the reference "Zhao & Chen, 2018."

REVIEWED  
By Andrew Colombo-Dougiovito at 1:08 pm, Jul 13, 2020

Please check if the expansion added for PRISMA is correct.

**Subject: [EXT] Adapted Physical Activity Quarterly - Decision on Manuscript ID**

From: Adapted Physical Activity Quarterly - To: andrew.colombo-dougovito@unt.edu - Cc: - Date: April 28, 2020 at 10:34

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28-Apr-2020

Dear Dr. Colombo-Dougovito:

It is a pleasure to accept your manuscript entitled "Social skill outcomes following physical activity-based interventions for individuals on the autism spectrum: A scoping review spanning young childhood through young adulthood" in its current form for publication in the Adapted Physical Activity Quarterly. Expect that the Production Office will contact you soon to finalize details regarding the publication of your manuscript.

Thank you for your fine contribution. On behalf of the Editorial Board of the Adapted Physical Activity Quarterly, I look forward to your continued contributions to the Journal.

Sincerely,  
Dr. Jeffrey Martin  
Editor, Adapted Physical Activity Quarterly



# Journal of Sports Media

## She's a lady; he's an athlete; they have overcome: Portrayals of gender and disability in the 2018 Paralympic Winter Games

--Manuscript Draft--

<b>Manuscript Number:</b>	JSM-D-19-00046R1
<b>Full Title:</b>	She's a lady; he's an athlete; they have overcome: Portrayals of gender and disability in the 2018 Paralympic Winter Games
<b>Article Type:</b>	Original Study
<b>Keywords:</b>	gender; Disability; Paralympics
<b>Corresponding Author:</b>	Tracy Everbach, Ph.D. University of North Texas Denton, TX UNITED STATES
<b>Corresponding Author's Institution:</b>	University of North Texas
<b>First Author:</b>	Karen Weiller-Abels, Ph.D.
<b>Order of Authors:</b>	Karen Weiller-Abels, Ph.D. Tracy Everbach, Ph.D. Andrew M. Colombo-Dougovito, Ph.D.
<b>Order of Authors Secondary Information:</b>	
<b>Abstract:</b>	<p>This qualitative content analysis of the National Broadcasting Company's (NBC's) coverage of 2018 PyeongChang Winter Paralympic Games sought to examine how the broadcasters framed the intersection of gender and disability in Alpine skiing coverage. The researchers found that athletes' disabilities were framed in a medicalized way, as something they should "overcome," and that Paralympic athletes with disabilities were portrayed as inferior to able-bodied athletes. Results also showed that women athletes received less coverage than the men, that women athletes were placed into traditional gender role frames, and that women were portrayed in a sexualized manner. The researchers discovered that while Olympic Games media coverage has been dominated by women in recent years, the Paralympic Games coverage oppressed women athletes with disabilities by stereotyping and marginalizing them, and stigmatized both male and female athletes with disabilities by framing them as aspiring to be able-bodied. Women athletes with disabilities were doubly stereotyped and marginalized by their sex and disabled status--highlighting the intersection of gender and disability. The authors also make recommendations to improve coverage of disabled women athletes.</p>
<b>Suggested Reviewers:</b>	<p>Marie Hardin, Ph.D dean, Pennsylvania State University University Park : Penn State mch208@psu.edu expert in women and sports; also has studied disability and sports</p> <p>Erin Whiteside, Ph.D Associate Professor, University of Tennessee ewhites2@utk.edu Expert in feminist research on sports</p> <p>Molly Yannity, Ph.D Associate Professor, Quinnipiac University molly.yanity@qu.edu Expert on women &amp; sports research</p> <p>Andrew Billings Professor, University of Alabama acbillings@ua.edu expert in sports, media, women in sports, Olympic sports, sports broadcasting</p>
<b>Response to Reviewers:</b>	<p>To the editor:</p> <p>Thank you for the opportunity to revise and resubmit this article. We greatly appreciate the reviewers' comments and suggestions. We have taken their advice during the revision</p>

process with the chance to update the literature, better explain the method, further weave the theory of intersectionality into the manuscript, and more clearly focus the discussion.

Per the suggestions of both reviewers, we have added:

1. Information that updates the coverage of women in the Olympic Games to reflect that recently women in the Games have received more airtime than men and that coverage is less blatantly sexist.
2. Reorganization of the manuscript per Reviewer 1's comments about the order of the literature review content and the placement of the research questions.
3. The "gender bland sexism" framework as Musto, Cooky, & Messner outlined, per Reviewer 2's suggestions.
4. A clearer and more thorough definition of intersectionality and more explanation about how this theoretical basis is interwoven with our findings, per Reviewer 2's suggestions.
5. More information about recent media coverage of accomplished women athletes (e.g. USWNST), per Reviewer 2's suggestions.
6. Added a third research question "RQ3: How can the framing of disability and gender be viewed in an intersectional way?"
7. An expansion on our methodology and specifics of our coding.
8. Inserted justification in the results section about why the announcers' fixation on falling down is important when it comes to athletes with disabilities.
9. Added answer to new research question in the results section.
10. Reworked the discussion section to incorporate more information on intersectionality.
11. Added recommendations for sports journalists, broadcasters and producers to practice.

We added the following literature and references:

- Bell, T. (2019, February). More women competed in PyeongChang, but still lag behind men. Global Sport Matters. Retrieved from <https://globalsportmatters.com/culture/2019/02/14/more-women-competed-in-pyeongchang-but-still-lag-behind-men/>
- Billings, A.C., Angelini, J. R., & MacArthur, P. J. (2018). Olympic television: Broadcasting the biggest show on Earth. London and New York: Routledge.
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- Bissell, K., & Parrott, S. (2013). Prejudice: The role of the media in the development of social bias. *Journalism & Communication Monographs*, 15, 219–270.
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- Cresswell, J. W. (2007). *Qualitative inquiry & research design: Choosing among five approaches*. Thousand Oaks, London, New Delhi: SAGE Publications.
- Fawcett, B. (2018). *Feminist perspectives on disability*. New York, NY: Routledge.
- Flintoff, A., Fitzgerald, H., & Scraton, S. (2008). The challenges of intersectionality: Researching difference in physical education. *International Studies in Sociology of Education*, 18(2), 73–85.
- Hargreaves, J. (2000). *Heroines of sport: the politics of difference and identity*. London: Routledge.
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- Hilvoorde, I. and Landeweerd, L., 2008. Disability or extraordinary talent – Francesco Lentini (three legs) versus Oscar Pistorius (no legs). *Sport, Ethics and Philosophy*, 2(2), 97–111.
- Lindemann, K. (2010). Masculinity, disability and access-ability: Ethnography as alternative practice in the study of disabled sexualities. *Southern Communication Journal*, 75(4), 433–451.

MacArthur, P. J., Angelini, J. R., Billings, A. C., & Smith, L. R. (2016). The dwindling Winter Olympic divide between male and female athletes: The NBC broadcast network's primetime coverage of the 2014 Sochi Olympic Games. *Sport in Society*, 19, 1556–1572. DOI: 10.1080/17430437.2016.1159193

Martin, J. J. (2019). Mastery and belonging or inspiration porn and bullying: Special populations in youth sport. *Kinesiology Review*. Advance online publication.

McRobbie, A. (2009). *The aftermath of feminism: Gender, culture and change*. Los Angeles, CA: Sage.

McRuer, R., & Mollow, A. (2012). *Sex and disability*. Durham, NC: Duke University Press.

Moodley, J., & Graham, L. (2015). The importance of intersectionality in disability and gender studies. *Agenda*, 29(2), 24–33. doi:10.1080/10130950.2015.1041802

Moradi, B. (2017). (Re)focusing intersectionality: From social identities back to systems of oppression and privilege. In K. A. DeBord, A. R. Fischer, K. J. Bieschke, & R. M. Perez (Eds.), *Handbook of sexual orientation and gender diversity in counseling and psychotherapy* (p. 105–127). American Psychological Association. <https://doi.org/10.1037/15959-005>

Musto, M., Cooky, C., & Messner, M. A. (2017). 'From fizzle to sizzle!' Televised sports news and the production of gender-bland sexism. *Gender & Society*, 31(5), 573-596. DOI: 10.1177/0891243217726056.

National Center on Disability and Journalism. (2018). *Disability Language Style Guide*. Phoenix, AZ: Author. Retrieved Feb. 11, 2020 from <https://ncdj.org/style-guide/#>.

Purdue, D. E. J., & Howe, P. D. (2012): See the sport, not the disability: exploring the Paralympic paradox, *Qualitative Research in Sport, Exercise and Health*, 4, 1-17. DOI:10.1080/2159676X.2012.685102.

Pullen, E., Jackson, D., Silk, M., & Scullion, R. (2019). Re-presenting the Paralympics: (contested) philosophies, production practices and the hypervisibility of disability. *Media, Culture & Society*, 41(4), 465-481.

Stewart, D. L. D. (2018). Using intersectionality to study and understand LGBTIQ people in sport. In V. Krane (Ed.), *Sex, gender, and sexuality in sport: Queer inquiries* (pp. 33-48). New York, NY: Routledge.

Tanner, S., Green, K., & Burns, S. (2011). Media coverage of sport for athletes with intellectual disabilities: The 2010 Special Olympics National Games examined. *Media International Australia*, 140, 107-116.

Van Gorp, B. (2010). Strategies to take subjectivity out of framing analysis. (pp. 84-109). In P. D'Angelo & J. A. Kuypers (Eds.), *Doing news framing analysis: Empirical and theoretical perspectives* (pp. 312-330). New York, NY: Routledge.

Women's Sports Foundation. (2018). *Women in the Olympic and Paralympic Games: An analysis of participation, leadership, and media coverage*. <https://www.womenssportsfoundation.org/wp-content/uploads/2018/02/2018-olympic-paralympic-theory-and-practice-web.pdf>

#### Manuscript Classifications:

#### Author Comments:

To the editor:

Thank you for the opportunity to revise and resubmit this article. We greatly appreciate the reviewers' comments and suggestions. We have taken their advice during the revision process with the chance to update the literature, better explain the method, further weave the theory of intersectionality into the manuscript, and more clearly focus the discussion.

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3. The "gender bland sexism" framework as Musto, Cooky, & Messner outlined, per Reviewer 2's suggestions.
4. A clearer and more thorough definition of intersectionality and more explanation about how this theoretical basis is interwoven with our findings, per Reviewer 2's suggestions.
5. More information about recent media coverage of accomplished women athletes (e.g. USWNST), per Reviewer 2's suggestions.
6. Added a third research question "RQ3: How can the framing of disability and gender be viewed in an intersectional way?"
7. An expansion on our methodology and specifics of our coding.
8. Inserted justification in the results section about why the announcers' fixation on falling down is important when it comes to athletes with disabilities.
9. Added answer to new research question in the results section.
10. Reworked the discussion section to incorporate more information on intersectionality.

11. Added recommendations for sports journalists, broadcasters and producers to practice.

We added the following literature and references:

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## DISABILITY AND GENDER IN THE PARALYMPICS

**She's a lady; he's an athlete; they have overcome: Portrayals of gender and disability in the 2018 Paralympic Winter Games**

*"Women with disabilities face double discrimination—discrimination based on gender and discrimination based on disability...The limited available statistics suggest that economically, socially, and psychologically, women with disabilities fare considerably worse than either women who are nondisabled or men who are disabled."* (Women and Disability Awareness Project, 1989)

Sports media are quite powerful in influencing societal attitudes toward women athletes as well as shaping the relationship between women and sport (Villalon & Weiller-Abels, 2018). Historically and currently, women athletes and teams have received a limited amount of total sports media coverage as compared to the massive amount of coverage given to men (Cooky, Messner & Hextrum, 2013; Higgs & Weiller, 1994; Kane & Greendorfer, 1994; Tuggle, 1997). Although contemporary media attention to high-profile women athletes exists (e.g., Megan Rapinoe, Serena Williams), mass media coverage and social status of women athletes overall have failed to equal the coverage and status of men in sports (Davis & Tuggle, 2012).

When covering sporting events for individuals with disabilities, sports journalists historically have portrayed athletes—especially women athletes—as outsiders and subjected them to a "double oppression" (Deegan & Brooks, 1985; Fine & Asch, 1988; Hargreaves, 2000; Wendell, 1989). Disability scholars (Garland-Thomson, 2011; Lindemann, 2010; McRuer & Mollow, 2012) suggest society demeans those whose bodies are considered disabled and glorifies those whose bodies are considered "normal" (Butler & Bissell, 2015, p. 229). In many instances, coverage of disabled

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athletes centers on a medicalized conception of disability and refers to athletes as needing to “overcome” or “triumph” over their disability in pursuit of an “able-bodied ideal” (Beacom, French, & Kendall, 2016; Thomas & Smith, 2003).

Women athletes are still viewed, albeit in some cases more subtly, as invaders in a sports world still considered to be a “boy’s club” and are recognized more often for specific sports considered “feminine” (Adams & Tuggle, 2004). Sports journalism in general continues to be undertaken and presented in a gendered manner. Competitions in which women wear minimal, tight-fitting clothing have received undue attention by a variety of media outlets, (Coche & Tuggle, 2016; Hardin & Greer, 2009) therefore maintaining the hierarchical status quo by reinforcing what is “acceptable” or “expected” in women’s sports (Stewart, 2018).

The Olympic Games, at various times, have been exceptions to this rule, as in recent years women athletes have received more airtime than men (Billings, Angelini, MacArthur, Bissell, & Smith, 2014; Billings, Angelini, & McArthur, 2018; Coche & Tuggle, 2016; Coche & Tuggle, 2017; MacArthur, Angelini, Billings, & Smith, 2016). Although Coche & Tuggle (2017) found that women received more airtime than men in the 2016 Rio summer Olympic Games, the focus was primarily on sports considered to be socially acceptable, such as gymnastics. Billings, Angelini, & MacArthur (2018) note that NBC network coverage of the Olympic Games has evolved over the past two decades to present women first and foremost, and to highlight athletes by their success and nationality more than their sex: “...it is clear that when medals are at stake within major international sport, viewers focus less on the biological sex of the athlete competing, placing more focus on the colors one wears: red, white, and blue” (p. 163).



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In considering representation in the Paralympic Games, it is vital to consider that bodies with disabilities also are gendered bodies (Flintoff, Fitzgerald & Scraton, 2008), and this intersection can create instances of double discrimination (Fawcett, 2014; Moradi, 2017). While the number of women competitors in the Paralympic Games increased to 1,669 in 2016 from 1,523 in 2012, women make up less than one-fourth of the total Paralympic Games' competitors (Bell, 2019; Women's Sports Foundation, 2018). During the 2018 Paralympic Games, four major online websites (ESPN, NBCOlympics, *The New York Times*, and *USA Today*) published only 34 articles about Paralympians—a majority about men athletes (Women's Sports Foundation, 2018, p. 5).

The Paralympic Games occur only two weeks after the Olympic Games, however, a paucity of research has examined gender differences in the media coverage. Only in recent years have concerns been raised about how disabled athletes are represented in media (Beacom et al., 2016). Historically, it was thought every intention was made to erase disability from coverage (Buysse & Borchering, 2010; DePauw, 1997); however, a recent shift toward “hypervisibility” has been recognized (Pullen, Jackson, Silk, & Scullion, 2019). In an era of ever-increasing coverage of mega-sport events and access to athletes, appropriate representation is paramount, as media representations are reflected in the views of society (Beacom et al., 2016). Moreover, few have considered the intersectionality (Crenshaw, 1990; Hill Collins, 2019) of gender and disability in these media representations and its impact on journalism coverage.

This study examines media coverage of disabled athletes participating in the Paralympic Games. Researchers analyzed NBC network's coverage of the



PyeongChang 2018 Winter Paralympic Games in South Korea. Specifically, this study focused on analyzing the intersection of disability and gender in the Games, broadcast from March 9 to March 18, 2018.

### **Literature Review**

Disabled individuals historically have been misrepresented in news media, usually in a negative and stereotyped way. Often disability is portrayed in a medicalized manner focusing on the deficit over the lived experiences that disability plays in an individual's life (Ellis, 2008). This focus creates a narrative of success for athletes *overcoming* their disability, as many do not correlate disability with success. Yet, this serves to further “other”-ize individuals and perpetuates a stigma (Pullen et al., 2019). This continued display of negative stereotypes is absorbed by society and continued in common thinking—even for disabled individuals. In interviews with wheelchair basketball players about how they felt about television commercials featuring people with disabilities, Hardin (2003) found that people with disabilities internalized the “able-bodied ideal.” Despite the athleticism present and legitimacy of disabled sport, a continued focus—even preoccupation—on the athlete's disability rather than the sport competition continues to pervade media coverage (Hilvoorde & Landeweerd, 2008; Tanner, Green, & Burns, 2011).

It also is a long-established fact that women athletes receive much less televised and print sports media coverage than men athletes receive, and the coverage is often framed in a gendered manner (Cooky, Messner & Hextrum, 2013; Higgs & Weiller, 1994; Kane & Greendorfer, 1994; Tuggle, 1997). Cooky et al., (2013) found that television news media coverage of women's sports constituted less airtime than in the

1990s. This lack of coverage served to devalue and silence women athletes and sent a message that men's sports are superior—in essence, sports are for men. The authors pointed out women athletes are sexualized and trivialized in sports media coverage. In a longitudinal study of 25 years of coverage of women's sports, Musto, Cooky, & Messner (2017) pointed out that overt sexism is no longer the norm in televised coverage and that women athletes receive more respectful, yet lackluster, coverage, which they deemed “gender-bland sexism” (p. 575). Musto et al., theorized that sports media make coverage appear equitable, but actually assert male superiority and masculine hegemony.

In the Olympic Games, women athletes recently have received more airtime and televised media space than men (Billings, et al., 2014; Billings, et. al., 2018; Coche & Tuggle, 2016; MacArthur, et al., 2016). However, women athletes in professional and college sports continue to lack equitable sports media coverage. For example, the NBA is vastly more covered by sports journalists than the WNBA, and the men's NCAA basketball tournament receives more attention than the women's tournament. A focus on accomplished women athletes has occurred in some venues, such as media celebrations of the 2019 FIFA Women's World Cup champions, the United States Women's National Soccer Team.

### **Coverage of the Paralympic Games**

The Paralympic Games are the second largest multi-sport festival (Brittain, 2010), yet receive nowhere near the audience nor level of coverage of the Olympic Games. Founded shortly after World War II as a competition for disabled ex-servicemen and women in England, these competitions are conducted at the same location and on

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the same courses, courts, fields, and arenas as the Olympic Games (Gold & Gold, 2007). Studies of Paralympic media coverage also are fewer than those of Olympic media coverage, mostly focusing on the broader context of disability sport.

Some Paralympic Games studies have concentrated on the stereotype of the “cyborg” or “supercrip”—inspirational stories that depict athletes with disabilities as having special powers to “overcome” adversity and perform athletically (Howe, 2011). Howe notes a hierarchy of disability categories among athletes with disabilities, with wheelchair disabilities at the top. The original classification system that was developed by the International Wheelchair and Sport Association (IWAS) can be understood as a major reason why wheelchair athletes are celebrated ahead of athletes from other impairment groups. This system classified athletes with spinal cord injuries according to where the lesion was in their spine because back function is of great importance in sport (Howe, 2011, p. 870).

Howe (2011) adds that athletes with certain impairments benefit from advances in technology, while others do not. Those with visual impairment, cerebral palsy, or intellectual impairment may participate in sport without technological aids, such as wheelchairs or prosthetic limbs. Those with technological help may receive the “superhuman” label because of the advantage this technology provides, but they also often receive the attention and glory. As Howe (2011) writes, “Technology empowers some while leaving the status of others at best unaltered and at worst increasing their liminality (p. 880).” Yet, the “superhuman” narrative—in an attempt to popularize disability and make it “sexy”—could run counter to elite sport agendas (Pullen, et al., 2019). Further, these narratives disregard the true impairments that coexist with

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tremendous athleticism; often leading to the dismissal of the needs of those with less visible disabilities (Briant, Watson, & Philo, 2013) and coming at the cost of “othering” the individual (Pullen et al., 2019).

A 2019 study focusing on media coverage of athletes with disabilities found sports media emphasized the competitors’ athleticism more than their disability (Rees, Robinson, & Shields, 2019). This research, which examined media articles from 2001-2018, also found that women athletes with disabilities received less media coverage than their men counterparts. However, sports media continued to perpetuate a narrative that these athletes are “superhuman.” Rees et al., (2019), akin to Howe (2011), found that media coverage gave preference to certain disabilities over others; such as wheelchair athletes over people with cerebral palsy. In reference to the Paralympic Games, Thomas & Smith (2003), focusing on coverage of the 2000 games in Sydney identified four key implications: (1) coverage of the successes of athletes was characterized by a medicalized conception of disability; (2) athletes were portrayed as aspiring to or emulating able-bodiedness; (3) most coverage minimized the visibility of an athlete’s disability; and (4) men athletes were more likely to be cast in active poses. The first two points from Thomas & Smith highlight the “superhuman” narrative (Howe, 2011) and attempt to counterbalance the common stereotypes of disability with feats of athleticism. For example, portraying athletes as “victims” or “courageous” people who have “overcome” their disability could be interpreted as seeking to evoke pity and creating a certain narrative about disability common in even more recent Paralympic Games (Beacom et al., 2016). The fourth point of Thomas and Smith’s findings highlights the dual oppression that disabled women athletes can encounter. Not only

are disabled women athletes subject to misrepresentations of their disability, but they also must deal with continuous gendered coverage that minimizes their athleticism in search of fitting into cultural norms. Others have suggested that the mediated coverage of sporting performances are framed in light of “particular facets of [an athlete’s] identity” (Purdue & Howe, 2012, p. 4). Moreover, mediated coverage of disabled athletes—in particular, disabled women athletes—who compete at the highest level of athletic ability is rare and often can be negative.

### **Coverage of women in the Olympic Games**

Although women athletes have received more airtime in the Olympic Games than in the rest of the sporting world, the social status of women athletes has failed to equate with coverage and status of men (Davis & Tuggle, 2012). A study of the 2012 London Olympic Games--sometimes called “The Women’s Olympics” because of the plethora of women competing--found that for the first time since 1996, women athletes received more airtime than men (Coche & Tuggle, 2016). The authors warned about assuming the coverage was equitable; one-third of the airtime was devoted to women’s gymnastics, often perceived as a “feminine” sport (Hardin & Greer, 2009; Tjonndal, 2016). Additionally, more than 40% of the coverage was devoted to competitions in which women wore swimsuits, placing the appearance of women’s bodies before their skills. A study of magazine coverage in the 2012 London Games confirmed that women competitors received more coverage than men in *Sports Illustrated*, *Time*, and *Newsweek* (Blankenship & Everbach, 2013). In *Sports Illustrated*, the amount of coverage equaled or surpassed that of men athletes in various sporting events, including soccer, softball, basketball, gymnastics, swimming, and track and field. Unlike

the television coverage, the print media portrayed women athletes in action photos, appearing strong and competitive, rather than in passive poses. In fact, some of the men appeared in more sexualized photos than the women, particularly the swimmers (Blankenship & Everbach, 2013). In the 2016 Rio Summer Olympic Games, common themes from media representation included heterosexualizing women athletes, focusing on women as wives and mothers, the use of body shaming, and a focus on male privilege. A sense of propagating male hegemony was still present, with a strong focus on socially acceptable women's sports of gymnastics, diving, swimming, beach volleyball and track, particularly during prime-time hours (Coche & Tuggle, 2017; MacArthur et al., 2016; Villalon & Weiller-Abels, 2018). On the other hand, Billings et al. (2018) assert that nationality has become more important than biological sex when it comes to televised Olympic Games coverage.

### **Media representations of women athletes**

Historically, women were not able to compete on an elite level in sports, particularly after childbirth. Commentary often focused on the women athletes' "last shot" because she was going to focus on her personal life (Pflum Peterson, 2016). Sports media influence the public view of athletes through framing. For women athletes, this is more than exceptionally true. Media gatekeepers' decisions on what is stressed in coverage and presentation of all athletes, particularly women athletes, affect public perception. Highlighting and covering women athletes in a gendered manner, especially in high profile events such as the Olympic Games, demonstrates the framing of social acceptability. Emphasis usually centers on the grace and flexibility natural to women (Baraoffio-Bota & Banet-Weiser, 2006; Coche & Tuggle, 2016). This type of slanted

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media coverage depicts women as elegant and minimizes their power and strength (Daddario, 1998; Weiller, Higgs, & Greenleaf, 2004).

Previous research has found women athletes are likely to be represented in passive and sexual poses intended for the male gaze (Bishop, 2003; Davis, 1997; Daniels, 2009; Hardin, Lynn, & Walsdorf, 2005; Salwen & Wood, 1994). The framing of women emphasizes their femininity and conformity to traditional gender roles rather than the multifaceted reality of different kinds of bodies, races/ethnicities, sexualities, and abilities (Kane & Greendorfer, 1994). Frisby (2017) noted in her study of *Sports Illustrated* and *ESPN* magazine covers from 2012-2016, that despite an increase in sports participation of women since the 1972 passage of Title IX, the percentage of women featured on the covers had not increased and women athletes continued to be presented in sexualized poses.

Narratives regarding the “ideal woman” are prevalent in media construction. This also supports the notion that the nature of media is to bombard audiences with messages that reflect a hegemonic view of the woman athlete. In intersecting the media representation of both gender and disability, Bissell & Parrott (2013) note the very approach media take in representation suggests audiences are presented with messages that aid in the creation of prejudices and stereotypes, perpetuating how we as a society should interpret and think about social groups and categories.

These representations can be explained in a second-wave feminist framework as a manifestation of hegemonic masculinity, which ensures the inferior status of women athletes in sports. Women athletes are pressured to conform to socially constructed ideals of beauty rather than as aggressive, powerful, and strong athletes (Daniels, 2009;

Kane & Greendorfer, 1994). The second-class status of women in sport can be illustrated by the fact that many men and boys still use the term “girl” as an insult on the court and field, relegating women to a secondary status. However, later feminist approaches may point to such sexualized representations as “empowering” to women because the women are controlling their own sexuality (McRobbie, 2009). On the other hand, Daniels (2009) argues that sexualized images of women’s fit bodies remove them from athleticism and reframe them as sex objects.

Women athletes may internalize the dominant ideology reinforced by sports media that connects with masculinity the very qualities that make them good athletes—strength, competitiveness, and aggression. In turn, they may then feel pressure to present themselves in stereotypically “feminine” ways such as posing for glamorous, sexy photos in order to prove or enhance their femininity. A study of women college athletes’ perceptions about posing for sexual and nude photos showed that the women struggled with socially constructed gender roles (Everbach & Mumah, 2014). The study found that some of the athletes embraced Western societal notions of beauty such as ultra-femininity, thinness, and youth. However, other athletes saw such depictions as exploitative and wondered why they did not receive the same recognition for their athletic ability as men did. The study concluded that the masculine hegemony of sports forced women athletes to either accept or reject its norms rather than changing them.

The May 2019 *Sports Illustrated* swimsuit edition featured 13 pages of members of the U.S. Women’s National Soccer Team. However, instead of highlighting their skills and talent, the magazine posed them in \$100-\$300 bikinis, see-through swimsuits and thongs (Swimsuit Edition, 2019, pp. 99-114). Player Alex Morgan was quoted as saying,



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“The opportunity to be featured in the Swimsuit Issue four weeks before the World Cup is a huge honor” (p. 107). In contrast to this, after the U.S. women won the World Cup in July 2019, *Sports Illustrated* featured players on the cover in their soccer uniforms, on the field celebrating the victory, more in line with coverage of men who win championships. It was a stunning juxtaposition of women athletes’ portrayals and an example of how social construction of women athletes continues to be presented in a binary manner. Musto et al., (2017) note that current sports journalism considers women’s sports less interesting than men’s and women athletes less accomplished, even while insinuating sports give women and girls an equal opportunity. “When compared to the overt forms of sexism in past televised sports news, today’s gender-bland sexism makes the unequal status quo in sport even more difficult to see, and thus to challenge” the authors write (p. 592).

Despite the presence of women reporters on the sidelines during television broadcasts of men’s professional and college sports, women working in sports journalism are few and far between. In 2018, the Institute for Diversity and Ethics in sport, which issues periodic “report cards” on gender and race in sports media hiring, gave the Associated Press Sports Editors, which represents 75 major media organizations, a grade of F in gender hiring. The report found 90% of sports editors were men and 88.5% of sports reporters were men (Lapchick, 2018). Sports continue to be the domain of men, and men’s sports have higher status than women’s sports, a vicious circle that negates the value of media coverage of women’s sports (Hardin & Shain, 2006). In addition, women athletes with disabilities face marginalization compared with men athletes with disabilities.

### **Intersectionality**

Developed to analyze how multiple marginalized identities, in particular Black women, operate within systems of oppression (Crenshaw, 1990; Stewart, 2018), intersectionality can serve as a guiding framework to understand how the multiple identities of individuals (e.g., disability, gender, race) may impact individual experiences in different contexts (Moodley & Graham, 2015). Critical disability scholarship has argued that disability is socially constructed into binary categories; i.e., individuals are perceived as either “normal” or “abnormal,” weak or strong, depending on able-bodiedness (Hill Collins, 2019). Therefore, ability and able-bodiedness are linked to power, just as being male is interpreted as more powerful than being female. Men athletes are seen at the top of the hierarchy of strength and ability. Paralympic athletes defy the hegemonic and binary notions of able-bodiedness (Butler & Bissell, 2015), and Paralympic women athletes contradict notions of athletic strength and ability belonging inherently to men. Disabled women athletes’ existence is contrary to normative societal standards of an athlete. Therefore, these women athletes experience oppression for not conforming to what is “normal” on multiple intersecting levels. Further, it must be recognized that, “sport serves as an arena wherein a multitude of forces are played against and upon individual athletes in the service of competition and winning” (Stewart, 2018, p. 42).

### **News framing**

News framing consists of patterns by which media producers construct news stories, therefore setting a purported agenda of what audiences perceive as important (D’Angelo & Kuypers, 2010; Entman, 2010). These socially constructed narratives often

are subjective and biased, despite the fact the mainstream media in the U.S. purport to be objective and neutral (Entman, 2010). For instance, media coverage of African Americans has been shown to produce stereotypical patterns, such as linking Black people disproportionately to violence (Entman & Rojecki, 2001). Journalists adopt these patterns of bias, often unconsciously, through their training and education in journalism schools and in newsrooms (Shoemaker & Reese, 1996).

Feminist research has pointed out that news frames often reinforce gender-related socially constructed myths that reinforce a dominant ideology placing men at the top of a social hierarchy (Hardin & Whiteside, 2010). Sports journalists assume that audiences prefer men's sports to women's, without any evidence to back up that assertion, and therefore devote more coverage to men's sports (Creedon, 1994; Knight & Giuliano, 2003). A similar bias is shown in coverage of disabled sport. Much like gendered stereotypes are reinforced through media coverage, positive or negative views of disability are influenced heavily by the framing of coverage (Zhang & Haller, 2013). As previously noted, the purpose of this study is to examine the media coverage of disabled women athletes participating in the Paralympic Games. As little focus has previously been directed at the intersection of gender and disability in the sport coverage of athletes, this exploratory study was guided by the following research questions:

RQ1: How is disability framed in NBC's coverage of the 2018 PyeongChang Paralympic Games?

RQ2: How is gender framed in NBC's coverage of the 2018 PyeongChang Paralympic Games?

RQ3: How can the framing of disability and gender be viewed in an intersectional way?

### **Method**

To examine differences in media coverage of gender and disability, three main sports (i.e., six Alpine skiing events, five cross-country events, and three snowboard events) from the 2018 Winter Paralympics were recorded from the National Broadcast Company (NBC) coverage. Each of the three included both women's and men's divisions. The coverage consisted of 46 hours with commercials and included both event coverage and narration as well as feature packages on individual athletes. The total amount recorded (with commercials and announcements) for each sport across each individual event was 22 hours of Alpine skiing coverage, 11 hours of cross-country, and 13 hours of snowboarding coverage. Due to the extensive volume of coverage, analysis was limited to the Alpine skiing coverage, as the women's and men's Alpine skiing events were structured similarly and could be used comparatively.

Three researchers developed coding guidelines based on the previous literature regarding media coverage of women in sports, media coverage of disability in sports, media framing, and intersectionality. To guide analysis, the following specific initial concepts were developed as codes to which the researchers paid attention in their viewing of the broadcasts included:

- Portrayals of athletes by medicalized descriptions of disability
- Portrayals of athletes as having "superhuman" talents/abilities
- Comparison of athletes to able-bodied counterparts
- Characterization of Paralympic athletes as inferior to Olympic athletes

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- Characterization of men athletes as superior
- Characterizations of women athletes as inferior
- Sexualized representations of women athletes
- Portrayals of women athletes by family relationships
- Portrayals of women athletes by physical appearance
- Intersection of gender and disability in coverage

The coders, scholars who included a former journalist familiar with media production practices, watched the coverage, took notes, wrote memos through an inductive and comparative approach (Creswell, 2007), then met to discuss their findings. Through multiple discussions and phenomenological, comparative examination of notations and quotes taken from coverage, the authors developed themes and sub themes which were then discussed until authors reached 100% agreement.

The authors began with descriptive coding, as outlined by Hesse-Biber (2017), in which they identified initial concepts in the language used by the announcers and through the visuals presented (See list of initial concepts above). They then progressed to the second step of categorical coding, in which they began to identify patterns through the broadcasters' language and the visual images. Finally, researchers developed the third and final round of analytical codes to identify the overall themes evidenced by the coverage. Internal reliability and validity checks were conducted by continuously meeting to compare details, notes, and consistency of researchers' theme development. The researchers agreed upon the following overall themes in the 2018 Paralympic Games coverage, which reflect culturally embedded frames journalists often employ to make meaning and sense of the stories they tell (Van Gorp, 2010).

### Results

Results indicated four major frames (two disability and two gender related), in the NBC coverage of the 2018 Paralympic Games. Themes referring to disability coverage are: (1) Athletes framed as “overcoming” their impairment; and (2) Athletes seen as inferior to able-bodied athletes. Themes referring to gender differences in coverage are: (1) Traditional gender role stereotypes; and (2) Sexualization of women. The intersectional nature of the framing also is discussed.

### Disability

The first research question sought to identify patterns in the coverage of athletes’ disability during the competition. The following themes emerged for RQ1: How is disability framed in NBC’s 2018 coverage of the PyeongChang Paralympic Games?

**Athletes framed as “overcoming” their impairment.** Much of the discussion about these athletes focused on medical definitions of their impairment. While each category of competition had specific requirements for athletes to ski (such as standing or sitting, or visual impairment), the announcers went into great detail about the disabilities of these skiers. They included specific medical information on each impairment, including visual impairment, accidents, amputations, birth defects, and cerebral palsy, and they reported how athletes became impaired. For example, in the men’s downhill standing event, an announcer noted that Japanese skier Hiraku Misawa is “a one-leg amputee, from a road accident when he was just 6 years old.” The announcer added, “He has had time to work with his impairment and go about adapting.” This framing that the impairment needed to be prevailed over repeatedly

emerged. Czech skier Tomas Vaverka “has cerebral palsy,” an announcer said. “You can hear his groans as he fights the course.”

When discussing a Dutch skier Neils De Langen in the downhill sitting competition, an announcer noted the skier lost his leg when he was 11 months old, and “these athletes will tell you they are not deterred by their impairments.” Japanese champion Taiki Morii “began skiing after watching the 1998 games in Nagano on television as he was hospitalized for a motorcycle accident,” according to the announcer. “He took that inspiration and here he is, a multiple gold and silver medal winner at the Paralympic Games.” A profile of gold medalist Andrew Kurka noted that he once was a wrestler “but his dream was shattered when he broke his back at age 13 in an ATV accident.” His physical therapist recommended skiing, and Kurka was featured as saying, “It took me breaking my back and then starting to ski again to realize I could still be the best in the world.”

This type of narrative suggests athletes with disabilities have something to overcome. In addition, it is framed to serve as inspiration for able-bodied people, adding to the diminishment of their work and skill.

**Athletes seen as inferior to able-bodied athletes.** Several times announcers applauded athletes for “just getting to the bottom” of the hill, remarks seldom or never heard in able-bodied skiing competitions. “Getting to the bottom and finishing on the opening day is sometimes more of an achievement to some of these athletes than going for the medals,” said one announcer. While the Paralympics features the world’s top athletes in their field, announcers commonly framed them as lesser than Olympic

competitors. In the women's Super G competition, an announcer noted two different athletes' limb impairments, then said:

Why are these athletes competing together? Essentially, they are competing against the standard they have set in their class. But they also are competing against other people. In some ways it's like they are held to a much higher standard. They not only have to do well for themselves but do better than others.

The NBC broadcast showed these athletes falling, repeatedly, often framing them as incompetent. "Oh, it's a poor, poor start for Britain's Menna Fitzpatrick," an announcer said during the women's downhill visually impaired competition. When a skier wiped out in the women's standing downhill event, an announcer said, somewhat gleefully, "Down we go!" In other cases, a fall was met with silence from the announcers or coverage would abruptly move to the next competitor without explanation. When Canadian Braydon Luscombe fell in the men's downhill standing event, the announcer noted that "his body weight is out of the normal range for the ski," and "we learn from our failing, and I am sure Luscombe will go back to his team and talk it out." Although coverage of any athletes falling is common among media coverage—particularly during events such as skiing—how the Paralympics announcers framed this coverage was holistically different for the disabled athletes. In reference to disabled athletes, the announcers seemed to view this occurrence as an inevitability. Whereas with able-bodied athletes a fall would be tragic and unexpected, for the disabled athletes, the announcers seem to view the completion of the event as the unexpected outcome.

These sorts of characterizations serve to paint athletes with disabilities as different from able-bodied athletes, suggesting that they are to be pitied rather than



heralded. Further, framing the accomplishments of these athletes as inspirational for just showing up perpetuates the stigma of disability.

### **Gender**

The following themes were identified with regard to RQ2: How is gender framed in NBC's 2018 coverage of the PyeongChang Paralympic Games?

**Traditional gender role stereotypes.** The NBC Paralympics Alpine skiing announcers, all men (the main program anchor was a woman, Carolyn Manno), repeatedly drew attention to the sex of the women competitors, but they did not mention the sex of the men competitors. Commentators referred to women competitors multiple times as "lady," whereas men competitors were identified by their country (e.g., the Spaniard, the Italian, the Norwegian). In essence, this framing inferred that men were representing their country, while women were representing themselves. Commentators used terms that identified women athletes as less athletic than the men. The focus was largely on their gender rather than their status as athletes. For example, a man broadcaster described a French woman skier as "the lady who has given us 1:30:30 and there is a familiar smile in there." When a Swiss woman skier fell in her event, an announcer said, "She is a fighter, believe me, this lady is a fighter." No men athletes were identified by their sex in the coverage we watched and coded. For men competitors, announcers used phrasing such as "Can the great Spaniard do it again?," "It's an even bigger day for the young Italian," and "big support here for the Welshman." This is consistent with literature showing men athletes are considered the top of the hierarchy in sports coverage.

Coverage framed several women athletes by their status as a wife or a mother. The broadcasters made numerous references to women athletes' husbands and children when covering the competitions. For instance, coverage of USA Alpine skier Danelle Umstead, who competes in the visually impaired category, focused on her 2008 wedding to her husband, coach, and guide, Rob Umstead. The feature also included shots of their child and highlighted her commenting that she is "a pretty lucky girl." The announcers also noted that she is known as the "team mom." During her run down the hill, the announcers referred to her husband's coaching work as a major factor in her success, although she is the athlete. ("He is coaching her to be more aerodynamic.") After she finished in eighth place, an interviewer asked her what it means to have her husband and her son by her side. This not only emphasized traditional gender roles but assumed heterosexuality as the norm in women's sports.

On the other hand, coverage of the men did not emphasize their marital or parental status. Announcers sometimes referred to a man competitor's relative also being an athlete ("his sister also is on the circuit") or to the fact he had children, but the family members were not named and the athletes' role as a husband or father was not the main focus. This type of gendering contributes to the marginalization of women athletes by placing more importance on external factors in their lives rather than their skill, strength, and talent, or the myriad other attributes they possess.

**Sexualization of women.** The announcers used particularly feminine markers to characterize successful women skiers. Comments using terminology such as "grace and beauty" or "beautiful form" were commonly used with women, while the announcers referred to men athletes as "powerful," and as having "precision," "focus," and

“perseverance.” Broadcasters described a woman skier by her “hair flowing in the wind behind her helmet.” They characterized several women athletes as skiing “passively.”

The men also expressed surprise when women excelled in the competition. “When I watch her ski, it absolutely blows me away, how well she skis,” an announcer said about USA skier Stephanie Jallen. When a woman fell on the course, “it must have been nerves,” the announcer said. This focus on women’s appearance and their descriptions as inferior athletes diminished their accomplishments.

The men skiers, on the other hand, were described as aggressive, ambitious, and strong. Announcers applauded men athletes for being “at the top of the pile” and also for being the “medal hopes” for their countries. One man skier was a “gentle giant,” another “wants, craves, one of the medals here,” and a third was “a big, powerful athlete.” When a man fell, the course was unusually slippery or the skier “hit a bump.” Men were represented as the superior athletes in competition. Additionally, more airtime in the NBC Alpine skiing coverage was devoted to men’s events than to women’s events; more men skiers competed than women skiers. Only 23.6% of the overall competitors in the 2018 Paralympics were women, which corresponds with the lack of airtime for women’s competitions (Bell, 2019). The broadcasters’ treatment of women as secondary and use of feminine markers during the competition contributed to their marginalization in sports. It also should be noted that the athletes represented little racial or ethnic diversity; they all were from White European or Asian backgrounds, which is common, but not exclusive, to winter sports.

### **Intersectionality**

Addressing RQ3, analysis of the coverage of the 2018 Winter Paralympic Games in PyeongChang revealed that women athletes with disabilities were doubly stereotyped and marginalized by both their sex and their status as disabled athletes—highlighting the intersectionality of gender and disability and affirming previous literature showing women athletes with disabilities are subject to a “double oppression,” marginalized for both their disability and also for being women (Deegan & Brooks, 1985; Fawcett, 2014; Fine & Asch, 1988; Moradi, 2017; Wendell, 1989). Coverage of the women athletes focused on women’s traditional gender roles. This broadcast emphasized the women athletes’ femininity and traditional, stereotyped cultural norms, rather than the multifaceted contributions of women in society. Emphasis was on women athletes being less powerful and less capable than men. Women athletes in the Paralympic Games were portrayed as heterosexual wives and mothers, without any possibility of other sexuality or role in society. They also were portrayed as individual competitors, rather than part of a team. This minimized their athletic success and continued the idea of their marginalization as athletes. However, men Paralympic athletes did not receive this kind of coverage. Men were referred to as representatives of their countries and heralded for their roles as athletes who trained hard for their success. Even when a woman athlete competed in the Paralympics—the top competition in the world—she was not given complete credit for her own success, as demonstrated by the broadcasters’ attribution to Danelle Umstead’s husband and coach for her performance on the course. While this type of sexism may not be blatant, it fits into the “gender bland sexism” framework identified by Musto, Cooky, & Messner (2017). The intersection of disability and gender in the coverage resulted in slanted, stereotypical portrayals of the women athletes.

### **Discussion**

While the literature shows that Olympic coverage of able-bodied women athletes recently has become more prevalent and less gendered, this study suggests that women athletes in the 2018 Paralympic Games were stereotyped and minimized in intersectional ways. The intersection of multiple identities, as described by Crenshaw (1990), within systems of oppression can serve to privilege or oppress. In the case of these women Paralympic athletes, it served to oppress, as they were continually characterized by the broadcasters as outsiders and othered, both because of their sex and because of their disability. These results mirror and expand upon those found by Buysse and Borcharding (2010) of the 2008 Paralympic Games. The authors showed how the amount of coverage and ways of representing disability were skewed against disabled women athletes. Further, disabled women athletes were represented as non-athletic and inferior to their men counterparts; further reinforcing gender and disability stereotypes and amplifying the “male and able-bodied hegemony in sport” (Buysse & Borcharding, 2010, p. 319) Unfortunately, when it comes to appropriately addressing those with multiple marginalized identities, sports media has done little to nothing to correct this poor representation.

Producers and announcers of such broadcasts must become mindful that their comments and language can further marginalize women athletes, particularly those with disabilities, by treating them as lesser than men athletes and adhering to outdated gender stereotypes and heavily medicalized definitions of disability. Commentators and producers in future Paralympics Games should take steps to check the language they use. For example, calling a woman athlete a “lady” only is appropriate if using the term

“gentleman” for men athletes. More equitable language would identify all athletes by their country affiliation. Profiles of athletes should be about the athletes’ accomplishments and achievements, not about their affiliation with a spouse or partner, nor be focused on the mishaps of the athlete or medicalized nature of the disability.

Broadcasters also are advised to refrain from framing the experiences of athletes with disabilities as inspiring because they “overcame” their disability to compete in the Paralympics or that athletes “should be proud just to be there.” This indicates to audiences that they should feel sympathy or pity for these athletes and further propagates the social stigma of disability (Ellis, 2009). It also can insinuate that these athletes possess “special” powers (as described by Howe, 2011) to reach the status of international competition while trying to emulate able-bodied athletes. Ultimately, by failing to represent disability appropriately (Beacom et al., 2016), coverage belittles the important role these athletes serve as representatives for younger generations by framing participation as “overcoming” akin to “inspiration porn” (Martin, 2019). This type of framing perpetuates stigmas of disability to please able-bodied audiences, rather than portraying the athletes’ skill or providing meaningful representation for future disabled athletes. Instead of discussing medicalized descriptions of the competitors’ impairments—which highlights their differences in relation to able-bodied people—sports journalists should treat them as athletes in their own right. Multiple shots of skiers wiping out on the course and pitying comments by announcers caused the athletes to appear as victims of their impairments, rather than as athletes who made errors, much as Thomas & Smith (2003) found in coverage of the 2000 Paralympic Games. It also

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served to minimize their achievements because of their disability, rendering them less important than able-bodied athletes of the Olympic Games.

Furthermore, though this analysis focused on the representation of disability and gender within the Paralympic Games, little mention was given to those with additional identities who may also be marginalized. As this analysis included only the winter sports, the ability to analyze a third level of oppression stemming from racial or ethnic identities was moot—though, perhaps this speaks more to how those with identities other than White are impacted more broadly in winter sports than the representation within the Paralympics Game or the media coverage therein. Additionally, though men and women were prominent genders represented and women, as mentioned, are subjected to greater oppression within media coverage, gender is a nonbinary construct (Thorne et al., 2019). Grouped within “men’s” and “women’s” events, this forced binary is represented by media to oppress women’s sport—further still, non-cisgendered, individuals may experience further levels of misrepresentation and oppression that traditional methodologies may have difficulty in analyzing.

Sports media coverage of the intersection of gender and disability continues to be problematic. Overall, athletes with disabilities are not objects of pity, nor are they “superhuman.” The work ethic, training, skill and talent of Paralympic athletes are equal to that of Olympic athletes and they should be framed with respect, accuracy, and equality in media coverage. To ensure appropriate representation within media coverage, sports journalists and announcers should seek to authentically represent athletes without stereotypical, engendered language, and to employ camera angles similarly for all athletes. (For examples, see the Disability Language Style Guide from

the National Center on Disability and Journalism, 2018: <https://ncdj.org/style-guide/#>).

As media continue to hold tremendous sway over the societal views of topics, they must work to appropriately provide representative coverage. This may be best accomplished by including women and disabled individuals as anchors, field reporters, editors, producers, technicians and/or visual journalists.

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This is an original study and has not been previously published.

Tracy Everbach, Ph.D.

Tracy.Everbach@unt.edu

**Subject: [EXT] Re: Assistant with accepted manuscript in the Journal of Sport**

From: Mary Sheffer - To: andrew.colombo-dougovito@unt.edu - Cc: - Date: October 28, 2020 at 15:09

Hello Andrew,

I'm unable to resend a formal acceptance letter from the Journal's webpage. However, I hope this email will suffice for your dossier. Let me once again congratulate you on your manuscript (*She's a lady; he's an athlete; they have overcome: Portrayals of gender and disability in the 2018 Paralympic Winter Games*) in the Journal of Sports Media v16.1., which is set to go to print in the spring of 2021.

I will be in touch as the publication date draws near.

Peace,  
Mary Lou

Mary Louise Sheffer Ph.D.  
Interim Associate Director of the School of Communication  
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Editor *Journal of Sports Media*  
"Cast off your anxieties on Him, for He cares about you." 1Peter 5:6

On Wednesday, October 28, 2020, 02:48:16 PM CDT, Colombo-Dougovito, Andrew <andrew.colombo-dougovito@unt.edu> wrote:

Hello, Dr. Sheffer,

I'm reaching out to you to see if you can send me the formal confirmation email from the Journal of Sport Media regarding my recent co-authored article (*She's a lady; he's an athlete; they have overcome: Portrayals of gender and disability in the 2018 Paralympic Winter Games*) with Drs. Weiller and Everbach.

I am currently applying to be a fellow for SHAPE America (the application is due on Sat, 10/31) and they require confirmation for any currently in-press articles on my vitae. I attempted to access the letter, as well as the accepted draft of the manuscript, through the journal's submission portal but when I sign-on through my email (andrew.colombo-dougovito@unt.edu) the submission is not linked with my account.

Could you help either connect my account so that I can access it through the submission portal or forward me the formal acceptance email with the associated accepted PDF of the manuscript?

Thank you in advance for your assistance.

Cheers,  
Andrew



**Andrew M. Colombo-Dougovito, Ph.D., CAPE**

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## Recent Publications

Colombo-Dougovito, A.M. , Blagrove, A. J., & Healy, S. (2020). A grounded theory of adoption and maintenance of physical activity among autistic adults. *Autism*. Advanced Online Publication. DOI: [10.1177/1362361320932444](https://doi.org/10.1177/1362361320932444)

McNamara, S., Colombo-Dougovito, A. M. , Weiner, B., & Ahearn, C. (2020). Adapted physical educator's perceptions of educational research. *Research Quarterly for Exercise and Sport* . Advance Online Publication. DOI: [10.1080/02701367.2020.1732858](https://doi.org/10.1080/02701367.2020.1732858)

Colombo-Dougovito, A. M. , Block, M. E., Zhang, X., & Strehli, I. (2020). A multiple method review of accommodations to standardized assessments commonly used with children and adolescents on the autism spectrum. *Autism*, 24 (3), 693-706 DOI: [10.1177/1362361319884400](https://doi.org/10.1177/1362361319884400)

Colombo-Dougovito, A. M. , Kelly, L. E., & Block, M. E. (2019). The effect of task modifications on the fundamental motor skills of boys on the autism spectrum. *Journal of Developmental and Physical Disabilities*, 31 (5), 653-668. DOI: [10.1007/s10882-019-09666-4](https://doi.org/10.1007/s10882-019-09666-4)

## Publications Available Soon

Colombo-Dougovito, A.M. , & Lee, Ji. (in press). Social skill outcomes following physical activity-based interventions for individuals on the autism spectrum: A scoping review spanning young childhood through young adulthood. *Adapted Physical Activity Quarterly*.


Weiller, K. A., Everbach, T., & Colombo-Dougovito, A. M. (in press). She's a lady; he's an athlete; they have overcome: Portrayals of gender and disability in the 2018 Paralympic Winter Games. *Journal of Sports Media*.

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the  
**ADAPTED**  
project



# A grounded theory of adoption and maintenance of physical activity among autistic adults

Autism  
1–15  
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Andrew M Colombo-Dougovito<sup>1</sup> , A Josephine Blagrove<sup>2</sup>  
and Sean Healy<sup>3</sup> 

## Abstract

**Background:** Although a growing body of literature has explored the physical activity experiences from the perspective of children on the autism spectrum, the perspective of autistic adults remains largely unheard. Due to this absence of perspective, there exists limited knowledge of the appropriateness and generalizability of current models and theories of physical activity for this population.

**Methods:** A constructivist grounded theory study was conducted to explore the experiences of adoption and maintenance of physical activity from the direct perspective of autistic adults. Autistic adults ( $n=23$ ) from the United States and the United Kingdom were recruited.

**Results:** A total of 29 codes emerged from the coding process. These codes were formed into four broad categories: (1) individual attributes; (2) environmental factors; (3) social relationships; and (4) social experiences. The interconnectedness of these four categories was explored.

**Conclusions:** The findings and presented model highlight the importance of building successful experiences for young children on the autism spectrum, so that they are more likely to continue physical activity into their adult life. Furthermore, findings emphasize the importance of creating noncompetitive, sensory-friendly physical activity experiences for autistic adults that offer flexibility in social engagement.

## Lay abstract

Little is known about how autistic adults experience physical activity. To begin to change this, we interviewed 23 autistic adults from the United State and the United Kingdom about their past and current experiences of physical activity participation. The interviewees told us about how their physical activity experiences were highly influenced by their individual strengths, the setting in which the activity took place, the presence of people to support their physical activities, and the sensory experiences they had while in physical activity. Through these interviews, we were able to create a model that represented the physical activity experiences discussed. Based on the model that emerged from this study, we recommend physical activity opportunities are made available that are noncompetitive, sensory-friendly, and that allow for participants to socialize as they prefer.

## Keywords

autism spectrum disorder, life span development, physical activity, sensory factors, socio-environmental barriers

Autistic adults<sup>1</sup> are at a greater risk for a host of health problems compared to their nonautistic peers (Bishop-Fitzpatrick & Kind, 2017; Cashin et al., 2016; Croen et al., 2015). Physical inactivity is a key, modifiable risk factor for a host of health outcomes. Indeed, physical inactivity is the fourth largest cause of death worldwide (Kohl et al., 2012) and has been linked to an increased risk for cancer, hypertension, type 2 diabetes, and coronary heart disease

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(Blair & Brodney, 1999). Participation in physical activity (PA) can also decrease an individual's susceptibility to stress and anxiety (Stubbs et al., 2017), decrease the risk for diabetes (Colberg et al., 2016), improve sleep (Saunders et al., 2016), and reduce symptoms of depression (Schuch & Stubbs, 2019). Although research on PA among autistic adults is sparse, research involving autistic youth suggests PA may offer additional benefits for the autistic population (Bremer & Lloyd, 2016; Healy et al., 2018; Lang et al., 2010; Sowa & Meulenbroek, 2012). Additional studies have also found PA participation to result in improved parent quality of life (Toscano et al., 2018), and improved sleep (Brand et al., 2015).

Despite the array of benefits that can be gained from PA participation, levels of PA among autistic adults remain low. Benson and colleagues (2019) compared PA levels between young autistic ( $n=15$ ) and nonautistic adults ( $n=17$ ), using both self/caregiver-report and objective measures. On average, nonautistic adults participated in over twice as much daily moderate-vigorous PA (MVPA) as the autistic sample (15.5 vs 36.8 min). Similarly, significantly more nonautistic adults met the PA recommendations for adults of  $> 150$  min of MVPA per week, compared to the autistic adults (82.4% vs 40%, respectively) (Benson et al., 2019). Moreover, autistic adults are significantly less active than nonautistic children and adolescents (Garcia-Pastor et al., 2019), suggesting the disparity in activity levels between autistic and nonautistic individuals—that is well reported during adolescent years (Dreyer Gillette et al., 2015; Healy et al., 2019; McCoy et al., 2016; Pan et al., 2017; Stanish et al., 2017)—widens as the individual moves into adulthood.

For autistic individuals, accessing and participating in PA may be hindered by a greater array of barriers than face the nonautistic population. Although research with autistic adults is sparse, research with autistic children is gaining greater attention. Research exploring the barriers to PA among autistic children has found that intrapersonal, interpersonal, and community factors play a role in diminished access (Blagrove & Colombo-Dougovito, 2019; Obrusnikova & Miccinello, 2012; Stanish et al., 2017). Autistic children have also engaged in interviews to recall their PA experiences. For example, children (Blagrove, 2017; Healy et al., 2013) and adolescents (Arnell et al., 2018) have had their perspective heard and spoke of the importance of positive PA experiences, but recalled an array of barriers they experienced, including low perceived physical ability, sensory issues, concerns about negative social interaction such as bullying, and anxiety related to participation.

Although the knowledge base on autistic children's experiences in PA grows, much less is known about autistic adults. Nichols and colleagues have begun to address this gap in the literature. Interviews with parents of eight autistic adult children provide an insight into the barriers and facilitators experienced by this population (Nichols

et al., 2019). Several factors emerged as being influential; factors that either facilitated or restricted PA participation. First, parents spoke of their positive attitudes to PA and the availability of financial resources and free time as being factors that led to their adult child being more active. Conversely, a host of barriers to PA was also revealed in this study: parents spoke of their lack of interest in PA and their concern for their adult child's safety as being detrimental to their adult child's PA levels. The parents also listed a multitude of traits of their adult children that they perceived as being reasons for their child's inactivity, such as motor skill delays, aggression, and hypersensitivity. Finally, parents spoke of the importance of the availability of programs and facilities. Whereas many of the parents spoke of how local programs (e.g. Special Olympics) and accessible facilities were critical for PA participation of their adult child, other parents who lived in more rural locations noted that a scarcity of programs for their adult child was a significant barrier to participation (Nichols et al., 2019).

Although the perspective of parents and caregivers has been informative, the perspective of autistic adults requires attention. Autistic adults need to be recognized as the "expert of their own lives" (Caldwell, 2014). Their perspective is crucial for informing the development of interventions and programs to increase PA participation for autistic adults (Nind, 2008). Therefore, the purpose of this study was to examine the lived experiences of autistic adults in regard to their adoption and maintenance of PA throughout their life spans.

## Methods

This study used a constructivist grounded theory design (CGT) (Bryant & Charmaz, 2007; Charmaz, 2006) to capture the lived experiences of PA adoption and maintenance among autistic adults across their life span. Grounded theory is a structured qualitative analytical methodology uniquely intertwined with the data collection process to "generate an inductive theory about a substantive area" (Glaser, 1992, p. 16). CGT adopts many of the key strategies from early versions of grounded theory (Corbin & Strauss, 1990, 2008; Glaser, 1978; Glaser & Strauss, 1967). This specific subdomain of grounded theory allows for the reflexive capture of the language, meaning, and actions of the researchers and research participants by acknowledging the complexity and subtle nuances of the daily lives of participating individuals, as well as situating the research in the social and environmental contexts that occur during data collection (Charmaz, 2017).

## Participants

Following ethical approval, participants were purposefully recruited through university autism clinics and networks. In addition, participants were recruited through online



**Table 1.** Participant demographics.

Pseudonym	Gender	Age, years (range)	Diagnosis	Education	Employment	Income (\$)	Marital status	Living situation	Location
Sandra	F	35–44	Formal	College	PT	NR	Married	Fam	UK
Christopher	M	35–44	Self	College	NR	NR	Single	Fam	MI (USA)
Cynthia	F	55	Formal	College	FT	30–49 K	NR	I	MA (USA)
Jack	M	18–24	Formal	HS	U	>10 K	Single	Parent	CA (USA)
Steve	M	55	Self	HS	R	70–89 K	Married	Fam	CA (USA)
Ashley	F	25–34	Formal	College	PT	>10 K	Single	Fam	GA (USA)
Heather	F	35–44	Formal	College	SE	>10 K	Single	I	CA (USA)
Susan	F	55	Formal	College	SE	>10 K	Divorced	Fam	UK
Elizabeth	F	25–34	Formal	NR	FT	NR	Relationship	I	NY (USA)
Jason	M	35–44	Formal	College	SE	90 K+	Married	Fam	RI (USA)
Zebo	M	18–24	Formal	HS	U	>10 K	Single	Parent	TX (USA)
Samuel	M	18–24	Formal	HS	U	>10 K	Single	Parent	CA (USA)
Mark	M	55	Formal	College	R	90 K+	Married	Fam	CA (USA)
Mary	F	45–54	Formal	College	SE	NA	Married	Fam	VA (USA)
Jeffrey	M	45–54	Formal	Some HS	SE	10–29 K	Married	Fam	CA (USA)
David	M	55	Formal	NR	SE	NR	Married	Fam	TX (USA)
Tim	M	18–24	Formal	HS	U	>10 K	Single	Parent	CA (USA)
Jessica	F	25–34	Formal	College	SE	50–69 K	Married	Fam	NY (USA)
Dan	M	18–24	Formal	HS	U	>10 K	Single	Parent	CA (USA)
Robert	M	45–54	Self	College	SE	>10 K	Relationship	Fam	CA (USA)
Nicole	F	25–34	Formal	College	FT	90 K+	Married	Fam	NY (USA)
John	M	55	Formal	College	R	NR	Married	Fam	VA (USA)
William	M	18–24	Formal	HS	U	>10 K	Single	Parent	CA (USA)

F = female; Fam = lives with family (either partner or partner + kids); FT = full-time; I = living independently; M = male; NR = not reported; Parent = living with parent; PT = part-time; R = retired; SE = self-employed; U = unemployed.

autistic groups by directly contacting page moderators, as well as through social media posts. Finally, a snowball sampling method was used to increase the reach of recruitment through participants' own personal networks. Participants were included if they had a diagnosis of autism or identified as autistic, were 18 years or older, were living independently, communicated verbally, and were willing to participate in interviews. Independent living for this study was broadly defined as living on own or with family (e.g. spouses, partners, or parents) with the autonomy to come or go without restriction.

A total purposeful sample of 23 participants—12 males and 11 females—ranging in age from 18 to 75 years ( $m=40.45$ ) consented to participate (Table 1). Participants were from diverse educational and geographical backgrounds. Despite a large number of individuals having a college degree, a large portion made less than \$10,000 US annually and the majority worked either part-time or were unemployed—especially those ages 18–24—at the time of interviewing.

Of the participants, 20 had a formal diagnosis of autism, and three were self-diagnosed. Participants who identified as “self-diagnosed” were given the AQ-10 to determine the individual's position on the autism-normality continuum (Baron-Cohen et al., 2001). The AQ-10 is a measurement tool that is used to screen autistic traits

in adults with normal intelligence and has been shown to have discrimination validity and good screening properties (Woodbury-Smith et al., 2005), as well as a limited diagnostic bias (Murray et al., 2017). All self-identified autistic participants met the criteria identified of  $\geq 6$  (Allison et al., 2012) for autism spectrum disorders (ASD).

### Data collection

Data were collected through open-ended, semistructured interviews. Prior to consent and data collection, each participant was provided an overview of the study by their preferred method of communication (i.e. written or oral). Once written consent was obtained, participants were provided an overview of the main interview questions to alleviate any potential anxiety associated with the interview process and to allow participants to prepare. Interviews were conducted using the participants' preferred medium of communication—that is, video interview (Skype or FaceTime), phone interview, or in-person—as identified during the consent process. Interviews ranged in length from 20 min to over 2 h, though the majority took approximately 1 h to complete. Each interview followed a similar format. A predetermined set of main questions were asked in each interview, with follow-up questions and probes used as needed.

**Table 2.** Sample interview questions.

Question
What does being physically active mean to you?
What were your favorite activities to participate in, when you were a child?
a. Why were these your favorite?
Did you prefer activities that involved moving (such as sport) or sitting (such as television)? Why, did you prefer [repeat back preference]?
Did you and your family do any PAs together? If so, can you please describe these activities?
a. How did these activities make you feel?
b. Was there anything you enjoyed or disliked about these activities?
Were there any sports/activities you would have liked to participate in at school?
a. If so, what sport/activities?
b. Why did you not participate in this activity?
c. What made it possible for you to participate?
Looking back, how has your PA level changed over time? Please explain.
Do you consider yourself to be physically active now? Please explain.
a. If yes, what types of PA do you participate in? Typically, how often do you play/do [repeat from above]? For how long?
b. If no, how do you feel about this?
What activities, if any, do you enjoy participating in as an adult?
a. How do you feel when you are participating in these activities?
b. Why do you think you mostly participate in active/sedentary activities (such as ____)?
Are there any activities that you do, but do not enjoy? If yes, why do you do these activities?
a. How do you feel when you are participating in these activities?
Do you usually participate in PA by yourself or with others?
a. Do you rather participating in PA by yourself or with others? Why?
What do you do that has a good impact on your health, if anything?
a. Do you think that PA is related to your health?

PA: physical activity.

### *Interview schedule*

The first and second authors, individually, conducted each interview. Each interviewer had extensive prior experience conducting interviews, including with those on the autism spectrum. Interviews followed a similar format guided by main questions (see Table 2). Prior to the interviews, the authors identified several follow-up prompts to main questions to increase the likelihood of capturing depth in each area of interest. During the interview, probes were used for main and follow-up questions. Interview questions were reviewed prior to the study by three independent experts in the field who have previous experience conducting interviews with autistic individuals. The interview questions followed a chronological order, starting with activity experiences in childhood and concluding with questions pertaining to the adults' current experiences of PA.

### *Ethical issues and approval*

The standard of ethical research was followed throughout the study. After university ethical approval, each study participant gave written informed consent after receiving verbal and written information. Furthermore, prior to each interview, each participant verbally reaffirmed their consent to participate.

### *Data analysis*

Interview data were transcribed verbatim, then initially coded (Charmaz, 2006) using Dedoose analytic software (Version 8.0.35, SocioCultural Research Consultants, LLC, 2018). A constant comparative method of data analysis (Bryant & Charmaz, 2007; Charmaz, 2006; Glaser & Strauss, 1967; Henwood & Pidgeon, 2003) was used by the researchers to code and analyze the results simultaneously. During the interview process, the first and second authors took analytic notes during each interview and debriefed with each other immediately following each interview. In accordance with grounded theory methodology (Charmaz, 2009; Urquhart, 2012), data were first open coded searching for broad ideas, then to a focused coding stage, and finally a theoretical sampling. The first and second authors coded line by line each of the interview transcripts. Interrater reliability (IRR) was measured using Cohen's kappa (McHugh, 2012). Based on three randomly selected interviews, the first and second authors demonstrated an IRR of 0.90; above the a priori criterion of 0.80.

Following open coding and prior to focused coding, the third author independently confirmed the open codes; all discrepancies were discussed as a group to clarify open codes until consensus was reached. During focused

**Table 3.** Themes, codes and excerpts.

Theme	Code	Excerpt example
Environmental factors	Environmental barriers	"But you know, when it came to school sports, um, I wasn't allowed to do school sports, um, because you're—I mean, when I went to school and if you were in special ed, uh, you weren't allowed to participate in, uh, general educational activities at school." (Jeffrey)
	Environmental facilitators	"We made use of the environment to the best of our ability. And there was no grass and, you know, trees, um, so we did sidewalk games. There were a lot good, uh, lines on the sidewalk, on the pavement, so we had good games that we could play. Um, you know, from the corners of the, the, the limestone squares." (Heather)
	Recess	"I was by myself mostly. I can remember trying to join in and being rejected." (Susan)
	Location	"Yeah. And I love the forests. I love—I love the ocean. I love everything, you know, nature. I didn't like so much the sort of—the, the formal areas." (Robert)
Individual attributes	Technology	"it still—it tracks my steps, and it tells me if I'm—did a better job, um, some days than other days. And I think that's helped some, um, but I used to look at it more than I do now." (Christopher)
	Body image	"I'll probably actively resist any attempts to get me into their pool because swimsuits." (Jessica)
	Cognitive barriers	"I had some challenge understanding, like, the rules. It was more or less, like, the directions of how the game is supposed to be played that I had difficulty with." (Nicole)
	Health status	"Current health, health level. Well, I always say—and it's probably not true. I always say I'm very healthy." (Mark)
Individual Attributes cont.	Motivation	"it's about pleasure, it's about finding fun" (Jessica)
	Opinions on PA	"I mean, it looks like people want to be on display when they're exercising. That is kind of what the gyms are like." (Susan)
	Perceived competence	"And by the time I was in elementary school, they wanted me to join the swimming team because I was really good." (Elizabeth)
	Physical barriers (personal)	"I'd love for my joints don't ache. Um, I've had pain all my life. I've grown up with it" (Sandra)
Physical facilitators (personal)	Physical health	"I was good at keeping a rhythm and I have very, very strong legs." (Jessica)
	Mental health	"I exercise and then I don't, like, my depression doesn't go away. But everyone tells you if you exercise and your depression'll go away, and then it doesn't, and then I don't exercise 'cause I'm discouraged." (Christopher)
	Fun or lack of	"It's been quite a while since I played [soccer]. But, yeah, I had a lot of fun playing it." (William)
	Drop out	"I mean, with super competitive games, I can't have fun because all I can think about is winning." (Dan)
Defining activity	Drop out	"I used to [work out]. I can't anymore." (David)
	Defining activity	"a great deal of exasperation and annoyance in in exchange for potentially better health." (Jessica)
	Mental health	"Being physically active, I think of, you know, going out, w-walking, jogging, bike riding, that sort of stuff." (Cynthia)
	Success	"But it's just become so overwhelming. I—my husband goes to the gym, and I was going with him as a guest for a little while, but I just—it got to the point where I would just start having a lot of anxiety on the way to the gym, so I just stopped going." (Nicole)
Sensory experiences	Success	"I don't have as much of a problem balancing." (Jason)
	Sensory experience	"I swim, part of it's sensation, biking. I can bike in circles like this. Get a lot out of that." (Mark)
	Social positive	"Yoga is so nice 'cause it is so antisocial [laughter]. Like it's, it's just—you know, you walk into a room, you set up yoga mats. All face the same direction. Nobody looks at each other. You don't talk with each other and pretend that other people aren't there. And then the teacher comes in and the teacher doesn't talk to you. The teacher talks to the class, and you can kinda like get through the whole thing without talking to anybody. It's awesome." (Elizabeth)
	Social negative	"It seemed to be like at the time. And there were other girls that were kind of in the middle. I don't mind going for a walk but let's walk to a bookstore and then go home and read. They may have been around but I just—I couldn't seem to find them or I didn't how to find them." (Steve)
Masking	Masking	"Honestly, uh, I, I just tried to, like, um, um—the stuff any normal kid would do and just try, um, to not draw attention to what, um, uh, I have. Um, but, um, h-ho-honestly, I just tried to act like a normal kid, even though I knew I wasn't." (William)
	Marginalization	"o, um, I've always been, um, outcast, basically, you know." (David)
	Bullying	"That whole bullying thing. It really degrades a person's thinking. And then you don't wanna do anything. I mean, it's just like at school with me. I, I was scared to death to go out on the playground 'cause I was afraid I was gonna get beat up every day, you know" (Jeffrey)
	Family attitudes	"I don't know. I mean, I feel like maybe if they had pushed me more to do, like, more, um, activities, I would be better at them now. I mean, of course, back then, I didn't want to be pushed at it but now, I probably would of" (Dan)
Others attitude, skill, support	Others attitude, skill, support	"If I find a friend to do it with [I'd go to the gym]." (Samuel)

PA: physical activity.

The above questions were pulled from a larger interview schedule that contained 48 main questions; some questions included one to three priori probing questions as shown above.

coding, each author independently grouped the open codes by commonalities. These groupings were discussed and manipulated as a group, until the authors reach 100% agreement. During the focused coding process, each author used memo writing to frame their thoughts around each open code. Finally, the authors, using the analytic notes, focused codes, and memos, jointly conducted the theoretical sampling phase. During this phase, authors indexed the codes (Braun & Clarke, 2013), allowing them to manipulate the focused codes about the relationships demonstrated within the data and defined them into categories (see Table 3). Through several theoretical iterations, the categories and subsequent model were further defined until the authors reached 100% agreement.

### Data credibility

To ensure the credibility of the data collection and analysis of this study, several steps were taken. Prior to conducting each interview, the first and second authors bracketed their thoughts, situating their prior assumptions and feelings (Tufford & Newman, 2012). Once data were transcribed, each transcript was sent to the corresponding participant for confirmation of the content of the transcript and allow for further or clarifying detail. Once a preliminary grounded theory was developed, the researchers returned the model to the participants for analysis and feedback. Of the 23 participants, 12 provided feedback on the entire model. Feedback, overall, was positive and confirmatory of the presented model; critical feedback of the model from respondents focused on cosmetic issues such as font size and curvilinear versus linear lines.

### Findings

A total of 29 codes emerged from the thematic open coding process of 1244 excerpts; these codes included body image, environmental barriers and facilitators, motivation, perceived competence, as well as social positives and success. During focused coding, open codes were collated into four broad categories: (1) environmental factors; (2) individual attributes; (3) sensory experiences; and (4) social relationships. Focused coding revealed that each factor impacted individuals both positively and negatively, and each factor was interdependent with the other categories.

Through the theoretical coding process, a cyclical model emerged demonstrating the interconnectedness of the categories discussed by participants. This model—the Grounded Theory of PA Adoption and Maintenance in Autistic Adults—is demonstrated in Figure 1. The following sections will describe the model's phases, while rooting each step within the collected data and connecting referenced data to related categories. All participant names have been replaced by a pseudonym.

### Step 1: selection of activities

Activity selection is the first step in the model cycle. Participants discussed how throughout their life, they made choices regarding what activities to select and which to avoid. The categories of *Social Relationships* and *Individual Attributes* were very prominent within this step.

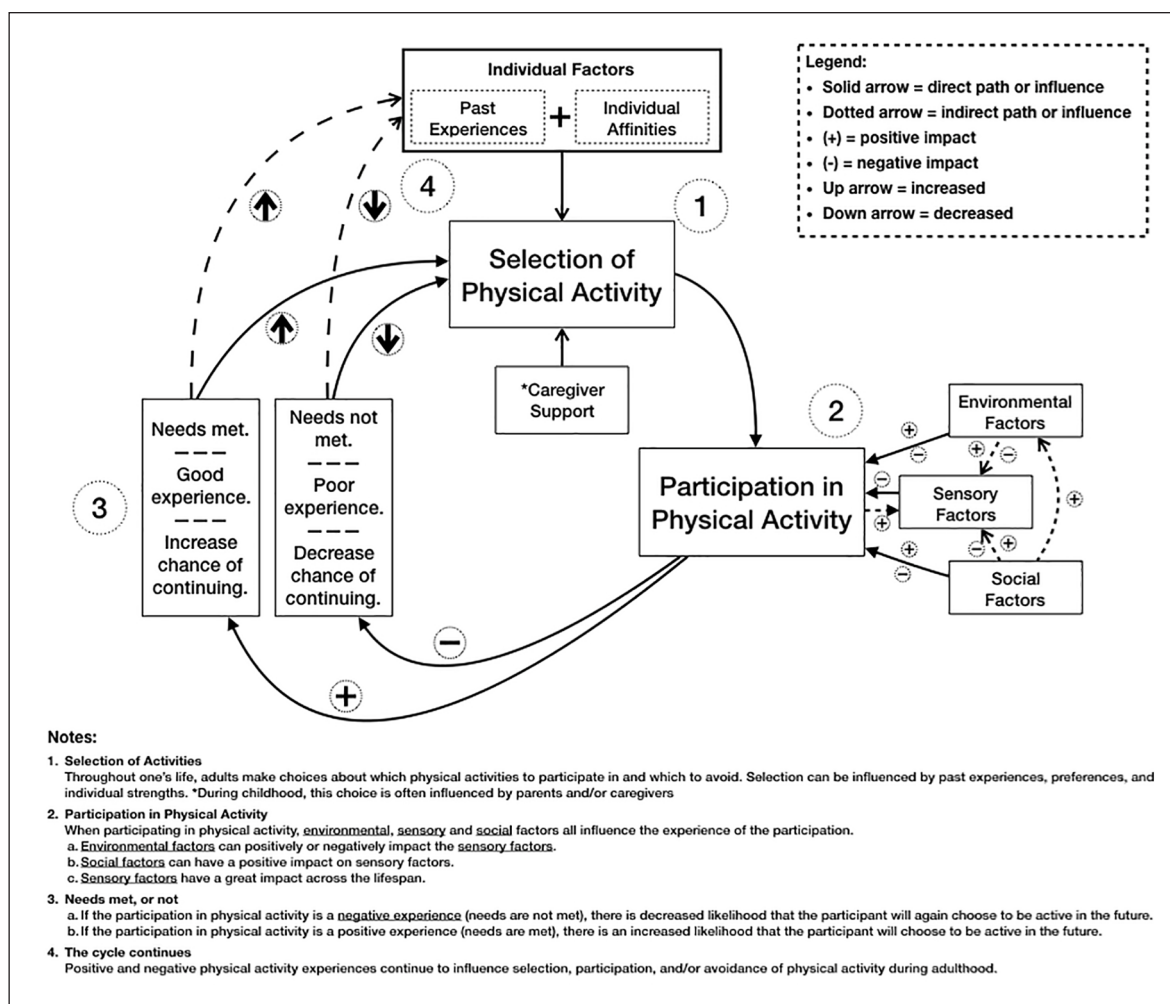
**Social relationships.** Referencing the category of *Social Relationships*, the activities chosen during childhood were strongly influenced—both positively and negatively—by caregivers, siblings, friends, and close relatives. Sandra reflected, positively, that:

We were one, two, three, four, five—sometimes six, uh, [groups] of younger parents, my parents were and other younger parents. And they were, uh, a Saturday evening get together with squash, badminton, uh, yeah, dancing, that kind of thing. So quite well encouraged. And the children had their little games as well. Like, uh, tetherball—what was the right word?

Jason reflected that, “my parents also helped with a lot of those things,” and that, “A lot of it was the support of my siblings, uh, helping me and trying new things out . . . it was a lot of support from them.” This support, or lack of support, during early years was seen across multiple participants. Participants reflected on these early experiences and the necessity of support to surpass barriers to activity and overcome a lack of access to PA spaces. Jason further highlighted the importance of this relationship by stating that, “It was a lot of support from my parents of saying, “No, you can’t. You can’t just sit at home.”; a common situation reported by many of the older participants. Nicole recalled,

One of my best friends had played soccer, and every time I went to her house, we played soccer. And finally, I remember her saying, “Why don’t you sign up for soccer? You’re so good at it.” Like, I was really—I-I was a really fast runner, and it never even occurred to me that—“yeah, that I could take something that I enjoyed and actually make it more of a structured thing.” So, I took her advice.

Conversely, participants discussed how if their experiences in an activity as children were negative, the selection of that or a similar activity as adults was less likely. Sometimes, this appeared as lacking access to the activity—Mary recalled, “When I wanted to play with other people, they just wouldn’t have me.” Primarily, these negative experiences originated from poor accommodations by those leading the activity or negative interaction with peers participating in these activities. Heather shared, “the general consensus that was if you weren’t making the game better, just sit out.” This led individuals to assume a lower perceived competency in the skills necessary for that activity. Mary, reflecting on several situations, said:



**Figure 1.** The grounded theory of physical activity adoption and maintenance in autistic adults.

There were times when if I did something—even if I really did something right physically, actually managed to catch a beach ball that was being thrown, I would be told that this wasn't any good 'cause if I could do it once in a million times, I should be able to do it always. Or I—if I was very good at something that was not physical, I was really disdained because I was told that basically, I had no right to be great in some things and so disgustingly horrible in others.

Jeffrey said, "It really degrades a person's thinking . . . then you don't want to do anything."

As individuals aged, social relationship continued to be important in the selection of activity, as well as for enjoyment. Jack stated, quite succinctly, "It's usually more fun with others than just do it by myself." Though, as some adults referenced, finding social groups as an adult is difficult and can decrease chances or motivation to be physically activity. Christopher said:

Socializing really helps me, [sic] and that's a beauty and it's a bane because it's, like, I feel like I have to be social to get

exercise. And I should really be doing it, like, alone, but I just—it's a lot harder to do alone.

For Jason, "If it's not social, if it's not mental, if it's not physical, it falls apart. Like I can't—I've tried to do certain ones without doing the others." Although these social interactions and supports may look different from nonautistic social engagement, in regard to selecting and PA, autistic individuals benefited from social supports.

**Individual attributes.** In addition to the *Social Relationships* that shaped an individual's uptake of PA, many individuals discussed factors related to themselves—or their *Individual Attributes*—that ultimately impacted their PA choices. Jessica, reflecting on childhood experiences, stated:

I was poor at every activity that the team did except for rowing, so any kind of socializations, the, the calisthenics, the jogging, the, you know, whatever. The—I was not good at it. I was good at keeping a rhythm and I have very, very strong legs.



Most participants discussed the complexity of these *individual attributes* as having the potential for both positive and negative impacts. Robert said, “I was always a good runner and [sic] cyclist because I had [sic] years of that and, and hiking in the mountains. [sic] I had done that, you know, a lot before.” He, also, “lack[ed] upper body strength and, uh, and tone for sure—muscle tone.” Yet, because he had perceived strengths in running and cycling, those outweighed the perceived lack of upper body strength and, “helped [Robert] feel better about [him] self, and become more so—develop better coordination.” In addition to influencing the choice of activity, perceived competencies impacted choices within physical activities. Susan stated that:

My preferred place to play was the left wing in hockey. But, I mean, I’m right-handed. And it meant that everybody was on one side of me. I was left on one side. And I only had to concentrate on one side instead of all around me.

By “playing to one’s strengths,” participants felt they could improve the likelihood of their overall success, allowing them to select activities where they also may have some weaknesses. In certain instances, this resulted in “aging out” of certain activities. Elizabeth, for example, not wanting to swim competitively said she, “just took swimming lessons over and over again up till, like the highest level,” until she was too old to register.

## Step 2: participation in PA

Once an autistic individual selected a PA and begun participating in that activity, a multitude of factors shaped the nature of their participation. These factors are encapsulated in the categories of *environmental factors*, *sensory experiences*, and *social relationships*. The impact of these factors varied across participants, impacting some participants in certain areas more so than others; yet, each participant mentioned various aspects of each category. In addition, these factors had a direct or indirect influence over one another, and synergistically impacted the individual’s participation experience. Those influences were often interconnected, making it difficult to parse out any one factor that was singularly dominant in a given scenario.

**Sensory experiences.** When discussing sensory factors, several were mentioned that strongly influenced the individuals’ level of enjoyment in PA. Most commonly, though, sensory experiences in PA were recalled with sadness and frustration. For example, Jessica discussed how the noise level in a PA environment limited the time she was willing to spend in the environment, “I didn’t really wanna spend that much time in a place that was very loud, and I also had just kind of—it, it doesn’t necessarily occur to me to join those, those group activities.” Similarly, an unpleasant sensory experience of the PA itself affected the choices that David made regarding exercise; he stated: “You know,

. . . I-I can’t do sit-ups and stuff because that’s so disorienting for me. It makes me nauseated.” The importance of the activity itself as a factor that affected the individual’s sensory experience was reinforced in our refinement of our model. A previous drafted model of Figure 1 only considered the sensory factors as external (i.e. in features of the environment) and negatively impacting the PA. After discussing with participants, some mentioned that the PA itself could provide a sensory experience, such as swimming having a positive impact on the sensory experiences of individuals or sit-ups in the instance of David.

When considering the experiences of autistic individuals regarding PA and the various influential factors, it is easy to look at this model and find one’s self regardless of diagnosis status. Yet, it is important to recognize how such areas have a unique impact on an autistic individual versus a nonautistic individual. In one case, Nicole discussed an instant of sensory overload during a team activity:

[There was] a lot of verbal commands all at once. Like shouting from the sidelines is very confusing. Some of my teammates would be shouting one thing, and my coach would shouting the other, and I just kind of—. . . , like, I still remember one game, I just stood in the middle of the field and didn’t move. I can carry on a conversation with you as long as I don’t make eye contact. Because . . . one will disrupt the other. So we have these very fragile, uh, pathways trying desperately to integrate all day long. And they’re shaky.

And it appears that these sensory experiences also affected Nicole’s PA choices in adulthood as she discussed how, as an adult “it’s just too loud, too overwhelming—I just can’t deal [with the gym].” Occasionally, issues with the sensory experiences could be a result of social norms—Heather, in discussing why yoga is an appealing activity for her, said, “So I can carry on a conversation with you as long as I don’t make eye contact. Because two—one will disrupt the other.” Yoga offered her the opportunity for social engagement while being physically active but did not require certain social norms such as an eye contact that would otherwise cause sensory overload. The PA setting and those experiences within it may be what cause an autistic individual to become overwhelmed, often forcing individuals to choose between being active and being comfortable.

**Environmental factors.** Considering the influence of *environmental factors*, for Jason, success was inexplicably tied to the perception of an activity as “fun.” Jason specifically highlighted the outdoors as a space that he liked to participate in PA—which was shared by a plurality of participants—because, “I’m, you know, jumping across rivers, or creeks, or areas. I’m like going into the water. Like it’s just—that’s my idea of fun.” In addition, the environment, in seemingly small ways, can have a great impact on an individual’s experience. For many participants, one particular negative aspect of a space could be enough to

overwhelm the “good” aspects of a space. Elizabeth, for example, stated:

[name removed], that was a really nice gym. Like it was small and like—it did have a big running track that I didn’t use, but like it was a normal gym. But the way the machines were organized was so that they all kinda—I d—I don’t know how to describe it without drawing a picture, but none of—the machines weren’t facing each other in a way—that you were—you couldn’t see each other’s faces when you were using the machines—like in a way that people weren’t like—it didn’t feel like we were looking at each other.

Nicole further demonstrates how, despite many aspects of a space “working” for them, one particular piece of gym etiquette could ruin an otherwise good experience. For Nicole, it was important that individuals, “wipe down the equipment. I don’t like the feeling of, like, the slimy, like, sweat that people leave behind. So it’s just—it gets that—it’s very overwhelming for me.” When considering creating the optimal environment for increasing the likelihood of success for autistic individuals, participants made it clear that these measures need to be individualized but small things should not be overlooked.

**Social relationships.** Similar to the experiences in Step 1, autistic adults found encouragement to continue PA through their own social network. This often resulted in PA that was less competitive and more accommodating. Christopher said, “when the sports were less competitive, the barrier to entry was lower, um, so it would just go, like, ‘We’re all—we’re all playing basketball in this recess lot. Um, you know, just come on.’” For Jessica, even into adulthood, her parents remain an important social support for maintaining PA; “They try to exercise multiple times a week. So, I’ll be scheduling an exercise date, um, for each of them.” For her this meant, “I’ll get to spend time with them and we will also exercise for probably an hour or something.” Though, it is important to recognize that some individuals are more comfortable with smaller groups or even one-on-one. David said trying to converse with more than one person, “make [him] dizzy just trying to listen.” When asked, “Why hiking and camping were his favorite activities?,” he said, “the fact that probably I’m not around a bunch of people,” then laughed.

### Step 3: needs met, or not

Through the influence of the various factors mentioned above, the third step of the model focuses on whether individuals persisted in an activity or not. Each participant identified a set of needs that, in many circumstances, coalesced to influence their perception of a successful experience. For example, if needs were unmet, the potential for a positive experience in that activity was limited. Yet, needs were not uniform across participants; one

factor that was negative for one participant may be of no consequence to another. Furthermore, it is important to highlight that all the positive and negative experiences do not occur in isolation.

**Negative experiences.** PA is one part of the whole that is an individual’s day. If a participant was overwhelmed prior to the PA experience, or as they start their PA pursuit, this impacted how elements of the PA environment or task impacted their experience. This led some to choose to stay clear of PA if they knew it took a certain level of mental or physical energy that they did not have available. For example, considering her own personal health status, Heather stated, “If the conditions weren’t a barrier, I would be very—I imagine I would be very active.” David, reflecting on sensory issues, said “I can’t breath without fee-feeling overload. I can’t—any kind of movement at all—I-I mean, just watching a video—the movement from a video causes visual overload for me.” Furthermore, in referencing her own individual attributes, Cynthia said:

I have terrible executive functional skills, which means my time management stinks, my organization stinks, and I think if I was better at staying more organized and better at organizing my time, I probably would be more inclined to do more things.

When considering the complexity of PA engagement, Susan highlighted how a particular activity (i.e. swimming) is cost-prohibitive; yet even if it wasn’t, she would still have to check ahead if the pool wasn’t “too wild or noisy.” For some participants, balancing the added demands of certain activities—even with appropriate supports—lead to dropping out from the activity. William mentioned that he, “wish[es] I [he] could’ve carried on the sports, but I j—I just got burned out.”

One reason for dropping out of activity was the increased prevalence of “competitiveness.” For many participants, this was overwhelmingly a point at which they would self-exclude themselves from an activity. Jason shared that:

Swimming was a really big thing. Man, I loved it. It was the coolest thing. I actually ended swimming because it became competitive. That happened like right around with or sixth grade. . . . It’s kind of sad, but [sic] essentially, I was just like, “I don’t wanna compete anymore. I just wanna do this for fun.

Jeffery, when asked about why he stopped playing sports, said, “I was like, ‘Well, what’s the point? You’re not gonna let me play in the game. There’s no point in me continuing to hurt myself, uh, to benefit your team. It’s just not gonna work.’” William said, “Yeah. Um, farm league, that was, uh—that was little league baseball so more serious. Um, so after that, I didn’t really participate in sports anymore.” Even when participants were involved

in activities with adequate social support, ultimately, competitiveness ruined activities for most autistic participants. Christopher said:

Well, the people were accepting and includings . . . I think there's kind of a metamorphosis that happens in junior high where people get more competitive and, and, um, like, harsher, um, towards people who are different. And I think that—and I've read that in other autism, autism people have said that on other communities. And I think that, that sticks permanently, like, uh, though I think it's probably worse now.

**Positive experiences.** In many instances, participants highlighted how an accepting and inclusive social environment led to increased success and continuation of PA. Dan describes this clearly: “I mean, I’ve chosen a lot of times not to be inactive, but of course, if there was somebody that wanted to do something with me, I would be active more.” For some, acceptance of who they were or the individual differences they possessed impacted greatly their experience. Robert shared that many people were not “tolerant” of him and didn’t accept that he was different; he said, “I just want to be . . . [but] I get frustrated every not and then [because] they treat me like, like I’m a criminal or a delinquent.” William stated that he was bullied from, “literally, elementary school all the way up to my freshman year,” and had little support from family who said, “it was all my fault.” Robert shared, in reference to his enjoyment of surfing, “At school, everybody—teachers always yelling at you and kids bullying you. But when you’re in the water or even skating a ramp, I mean, you’re just—you’re free to learn what you want, to express yourself.”

For some, the benefits of PA on mental health were the reason to persist. Mark mentioned that, “when I feel depression, if it’s there, I go swimming, and it usually lifts,” and Ashley stated that being physically active helps, “reduce anxiety and stress.” Yet, it is also important to highlight that benefits from PA are not universal nor do individuals often feel benefits after a single bout of exercise. Christopher related that sometimes he exercises and his “depression doesn’t go away,” yet, “everyone tells you if you exercise and your depression’ll go away. Then it doesn’t and then I don’t exercise ‘cause I’m discouraged.” While presenting a summation of the experiences of the participants in reference to their needs being met or not, it is important to highlight that there was no singular negative or positive experience that emerged from the collected data.

#### **Step 4: continuing of the cycle**

The last step of this model suggests that every experience in PA, whether positive or negative, influenced the autistic adult’s future PA choices. For some, negative experiences decreased the likelihood of participating in certain types of activities. Jessica, when discussing past PA experiences, said, “so my experience might be tainted somewhat by the fact that I was bullied in, in elementary school.

Like, perhaps, if that hadn’t happened, I would’ve been more inclined to do team sports and things like that.” For Tim, this meant starting small and building successes. He said that he’s been doing a walking class and trying to “reach three miles an hour” which is “still very difficult for [him].” For many adults, their patterns of PA have changed over time. For Mark, his activity has, “changed some, but not a lot probably.” He was an avid swimmer and played lots of basketball; so despite living in multiple cities as an adult, he was always able to find the activities he had an affinity. Yet, despite many participants dropping out or being excluded from certain physical activities as children, there was not a single participant that did not participate in some form of PA as an adult. For some, after years of trying different activities, they have settled on walking or hiking (often in a small group or with pets) like John. As an adult, he said like to “go for walks” which he does more often than when he was a child. Others kept trying different activities (e.g. yoga, swimming, weightlifting, soccer) using their prior experiences as a guide for selecting new activities or settings to be physically active. This seems to be rooted, for many, in experiences that were positive or provided “good” experiences. Elizabeth recalled that she has memories of, “always moving when [she] was little,” and that she, “was happier and did not have the same, like, level of sensory problems.” A benefit from PA that she has noticed is absent in adulthood due to more limited engagement.

## **Discussion**

In recognition that PA behavior, and the associated influential factors, may differ among autistic adults compared to nonautistic adults, this study sought to develop a grounded theory describing the process by which autistic adults adopt and maintain PA participation. The emergent model from this grounded theory analysis represents the PA experiences of 23 autistic adults across their life spans. Although aspects of the model parallel our understanding of PA participation in nonautistic adults, several unique components were apparent. For example, differences were apparent relating to the influence of individual, social, sensory, and environmental factors on PA selection and participation for autistic individuals. The findings from this study supply a foundational model to understand the PA participation of autistic adults across the life span, address the gap in knowledge pertaining to PA among this population, and serve to inform research and practice in this area.

### ***Importance of social support and the effects of negative social interactions***

Contrary to the belief that autistic individuals lack social motivation (Chevallier et al., 2012), social relationships were recalled as being important to the PA experiences of



adults across their life span and were often sought out in support of PA goals. Supports of both family and friends were very important during childhood years or with new activities as represented in Step 1 of the model. This mirrored recent qualitative findings in families of adolescent and adult children on the autism spectrum. Blagrove and Colombo-Dougovito (2019), in looking at barriers to community PA engagement in families with at least one autistic child, suggest that community acceptance and social supports are vital for continued engagement. Similarly, Nichols et al. (2019), in interviewing parents, found that support from parents and community organizations can be beneficial to the continued engagement of autistic individuals. In the present sample, the perceived importance of these supports from caregivers generally decreased with time and with more positive experiences. Yet, even in adulthood, some participants shared that they wished they had someone to participate with, such as attending a yoga class or walking in the park, and that this would help them better engage if they were currently struggling with their motivation.

In the present study, most adults—even from a young age—described a desire to participate in collaborative, noncompetitive activities which impacted, ultimately, their choice and support within a given activity as seen in Steps 1 through 3. When considering the plurality of offerings of PA for adults, most activities are competitive even without formal competition. As a society, team sports and competitive activities are centered. PA opportunities such as basketball, volleyball, soccer, baseball, and even kickball are all framed on competition. Few opportunities exist for individuals to participate in activity, together, without competing against each other. Given the desires of most autistic adults in this study to participate in noncompetitive activity, even if many other areas of need are met, they may still have a lack of options to engage in social PA. To meet the needs of the autistic community, in addition to providing opportunities that are sensory-friendly, organizations (i.e. local recreation departments, fitness centers, athletic organizations) should deemphasize the competitiveness of activities and instead emphasize the social aspect of the activities.<sup>2</sup>

Despite the desire to have social experiences in PA settings and the positive impact that a social network could have on the participation of autistic individuals, negative social experiences were often devastating to the PA engagement of the autistic adults in this study. Early experiences with bullying either in school or in community PA discouraged participants from engaging in PA later in life, and the narratives that they were told in their younger years by adults or other children formed the lens through which they saw their bodies and their ability levels well into their older adult life. These negative experiences reflect the bullying experiences recounted by children with ASD interviewed about their engagement in PA (Blagrove, 2017; Healy et al., 2013), and stresses the importance of addressing bullying in PA settings. Brewster and Coleyshaw (2010) reported

similar findings with autistic youth and outdoor leisure activities, with many children wanting to go outdoors, but having a limited network to do so or having negative social experiences that caused them to withdraw from future outdoor pursuits. Even with support as an adult from spouses/partners, friends and family members, when exposed to bullying in PA settings as a child, the autistic adults in this study were rarely able to get past the negative dialogue regarding PA that had been internalized—often choosing to not participate in the activities in which they had the worst social experience.

### *The environment: facilitating or impeding participation?*

This study, for the first time, provides an insight into the relationship between PA experiences and the physical environment among autistic adults. Most commonly participants recalled how they had negative sensory experiences in response to aspects of the environment such as loud noises, lights, and certain textures. Participants discussed in Step 2 how they were sometimes overwhelmed by disorganization and excessive numbers of people within a PA environment. The physical environment has long been recognized as a crucial factor in the provision of effective multilevel PA interventions (Alfonzo, 2005; McCormack & Shiell, 2011; Sallis et al., 2006). Environments that are stimulating and congruent with the needs and preferences of certain populations are an essential determinant of PA.

The nature of the environment–PA relationship is not generalizable across all populations; however, for example, the influence of the physical environment for adults (Moran et al., 2014) differs from that among children (Davison & Lawson, 2006). Research with children on the autism spectrum suggests that the environment plays a unique and impactful role in their PA participation; physical barriers (e.g. lack of or unsafe equipment) and facilitators (e.g. the presence of exercise equipment and facilities) have been identified as being influential (Obrusnikova & Cavalier, 2011). Children on the autism spectrum have also spoken about their aversion to a host of environmental features that impede upon enjoyable PA participation, including loud noises, uncomfortable temperatures, and visual distractions (Blagrove, 2017; Healy et al., 2013). The characteristics of the environment–PA relationship that was revealed in the current study suggest a similar significant environment–PA relationship exists for autistic adults. How the PA shapes PA for autistic adults clearly requires further study and careful consideration in PA program planning for this population.

### *Motivation to be active*

Each step of the presented model demonstrates the factors that contribute to the autistic adults' motivation to

participate in PA. Unsurprisingly, the activities that adults were successful in as children were often activities they felt comfortable participating and engaging in throughout adulthood. Furthermore, contrary to studies involving autistic children and teens that report that individuals engage in less PA as they age (R. A. Jones et al., 2017; Stanish et al., 2017), the autistic adults in this study recognized the importance of PA and continued (or wanted to continue) active pursuits when they experienced success as seen in Step 4. Yet, for many autistic individuals, co-occurring conditions, such as dyspraxia (McAuliffe et al., 2017), obesity (Must et al., 2017), and hypermobility (Baeza-Velasco et al., 2018), make engagement in PA more strenuous and/or painful than their nonautistic counterparts. Participants in this study highlighted this concern; several participants reported co-occurring conditions that made participation in PA demotivating due to pain, weight impeding movement, joint and muscular skeletal issues, and motor planning impairments.

In addition, autistic individuals have reported having heightened sensory experiences in certain situations or settings (Jones et al., 2003; Robertson & Simmons, 2015; Robledo et al., 2012). Often, little attention is given to these alternative sensory experiences within PA settings (Blagrove, 2017; Healy et al., 2013; Yessick, 2018). This study, seen in Step 2, stresses the previous findings of sensory issues impacting on PA participation among autistic individuals. All participants reported some form of sensory influence when attempting to participate in PA that either positively or negatively impacted their continued involvement. Sensory visual experiences during team sport, the volume of music in fitness centers, or certain smells impacted participants' choice to participate in physical activities. Conversely, environments that were more neutral sensory experiences such as the outdoors or activities that provided positive sensory feedback (e.g. swimming) were found to have the opposite effect.

### *Situating the present model*

Features of the emergent model reflect other theories used to explain PA participation. The findings of the current study, for example, lend credence to the use of ecological models that recognize that multiple levels of influence act upon our behaviors. This was very apparent in the current study's findings. Influential factors were multifaceted, with interpersonal, intrapersonal, social, and environmental factors all shaping PA participation. Moreover, influential factors were interactive. The environment regulated the sensory factors, the social factors sometimes offset the negative influence of the environmental factors, and so on. It is apparent from the current study that multilevel, highly individualized interventions are required to promote PA among autistic adults.

This study also demonstrated a process of PA participation that is cyclical in nature. Participants recalled a process

of selecting activities, experimenting with activities, and reselecting activities throughout their lives. The transtheoretical model (TTM) (Prochaska & DiClemente, 1983) provides an obvious comparison. The role of the TTM's "decision-making balance" (Marshall & Biddle, 2001) was particularly evident in this current study's data. In the phases of "selection of PA" and "participation," participants continuously weighed the pros of PA participation (e.g. socialization, health benefits, positive sensory experiences) with the cons (e.g. negative social interactions, competitiveness, negative sensory experiences). As is delineated in the TTM, the choices made in continuing, relapsing, or modifying PA behaviors was shaped by this decision-making balance.

Uniquely, this model adds sensory factors as an integral part of the PA experience of autistic individuals that is interwoven throughout PA engagement. Previous articles that have discussed "theoretical frameworks of sensory consequence" (Tse et al., 2018, p. 1667) looked at movement as a product of the need for sensory feedback, or with authors promoting the use of PA to diminish stereotypical movements (Lang et al., 2010). This study identifies sensory factors as inherently embedded in the mechanism of engagement. Thus, through participation in PA experiences, sensory feedback within a PA and its setting can be both a barrier and a facilitator to engagement.

### *Limitations*

Several limitations of the current study should be noted. First, this study only included autistic adults who communicated verbally. Yet, research has estimated that 25%–30% of autistic children (Anderson et al., 2007; Lord et al., 2004; Norrelgen et al., 2014) do not develop functional language—to the authors' knowledge no estimations exist for adult populations—and those who communicate via means other than verbal communication are traditionally excluded. PA experiences of individuals who communicate in ways other than verbal communication may be different than the adults in the present sample; thus, limiting the transference of this model. Future research should consider how those who communicate by means other than verbal communication experience PA participation. Second, the frame of experiences, and thus the data that were collected, was limited to the questions posed by the researchers. Efforts were made to ensure questions captured broad experiences; however, there remains the possibility that certain aspects of the experiences of participation in PA are not included. Finally, it is important to highlight that all the included participants were physically active (based on their own definition of PA) on a regular basis to some degree. The recruitment procedures and the nature of the study purpose may have attracted autistic individuals that had a greater interest in PA, ultimately, omitting those who engage in little to no PA. The experiences and views of autistic individuals who engage in no PA or low levels of PA should be sought in future research.

## Conclusion

This grounded theory captures the PA experiences of 23 autistic adults through the analysis of their account of past and current experiences with PA. This model highlights the importance of building successful experiences for young children on the autism spectrum, so that they are more likely to continue PA into their adult life. Furthermore, it emphasizes the importance of creating noncompetitive, social experiences for individuals that offer flexibility in social engagement and accept the differences one might have in their social interaction. In addition, the PA experiences an autistic individual has can be positively or negatively influenced by other people in the environment and the sensory factors that exist therein. It also suggests that each experience is very specific to each individual and can vary from day to day, as PA does not happen in isolation of the rest of an individual's daily experiences. As a theory, this model needs further testing to understand how each area impacts an autistic individual's experience and persistence in certain activities. Through this model and continued research that includes hearing the authentic experiences of autistic adults, researchers and practitioners may be better equipped to provide recommendations for making PA more accessible and enjoyable.

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## Notes

1. The authors purposefully chose to use identity-first language in respect of the participants included in this study and in concordance with a plurality of autistic adults (Kenny et al., 2016).
2. It should be noted that the "social aspect" in this context does not require engagement with others; simply cohabiting the same space for recreation or participating in parallel activities created a sense of connection and motivation that many autistic adults in this study needed.

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## Adapted Physical Educators' Perspectives of Educational Research

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### ABSTRACT

**Purpose:** Educational research often provides insight into the potential best practices to use within the classroom setting. Yet, limited information is available on teachers' perspectives toward research in the field of adapted physical education (APE). The current study examined adapted physical educators' perceptions toward research. **Method:** Sixty general physical education and APE associations within the United State of America were emailed a survey adapted from the National Center for Research Policy and Practice. **Results:** One hundred twenty-four adapted physical educators were included within the study. Spearman correlations and frequency counts of open-ended responses were used to analyze the data. Overall, findings indicated that a majority of participants had conducted research, with most participants mentioning it helped them learn more about a particular issue they were facing. Adapted physical educators reported a high rate of engagement with research and that research has a positive impact on important issues, such as behavior management and advocating for students with disabilities. Although positive overall perceptions toward educational research were reported, several items that related to the usefulness and accessibility of research were ranked quite low. In addition, it was found that higher levels of education and years of experience were correlated with lower perceptions toward the validity and usefulness of research. **Conclusion:** This study highlights the important role research plays in the practice of adapted physical educators; however, researchers need to present their research findings in a more practical way for teachers to translate to their own situations.

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The art and implementation of teaching is a complex practice. This has led educators to question how to navigate the complexities associated with the “art of teaching” (Montgomery & Smith, 2015). Some of the greatest challenges for teachers include identifying effective pedagogical strategies, distinguishing between efficient and inefficient teaching strategies, and determining the extent to which an activity promotes student learning (Montgomery & Smith, 2015). Educational research, which is defined as education research as the “scientific field of study that examines education and learning processes and the human attributes, interactions, organizations, and institutions that shape educational outcomes” (American Educational Research Association, 2020), could be a useful tool for educators to overcome the complexities associated with the “art of teaching”. However, educational researchers are often perplexed as to why research in the field of education is seldom used by educators within kindergarten through the 12th grade (K-12) settings (Montgomery & Smith, 2015). This may be because teachers in K-12 settings often have expressed the belief that academics and research articles focus on

theory over applicable practices that support teachers' daily challenges (Bevan, 2004; Harrison, Davidson, & Farrell, 2017; Montgomery & Smith, 2015; Vanderlinde & van Braak, 2010). Furthermore, within the fields of education and kinesiology, researchers often do not prioritize the dissemination and accessibility of research to practitioners (Armour, 2017; Casey, Fletcher, Schaefer, & Gleddie, 2017).

Although prior research that studied a variety of practitioners from the broad field of education suggests an overall negative undertone toward educational research, (Armour, 2017; Bevan, 2004; Harrison et al., 2017; Montgomery & Smith, 2015; Vanderlinde & van Braak, 2010); it is still unknown whether similar sentiments extend to adapted physical education (APE) teachers. APE programs have the same overall objectives as general physical education programs; however, APE programs specialize in making accommodations and modifications to personalize the programs to meet the individual needs of students with disabilities (Dunn & Leitschuh, 2014). Adapted physical educators are unique compared to general physical educators, as they need knowledge about



both physical education curriculum (e.g., sport skills, locomotor skills, and fundamental motor skills) and skills associated with special education (e.g., adaptations, behavior management, assessment). Hence, APE is often referred to as a multidisciplinary field that incorporates key aspects from both physical education and special education (Dunn & Leitschuh, 2014). For an adapted physical educator the extensiveness of scholarly research that could be useful to a particular lesson or child may be quite intimidating. This is further complicated by the fact that useful research for adapted physical educators may be found in academic journals associated with special education, physical education, or other related fields (e.g., physical therapy, disability studies). In relation to practitioners that work with youth in physical activity settings, Armour (2017) suggested that it is impractical “to expect teachers to both understand and connect these different sources of knowledge that, in themselves, are dynamic” (p. 44). Armour continues to explain that many researchers make very few attempts to synthesize knowledge across disciplinary boundaries, yet we expect practitioners to do this on a daily basis. Furthermore, researchers often adopt isolationist practices that further prevent integration between disciplines (Armour, 2017; Evans & Davies, 2011), which is problematic for adapted physical educators, who are in a uniquely multidisciplinary profession.

The majority of concerns articulated by K-12 teachers revolve around the issues of dissemination, accessibility, and relevance (Armour, 2017; Casey et al., 2017; Montgomery & Smith, 2015). School leaders and teachers alike have often explained that academic research is difficult to access and, therefore, rarely utilized (Armour, 2017; Casey et al., 2017; Coburn, Honig, & Stein, 2009; Harrison et al., 2017; Montgomery & Smith, 2015; Penuel et al., 2017). One major factor to this inaccessibility is that academic research findings are generally published within academic journals, which are written primarily *by* and *for* tenured and tenured-track faculty at universities. Academic journals regularly require the use of academic jargon and technical language, which create additional barriers to easily read and comprehend research (Binswanger, 2015; Borg, 2010; Funk, Tornquist, & Champagne, 1989). The difficulty with properly accessing academic research is directly influenced by the tenure and promotion process, which is commonplace at most universities (Armour, 2017; Binswanger, 2015). For example, publishing in high impact journals continues to be a crucial component of receiving tenure and promotion for most scholars. Montgomery and Smith (2015) point out that this is problematic, as:

Most well respected journals are those which do not accept articles unless they have undergone a process of “peer review,” [thus] it comes as no surprise that even researchers who have a strong interest in contributing to K-12 education still write predominately for an audience of their university peers ... As a result, the research writing that university faculty produce conforms to certain, standard assumptions about what is considered acceptable by those peers in terms of content, conventions for communicating that content, and the standards for judging that content. (p. 102)

The rigorous and persistent standards established by academic journals results in K-12 teachers’ often perceiving that educational research is inaccessible, as well as void of much usefulness to their day-to-day duties and practices.

Scholars are often puzzled by the pessimistic responses voiced by K-12 teachers in relation to educational research (Bevan, 2004; Montgomery & Smith, 2015). For example, school leaders and K-12 teachers have explicitly indicated that research is often not timely enough to be useful and is published in locations that they are unlikely to access (Armour, 2017; Casey et al., 2017; Harrison et al., 2017; Penuel et al., 2017). Teachers have also questioned the validity of research findings, the sustainability and feasibility of using research, and the usefulness of research interventions in their own classes (Harrison et al., 2017; Penuel et al., 2017). The negative perceptions toward educational research become increasingly perplexing when considering that educators have frequently expressed that they would like to learn additional strategies and evidenced-based practices to improve students’ learning (Bevan, 2004; Bittner, McNamara, Adams, Goudy, & Dillon, 2018; Drill, Miller, & Behrstock-Sherratt, 2012; Montgomery & Smith, 2015). However, educators usually get information concerning effective teaching strategies from other colleagues or general online searches, rather than from reading, synthesizing, and interacting with empirical research. Unfortunately, high quality research often is circulated within academic research journals instead of disseminated in locations where teachers are more likely to encounter it (Armour, 2017).

When K-12 teachers engage with research in a meaningful way, their teaching skills and day-to-day practice are likely to benefit (e.g., Bittner et al., 2018; Wong et al., 2015). For example, many scholars have suggested that teachers can increase their teaching efficiency by developing the skills to identify evidence-based practices, using evidence-based practices within their instruction, and, when the scientifically based evidence is not available, independently use basic research concepts to find solutions (Montgomery &



Smith, 2015; Vanderlinde & van Braak, 2010). Employing evidenced-based practices may be even more important when considering students with the greatest needs, such as those with disabilities. For example, 27 evidenced-based practices have been identified that can lead to beneficial outcomes for children on the autism spectrum (Wong et al., 2015). Each evidenced-based practice is connected to specific outcomes that are based upon the child's age, as well as the duration and implementation of the particular evidenced-based practice. Bittner et al. (2018) highlight the importance of general and adapted physical educators' understanding and use of evidence-based instruction with regards to teaching children on the autism spectrum. Bittner and colleagues (p. 19) stated that:

Professionals' depth of understanding of established evidence-based practices (e.g., exercise, visual schedule, video modeling) may lead to stronger and more meaningful instruction for students [on the autism spectrum] in a variety of settings and content areas (e.g., physical education). Specifically, if practitioners successfully used an array of evidence-based practices when teaching physical education curriculum standards, it would subsequently allow students with ASD to more effectively learn physical activity skills and increase their activity engagement.

Understanding and employing theoretically driven practices is essential when teaching students with unique and complex needs. Yet, too often, adapted physical educators—particularly, trainee or new-to-service—rely heavily on trial-and-error of unreliable practices, rather than the academic literature, to find educational practices (Colombo-Dougovito, 2015).

There is a growing amount of research emphasizing the importance of using research within teachers' daily practices, including the use of research specific to teaching children with disabilities in physical education settings (e.g., Bittner et al., 2018; Dillon, Adams, Goudy, Bittner, & McNamara, 2017; Healy, Nacario, Braithwaite, & Hopper, 2018). However, little is known about how adapted physical educators access and perceive research. Therefore, the current study sought to examine adapted physical educators use of research and perceptions toward research. The following research questions guided this inquiry:

- a. How frequently do adapted physical educators conduct and/or use research, and for what purposes?
- b. Where do adapted physical educators access research?
- c. What are adapted physical educators' perceptions toward research?

## Method

### Participants

The current study examined adapted physical educators' perceptions toward educational research. A multistage sampling technique (Creswell & Plano Clark, 2018), in which multiple samples at various stages of the research process are recruited, was used for this study. More specifically, 60 physical education and APE associations within the United States of America (US) were initially asked to e-mail their members a survey on their perceptions toward educational research. The e-mail invitation included a link to Qualtrics (i.e., the hosting platform) that contained an embedded informed consent form, a demographics survey, and a perceptions survey. After the initial round of recruitment, the investigators emailed 19 former adapted physical educators of the year in the US to complete the survey and, using a snowball sampling procedure, all adapted physical educators of the year were asked to forward the message to their APE colleagues. Inclusion criteria consisted of being a current, practicing adapted physical educator in the US. The institutional review board at the lead author's affiliated university approved the procedures for this study.

### Survey development

The research perception survey employed in the present study was modified from a survey originally developed by the National Center for Research in Policy and Practice (NCRPP; Penuel et al., 2017). The original survey was developed to examine school and district leaders' perceptions toward educational research. The original survey initially underwent two rounds of interviews with educational leaders across the nation. The survey was then pilot tested with 265 education leaders. The pilot test data were used to generate reliability scales, as well as to identify additional issues with the survey content. Overall, each survey construct had adequate reliability coefficients (Cronbach's alpha coefficients ranged from .67 to .93).

The investigators revised the NCCRP survey to better suit the purposes and population of this study. Two of these investigators are current adapted physical educators that have conducted and contributed to multiple research studies. The survey revisions included minor grammatical alterations in wording and sentence structure. After the initial adaptation of the survey questions, seven experts reviewed the survey and provided feedback on content relevancy and question structure. The APE experts each had at least three years of

experience, either as an APE higher education professor ( $n = 4$ ) or as an adapted physical educator ( $n = 3$ ) and have been involved with conducting research. After receiving critical feedback, the researchers reexamined and revised the survey questions. All changes were discussed by the four investigators until 100% agreement was achieved.

The final version of the survey had 42 questions. The first 10 questions served as a demographics survey. These questions asked participants to provide demographic information such as gender and the highest college degree attained. In addition, the survey included questions specific to their professional role and experience, such as their current status as an adapted physical educator, years of experience as an adapted physical educator, student age groups that they teach, and their highest level of APE training. The remaining 32 questions were divided into three sections based on the aforementioned research questions.

Nine questions were developed to specifically address how frequently adapted physical educators use research and for what purposes. This section of the survey was divided into two multiple-choice questions, five Likert style questions, and two open-ended questions. Within the two multiple-choice questions, participants were asked to indicate how frequently they conducted research and why they did or did not frequently conducted research. In addition, five Likert style questions (1 = Never, 4 = All of the time) were used to collect data on how often the participants had encountered research that impacted their practices. Finally, the two open-ended questions included: (1) "Share an experience you had where you used research to inform a decision with regards to your teaching?"; and (2) "Think about a time when a piece of research you encountered changed your thinking or opinions about possible solutions to a professional problem you encountered. What was that piece of research and how did you use it?"

Three questions were used to identify where adapted physical educators accessed research. The first question in this section asked respondents to identify what mediums they used to access educational research from 14 possible sources. The sources ranged from consulting with experts in the field (e.g., school administrators, university professors) to peer networks (e.g., professional associations) and media (e.g., textbooks, journal articles). The second question asked participants whether they had access to a university library (yes or no), and the third question asked how frequently they use a library system to access research (1 = Never, 5 = Daily). Nineteen Likert style questions (1 = Strongly Disagree, 4 = Strongly Agree) were used to assess respondents' agreement with

statements about the relevance, value, and credibility of research as it related to their own work. An example item from this section included "By the time research findings are published, they are no longer useful to me".

### **Data analysis**

The descriptive statistics were analyzed and reported for all the demographic information, and for multiple-choice and open-ended questions. Cronbach's alpha was used to determine internal consistency between all the Likert style questions ( $n = 24$ ) and found that the survey items had an acceptable overall reliability score of .890, which is considered to be good (George & Mallery, 2003). In addition, the Likert style questions used to assess research question one (five questions, Cronbach's alpha coefficient = .90) and research question three (19 questions, Cronbach's alpha coefficient of .84) both had good internal consistency coefficients. Spearman's correlation coefficients were used to analyze the correlations between each Likert style question and key demographic variables (i.e., gender, level of APE training, level of education, years of experience), as well as the multiple-choice question of "how often they conducted research".

For the open-ended questions, an inductive category development method (Thomas, 2006) was used to analyze the data. Inductive category development begins with determination of categories emergent in the data, followed by comparing them with old categories and forming new categories into larger themes until consensus is reached for all data. First, two of the investigators individually analyzed the responses and generated codes. The codes were then organized into meaningful category. Each category was given a description. Next, the two investigators met to discuss the discrepancies in their coding and developed categories that reflected both of their codes and categories. After reexamining the categories, the researchers reviewed each statement again within each category and discussed discrepancies. Statements were moved to other categories until 100% consensus was reached among the two researchers. Finally, a third investigator reviewed the categories and definitions until 100% consensus was attained.

## **Results**

### **Demographics**

One hundred twenty-four adapted physical educators completed at least 80% of the survey and were included within the analysis. The participants comprised of 59.7% females ( $n = 74$ ) and had APE teaching

experience that ranged from one to 41 years ( $M = 13.65$ ,  $SD = 9.70$ ). In total, 36 states and one US territory (Guam) were represented in this survey. The most commonly represented states were New York (21%,  $n = 26$ ), Maryland (12.9%,  $n = 16$ ), and Missouri (9.7%,  $n = 12$ ). Most participants reported that they primarily delivered APE services with an itinerant service-delivery model (29.8%,  $n = 37$ ). In addition, the most commonly indicated level of training with regards to APE was a bachelor's degree with one or two courses in APE (30.6%,  $n = 38$ ), which was followed by a master's degree in APE (29.8%,  $n = 37$ ). Sample demographic statistics are displayed in Table 1.

### Frequency of use of research

The majority of the participants indicated that they had conducted research ( $n = 76$ , 61.3%). Within the group who reported that they had conducted research, participants indicated that they did this on a yearly ( $n = 31$ , 25%), monthly ( $n = 32$ , 25.8%), weekly ( $n = 11$ , 8.9%), or daily ( $n = 2$ , 1.6%) basis. The most common reasons cited for those who indicated that they conducted research on a daily, monthly, or yearly basis included: (a) "to discover better ways of teaching" ( $n = 39$ , 51.3%), (b) "to improve my ability to advocate for students and field" ( $n = 37$ , 48.7%), and (c) "because

it is good for my professional development" ( $n = 33$ , 43.4%). Of the 48 participants who indicated that they did not conduct research or conducted research on a yearly basis, the most common reasons cited for not regularly conducting research included: (a) "my job is to teach not do research" ( $n = 45$ , 93.8%), (b) "have no time for research" ( $n = 38$ , 79.2%), and (c) "other" ( $n = 15$ , 31.3%). Within the "other" response, participants that indicated that they did not regularly conduct research cited issues such as "[I have] never been asked to conduct research" and "Professional development needed. Lack of support".

The four-point (1 = Never, 4 = All of the time) Likert style statements that addressed participants regularity of encountering research that impacted their professional lives; the highest ranked statement was "How often have you encountered research that expanded your understanding of an issue" ( $M = 2.51$ ,  $SD = .57$ ). This was followed by "How often have you encountered research that provided a framework for making improvements in the field" ( $M = 2.38$ ,  $SD = .61$ ) and "How often have you encountered research that provided a common language and set of ideas for you and your colleagues" ( $M = 2.35$ ,  $SD = .66$ ). The lowest ranked statements were "How often have you encountered research that brought attention to an issue that you had not faced" ( $M = 2.26$ ,  $SD = .51$ ) and "How often have you encountered research that changed the way you look at problems you face in job" ( $M = 2.20$ ,  $SD = .57$ ). Only 88 participants completed this portion of the survey, as this was the last set of Likert style questions in the survey. How frequently they had conducted research was the only variable significantly correlated with any Likert scale questions. This variable was negatively correlated with the question "How often have you encountered research that provided a common language and set of ideas for you and your colleagues" ( $r = -.302$ ,  $p = .004$ ), and positively correlated with the question "How often have you encountered research that brought attention to an issue that you had not faced" ( $r = .211$ ,  $p = .048$ ). Figure 1 displays the correlation coefficients between the identified variables and the Likert style questions.

For the open-ended questions, a qualitative inductive analysis (Thomas, 2006) was conducted. The first question was: "Share an experience you had where you used research to inform a decision with regards to your teaching?". As the open-ended questions were not required to be completed, only 78 participants (63%) completed the first question. Nine categories constructed from the first open-ended question, which included: (a) informs best practice, (b) professional development, (c) leadership, (d) advocacy, (e) disability specific, (f) assessment, (g) behavior management, (h)

**Table 1.** Participant demographics and professional development attendance.

	Sample ( $N = 124$ ) % ( $n$ )
Gender	
Female	59.7 (74)
Male	39.5 (49)
Prefer not to comment	0.8 (1)
Highest level of formal APE training:	
Bachelor's with one or two courses in APE	30.6 (38)
Bachelor's with concentration in APE	7.3 (9)
Master's in APE	29.8 (37)
APE state endorsement	21.8 (27)
Doctorate in APE	3.2 (4)
None	4.8 (6)
Other	3 (4)
School Type	
Private	2.4 (3)
Public	73.4 (91)
Special/Segregated School	17.7 (22)
Residential School	1.6 (2)
Other	4.8 (6)
Age of Students Taught	
0-3	9.7 (12)
4-7	59.7 (74)
8-11	69.4 (86)
12-15	64.5 (80)
16-18	45.2 (56)
19 or above	28.2 (35)
Primary delivery of APE service model:	
Self-contained or one on one	23.4 (29)
General PE	16.9 (21)
One-on-one, self-contained, and general PE	25.8 (32)
Itinerant	29.8 (37)
Other	4.0 (5)

Note. APE = Adapted physical education, PE = Physical education.

	How often have you encountered research that:				
	Expanded your understanding of an issue	Provided a framework for making improvements in the field	Provided a common language and set of ideas for you and your colleague	Brought attention to an issue that you had not faced	Changed the way you look at problems you face in job
Gender	-.180	-.123	-.159	.017	-.003
Level of Education	.078	-.001	-.061	-.027	.012
Level of APE	.098	.029	.083	-.015	.123
Training					
Freq of Conducting Research	.087	.190	-.302*	.211*	.190
Yrs of Exp	-.185	-.115	-.146	-.081	-.090

**Figure 1.** Research frequency correlation summary.

\* =  $p < .05$ , Yrs = Years, APE = Adapted physical education, Freq = Frequency, Exp = Experience.

curriculum, and (i) I do not use research. Some of the responses were categorized into two categories when deemed appropriate. Table 2 displays an overview of the categories, example statements, and a frequency count of the categories for the first open-ended question.

The second open-ended question analyzed was: “Think about a time when a piece of research you encountered changed your thinking or opinions about possible solutions to a professional problem you encountered. What was that piece of research and how did you use it?”. Only 68 participants (55%) completed the second open-ended question. Seven categories were constructed from the second open-ended question, which included: (a) informs best practice, (b) research is not useful or cannot comment, (c) program design, (d) advocacy, (e) disability specific, (f) behavior management, and (g) collaboration and personal growth. Some of the responses were categorized into multiple categories (e.g., up to three different categories) when deemed necessary. Table 3 displays an overview of the categories, example statements, and a frequency count of the categories for the second open-ended question.

### Access to research

To identify how adapted physical educators’ access and obtain research, three questions from the survey were analyzed. For the question that pertained to identifying mediums used to access research, the most commonly

reported sources used included consulting with colleagues ( $n = 94$ , 75.8%), and professional state conferences ( $n = 84$ , 67.7%). The sources that were the most seldom cited were the state department of education ( $n = 19$ , 15.3%), “Other” ( $n = 4$ , 3.2%), and “I don’t use research in my professional life” ( $n = 1$ , 0.1%). Table 4 displays an overview of the sources adapted physical educators indicated using to access research. In addition, 56.5% ( $n = 70$ ) of the participants indicated that they had access to a university library. The most commonly reported frequency for using the library system to access academic research was never ( $n = 53$ , 42.7%), which was followed by yearly ( $n = 39$ , 31.5%), monthly ( $n = 25$ , 20.2%), and weekly ( $n = 7$ , 5.6%).

### Perceptions toward research

Nineteen Likert style statements (1 = Strongly Disagree, 4 = Strongly Agree) were used to assess participants’ perceptions toward the relevance, credibility, and value of research. The highest ranked statements were: “Researchers provide a valuable service to education practitioners” ( $M = 2.69$ ,  $SD = .66$ ) and “A well-designed study with strong findings can change people’s minds” ( $M = 2.69$ ,  $SD = .66$ ). The lowest ranked statement was: “Education research is a waste of money” ( $M = 1.65$ ,  $SD = .51$ ). Table 5 displays an overview of the results of this section.

Gender was the only variable not found to significantly correlate with any of the statements,  $p > .05$ . Level of education was found to have a significant positive



**Table 2.** Overview of analysis of open-ended question one responses.

Category	Definition	Ex Quote	Freq
Informs best practice	Utilizing instructional strategies to improve successful engagement and learning through daily lessons	I used research on throwing soft object as hard as possible get correct body mechanics from students, instead of focusing on getting the object to the target. I participated in a HR and learning study where I tried to get my students HR in the correct zone and send them back to class to see if they learned better after PE.	26
Disability Specific	Comments targeted toward a specific disability	I read some research for students who are visually impaired that helped change the way I conducted some of my units. I work with students with autism. Based on the research I have done on the neurological aspects of autism, I have changed the way I teach some skills and adapted the materials and equipment to better meet the needs of my students. I also researched executive functioning deficits in students with autism and have a better understanding of my students' behaviors.	14
Behavior Management	Addressing means to guide students' actions to be positive and on-task	At a regional conference in TX, one session discussed research in regards to behavior. The overall takeaway I had was that teachers and students alike can determine the antecedent, behavior, and consequence. However, the consequence is often perceived different by the student. Their consequence is generally seen as positive. With this in mind, when my students present behaviors, I try to understand what the consequence is from their perspective. Allowing me to level with them from several different approaches. Mindfulness has helped with our behavior managements. It took research to prove to other teachers how it could help.	11
Assessment	Collecting data to inform discussions and practice	Utilizing standardized assessments and researching the beat assessments to use helped me determine needs of my students. I use either the Test of Gross Motor Development by Dale Ulrich or how a student scores on the Ohio PE Standards to choose which classrooms and environments will be best suited to each child's needs. From these scores and the student's likes and dislikes as well as the student's personality the facts and research helped placed the students in the best possible environment for PE based on their physical, emotional and social abilities.	9
Advocacy	The act of positively promoting the field to stakeholders	SHAPE America research on why students need more PE presented in front to school board members. I used research to advocate for use of music in my class to increase activity level.	9
I do not use research	Have not engaged in research or do not find it useful	Research has not influenced my job/work with my students. I have found that educational research is often outdated and no longer practical.	7
Curriculum	The structured scope and sequence of the information delivered to the students	Our district content area curriculum department used a student feedback survey to gain current perspectives in high school certain classes. The data was shared amongst a group of established content area teachers in the district. Through the research, we identified many strengths and areas of improvement to build the quality of our elective classes. Conducted a study on the length of time it would take to teach my 3rd graders to be proficient with dribbling a basketball with both hands.	6
Leadership	The act of supporting others by delivering information that directly supports students	I conducted a state-wide needs survey to identity the greatest needs of APE teachers in the State and provided professional development for the areas of greatest need. I also conducted research on a new piece of equipment to see if the equipment improved school readiness for student. I used research to assist my PE Department supervisor on the Universal Design for Learning in her understanding of it. We used my classes to design lessons & create videos for our department to learn from, which assisted in my teaching.	5
Professional development	The act of gaining knowledge that directly benefits students	I read many books related to autism and various other challenges. I explored many methods for evaluation of progress. I researched communication techniques. I attended conferences from which I gleaned many innovative ideas. I researched adaptive equipment and behavioral techniques to accommodate challenges.	3

Freq = Frequency, PE = Physical education, HR = Heart rate, APE = Adapted physical education, SHAPE = Society of Health and Physical Educators.

correlation with three statements: (1) "Educational research is too impractical to be useful for teachers" ( $r = .185, p = .027$ ); (2) "Educational researchers segregate themselves from practitioners and daily practice"

( $r = .214, p = .017$ ); and (3) "Educational research can be used to support any opinion" ( $r = .198, p = .027$ ). Level of APE training had significant positive correlations with the statements: (1) "Research can address practical

**Table 3.** Overview of analysis of open-ended question two responses.

Category	Definition	Ex Quote	Freq
Research is not useful or cannot comment	Have not engaged in research or do not find it useful	It is difficult to say since there is such little research out there that supports the students that I work with. There is no research: it has been more trial and error being adaptable and doing what works best. There isn't any.	24
Informs best practice	Utilizing instructional strategies to improve successful engagement and learning through daily lessons	Over the years I'll come across articles in professional journals that deem certain traditional exercises dangerous and I implement the newer techniques with my students and try to educate them (as well as my colleagues) about the reasons for the changes. 10+ years ago when research into video modeling was first introduced. It changed the way I worked with many of my students.	20
Program Design	Considering multiple factors that guides the development of the mission and vision of an APE program	Design a peer teaching program in APE with regular education students working with special education students in PE. We researched on standard based grading during CLT and professional developments. We found the benefits and side effects of using this grading system. Helped us to enhance the benefits for our school. Also to create solutions for the side effects.	12
Disability Specific	Comments targeted toward a specific disability	Reading studies and paper about various disabilities helps to keep me up to date on techniques I can use to help those students. Teaching techniques for students with autism, down syndrome, muscular dystrophy etc. Hands on experience with different disabilities and watching stories of individuals with disabilities and how they have overcome disabilities-inspires thinking outside the box. And research I have done to write various grants and new courses.	8
Behavior Management	Addressing means to guide students' actions to be positive and on-task	Communication research that opened the doors for relationship building and increased participation. In our school district we researched better ways to discipline students. We can across PBIS which has changed the way our schools handles discipline problems.	7
Advocacy	The act of positively promoting the field to stakeholders	At a professional conference recently, I was exposed to data on teacher stress and burnout. I returned to my school and started an employee health and wellness initiative.	2
Collaboration and personal growth	The act of two or more people sharing ideas and thoughts with equal power within the conversation	I like to read research and then discuss it with colleagues. Understanding how other professionals perceive the information they've been given and then collaborating on how best to solve an issue or problem.	2

Freq = Frequency, PE = Physical education, APE = Adapted physical education, PBIS = Positive Behavior Support Intervention.

**Table 4.** Sources used to access research.

	Sample (N = 124) % (n)
Books	43.5 (54)
Academic Journals	52.4 (65)
Professional Journals	62.9 (78)
Professional Newsletters	36.3 (45)
Social Media	45.2 (56)
Web-Based Sources	46.8 (58)
National PD	58 (46.8)
State PD	67.7 (84)
Consulting with University Professors	25.8 (32)
Consulting with Colleagues	75.8 (94)
Consulting with School Administrators	20.2 (25)
State Department of Education	15.3 (19)
School Delivered PD	33.9 (42)
I Don't Use Research	0.8 (1)
Other	3.2 (4)

APE = Adapted physical education, PD = Professional Development.

problems facing schools" ( $r = .191, p = .034$ ); and (2) "Research can provide a valuable service to education practitioners" ( $r = .248, p = .005$ ). The frequency in which participants indicated they conducted research was found to have significant negative correlation with the statement "Educational researchers segregate themselves from practitioners and daily practice" ( $r = -.234, p = .009$ ). In addition, the frequency variable was found to have significant positive correlation with the statement

"Educational research provides results that can help leaders improve education outcomes" ( $r = .205, p = .022$ ). Lastly, years of experience was found to have a significant positive correlation with the statement "Educational research is a waste of money" ( $r = .255, p = .004$ ). Figure 2 displays the correlation coefficients between the identified variables and the questions.

## Discussion

This study aimed to examine adapted physical educators' perceptions toward and use of research. The current study suggests that many adapted physical educators use, access, and have engaged in research. Although this may initially appear to be counter to a plethora of research that has expressed that K-12 practitioners often feel that educational research has little influence to their practices (e.g., Coburn et al., 2009; Harrison et al., 2017; Montgomery & Smith, 2015), these findings are similar to two recent studies that utilized a similar survey to the one presently employed (Hopkins, 2016; Penuel et al., 2017). These studies found that a national representation of school administrators and state science leaders held

**Table 5.** Perceptions toward research.

To what extent do you agree or disagree:	M (SD)
Research helps identify solutions to problems facing schools	2.57 (0.63)
There is a disconnect between the research world and the ed world	2.57 (0.71)
Research addresses questions that help us make better decisions	2.56 (0.59)
When confronted with a problem or decision, it is valuable to speak with ed researchers	2.56 (0.65)
Ed research is too impractical to be useful for teachers	1.86 (0.65)
I can find evidence to contradict the findings of any ed research study	2.19 (0.61)
Ed researchers segregate themselves from practitioners and daily practice	2.36 (0.73)
By the time research findings are published, they are no longer useful to me	1.84 (.069)
Research can address practical problems facing schools	2.65 (0.63)
Research can provide a valuable service to ed practitioners	2.69 (0.67)
Ed research is a waste of money	1.65 (0.51)
Ed research is usually objective	2.46 (0.63)
Ed research provides results that can help leaders improve ed outcomes	2.64 (0.65)
The claims that research studies make are trustworthy	2.44 (0.56)
Ed research reports are rarely consistent with each other	2.01 (0.47)
Ed research can be used to support any opinion	2.31 (0.75)
Ed research is generally conducted to improve the careers of researchers, not to improve schools	2.09 (0.70)
A well-designed study with strong findings can change people's minds	2.69 (0.67)
Researchers frame their results to make political points	2.10 (0.59)

M = Mean, Ed = Education.

generally positive views toward the usefulness of research and engaged with research regularly. For example, Penuel et al. (2017) found that school administrators reported using research when making decisions for a variety of purposes (e.g., designing professional development, curriculum adoption). Further, it should not be surprising that participants had a generally positive view toward research due to the reported high levels of use of research. Landry, Lamari, and Amara (2003) suggest that the frequency of one's use of research may result from the need to acquire relevant research that addresses a particular problem. Thus, these findings may align with previous studies that have suggested that teachers engaged in research are often very interested in practical ways to improve their practices (Drill et al., 2012; Montgomery & Smith, 2015).

Although many of the scores from the Likert scale statements revealed that teachers in this study had positive perceptions toward the usefulness of research and the need for high quality research, many stated they believed research was not useful to their practice. For example, when participants were asked to discuss a piece of research that had been useful to them, 35% of the respondents reported that either research was not useful to them or that they couldn't think of any research at the moment. One participant noted that they had never been asked to conduct research. Although research may not be a direct component of

many educators' jobs, this sentiment highlights the need for more collaborative relationships between researchers and educators. Furthermore, within the open-ended responses very few were able to identify a specific research study that influenced them. This aligns with Penuel et al. (2017) findings, who suggested that this may be because recalling the name, authors, and year of publication may have been too lofty of a goal for practitioners outside the field of academia. To encourage researcher-practitioner collaboration, specific methodologies must be examined and implemented. Casey et al. (2017) outlined four approaches to practitioner-based research that may be applicable to the physical education and youth sport fields. One approach highlighted, the action research approach, enables teachers to collaborate with researchers in order to effectively collect and analyze data, as well as interpret the findings.

In order to promote teachers' usage of and perceptions toward research, it is essential to locate what sources are being used to access research. Based on the present findings, attending and presenting at conferences, as well as publishing in the professional journals where adapted physical educators are accessing research, may be ideal locations to disseminate research to this population. This once again aligns with Penuel et al. (2017) research, who suggested accessing research may be less of the issue for educational leaders than earlier research would have us believe. Furthermore, in contrary to contemporary images of inaccessible researchers in ivory towers, adapted physical educators in the present sample reported that they leveraged their affiliations with professional associations and peer networks to access research. The intentional efforts to promote the access and use of research through professional associations and networking among colleagues should be studied and compared with other approaches such as using online technology to disseminate knowledge. Scholars should also consider presenting their research at conferences that practitioners are more likely to attend, such as The Society of Health and Physical Educators (SHAPE America) or state APE or general physical education conferences. Even though a majority of participants from this study appear to be accessing research and have access to a university library system, only a minority of them are accessing these resources on a regular basis. University library systems often are crucial mediums to use when identifying research, as universities often prioritize providing their students and staff access to the latest research (Willinsky, 2014). Furthermore, subscriptions to academic journals can be quite costly. Taking into account all of the expenses K-12 schools have to consider, these

To what extent do you agree or disagree:	Gender	Level of Ed	APE training	Freq of Research	Yrs of Exp
Research helps identify solutions to problems facing schools	-.049	-.085	.102	.073	-.016
There is a disconnect between the research world and the ed world	.024	.084	.091	-.131	.013
Research addresses questions that help us make better decisions	-.019	-.098	.099	.167	-.033
When confronted with a problem or decision, it is valuable to speak with ed researchers	.033	-.082	.061	.100	-.074
Ed research is too impractical to be useful for teachers	-.015	.185*	-.031	-.134	.130
I can find evidence to contradict the findings of any ed research study	-.092	.024	-.135	-.051	-.044
Ed researchers segregate themselves from practitioners and daily practice	-.126	.214*	.090	-.234*	-.031
By the time research findings are published, they are no longer useful to me	.027	.060	.138	-.099	-.008
Research can address practical problems facing schools	-.010	-.119	.191*	.017	-.164
Research can provide a valuable service to ed practitioners	.006	-.032	.248*	.077	-.064
Ed research is a waste of money	-.077	.151	.066	.013	.255*
Ed research is usually objective	-.080	-.059	.036	-.041	-.029
Ed research provides results that can help leaders improve ed outcomes	-.167	-.099	.058	.205*	-.174
The claims that research studies make are trustworthy	-.091	-.028	.123	-.087	-.033
Ed research reports are rarely consistent with each other	-.035	.008	-.078	-.034	.096
Ed research can be used to support any opinion	.016	.198*	-.083	.024	.163
Ed research is generally conducted to improve the careers of researchers, not to improve schools	-.130	.078	.015	-.057	-.012
A well-designed study with strong findings can change people's minds	-.068	.004	.000	-.016	-.079
Researchers frame their results to make political points	-.082	.072	-.048	.006	.036

**Figure 2.** Research perception correlation summary.

\* =  $p < .05$ , Yrs = Years, Ed = Education, APE = Adapted physical education, Freq = Frequency, Exp = Experience.

institutions may not be willing to cover academic journal subscriptions. In order to make their research more readily available to teachers researchers should consider alternative mediums to disseminate their research, such as social media platforms and open-access journals. Scholars should consider publishing their research in reputable open-access journals in APE, such as the *European Journal of Adapted Physical Activity*, as well journals with a large practitioner focus, such as *Journal of Physical Education, Recreation and Dance* (JOPERD) and *PALESTRA*. Growing teachers' access to research is essential in increasing their access and use of it.

Professionally engaged teachers are generally very interested in concrete ways to improve their practice (Drill et al., 2012; Montgomery & Smith, 2015). Unfortunately, high quality research is primarily circulated in academic research journals instead of being disseminated in locations where teachers are more likely to encounter it (Armour, 2017; Casey et al., 2017). Mediums such as blogs, podcasts, and social media may be ideal to disseminate research to educators. For example, McNamara, Healy, and Haegele (2019) recently surveyed 94 adapted physical educators on their professional use of social media. Adapted physical educators reported frequently using social media networks, such as Facebook and Twitter, to access information related to teaching physical education to students with disabilities. In addition, a majority of the participants (49%) spent approximately an hour a day using their social media accounts. However,

teachers may be more likely to use social media to find pictures, videos, or quick information related to their profession, and may not take the time to read an entire academic article. Nonetheless, the use of more flexible avenues of dissemination may lead to more accessible two-way communication routes, where scholars and teachers can more easily influence one another, and in turn benefit their field (Armour, 2017). Thus, efforts that are more concerted should be made to disseminate research to adapted physical educators through "unconventional" ways, as it has been suggested that these settings may be ideal to foster networks where educators can share knowledge, develop their practice, and engage in collaborative professional learning (McNamara et al., 2019).

Evidence regarding some of the individual characteristics within the present sample may help further explain the results. According to correlational analyses, years of experience and higher levels of education were correlated with lower perceptions toward the validity and usefulness of research. Surprisingly, this suggests that those with greater amounts of training and experience had more negative views on the importance or usefulness of research. This finding may indicate that teachers with higher levels of education and years of experience may believe educational research is not addressing their particular problems or needs in the K-12 setting. In addition, "for many K-12 teachers, research is something that is either "done to them," or "forced upon them" in the form of poorly implemented policies



which require extensive amounts of additional time, resources, or documentation on the part of the teacher” (Montgomery & Smith, 2015, p. 103). Future research should further examine how different groups of adapted physical educators perceive the relevance and validity of research in their professional lives.

Armour (2014) proposed a translational research mechanism called “pedagogical cases” in an attempt to bridge the gap between researchers and practitioners within the field of physical activity education. This framework aims to help researchers summarize research from multiple “fields in a concise, focused, and engaging and relevant manner” (Armour, 2017, p. 45) to physical activity education practitioners, such as general and adapted physical educators. The original framework requires that academics working together on studying the complex needs of a specific young learner come from different backgrounds and disciplines (Armour, 2014). The most recent iteration of the model (Casey, Goodyear, & Armour, 2016), proposes that academic teams should also incorporate the expertise of practitioners, as these practitioners are able to offer a critical reflection on the outcome, as well as the applicability of the research. However, the pedagogical cases framework is only at preliminary conceptual stages (Armour, 2017), as well as this model may not be able to overcome the persistent, complex, and widespread research to practice gaps within educational research. Nonetheless, with the dearth of translational models available within the field of physical education, this framework may be a valuable starting point for distributing research to both general and adapted physical educators.

### Limitations

Several limitations should be addressed. First, as with most survey research, many of the survey questions were not able to determine the rationale behind the participants’ answers (Portney & Watkins, 2009). Future research should utilize individual or group interviews to explore in greater depth adapted physical educators’ usage and perceptions of research. This may alleviate this limitation, as this would allow the researchers to ask follow-up questions and gain further insight on the matter. Second, this study only used simple face validity methods within the adaptation process of the survey, thus these results should be generalized with caution (Portney & Watkins, 2009). Third, comparisons between adapted physical educators within different states may be problematic. Each state in the US controls the parameters for teaching certificates. States have the ability to require, or not require, specific criteria for teaching APE. Hence, depending on

the state from which an adapted physical educator resides, the degree of training and education related to APE may differ drastically (McNamara & Dillon, 2020). Fourth, the results were self-reported and therefore dependent upon the trustworthiness of the participants’ responses (Portney & Watkins, 2009). Fifth, and finally, a selection bias may exist within the present sample, as those participants were recruited through national and state level organizations in the US. While these organizations intend to serve the profession as a whole, not every adapted physical educator is a member of such organizations and those that are may have a greater motivation in seeking out new information to use in their own teaching practice.

### Conclusion

Overall, adapted physical educators reported a high rate of engagement with research—including many whom conducted research—and that research has a positive impact on issues that may be most pertinent for their situation. Findings also demonstrate that a disconnect between researchers and adapted physical educators may exist; especially when considering participants with higher levels of education and experience. This may be partially due to the fact that high quality research is often published in academic journals that are often unused or inaccessible to teachers (Armour, 2017; Drill et al., 2012; Montgomery & Smith, 2015), and a disincentive for academic scholars may exist in publishing in locations such as blogs that are more utilized by teachers (Armour, 2017; Binswanger, 2015; Frey, 2003). This study highlights the important role research plays in the practice of adapted physical educators; however, researchers must make a more concerted effort to provide research findings in a more practical way so that teachers may better translate findings to their own situations (Drill et al., 2012; Montgomery & Smith, 2015). Future researchers should examine more efficient means to increase adapted physical educators’ access and use of research within their daily lives.

### What does this article add

Limited information is available on adapted physical educators’ access and perspectives toward research. Thus, this article begins to build our understanding of how adapted physical educators engage and perceive research. Within the results, it was interesting to note that there was a high rate of engagement with research and that research has a positive impact on issues that may be most pertinent for their situation. In relation to


how this population accesses research, the most commonly reported sources used included consulting with colleagues, professional state conferences, and professional journals. Entities that disseminate research, such as professional development organizations and academic journals, should use this information to better reach these groups of professionals. Surprisingly, higher the level of education and years of experience were correlated with lower perceptions toward the validity and usefulness of research. This suggests that adapted physical educators with greater amounts of training and experience may have more negative views on the importance or usefulness of research. Perhaps adapted physical educators are simply using what they believe has worked for them in the past, thus they no longer spend as much time seeking out growth through research. In addition, one pattern constructed from the open-ended responses was that research was not very useful to adapted physical educators' daily practices. These findings highlights the need for researchers to use more practical ways to better disseminate research for adapted physical educators to translate to their own context. In addition, this article may guide future research examining more efficient means to increase adapted physical educators' access and use of research within their daily lives.

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# A multiple-method review of accommodations to gross motor assessments commonly used with children and adolescents on the autism spectrum

Autism  
1–14  
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## Abstract

The purpose of this study is to understand the common accommodations used during standardized motor assessment of children on the autism spectrum. This study was completed in three parts: (1) a narrative review of the literature; (2) an open-ended survey sent to the first authors of the identified articles; and (3) a descriptive analysis of responses. Results revealed that 56.7% of the identified articles did not report enough information of assessment procedures, 18.9% followed the assessment manual, 16.9% provided accommodations on a needs basis, and 7.5% used a consistent modified protocol. Individual responses showed that extra demonstrations ( $n=5$ ) were the most frequent accommodation, followed by extra breaks ( $n=3$ ), picture cards ( $n=2$ ), and hand-over-hand assistance ( $n=1$ ); some respondents stated that they did not provide accommodations. The findings indicate that a clear set of accommodation for motor skill assessments does not exist, though some commonalities were reported. Further research is necessary to understand the impact of accommodations in the assessment process, as well as which accommodations are needed and/or effective.

## Lay abstract

Research has shown that children and adolescents on the autism spectrum develop gross motor skills such as running, jumping, throwing, and kicking at slower rates than their non-autistic peers. Accommodations to these types of assessments can help improve the performance and reduce the anxiety of children on the autism spectrum. However, there is little consensus regarding these accommodations, especially within the research process. In this study, the authors searched the literature for studies that used gross motor skill assessments with youth on the autism spectrum, then sent a survey to the first authors of those studies asking them to describe their assessment protocol. By understanding the assessment protocol, the authors looked for commonalities of application of gross motor assessment. Little consensus exists among the literature and in the reported practices of researchers. The findings of this work can help those providing gross motor assessment to youth on the autism spectrum, though further research is needed to understand how to best provide accommodations and under which circumstances.

## Keywords

autism spectrum disorder, fitness assessment, gross motor assessment, modifications, motor development

A growing body of research has suggested that many individuals on the autism spectrum experience delays in motor skill development and coordination (Bhat, Landa, & Galloway, 2011; Fournier, Hass, Naik, Lodha, & Cauraugh, 2010). This delay is evident early in a child's life (Ketcheson, Hauck, & Ulrich, 2018; Lloyd, MacDonald, & Lord, 2013) and persists as children age (Liu, Hamilton, Davis, & ElGarhy, 2014; Staples & Reid, 2010). Given the evidence

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of decreased physical activity participation (Jones et al., 2017; MacDonald, Esposito, & Ulrich, 2011) and increased risk for obesity (Healy, Aigner, & Haegele, 2018) in this population, despite evidence of the benefits of physical activity (Healy, Nacario, Braithwaite, & Hopper, 2018), building motor skill competence is a vital component for future physical activity participation (Haubenstricker & Seefeldt, 1986; Stodden et al., 2008).

Delays in gross motor skill development among children on the autism spectrum may be associated with the defining core symptoms of autism identified in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM-5; American Psychiatric Association [APA], 2013). For example, differences in social communication have been found to be correlated with gross motor skills (Colombo-Dougovito & Reeve, 2017; Pusponogoro et al., 2016; Sipes, Matson, & Horovitz, 2011). Furthermore, individuals on the autism spectrum who have a greater demonstrated delay in their gross motor skills have also been shown to have greater social skills delays, including less receptive language skills (Mody et al., 2017), less pragmatic language skills (Stevenson, Lindley, & Murlo, 2017), lower social communicative skills (MacDonald, Lord, & Ulrich, 2013b; Papadopoulos et al., 2012), as well as lower facial processing and other social skills (Leonard et al., 2014; Sumner, Leonard, & Hill, 2016). Delays in gross motor skill development have also been shown to impact adaptive daily living skills (MacDonald, Lord, & Ulrich, 2013a; Travers et al., 2016). In addition, parents have reported a lower quality of life for their children on the autism spectrum when their children experienced greater delays in their motor skills development (Ayers, Taylor, Branscum, & Hofford, 2016; Hedgecock, Dannemiller, Shui, Rapport, & Katz, 2018; Toscano, Carvalho, & Ferreira, 2017). Finally, lower physical fitness scores were also reported among children in this population who experienced delayed motor skills (Pan, 2014). Acquiring gross motor skills is particularly important for the development of the human body, which contributes to almost every area (e.g. physical, psychological, and cognitive aspects) of growth and well-being across the lifespan (Anderson, 2018), and is vital for later physical activity participation (Haubenstricker & Seefeldt, 1986; Stodden et al., 2008). As children grow, gross motor skills are necessary for participation in more complex movements such as in organized sport or lifetime leisure activities (Clark & Metcalfe, 2002). To ensure that interventions and programming to build gross motor skills are started early enough and in the most appropriate way, standardized assessments are the vital first step.

Since children on the autism spectrum may not receive information and instruction in the same way as their typically developing peers, following gross motor skill or fitness instruction may be difficult (Berkeley, Zittel, Pitney, & Nichols, 2001; MacDonald et al., 2013b). This suggests

that an adaptation of the learning or assessment context is necessary (Horvat, Kelly, Block, & Croce, 2018). For instance, the typical administration of standardized gross motor assessments, such as the Test of Gross Motor Development (TGMD-2/TGMD-3; Ulrich, 2000, 2019), is a visual demonstration followed by verbal instruction by the assessor. Staples and Reid (2010) demonstrated that some children on the autism spectrum may have difficulty following this assessment protocol. In one of the earliest accounts of gross motor skill delay in populations on the autism spectrum, Berkeley et al. (2001) stated that many participants were focused on “moving from point A to point B as the main objective versus ‘seeing’ that the form used to get from point A to point B was different” (p. 413). This subtle misinterpretation and lack of understanding during the assessment process have potentially large implications for reported scope or magnitude of gross motor skill delay in this population.

Given the ubiquity of gross motor skill and fitness assessment in program planning and interventions, it is imperative that assessment procedures are provided in an accessible manner for the individual being assessed to understand (Block & Taliaferro, 2014). Due to barriers in communication (APA, 2013) and the potential differences in the ability to imitate among children on autism spectrum (Chetcuti, Hudrey, Grant, & Vivanti, 2019; Williams, Whiten, & Singh, 2004), researchers have often resorted to providing accommodations to the assessment procedures, as needed, to ensure that study participants “understand” what is expected of them during a particular assessment. Evidence demonstrates that when researchers provide accommodations, such as visual supports, those accommodations can have a significant impact on the scores of those being assessed (Breslin & Rudisill, 2011, 2013). In a 2017 case study, Liu, Breslin, and ElGarhy compared four reliable and valid instruments: the Bruininks–Oseretsky Test of Motor Proficiency-2 (BOT-2; Bruininks & Bruininks, 2005), the Movement Assessment Battery for Children-2 (MABC-2; S. E. Henderson, Sugden, & Barnett, 2007), the Peabody Developmental Motor Scale-2 (PDMS-2; Folio & Fewell, 2000), and the TGMD-2 (Ulrich, 2000). The experienced assessor in this project added pictures, short verbal instructions, and demonstrations to the original protocols to support the child’s individual needs. The study revealed that the 5-year-old boy on the autism spectrum achieved the best results on the PDMS-2 and the BOT-2 with the additional accommodations, allowing researchers to conclude that appropriate assessment instruments should be chosen in accordance to the project and evaluation goals (Liu et al., 2017). Yet, when providing motor or fitness assessments with the intention of comparing scores to other participants within the same study, unless each person receives the appropriate, necessary accommodations, the data lose their comparability. As mentioned

previously, gross motor skill development and fitness may play an important role for the overall development of children on the autism spectrum (Pusponegoro et al., 2016; Sipes et al., 2011; Sumner et al., 2016). Unfortunately, unless commonalities among assessment procedures are found and guidelines are presented, the continued inability to determine the magnitude of delay will remain.

The present argument is not that gross motor skill delays or fitness differences do not exist in populations on the autism spectrum; there is a plethora of evidence to suggest that these differences exist, though our understanding of the magnitude is still unclear (Staples, MacDonald, & Zimmer, 2012). However, given the differences in social communication, potential difficulty with person-to-person imitation (Chetcuti et al., 2019; Williams et al., 2004), and documented differences with motor coordination (Fournier et al., 2010), the difficult work remains in understanding if the present documented motor delay, as well as differences in fitness and motor skills, is truly due to: (1) limited motor ability, (2) a limited understanding of what is asked, and/or (3) a poor administration of the assessment protocols. Therefore, to have a better foundation to understand the gross motor delays seen in populations on the autism spectrum, the purpose of this study was to explore what common accommodations have been used by researchers during past standardized assessments of children on the autism spectrum.

## Methods

To gain insight into the procedures being used to assess children on the autism spectrum, studies were identified that measured on the gross motor skills or fitness ability of children on the autism spectrum by using a standardized assessment. The study was completed in three parts: (1) a narrative review of the literature, (2) an open-ended survey sent to the first authors of the identified articles, and (3) a descriptive analysis of responses.

### Narrative review

A narrative review of literature was completed in April 2018 to identify studies that have assessed youth on the autism spectrum using a standardized gross motor skill or fitness assessment. Following PRISMA guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009), search strategies for the study were developed around several keywords determined by the authors. Three lines of identified search terms were as follows: (1) *autism, Autism Spectrum Disorder, Pervasive Developmental Disorder, PDD-NOS, Childhood Disintegrative Disorder, Rett disorder, developmental disorder*; (2) *gross motor performance, gross motor skills, gross motor ability, gross motor assessment, fitness*

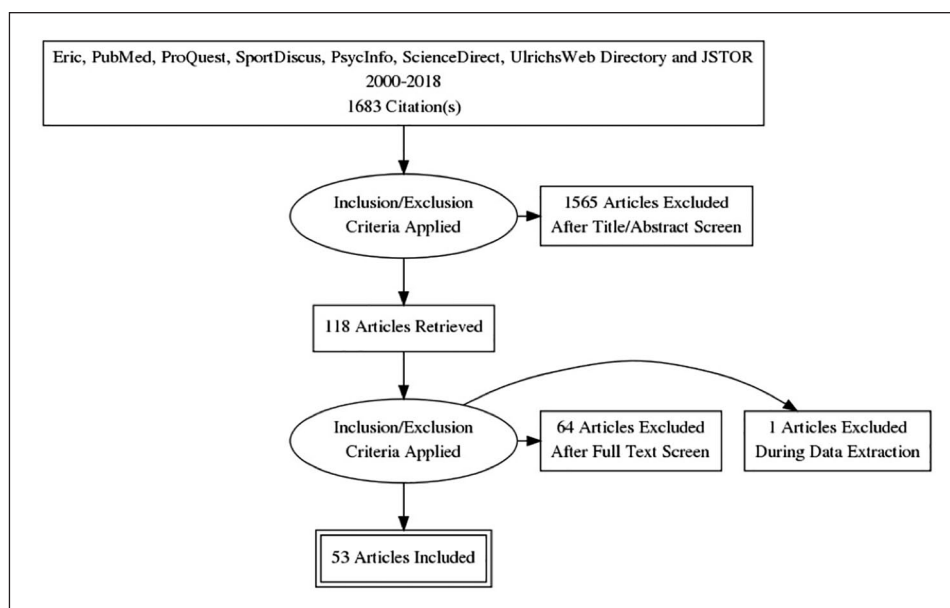
*assessment, fitness ability, fitness performance, physical activity assessment, sedentary behavior assessment*; and (3) *children, youth, adolescent, teenager*. These search terms were used to search articles in the following databases: Eric, PubMed, ProQuest, SportDiscus, PsycInfo, ScienceDirect, UlrichsWeb Directory, and JSTOR. In order to determine whether articles were relevant, this search was conducted in three stages. In stage 1, two authors searched each of the identified databases and keywords. If the title appeared relevant to the context of the study, the author saved the article; after completing the initial screening, all duplications were removed. In stage 2, all authors independently screened the abstracts of the saved articles; if the abstract did not provide sufficient information related to the inclusion criteria or appeared to be unavailable, it was excluded from the study. Prior to stage 3, the reference section of the available full-text manuscripts was searched for additional articles not captured during the initial search. In stage 3, each author independently reviewed the remaining articles in full-text form for further screening; if the articles did not meet inclusion criteria, they were excluded from the study. Disagreements among authors were discussed until consensus was achieved.

To be considered for inclusion, studies needed the following: (1) a sample population of youth between the ages of 2 and 17 years with a diagnosis of autism spectrum disorder (ASD) or similar; (2) must have been published in English in a peer-reviewed journal after 2000 until spring 2018 with the full-text available; and (3) must have been used as a standardized gross motor skill or fitness assessment to assess participants in the study.

The search identified a total of 1683 articles. After screening the titles, abstracts, and keywords and removing duplications, a total of 118 articles were identified for full-text review. The reference section of each identified article was reviewed for any further articles that may have been missed during the initial search, and no additional articles were identified. All authors reviewed the full text of the articles for the inclusion criteria; only articles with complete agreement were considered for the next step. Articles were re-reviewed in cases in which the majority but not all of the authors of this study were in full agreement. A total of 53 articles met all the inclusion criteria. See Figure 1 for the flow of the review.

### Open-ended survey

After the literature review was completed, the first author's contact information (i.e. email address) was retrieved from the article; in certain cases (i.e. an author changing jobs), updated author information was retrieved from the author's faculty page. An email was used to send a consent form and an open-ended survey that asked the following information:



**Figure 1.** Flow of article selection during narrative review.

1. When was your study conducted?
2. What was your sample population?
3. What was your sample age range?
4. What was your sample gender breakdown?
5. What standardized assessment did you use?
6. Did you modify the assessment protocol?
7. Please provide the assessment protocol?
8. Was this protocol given to every participant universally?
9. If not, how did the protocol differ between participants? How did you decide who received each protocol?
10. What was the main outcome from your study?
11. In your opinion, how did the assessment protocol affect the outcome of your study?
12. If you were to replicate this study, what would you change about the assessment protocol?

Emails containing a link to the consent form and the aforementioned survey were sent on three separate occasions to the first authors of the 53 identified articles. Of the 53 articles identified, 43 unique first authors were identified. Of the 43 authors contacted, 12 consented and provided a response, and the response rate was 27%. Of the 12 respondents, 2 reported on multiple studies, as they received multiple emails and chose to respond in aggregate. The two authors who responded on multiple studies accounted for 5 of the 53 articles identified. All reported survey data were coded for the frequency of procedures, and responses were analyzed descriptively. In addition to coding responses, the method section of each of the identified articles was analyzed and descriptively coded for the assessment employed and type of accommodation described.

## Results

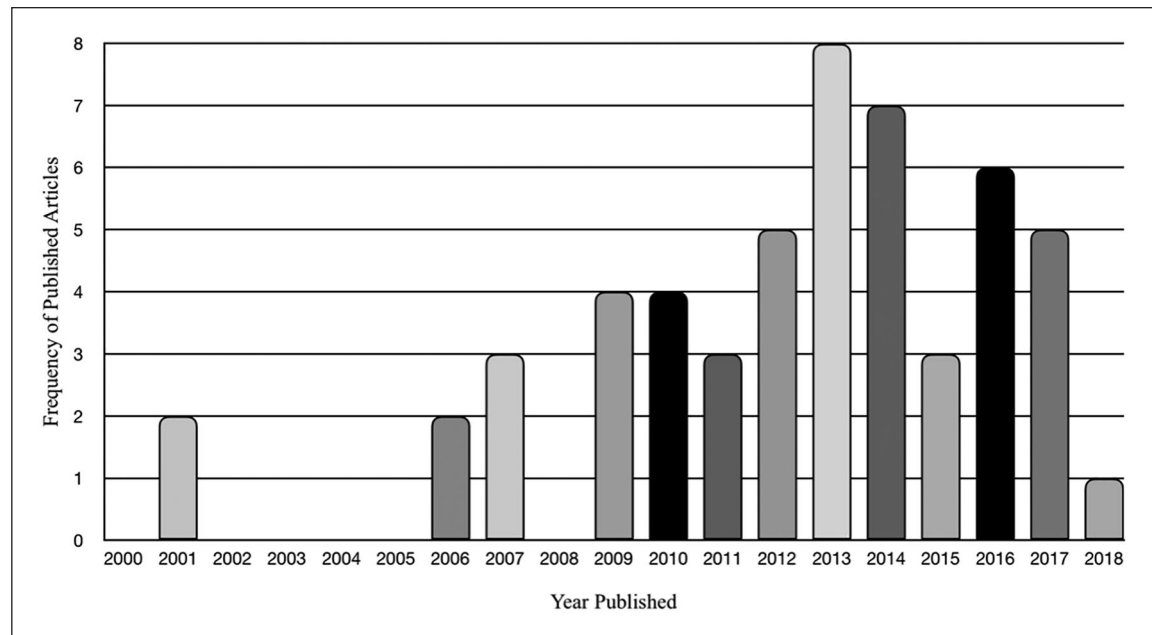
Of the 53 identified studies, the majority were published after 2009 with only two manuscript published before 2006 (both in 2001; Figure 2). A large number of articles were published between 2012 and 2017, with only one published in 2018. As this review occurred early in 2018, that is entirely not surprising.

### Motor assessments

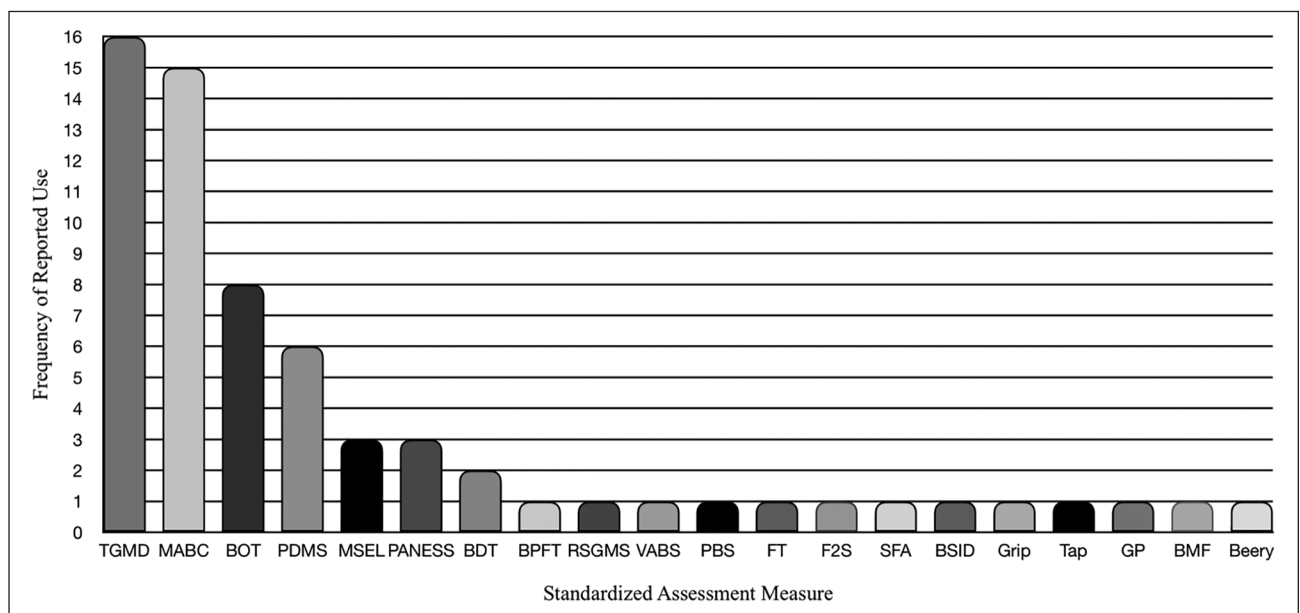
The TGMD ( $n=16$ ; Ulrich, 1985, 2000, 2019) and the MABC ( $n=15$ ; S. E. Henderson & Sugden, 1992; S. E. Henderson et al., 2007) were the most frequently reported assessment measures, followed by the Bruininks–Oseretsky Test of Motor Performance ( $n=8$ ; Bruininks, 1978; Bruininks & Bruininks, 2005) and PDMS-2 ( $n=6$ ; Folio & Fewell, 2000; Figure 3). See Table 1 for breakdown of the reported assessments. Despite inclusion within the search terms, few articles reported fitness-based assessments. This may be due to a reliance of the field to use more objective measures, such as pedometers or accelerometers, or difficulty with the assessment itself. In an article that was excluded from analysis, Lotan, Isakov, and Merrick (2004) stated that physical fitness levels “could not be measured with formal tests because of the fact that such tests require walking to a distance of a mile or a half a mile” (p. 732).

### Accommodations

Of the reported procedures in each article, 56.7% ( $n=30$ ) of the identified articles did not report enough information to



**Figure 2.** Frequency of the included published articles.



**Figure 3.** Reported standardized assessment of the included review articles.

TGMD: Test of Gross Motor Development; MABC: Movement Assessment Battery for Children; BOT: Bruininks–Oseretsky Test of Motor Proficiency; PDMS: Physical and Developmental Motor Scales; MSEL: Mullen Scales of Early Learning; PANESS: Physical and Neurological Examination of Subtle Signs; BDT: Battelle Development Inventory; BPFT: Brockport Physical Fitness Test; RSGMS: Rett Syndrome Gross Motor Scale; VABS: Vineland Adaptive Behavior Scales; PBS: Pediatric Balance Scale; FT: Flamingo Test; F2S: Floor to Stand; SFA: School Function Assessment; BSID: Bayley Scales of Infant Development; Grip: Grip Strength; Tap: Tapping Test; GP: Grooved Pegboard; BMF: Basic Motor Function; Beery: Beery Visual-Motor Integration.

determine the assessment procedures; the authors merely mentioned the assessment that was being used, the properties of the assessment, and/or the psychometric properties of the assessment. In 10 (18.9%) articles, the authors specifically stated that the researchers precisely followed the

instructions in the procedural manual for the associated assessment. However, it should be noted that one study used a 3-week familiarization period prior to assessment and one had a caregiver present, but not assisting, during assessment; both, otherwise reported adherence to



**Table 1.** Articles identified for using standardized assessment by year.

No.	Articles	Assessments	Accommodations
1	Berkeley, Zittel, Pitney, and Nichols (2001)	TGMD	Manual
2	Hauck and Dewey (2001)	Battelle Developmental Inventory	N/A
3	Hilton et al. (2007)	MABC	Manual, no specific instructions, use any strategies to help participants understand task demands
4	Jasiewicz et al. (2006)	PANESS	N/A
5	Lopata, Hamm, Voelkel, Sowinski, and Thomeer (2007)	BOT	N/A
6	Provost, Heimerl, & Lopez (2007)	PDMS-2	N/A
7	Provost, Lopez, & Heimerl (2007)	PDMS-2	N/A
8	Dowell, Mahone, and Mostofsky (2009)	PANESS	N/A
9	Jasmin et al. (2009)	PDMS-2	Caregiver present, but asked not to support
10	Pan, Tsai, and Chu (2009)	TGMD-2	Additional demonstration with instructions as needed
11	Zachor, Ilanit, and Itzhak (2010)	PDMS-2	N/A
12	Debolt, Clinton, and Ball (2010)	TGMD	Manual
13	Duronjic and Valkova (2010)	MABC-2	Manual translated to Czech
14	Kopp, Beckung, and Gillberg (2010)	MABC	N/A
15	Staples and Reid (2010)	TGMD-2	N/A
16	Breslin and Rudisill (2011)	TGMD-2	Acclimatization period, picture task cards (individually), short verbal prompts, physical demonstration, picture activity schedule (all skills fixed in order, with short verbal prompts)
17	Papadopoulos et al. (2012)	MABC	N/A
18	Sipes, Matson, and Horovitz (2011)	Battelle Developmental Inventory 2	N/A
19	List Hilton, Zhang, Whilte, Klohr, and Constantino (2012)	BOT-2	Additional demonstration, incentives to foster compliance, parents and siblings present, rewards such as food or favorite songs, breaks as needed
20	Lotan, Schneider, Wine, and Downs (2012)	Rett Syndrome Gross Motor Scale	N/A
21	MacNeil and Mostofsky (2012)	PANESS	N/A
22	Schurink, Hartman, Scherder, Houwen, and Visscher (2012)	MABC	N/A
23	Whyatt and Craig (2012)	MABC-2	Standardized procedures
24	Abu-Dahab, Skidmore, Holm, Rogers, and Minshew (2013)	Grip strength, tapping test, and grooved pegboard	N/A research technicians were trained for administrating/scoring and supervised for ongoing monitoring of reliability
25	Breslin and Rudisill (2013)	TGMD-2	Manual, picture activity schedule, picture task card
26	Kaur, Gifford, Marsh, and Bhat (2013)	BOT	N/A
27	Liu (2013)	MABC-2	Additional instructions as needed
28	Liu and Breslin (2013b)	MABC-2	Manual, additional instructions and demonstrations as needed
29	Liu and Breslin (2013a)	MABC-2	Manual, pictures, additional instructions and demonstrations as needed
30	MacDonald et al. (2013a)	MSEL	N/A
31	MacDonald et al. (2013b)	TGMD-2	Break as needed
32	Bremer, Balogh, and Lloyd (2014)	PDMS-2, MABC-2	N/A
33	Hawkins, Ryan, Cory, and Donaldson (2014)	BOT-2	N/A
34	Leonard et al. (2014)	Vineland Adaptive Behavior Scale, MSEL, MABC-2	N/A
35	MacDonald, Lord, and Ulrich (2014)	MSEL	N/A

(Continued)

**Table 1.** (Continued)

No.	Articles	Assessments	Accommodations
36	McPhillips, Finlay, Bejerot, and Hanley (2014)	MABC-2	N/A
37	Miller, Chukoskie, Zinni, Townsend, and Trauner (2014)	Basic Motor Function, Beery Visual-Motor Integration	N/A
38	Pan (2014)	BOT-2	Standardized procedures
39	Abdel Karim and Mohammed (2015)	PDMS-2	Manual
40	Ament et al. (2015)	MABC-2	N/A
41	Casey, Quenneville-Himbeault, Normore, Davis, and Martell (2015)	Pediatric Balance Scale (modified version of Berg Balance Scale), Flamingo Test, Floor to Stand Test	Verbal instruction
42	Ayers, Taylor, Branscum, and Hofford (2016)	TGMD-2	N/A
43	Bremer and Lloyd (2016)	TGMD-2	Picture task cards
44	A. Henderson et al. (2015)	TGMD-2	N/A
45	Mache and Todd (2016)	TGMD-3	Manual
46	Mahajan, Dirlikov, Crocetti, and Mostofsky (2016)	MABC-2	N/A
47	Pan et al. (2016)	Physical Fitness Test of Brockport Physical Fitness Test (BPFT)	N/A
48	Allen, Bredero, Van Damme, Ulrich, and Simons (2017)	TGMD-3	Comparative between traditional and combination of picture cards, short verbal prompts and physical demonstrations as needed
49	Colebourn, Gould-Victor, and Pazey (2017)	TGMD-2, BOT-2, School Function Assessment	N/A (verbal cues)
50	Guest, Balough, Dogra, and Lloyd (2017)	TGMD-2	N/A
51	Ketcheson, Hauck, and Ulrich (2017)	TGMD-2	Picture task cards (supplemented as needed) with visual demonstration
52	Liu et al. (2017)	BOT-2, MABC-2, PDMS-2, and TGMD-2	Manual, additional simple and short verbal instructions, additional demonstrations and pictures as needed
53	Kaur, Srinivasan, and Bhat (2018)	BOT-2	Pictures to illustrate activity, visual demonstration, use of simple instructions, and provision of practice trial with manual feedback as needed

TGMD: Test of Gross Motor Development; MABC: Movement Assessment Battery for Children; PANESS: Physical and Neurological Examination of Subtle Signs; PDMS: Peabody Developmental Motor Scales; BOT: Buininks–Oseretsky Test of Motor Proficiency; MSEL: Mullen Scales of Early Learning.

**Table 2.** Reported modifications from authors' responses.

Accommodations	Environmental cues	Video modeling	Picture cards	Extra breaks	Extra demonstrations	Hand-over-hand
Frequencies	None	None	2	3	5	1

standardized protocols listed in respective assessment manuals.

In the remaining articles ( $n=13$ ), the authors stated that an accommodation to the manual was used. Of those, nine articles (16.9%) used the accommodations *as needed* for each participant. Accommodations included the following: (1) additional verbal instructions, (2) additional demonstrations, (3) pictures or other visuals, (4) breaks or

rewards, and (5) physical assistance. Four (7.5%) of the included articles used a *consistent* modified protocol across all participants, often attempting to test the impact of each set of accommodations on the performance of the participants. In these studies, accommodations included the following: (1) acclimatization, (2) picture task cards, (3) picture activity schedule, and (4) additional short verbal prompts.

## Survey results

Of those authors ( $n = 12$ ) who responded to the short, open-ended survey, five reported that extra demonstrations were used, three provided extra breaks or rewards, two used picture cards, and one used hand-over-hand assistance (Table 2). One respondent reported that the official protocol was used; however, this respondent also stated that the protocol was not provided universally. This respondent did not report how the protocols differed, only that it was not modified. There were no reports of using other visual aids, such as spots on the ground or extra targets, or videos.

Of the 12 respondents, 50% ( $n = 6$ ) stated that the protocol was used universally and 50% ( $n = 6$ ) stated that it was not. This contradicts the findings of the reported methods in each of the reviewed articles. However, a misinterpretation in the wording of the question, “Was this protocol given to every participant universally?” could have occurred, as participants in the aforementioned question reported the assessment protocol. For example, it was reported that participants would receive an extra trial or demonstration within the protocol. Some children may have needed this, some not, yet the protocol was provided universally.

Answers varied when respondents were asked to reflect on the way the assessment protocol affected the outcome of the study, though two commonalities emerged. Respondents suggest that accommodations to standardized assessments: (1) increased reliability of findings and (2) increased enjoyment. On the reliability of the findings, one respondent stated, “Adjusting the protocol helped me to feel more confident that I was actually assessing their motor skills and not just assessing their comprehension or behavior.” Another, echoing that sentiment, stated, “It helped to ensure that I was actually assessing motor skills and not just behavior or understanding” and “adjustments increased the accuracy of our outcomes.” Not only did the possibility for increased reliability improve because of the accommodations, one respondent said, “We thought it made the data more reliable as the children were able to enjoy the session or sessions.” As assessments can be a trying and overstimulating experience for children on the autism spectrum, accommodations allow flexibility for both the researcher and child that can reduce potential friction allowing assessments to be completed. Accommodations of the assessment created a situation of comfort and trust that one respondent stated, “as critical.”

## Discussion

The purpose of this study was to explore the commonly used accommodations during past standardized motor skill assessments among youth on the autism spectrum. Based on the reported procedures in the reviewed articles, results found that accommodations were provided to participants

on the autism spectrum in only 25% of the cases. Many of the reviewed studies did not report enough information on the assessment procedures used, so it was difficult to determine if any systematic accommodations were provided. More interestingly, there were four studies (Bremer & Lloyd, 2016; Breslin & Rudisill, 2011, 2013; Ketcheson, Hauck, & Ulrich, 2017) in which strict adherence to the testing protocols were followed. In most cases, it is important for comparability and replicability that adherence to the testing protocols are precisely followed. However, one of the core characteristics of those on the autism spectrum is differences in communication. Strict adherence to the testing protocols—either to the manual or a modified protocol—may not utilize the communicative affinities of the child and only focus on those that they do not, thus, disallowing the child to show their true motor abilities. It may also be possible that not *all* children on the autism spectrum need accommodations. The included studies demonstrate it is a common practice to provide alternative protocols during the assessment process. Yet, of the reviewed studies that included enough information to identify the testing protocol, there is a great variety across the included studies, potentially, limiting the comparability between, and even within, studies. Furthermore, lack of reporting information limits the replicability of each of the study’s findings. Finally, without common guidelines for providing accommodations to children on the autism spectrum, some children may, ultimately, receive accommodations that do not need them and vice versa. With a limited understanding of the processes used, it is difficult to determine with utmost certainty the landscape of development in this area for children on the autism spectrum.

## Aggregating different procedures

The literature on ASD is replete with suggestions for how to present information to accommodate differences with communication, particularly when the information is presented verbally (e.g. Bernard-Opitz & Häußler, 2011; Bondy & Frost, 2011; Cohen & Sloan, 2008). Many items on motor skill assessments are presented in a combination of verbal cues and demonstrations, while in some cases items within tests are only presented verbally. For example, there are select items in the BOT-2 and MABC where only a verbal description is presented and then the child is expected to complete the task. In this assessment, the child may appear to have a motor deficit when in fact the child simply did not understand the instructions as they were provided. Similarly, both the BOT and the MABC have items that require “speed” (e.g. sorting cards as quickly as possible or string beads as quickly as possible). The concept of “as quickly as possible” coupled with confusion as to the expectation which limit a participant’s scores on these items. Again, are the results measuring receptive communication skills or measuring true motor ability?

These same sentiments were voiced by several researchers who completed the surveys in this study regarding the need for accommodations. Allowing accommodations to account for different communication modes, particular receptive verbal skills, certainly seems warranted when administering motor assessments to children on the autism spectrum (Block & Taliaferro, 2014).

Furthermore, despite the respondent's beliefs about increased reliability, major issues arise when published studies begin to be analyzed in aggregate. The idea of accommodation provides a potentially ideal situation for researchers and participants. However, this may result in unintended bias within the outcomes. Accommodations that are provided, but do not meet the needs of the individuals in that particular study, will do little to address this issue. In addition, the comparability of the assessment is lost when comparing a study that uses different protocols during the assessment process. Despite evidence that motor development occurs independently of intellectual ability (Lloyd et al., 2013), an element of cognitive function should be considered in the parlance of the assessment process. As many gross motor assessments necessitate a basic level of executive function to complete, this process must be considered in the conduct and interpretation of these measures. However, according to the respondents, simple items such as building in an acclimation period or practice test to ensure that the assessment is not of a novel skill can be beneficial. This could include having procedures in the clinical setting that are "friendly" to children on the autism spectrum, though no evidence was available to support this claim in the present review. However, it was clear through the reported responses that all respondents recognized this issue during the assessments of children on the autism spectrum and the potential it may have on the assessment itself.

### *Are visuals enough?*

When accommodations were provided, they included additional verbal instructions, additional demonstrations, pictures or other visuals, breaks or rewards, and physical assistance. As noted earlier, extra verbal directions might provide limited benefit given the differing modes of communication associated on the autism spectrum (Breslin & Liu, 2015). Extra verbal cues for a certain child on the autism spectrum may be akin to speaking louder to child who is deaf, while well intentioned, such accommodations may not be effective. However, some of these studies may have included participants with fewer support needs or greater communication skills whom may have benefited from repeated verbal cuing. Unfortunately, many of the reviewed studies did not specify participants' communication skills, so it is difficult to judge whether additional verbal directions were appropriate.

Certainly, the addition of visual supports is keeping with the literature on what is recommended to be effective for

children on the autism spectrum (Breslin & Liu, 2015; Cohen & Sloan, 2008). Visual supports such as visuals to show where to stand, visuals to show the movement, and visuals to show the schedule for session can all be useful in helping participants on the autism spectrum understand what to do, stay on task, and limit anxiety (Block, Klavina, & Davis, 2016; Fittipaldi-Wert & Mowling, 2009). Recently, visual accommodations, when provided systematically, have been shown to be reliable compared to the manual alone and can significantly improve performance (Allen, Bredero, Van Damme, Ulrich, & Simons, 2017). It was unclear, however, if the reported visual supports included video modeling. Recent research suggests that video modeling can be an effective means of helping children on the autism spectrum understand the nuances of a task (Bellini & Akullian, 2007; Hong et al., 2015; Spriggs, Gast, & Knight, 2016), and video modeling certainly could be effective when trying to explain how to perform specific motor tasks on motor assessments. However, items on the BOT and MABC in particular have been designed to be unique and may not be clear through verbal direction alone.

### *Are assessments capturing motor ability or receptive language?*

Regarding types of motor tests used in the reviewed studies, tests of motor abilities (e.g. MABC and BOT) were used in approximately 40% of the studies, tests of fundamental motor patterns (e.g. TGMD) were used in approximately 25% of the studies, and developmental motor tests (e.g. PDMS) were used in approximately 13% of the studies. Some of the issues associated with motor ability tests and children on the autism spectrum were noted earlier, including not knowing exactly what is expected and moving cautiously/slowly on timed items. Do children on the autism spectrum understand the cue, "go as fast as you can?" Are children on the autism spectrum motivated to complete a task as quickly as possible or simply complete the task at a more leisurely pace? Several researchers (Berkeley et al., 2001; Staples & Reid, 2010) have commented the selective focus of some participants during assessing, with participants focusing on the *what* (e.g. going from point A to point B) rather than the *how* (e.g. skipping, jumping, or running). Again, the comparability of motor assessments using timed items certainly should be questioned when given to children on the autism spectrum.

Tests that examine qualitative components of fundamental motor patterns such as the TGMD also present replicability questions when used with children on the autism spectrum. For example, many items on the TGMD require a forceful movement to allow all the components of the pattern to emerge. Throwing, striking, and kicking are examples of object control skills that require forceful effort to generate weight shift and follow through. Jumping, hopping, and running are examples of locomotor skills that



require forceful effort to demonstrate arm action and flight phases. If a child does not perform any of these skills forcefully, then these components will not be demonstrated. Do children on the autism spectrum with low or no verbal communication understand, “try your hardest,” “kick it as far as you can,” “jump really far,” or “run as fast as you can?” Even if a child on the autism spectrum understands the concept of try your hardest, lack of motivation/interest in the task may still prevent the child from displaying the most skillful pattern (Block & Taliaferro, 2014).

In addition, children on the autism spectrum might not have been asked to perform a skill forcefully or following a particular qualitative pattern due to a focus of many interventions on the hallmark characteristics of ASD (Staples et al., 2012) and a limited number of motor interventions (Colombo-Dougovito & Block, 2019). For example, children on the autism spectrum being taught using reinforcement-based programming (e.g. applied behavior analysis) are reinforced for completing a task. Yet, reinforcement is rarely associated with the quality of the movement required in fundamental motor patterns and little to no evidence exists to support such a program. Alternatively, programs using visual supports focus on completing tasks but not necessarily the quality or speed of completing tasks. As a result, it can be difficult to help children on the autism spectrum understand the concept of moving forcefully or quickly in order to display qualitatively mature movement patterns. The child on the autism spectrum who does not understand the concept of “try your best” through verbal or visual cues or is not motivated to put in the necessary effort into the movement by the assessor will not score well on tests of fundamental motor patterns and, therefore, may appear to be delayed motorically.

### *Fairness or standardization*

As noted earlier, accommodations such as extra visuals including videos that highlight specific components (Obrusnikova & Rattigan, 2016), protracted demonstrations focusing the child’s attention on specific components (e.g. arm action in locomotor patterns), and extra practice to make sure the child truly understands the task at hand is warranted. The goal of motor assessment should be to determine if a child on the autism spectrum has a true and significant motor deficit that needs remediation, and providing accommodations certainly seems warranted if this is the ultimate goal.

Although the appropriate delivery of accommodations to ensure sustained comparability and replicability across assessments is necessary, it seems unjust to provide an assessment without accommodations for the needs of the individual for the sake of standardization alone. Following the examiner protocol as provided is necessary in comparison to normative sample; yet, if without accommodations an individual score poorly, what does that assessment infer?

What programmatic changes are to be made? This is a paradox for which the authors cannot provide a definitive response. Without accommodation, assessment scores are likely capturing only a limited picture of the motor capabilities of youth on the autism spectrum, especially those with differing modes of communication. Yet, with accommodation, cross-study or within-study comparisons become difficult and interpretation becomes limited as to the generalized findings. It is clear, however, that there lacks a consensus among the research community as to the solution. Many found benefit in providing accommodation, yet only a few identified the potential issues with the current usage. Future research is needed to better understand the who, how, when, and what of accommodations for motor assessment, without which even the best intentioned and designed interventions will provide hollow evidence of growth.

### **Limitations**

Three limitations warrant caution in interpreting the findings of this study: (1) potential missed accommodations due to the limits of the included search terms and databases; (2) a misrepresentation of the frequency of accommodations due to limited description of assessment procedures in reviewed articles; and (3) limited triangulation of reported procedures and first author response. Regarding the first limitation, the authors attempted to include all potential identifiers for physical fitness and motor skill assessment during each database search; however, results included limited information of fitness assessments. These types of accommodations would be particularly important for secondary physical educators and personal trainers, when fitness assessment is more prominent than at younger ages. Future searches should further investigate the procedures demonstrated in the literature. Regarding the second limitation, it is concerning that only approximately 43% of the included articles had enough information about the assessment procedures to determine if accommodations were included or the manual was followed explicitly. Finally, the limited response from each first author did not provide a full account of each of the included studies. It is possible that many of the procedures used by authors of the included studies contained a variety of accommodations for motor skill and fitness assessments. Yet, due to limited information provided in text and lack of response from every author, it is difficult to make certain claims about the assessment processes for children on the autism spectrum. Future studies should make a greater attempt to provide clear information about assessment procedures; without adequate procedural information, replication studies and confirmatory results will be difficult to attain. This, however, may not be a critique of the authors, so much as, the journal and review process that places emphasis on the findings and interpretation over procedure with limited word counts and page limits.

## Conclusion

Recent research (Fournier et al., 2010; Liu et al., 2014; Lloyd et al., 2013; Staples & Reid, 2010) has shown the differences in motor skill development of children on the autism spectrum compared to their peers; however, as this study shows, the procedures on which those conclusions are made are not entirely consistent. Due to the core characteristics of autism (APA, 2013), the assessment process may present unique difficulties for children and adolescents on the autism spectrum to navigate. According to the recent literature (Breslin & Rudisill, 2011, 2013), visuals, such as picture cards or visual schedule, may allow for a greater transfer of information during the assessment process, while also potentially improving performance (Allen et al., 2017). It is encouraging that research has increasingly provided accommodations during the assessment process for children on the autism spectrum. However, differences between study protocols and minimally worded method sections limit the comparability of the aggregate findings and chance for replications, respectively. Future research should continue the work of Breslin and Rudisill (2011, 2013) and Allen et al. (2017) by investigating the effects of visuals on the assessment process. Additional accommodations, such as verbal cues, breaks, acclimation, and, even, the environment itself, need further research to understand the variables influencing the assessment process for children on the autism spectrum. Moreover, research should emphasize how best to effectively provide information to children on the autism spectrum so that assessments measure not only their motor ability but also their understanding or communication ability.

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# The Effect of Task Modifications on the Fundamental Motor Skills of Boys on the Autism Spectrum: A Pilot Study

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## Abstract

A growing body of research has shown children on the autism spectrum are behind their peers developmentally in regard to their gross motor skill development. Given the increased risk for obesity and other health related co-occurring conditions associated with autism spectrum disorder, building foundational gross motor skills is vitally important so that individuals grow into physically active adults. However, the research on motor skill interventions for children on the autism spectrum is limited. Therefore, a multi-element multiple baseline across behaviors single subject design was employed to test the effectiveness of a motor intervention based on task modifications developed based on Dynamic Systems Theory. Using a purposive sample of two boys, aged 7 and 8 years, on the autism spectrum, task modifications were evaluated to understand the impact on the child's motor performance and their performance's persistence across two skills (i.e., horizontal jump and two-hand strike;  $P1_{\text{jump-pre}} = 3$ ;  $P1_{\text{strike-pre}} = 4$ ;  $P2_{\text{jump-pre}} = 2$ ;  $P2_{\text{strike-pre}} = 2$ ). As a result of the task modifications, both boys scores increased according to developed skill criterion and the raw scores of the Test of Gross Motor Development, 3rd Edition (Ulrich 2018;  $P1_{\text{jump-post}} = 6$ ;  $P1_{\text{strike-post}} = 6$ ;  $P2_{\text{jump-post}} = 6$ ;  $P2_{\text{strike-post}} = 8$ ). Once the modifications were faded, both boy's two-hand strike performance persisted; however, one boy's horizontal jump performance returned to baseline levels. Yet, for this still there remained a high level of non-overlap (90.5%). This study demonstrates the potential impact that an intervention designed around task modifications can have; however, it also shows that interventions may need to be designed at an individual level and contain the flexibility to adjust to the needs of the child.

**Keywords** Gross motor development · Autism spectrum disorder · Dynamic systems theory · Constraint-based approach · Fundamental motor skills

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In recent years there has been a growing body of research that indicates many, if not the vast majority, of children on the autism spectrum display differences in their gross motor skill development (Fournier et al. 2010; Liu et al. 2014; Staples and Reid 2010). These motor skill delays start at a very early age (Ketcheson et al. 2018; Lloyd et al. 2013) and, when compared to typically developing peers, increase throughout adolescence (Liu et al. 2014). Differences in motor skill development begin so early for children on the autism spectrum that delays are often present before core behaviors of autism spectrum disorder (ASD), such as social communication deficits or repetitive behaviors, are noticeable or diagnosable; leading some researchers to suggest that motor skills be included as a part of the diagnostic criteria (Teitelbaum et al. 1998) or at minimum a part of screening criteria (Liu 2012).

Further, demonstrated delays in gross motor development are in combination with higher rates of physical inactivity (MacDonald et al. 2014; Stanish et al. 2017) despite evidence showing the numerous behavioral benefits of physical activity (PA) for children on the autism spectrum (Bremer et al. 2016; Lang et al. 2010; Liu et al. 2015), potential for increased social opportunities (MacDonald et al. 2011; Healy et al. 2018b), and potential increase in quality of life (Stacey et al. 2018). Moreover, despite demonstrated enjoyment (Stanish et al. 2015) and desire to participate (Blagrove 2017), children on the autism spectrum and their families face numerous barriers to physical activity (Must et al. 2015; Obrusnikova and Miccinello 2012).

Arguably, fundamental motor skills are vitally important to the participation in physical activity (Haubenstricker and Seefeldt 1986). Stodden et al. (2008, 2014) argue that there is a synergetic relationship between motor skills ability, or motor competence, and PA; i.e. that one begets the other. In young children, physical activity allows for the development of motor skills and competence (Stodden et al. 2008). As children age, fundamental motor skills become increasingly important for PA and more complex movements. This theoretical understanding of the interplay of motor skills and PA suggests that building motor skills is vitally important to overall development. This is further reinforced by the demonstrated link between motor skills and language development (Bedford et al. 2016), social skills (MacDonald et al. 2013a), and adaptive behavior (MacDonald et al. 2013b) in populations on the autism spectrum. Yet, motor skills are often an over looked area in this population (Staples et al. 2012) and given higher rates of obesity present in adolescents on the autism spectrum (Healy et al. 2018a), ensuring an early successful foundation for later participation in physical activity is vitally important. Without the appropriate development of fundamental motor skills, participation in physical activities will be difficult later in life (Healy et al., 2018b; Stodden et al. 2008).

The recent, limited research on motor skill interventions for individuals on the autism spectrum suggest that, seemingly, any motor skill intervention may provide benefit for children on the autism spectrum. In two past studies (Bremer and Lloyd 2016; Bremer et al. 2014), the presented intervention method was similar to physical education teaching (e.g. once or twice per week for 45 min). By focusing on one skill per week, children on the autism spectrum were able to increase their motor skill performance from baseline; though due to limited sample size, statistical data was not reported. Ketcheson et al. (2016) demonstrated significant improvement in fundamental motor skills using an intervention designed with the principles of classroom pivotal response treatment (CPRT). CPRT, stemming from behavioral theory, is based on

strategies to elicit behaviors (antecedents) and responses to the produced behaviors (consequences). However, the intervention was administered 20 h per week for 8 weeks and requires a high fidelity of implementation from the instructor; this high of a frequency and large dosage may not be possible for all providers or situations demonstrating a necessity for alternative options that provide for similar increases without the necessary time commitments. Further, an adapted physical educator in Bremer and Lloyd's study (2016) stated: "[there was] a lot of anxiety, so things were done very quickly with a lot of physical prompting to get them to do what I wanted them to do. Or if they threw the ball, it was like an aimless [throw] it wasn't directed." (p. 79). Highlighting the need for an intervention method that does not focus solely on verbal or physical prompts.

Dynamic systems theory (DST; Newell 1986; Newell and Jordan 2007) may provide the necessary framework for such an intervention. DST, according to Newell, suggests that behavior is the result of individual (e.g., a person's strength or coordination), task (e.g., the step or rules necessary for an activity or movement), and environmental (e.g., the playing surface) constraints that self-organize within the individual. Constraints in this theory are not negative, but neutral; having potential for either negative or positive effects. For example, a person walking on a carpeted surface will walk with a stable walking pattern; yet, if that person were to step on a patch of ice (i.e., a change in the environmental constraints, but the individual and task constraints remain the same), their pattern would shift to ensure they stayed upright and would walk with a new walking pattern.

According to a recent review (Colombo-Dougovito 2017), studies that have used DST as a foundation for understanding movement have provided strong evidence for the theory, yet little empirical evidence exists testing if the modifications of the constraints could improve movement; most studies focused on solely on the effect—good or bad—of modifying a specific constraint on movement. Yet, as the theory is presented, any change in constraints—intentional or not—will cause a change in the movement pattern. In only one example has a constraint been modified with the intention of improving movement. Vernadakis et al. (2015) manipulated task constraints in an intervention comparing direct instruction to exergaming. In this example, both intervention methods manipulated motor skill tasks to influence more mature movement patterns and showed an increase from pre- to post-assessment. Further, DST may prove a more optimal mode of instruction because, unlike other motor development theories, the characteristics of a child's ASD does not act as a barrier to overcome or disadvantage, but acts as another constraint that can either limit or influence certain behaviors, like movement, in different situations. However, as only one study was found that used DST as an intervention method, further inquiry must be made as to how DST might be used to influence the development of fundamental motor skills.

## Purpose

The purpose of this study was to determine if purposeful changes to task constraints, heretofore referred to as *task modifications*, could improve the development of motor skills in children on the autism spectrum. Additionally, can improvements persist in the absence of the task modifications. Using a multi-element multiple

baseline across behaviors single-subject research design, this study was guided by three main research questions:

1. How do task modifications influence the motor performance of children with ASD?
2. Do changes in motor performance persist in the absence of task modification?
3. How much time is required to effectively fade a task modification for a child with ASD?

The authors hypothesized that changes in performance would occur with the addition of the task modification and persist in its absence.

## Methods

Prior to collecting data, approval for this study was obtained from the Institutional Review Board (IRB) at a mid-Atlantic research university. The study (protocol #2016–0034, approved 02/25/2016) was deemed exempt from review because it posed minimal risk to participants. As this study focuses on a vulnerable population, a consent/assent procedure was employed. Parents and legal guardians of children known to have a diagnosis of ASD were contacted with information regarding the study and asked to provide consent. Children for whom consent had been given were asked for assent on an individual level and given information both verbally and visually. Assent was assumed when the child either verbally or nonverbally signaled agreement or engaged with the instructor, materials or both. The child's assent was sought on an ongoing basis throughout the study during each session. If a child demonstrated increased frustration or behavioral issues, he/she was first provided with a break from activity. If behaviors continued after a break, the session was ended for that day. If behaviors persisted across two consecutive days, the child was deemed to be dissenting participation and was withdrawn from the study. All consented children that were included in the intervention phases completed each session without increased duress.

## Participants

A total of 19 children receiving adapted physical education (APE) services at a central Virginia school for autism were recruited. Information packets and consent forms were sent home with the child. From a total of 6 consented participants, a purposive sample of two participants were selected for this study. Selected participants needed to have a formal diagnosis of autism or ASD. This was verified through parent report on the Social Communication Questionnaire (SCQ; Rutter et al. 2003). Additionally, participants needed to demonstrate one skill component of one manipulative and one locomotor skill, as measured by the Test of Gross Motor Development, 3rd Edition (TGMD-3; Ulrich 2018). By requiring that participants have one component, research can assure that, at minimum, participants are developmentally ready for that skill. If a participant demonstrated no components of a skill, it could be assumed that they are not developmentally ready for that skill and may not benefit from an intervention no matter how impactful; conversely, if a participant had more components of a skill, it would be



difficult to determine if growth was due to the intervention or simple maturation. Lastly, participants had to demonstrate the ability to receive prompts verbally or visually.

*Participant 1* was an 8-year-old boy with a diagnosis of autism from his developmental pediatrician. His SCQ score was 31, above the cut-off of 15. He had a body mass index (BMI) of 20.1. He had no reported co-morbidities. He was non-verbal, though very responsive to verbal commands and could communicate with an iPad. His overall initial raw score on the TGMD-3 was 22/100. He scored a 12/46 on the locomotor subtest and 10/54 on the object control subtest.

*Participant 2* was a 7 year-old-boy with a diagnosis of autism from his developmental pediatrician. His SCQ score was 19, above the cut-off of 15. He had a BMI of 15.3. He had additional diagnoses of microcephaly, epilepsy, and ADHD. He was non-verbal, but responded to verbal commands, and communicated using an iPad. His overall initial raw score on the TGMD-3 was 27/100. He scored a 8/46 on the locomotor subtest and 19/54 on the object control subtest.

## Setting

The intervention was provided one-on-one by each participant's APE instructor in a multipurpose room at the participant's home institution. The primary investigator (PI) was present, as was the participant's "teacher's aide (TA)." Measures were taken to minimize overall distraction in the environment; however, not all distractions were able to be accounted for, as the intervention was provided in the multipurpose room of the participant's school. Distraction events were documented within the data and analyzed to determine whether any effect on performance was potentially due to a less than ideal environment. Overall, the intervention did not appear to be adversely affected by the distractions, as the children received APE services in this environment regularly and was used to the occasional distraction. Sessions were video recorded for later assessment and reassessment. The majority of sessions were done with only the three adults and child participant in the room. This study was completed twice per week over 11 weeks for a total of 21 individual sessions.

**Instructor Training** Each of the child's APE teachers was trained in how to administer prompts and prompting procedures. Instructions were given over two 1-h training modules. After each session of administering the intervention, the APE teacher was asked to self-report on their performance for that session using a 5-pt. Likert scale (5 being highest/most agreement). Additionally, the primary investigator attended every session for both children to observe the intervention; three of these sessions were randomly chosen by the primary investigator to evaluate each instructor's adherence to prompting procedures based on a predesigned checklist. Overall, the instructors self-reported strong adherence to study protocol ( $M = 4.33$ ,  $SD = .65$ ), which was confirmed by the primary investigator's observation.

## Procedure

After an initial assessment using the TGMD-3, participants began the baseline phase for the intervention on the identified skills of horizontal jump and two-hand horizontal

swing. The horizontal jump, is also referred to as the standing long jump; this skill consists of an individual starting on two evenly spaced feet, swinging arms backward, then forwards propelling the individual forward, leaving and landing on two feet. The two-hand strike is commonly used in baseball and tennis; this skill consists of an individual standing parallel to a stationary ball with two hand on a striking implement (e.g., a tennis racket or baseball bat), stepping toward the intended target, swinging and hitting the ball in the direction of the step. For a great breakdown of the skill criteria for each skill see Table 1. The study used a multi-element multiple baseline across behaviors single-subject research design and the intervention was completed in 5 phases. A multiple baseline design allows changes in performance to be identified as having resulted from the intervention, as opposed to maturation or simple practice, since some participants or tasks receive the intervention and others do not (Kazdin 2011). Since the intervention involves instruction, a reversal design was deemed to be inappropriate, as the subsequent A phase would be inherently different from the previous A phase at baseline. To determine the necessary time required to fade the prompt, an A-B-B'-B''-C design was used, where A is baseline, B is the intervention, B' and B'' are the intervention with faded prompting procedures, and C is performance without prompting.

The first phase of the intervention was the baseline (denoted A). During this phase, participants were given a verbal and visual prompt to perform 20 trials of each of the chosen skills. The skills were assessed based on a set of criteria (see Table 1) developed from the combined criteria of the TGMD-3 and the *Everyone Can!* skill assessment items (Kelly et al. 2010). Both the TGMD-3 and *Everyone Can!* were developed from the *I Can—Achievement-Based Curriculum (ABC)* project (Kelly and Wessel 1991), which provided regular and special education teachers and physical educators information on how to individualize instruction for students with disabilities, including performance objectives for areas of motor development, such as aquatics, locomotor

**Table 1** Skill criteria for horizontal jump and two-hand strike

Horizontal Jump	Two-hand Strike
1 Stand with knees flexed with forward body lean**	1 Grip bat with hands together with preferred hand above non-preferred**
2 Arms extended behind body^	2 Stand sideways with non-preferred shoulder toward target**
3 Arms extend forcefully forward and reach above the head*	3 Hands start at shoulder level^
4 Two-feet takeoff, leaving the ground together***	4 Swing bat forward in horizontal plane at waist level**
5 Both feet contact ground ahead of body mass at landing**	5 Trunk rotation and derotation during swing*
6 Both arms are forced downward during landing*	6 Step toward target with non-preferred foot*
	7 Strikes the ball sending it straight ahead*
	8 Follow through beyond contact with the ball**

\* = Test of Gross Motor Development, 3rd Edition (TGMD-3; Ulrich 2018); \*\* = *Everyone Can!* (EC!; Kelly et al. 2010); \*\*\* = Combination of TGMD-3 & EC!; ^ = Additional/unique criteria

skills, body awareness, physical fitness, etc. The TGMD and *Everyone Can!* skill breakdowns and competencies came directly from the initial work of *I Can* (Kelly and Wessel 1991). In total, each new set of skill criteria has 5 to 8 criteria points, which will be referred to as “skill criteria” or “SC” hereafter. The focal skills for this study, the horizontal jump and two-hand strike, had 6 SC and 8 SC respectively.

These SC were rated on a 5-point scale—0=*not present*; 1=*partly emergent*; 2=*emergent*; 3=*nearly present*; and 4=*present*—for an overall scale of 24 points (6 SC  $\times$  4) for locomotor skills and 32 points (8 SC  $\times$  4) for ball control skills to detect changes in performance. The two extreme scores are self-evident; either the participant cannot execute the skill component (0, *not present*) or executes the component successfully (4, *present*). To earn a score of *partly emergent* (1), the participant executes the SC primitively. For example, when performing the third SC of the horizontal jump (i.e., “arms extend forcefully forward and reach above the head”), if a participant has his/her arms swing forward at different heights or not in unison, he/she would earn a 1. To earn a score of *emergent* (2), the participant’s actions must begin to resemble a pattern that resembles the mature form but is either rigid or errant and lacks coordination. Continuing with the jumping example, participants would earn a 2 if his/her swung forward in unison but stop prior to chest height. To earn a score of *nearly present* (3), the participant’s movements must be close to the mature pattern but may still look rigid or jerky. For example, continuing with the SC from above, a participant’s arms may swing in unison, but stop at shoulder height, not reaching above the head. During the baseline, a child’s performance determined which criteria point was the focus of the intervention. For example, if the participant could perform the first SC, the intervention focused on development of the second criterion point.

The SC and attributable task modifications, as well as levels of performance, were reviewed, analyzed, and revised through two rounds of feedback from experts in the fields of child development, motor development, and/or autism. Experts were provided both the new skill breakdown and accompanying task modification. Each SC and task modification were rated on a 5-point Likert type scale; responses were averaged and scores above 4 were accepted. Each SC and task modification received a rating above 4. The task modification (i.e., a purposeful change in a task constraint) was chosen based on its ability to influence an individual into the appropriate movement behavior for each SC.

Once the participant demonstrated a trend of performance (i.e., a minimum of three consecutive sessions at a similar performance level; Kazdin 2011), the intervention phase began; this is denoted as B. Since this is a multi-element multiple baseline design over two skills (i.e., behaviors), each participant started the intervention for the horizontal jump, while continuing at baseline for the two-hand strike. By delaying the intervention for the second skill, the ability to detect changes that can be attributed to the active intervention was enhanced. During the intervention phase, participants received a prompt using predetermined task modifications (see Table 2). During the intervention phase (B), instructors gave the task modification for the identified skill criteria on a one-to-one basis. As before, once a trend in performance was demonstrated by the participant, he or she was moved into phases B' and B'', respectively.

In phases B' and B'', the participant received a modified version of the same prompt as in the B phase. For example, with the two-hand strike, one modification was to apply tape to the handle in order to signal where each hand was placed; in the B phase, the



**Table 2** Modifications for horizontal jump and two-hand strike

Horizontal Jump	Two-hand Strike
1 Chair or low bench placed behind; prompt to sit	1 Two dots on bat handle where hands go (red preferred, green non-preferred)
2 Place in front of wall; prompt to touch wall with hands	2 Two spots on ground positioned perpendicular to the target (red preferred, green non-preferred)
3 Instructor holds noodle for child to touch with hands	3 Position by wall; tap [spot] on wall behind preferred shoulder
4 Two spots to start on; two spots to land on.	4 Set up limbo bar slightly above waist. Prompt to swing under
5 Low hurdle or rolled towel to jump over.	5 Place pin near rear foot for the individual to knock over with the outside of his/her heel.
6 Two cones to touch on either side of landing zone for child to touch with hands after landing.	6 Additional spot (blue) on floor, in front of green spot
	7 Target on wall
	8 Position by wall; tap [spot] on wall behind non-preferred shoulder

Note: Each modification is matched to the skill criteria of the same number from Table 1

tape was very evident and was made smaller each phase so that in B" it was only two dots. This fading procedure was continued until a trend in performance was demonstrated. Finally, in phase C, the participant was asked to perform the skill, as during baseline, without the task modification. For the horizontal jump, participants were prompted to sit on a chair to influence adherence to the first criteria of jumping (i.e., "stand with knees flexed with forward body lean"). During the B' phase, this was changed to a low bench, then a small hurdle (e.g., two cones with a pool noodle spanning the distance from the top of each cone at slightly above knee height for each child) in the B" phase. The small hurdle would not allow for the child to rest any weight and only acted as a guide for how low to go.

## Data Analysis

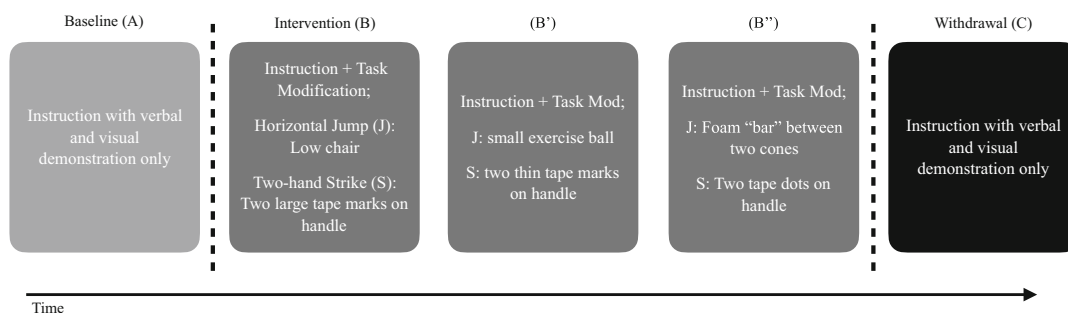
Data were graphed and analyzed visually (Lane and Gast 2014) to understand the effect of task modifications on the motor performance of participants. The PI assessed each child and scored the performances at each time point. Using a random number generator, intrarater reliability (IRR) was calculated on 3 random cases per child to insure reliability of coding performance. The primary investigator ensured that at least one case was chosen from each phase (i.e., A, B, or C) and from each measured behavior (i.e., one selected from one skill and one from another). These cases were re-coded two weeks after the initial coding. IRR was calculated at 92.8%, which was above the criterion goal of 80%. Further, the intervention for each participant was documented (Fig. 2), containing a minimum of three data points and four phase changes for each skill (Kratochwill et al. 2013). Non-overlap lines and effect sizes were calculated to further understand the task modifications impact on the motor performance of the participants (Parker et al. 2011).

## Results

Figure 2 demonstrates the change in skill performance across the intervention for both participants. The graphs demonstrate an increase in the gross motor scores of each sub-test skill at the introduction of the task modification (B Phase). Across each trial during the baseline phase for the locomotor skill of jumping, participant 1 averaged 7.3 ( $SD = .74$ ) and participant 2 averaged 6.6 ( $SD = 1.0$ ). After the addition of the task modification, average scores were 14.7 ( $SD = 1.54$ ) and 16.9 ( $SD = 2.0$ ) for participant 1 and 2, respectively. These scores persisted as the task modification was faded, however, improvements only persisted in one participant after the task modification was removed. Specifically, participant 1's score stayed consistent ( $M = 18.2$ ,  $SD = .76$ ), while participant 2's score reverted to a score similar to baseline levels ( $M = 7.0$ ,  $SD = 3.2$ ).

This pattern of change was seen similarly during the two-hand strike. During the baseline phase, average scores for two-hand strike was 6.4 ( $SD = .75$ ) and 8.6 ( $SD = .7$ ), respectively. These scores increased to 20.7 ( $SD = 1.4$ ) and 21.7 ( $SD = 2.2$ ), respectively, after the addition of the task modification. Scores persisted in each subsequent phase when the prompt was faded. However, unlike with the horizontal jump performance, both participant's two-hand strike performance persisted in the absence of the task modification during the C phase; 18.2 ( $SD = .7$ ) and 21.2 ( $SD = 1.1$ ), respectively. When considering the non-overlap lines, all but one graph in Fig. 1 had no overlap; in the one example of horizontal jump in Participant 2, there was still 90.5% non-overlap.

Lastly, the calculated overall effect size, across both measured skills, demonstrates a large effect (Cohen's  $d = 1.945$ ) as a result of the addition of the task modification. This statistic should be used with caution (Baguley 2009; Cohen 1977) due to the limited numbers of participants; however, in considering that the effect size demonstrates that the combine means of both skills in phase C were nearly 2 standard deviations above the mean of baseline data, there is strong evidence that task modifications may provide a strong foundation for quickly building motor skills in children with ASD that have the potential to be sustained in the absence of the task modification. Individual sub-skill effect sizes were calculated for both the horizontal jump ( $d = 3.96$ ) and two-hand strike ( $d = 15.01$ ) performances were calculated; though due to the limited number of participants and large effect sizes for the individual skills, the practical implications of these values is limited. Yet, given the starting points of both participants, overall across both skills participants demonstrated a 118% increase in SC. Specifically, participants demonstrated an 80% increase in horizontal jump SC and a 183% increase in two-hand strike SC over the course of the study.

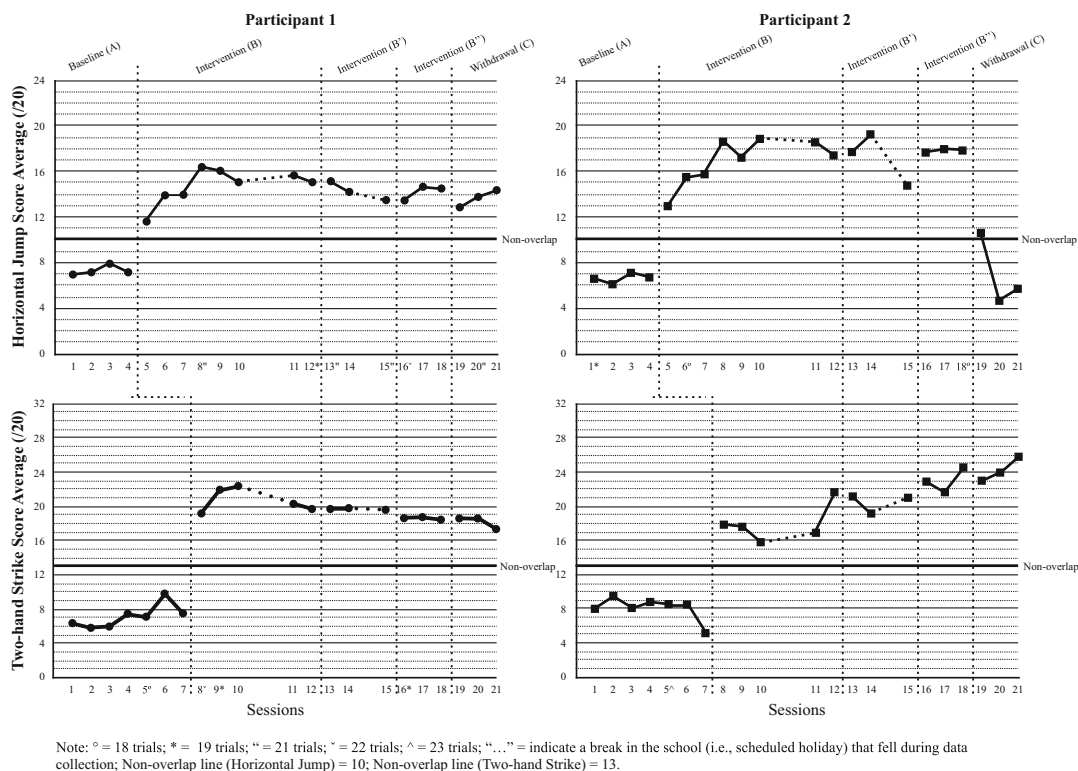


**Fig. 1** Visual breakdown of prompting procedure

## Discussion

The focus of this study was to understanding how task modifications (i.e. task constraints) could be used purposefully to improve the motor performance of children on the autism spectrum. Overall, results demonstrated positive support for task modifications to be used (1) as an intervention tool to influence motor performance and (2) as a model for intervention with children on the autism spectrum. As shown in Fig. 2 (above), the addition of a task modification marked a noticeable improvement in the motor performance of each participant within 1 training session, as Newell's DST (Newell 1986) would suggest. Furthermore, the continued trend seen in the two-hand strike performance, while the horizontal jump skill received the task modification shows that the improvement was not due to exposure or maturation, but by the task modification specifically. Furthermore, the persistence of improved motor performance demonstrates the strong influence that task modifications can have on motor performance in children on the autism spectrum. For example, with the two-hand strike, both participants demonstrated higher levels of motor performance after the removal of the task modifications. Lastly, the improvement in motor performance demonstrates the potential of task modifications to perturb a stable motor pattern into a more mature pattern within populations on the autism spectrum.

Similar to previous research (Liu et al. 2014; Staples and Reid 2010), both participants showed very delayed motor skills, demonstrating fewer than 30% of the possible skill criterion on the TGMD-3—not the expectation for a typically developing 7 or 8-year-old child. This delay was further seen in the SC of the two focus skills, horizontal jump and two-hand strike, for this study. Despite both visual and verbal directions, both



**Fig. 2** Graphs of Motor Skill Performance by Participant. Note: ° = 18 trials; \* = 19 trials; ° = 21 trials; ° = 22 trials; ^ = 23 trials; “...” = indicate a break in the school (i.e., scheduled holiday) that fell during data collection; Non-overlap line (Horizontal Jump) = 10; Non-overlap line (Two-hand Strike) = 13

participants performed only one of the criteria in the focal skills consistently during the pre-assessment. In the baseline phases, participants often focused on only one or two components of the skill, such as moving from A to B. This selective focus has been documented in previous research (Berkeley et al. 2001; Staples and Reid 2010) and has implications for the validity of standardized assessments in this population. Specifically, it is difficult to discern if the limited performance of motor tasks found in minimally or non-verbal children on the autism spectrum is due to a misunderstanding or limited understanding of the task, a selective focus on one aspect of the task during the demonstration, or an actual delay in motor skill ability. Yet, the addition of task modifications in this study shows the potential for its use as an intervention regardless of the origin or severity of delay. During the B phases of the intervention, both participants scores improved greatly from the baseline phase. Some improvement from baseline to the initial intervention phase was to be expected, as the task modification (if done correctly) would ensure that the participant completed an additional SC; yet, both participants nearly doubled their scores, on average, in both skills within one session of adding the task modification. Meaning that improvements were seen not only in the focus SC, but in subsequent criteria as well. These improvements persisted, and in one case continued improving, during the fading of the prompt and, in the case of the two-hand strike skill, persisted in the absence of the task modification. This is clearly demonstrated in the limited amount of overlap between baseline and intervention measurements.

The improvements were not consistent, however, in the horizontal jump for one of the two participants, demonstrating that the task modification and the length at which they are administered may need to be implemented on an individual level. As seen in Fig. 1, participant 2 demonstrates a decrease in performance in Phase C in the horizontal jump, but not in the two-hand strike. This result suggests—and is supported by DST (Newell 1986; Thelen 1995)—that for the horizontal jump the skill with the modification was not performed long enough or in a strong enough way for the new motor pattern to stabilize. While not unexpected, this suggests that task modifications may not act universally between individuals and that individualized instruction needs to be considered for any intervention using this approach. Further, the PI noticed a change in behavior within participant 2 during completion of the horizontal jump during the withdrawal (C) phase: (1) having to go barefoot, because of poor footwear (not done in previous sessions); (2) more jocular behavior (i.e. playing when performing the task) toward the PI, instructor, and teacher's aide; and (3) less focus during the demonstration. During this phase, participant 2 jumped using the practiced SC; however, he did not use the others SC, such as appropriate arm swing or landing on two feet, that were used during the intervention phases. Any one of these factors could have influenced the child's performance, demonstrating a potential bias in these findings. The jocular behavior demonstrates the potential for enjoyment during the practice of skills that can happen with task modifications, as well as the comfort level with the instructor and researcher. However, the limited focus also demonstrates the potential for monotony in practice during single-subject studies. Yet, these results—despite the lower scores for participant 2 in the horizontal jump—demonstrate that changes in motor performance can occur in a very short amount of time (< 20 trials) and how much improvement can be made out of the total amount of time (< 16 sessions).

However, what was not expected was how much of an increase occurred due to the introduction of the task modifications. The task modifications during the intervention

phases focused on improving one SC, yet influenced another SC. This suggests that while certain skill tasks may need dedicated task modifications, some skills may benefit from only one or two. This premise is seen in previous research using DST to manipulate treadmill walking patterns in infants with Down's syndrome (Ulrich et al. 1998) and further strengthens the evidence for the explanation of how motor behaviors occur provided by DST (Newell 1986; Newell and Jordan 2007). For example, in the present study, during the horizontal jump participants were asked to sit, reach back, then jump. While this focus on very beginning SC for the jump, when participants jumped they completed several later stage criteria, such as “swinging arms above the head”. Further, an intervention incorporating task modifications could continue growth by focusing on subsequent SC. Results of this study demonstrate that using appropriate task modifications can cause quick improvements that persist; future research should investigate whether subsequent modifications can be used, and if fading prompts are necessary.

Lastly, the large effect sizes ( $d = 1.945$ ) demonstrated for each skill showed how potentially powerful task modifications can be on the motor performance of individuals and provides reinforcing evidence to DST's claim that an individual's movement pattern will self-organize to a new pattern with the addition of any new constraints. Furthermore, when looking at the differences at the introduction of the task modification to each skill, the resulting increases can be attributed to the addition of the task modification and not natural factors, such as maturation. When looking at the shift from phase B to subsequent phases, the increased performance is maintained. This suggests that while fading the task modification, performance remained high as the participants started to move into a more stable, mature motor pattern. At the withdrawal phase (C), the motor skill persisted in most cases in the absence of the task modification. This further suggests that motor skills can be influenced positively in populations on the autism spectrum in a relatively short intervention (i.e., 40 trials per week per skill over less than 11 weeks); this is significantly less than that previous recommendations (i.e., greater than 18 weeks; Ketcheson et al. 2016) and may be more easily transferred to different settings with higher levels of time constraints.

## Limitations

Given the quick increase of skill performance provided by the task modifications, this technique may provide a reasonable method for improving motor skills in a short amount of time. Yet, these results should be taken with caution, as replication is needed. These findings provide initial, strong evidence—long needed—for the application of DST to motor intervention and a first step toward a dedicated motor intervention for children on the autism spectrum. However, given the small sample size, generalization is limited. Further limiting generalization, is the lack of female participants on the autism spectrum. This study sought to recruit female participants; however, of those that parents consented ( $N = 2$ ), one had no motor delay and thus may not have benefited from the intervention. The other had such as significant motor delay that a single motor skill with one consistently demonstrated skill criteria was not found. Future research should make a concerted effort to recruit female participants to understand how motor performance and the application of task modifications may differ.

Further, the task modifications and intervention for this study focused on only two motor skills, the horizontal jump and two-hand strike. While strong evidence was shown for DST's application in these two instances, it is reasonable to consider that this might not be the case with other motor skills. Research should look to replicate these findings during other motor tasks, even beyond the skills included in the TGMD-3, such as unique motor tasks like frisbee throwing. Last, while evidence suggests that motor performance was persistent in the absence of task modifications, this study lacked a true retention assessment. Future research should look at the impact task modifications have after a longer lapse in time to better understand if the motor skill patterns were truly perturbed into a new pattern or if ultimately individuals return to the previous pattern.

## Conclusion

Given the mounting evidence (Lloyd et al. 2013; Liu et al. 2014; Staples and Reid 2010) of motor delays in children on the autism spectrum, the limited evidence for motor interventions in this population, and the potential benefits (Bremer et al. 2016), a clear motor intervention is desperately needed. DST provides a beneficial framework that, in these findings and that of previous research (Colombo-Dougovito 2017), shows a great potential for improving the motor performance of individuals on the autism spectrum quickly and in a relatively short period of time. However, these procedures need further replication in broader samples to better understand exactly how to provide task modification in the most effective and efficient way, especially for unique, non-linear tasks.

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## Compliance with Ethical Standards

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Study protocols were reviewed and approved by a university internal review board prior to participant recruitment.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

**Conflict of Interest** Andrew Colombo-Dougovito declares that he has no conflict of interest. Luke Kelly declare that he has no conflict of interest. Martin Block declares that he has no conflict of interest.

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# *Experiences Participating in Community Physical Activity by Families with a Child on the Autism Spectrum: a Phenomenological Inquiry*

**A. Josephine Blagrove & Andrew M. Colombo-Dougovito**

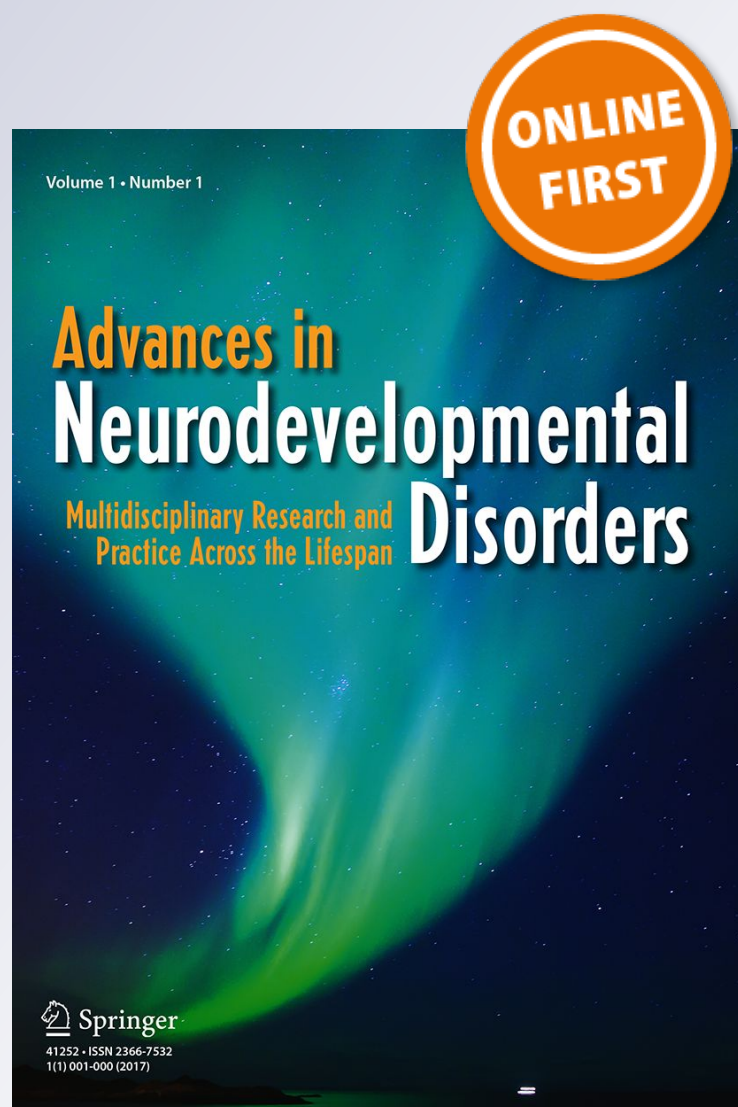
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# Experiences Participating in Community Physical Activity by Families with a Child on the Autism Spectrum: a Phenomenological Inquiry

A. Josephine Blagrove<sup>1</sup> · Andrew M. Colombo-Dougovito<sup>2</sup>

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## Abstract

**Objectives** Families with a child on the autism spectrum face challenges to participating in physical activity in the community. Yet, little research has examined these families' experiences and perspectives on such participation.

**Methods** This phenomenological study used semistructured interviews to collect data from 13 families with a child on the autism spectrum to understand their experiences as a family attempting to access physical activity opportunities.

**Results** Families discussed four overall themes related to participating in physical activity in the community: (1) safety outside the home, (2) lack of acceptance, (3) behavior affecting the family participation, (4) and limited opportunity for activity.

**Conclusions** Evidence suggests that physical activity can provide tremendous opportunities to build better connections within the community and improve quality of life, but the barriers discussed by parents in the present study suggest that families and their children on the autism spectrum might not yet have the same opportunities for access or support.

**Keywords** Autism spectrum disorder · Physical activity · Family relationships · Environmental barriers · Accessibility

Autism spectrum disorder (ASD) continues to gain worldwide attention and is well documented as one of the most prevalent neurodevelopmental disorders in the USA (Fombonne 2009; Lyall et al. 2017; Matson and Kozlowski 2011). According to the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*, ASD is characterized by deficits in social communication and repetitive and restrictive behaviors present from birth (American Psychiatric Association [APA], 2013). The most recent prevalence reports from the Centers for Disease Control [CDC] (2018) estimate that 1 in 59 children in the USA is diagnosed with ASD.

Although a wealth of research has examined populations on the autism spectrum and various stakeholders, an area slow to gain the attention of the broader ASD research community is physical activity (PA). A growing body of literature continues to identify the health benefits of physical activity, and a

small swath of that literature has shown that exercise is an evidence-based practice for individuals on the autism spectrum (Dillon et al. 2017; National Professional Development Center on Autism Spectrum Disorder [NPDC], 2015). Still, few studies have conclusively explored whether the benefits of PA apply to populations with ASD (Bremer et al. 2016; Lang et al. 2010; Sowa and Meulenbroek 2011) or whether barriers might exist to impede these populations' access to PA. Strong evidence exists on the determinants of PA among populations without a disability (Meyer et al. 2014), but few studies have focused on this issue for ASD populations (Ayvazoglu et al. 2015; Pan and Frey 2005). Of research that has included populations on the autism spectrum, the focus has been on activity levels (Stanish et al. 2017), beliefs about physical activity (Stanish et al. 2015), or patterns of participation MacDonald et al. 2011). Although individuals on the autism spectrum and their families might experience the same benefits of PA as most individuals, their lived environment creates unique facilitators and barriers to PA. Understanding these nuances will help policy makers, program managers, and frontline workers provide the most beneficial and successful services.

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The physical activity behaviors of families with a child on the autism spectrum are just starting to be explored. In a rare 2005 study, Pan and Frey (2005) found that age and sedentary behavior—not parent PA and support—were significant factors in the PA of youth on the autism spectrum. Their study also found a significant, negative association between sedentary behavior and overall PA—suggesting those who spent more time in sedentary behavior were less active than those involved in active, leisure pursuits—most likely due to limited opportunity (Pan and Frey 2005). Jones et al. (2017) identified several potential “ASD-specific” correlates related to PA, such as symptom severity, maladaptive behaviors, and psychotropic medication. Although substantial evidence is not yet available on these potential correlates, it is reasonable to assume that a child’s behavior would affect her or his own PA level and, given the heterogeneity among children on the autism spectrum, it is likely that symptomology will have an impact.

Stanish et al. (2017) provided further evidence to suggest that adolescents on the autism spectrum spend higher amounts of time in sedentary behavior and less time in PA than do peers without a disability. The Stanish et al. (2015) interview data indicated that most participants on the autism spectrum enjoyed PA and recognized the benefits; however, they frequently expressed that they were too busy to do PA, that PA was boring, they feared getting hurt, or that it was too hot or cold to do PA. These findings provide insight into building programs to increase PA among individuals on the autism spectrum, as overall satisfaction and competence when participating in activities is important for an individual’s mental health (Stacey et al. 2018); however, more empirical evidence is needed to understand the challenges, barriers, and potential facilitators of PA for individuals on the autism spectrum, particularly because of the great variance between individuals (Jones et al. 2017).

One important factor in understanding the facilitators and barriers to PA is the influence of family members, especially parents and siblings, as children are heavily reliant on these individuals for everyday activities. These internal and external influences can be explored using the socioecological model (Bronfenbrenner 1977). Used in previous studies to understand participation in physical activity by children with a disability (Blagrove 2017; Buchanan et al. 2017; Obrusnikova and Miccinello 2012) and in a research policy brief (Neumeier et al. 2017), this model identifies five barriers and facilitators to participation in activity: interpersonal, institutional, community, public policy, and physical environment. This model is unique because it focuses on the influence of factors at a variety of levels (Joseph et al. 2014) and was used in this study to explore influences on community physical activity for families with a child on the autism spectrum.

Using a socioecological model to examine the factors influencing afterschool PA, Obrusnikova and Miccinello (2012) identified several barriers and facilitators for children

on the autism spectrum. Specifically, intrapersonal barriers, such as lack of motivation or interest and impaired attention, comprehension, and motor performance, and intrapersonal facilitators, such as enjoyment in PA, managerial strategies to promote PA, and maximizing success and achievement, were most commonly reported, as opposed to interpersonal or policy factors. Importantly, this evidence suggesting that potential social, motor, attention, behavioral deficits, and narrow interests might contribute the greatest to physical inactivity in children on the autism spectrum (Obrusnikova and Miccinello 2012). Though these findings may center too much on the parents’ report, as the greatest interpersonal barrier reported was, “Parents do not have time or energy.” Some parents did list the availability or lack of community programs as influencing the child’s physical activity. The heavy focus on the intrapersonal behaviors demonstrates a potential hyperfocus on the child’s behaviors and disregards the potential ability that an accessible program designed to meet individual needs can have on overcoming those behaviors.

In a mixed-method study, Ayvazoglu et al. (2015) gathered evidence from six families with a child on the autism spectrum; each child’s PA was tracked through accelerometers, then each family was interviewed to understand the determinants and challenges of PA participation. Consistent with prior research, their study found that children on the autism spectrum were engaged in PA below the recommended amount and that most parents’ levels were also low. However, the authors noticed a trend: As parents increased their PA levels, so did the children, although the relationship was only marginally significant (Ayvazoglu et al. 2015). The Ayvazoglu et al. findings also revealed several potential barriers to PA in children on the autism spectrum, including understanding PA, living with the child, and awareness in school and community settings. Regarding the first barrier, Ayvazoglu et al. suggested that social deficits might play a role in limiting the success in PA. Behaviors exhibited by the child, coupled with caretakers’ attempts to “manage” those behaviors, limit the time available to engage in PA for all parties (Jones et al. 2017). Finally, the awareness in the school and community—or most directly, lack of acceptance in those settings—creates limited opportunities to engage in PA.

A small body of literature has discussed, besides barriers, the impacts that ASD has on the ability of a family to pursue leisure and physical activities. Family activity can be affected by the sensory needs of a child on the autism spectrum (Little et al. 2015) and has been shown to increase as children gain more independence (Haegele et al. 2017). These opportunities for activities are vitally important because, when barriers are reduced, PA provides an opportunity for tighter connections to family outside the nuclear unit and to the broader community (Ullrich-French et al. 2012). Family activities can also help improve motor abilities, which are tied to adaptive daily living skills (Schaaf et al. 2011; Travers et al. 2016) and may act as a



moderator of core autism symptoms (Fulceri et al. 2018). Further, evidence shows that families with children on the autism spectrum have lower reported quality of life (Lee et al. 2009) and that mothers experience higher levels of stress (Giallo et al. 2011), areas shown to benefit from regular PA engagement. Better understanding and improved support of increasing family PA might provide opportunities to increase quality of life and to improve health outcomes across the lifespan of this population.

Although the literature has established lower levels of PA for populations with ASD compared to peers without a disability, more information is needed to understand how to improve the activity levels of individuals with ASD. Given the increasing evidence of the benefits of PA for individuals on the autism spectrum and their family members, and given the emerging research on the barriers to PA faced by these families, this study explored parents' experiences participating in community PA with a child on the autism spectrum, to understand factors influencing participation.

## Method

### Participants

All research activities were approved by a university institutional review board. Purposive sampling was used to recruit parents from a similar geographic region who shared the experience of raising a child on the autism spectrum. Participants were recruited through emails sent to two local agencies who serve children on the autism spectrum. Interested families responded to the researchers by email or phone, and a follow-up phone call was held to (a) discuss the general overview of the study, (b) answer potential questions, and (c) schedule a day, time, and location for the interview. Participants were not included for this study if (1) there was more than one child on the autism spectrum in the family, (2) the child on the autism spectrum did not have a formal diagnosis, (3) at least one biological parent or legal guardian could not participate in the study, and (4) the participant family could not meet in person for the interview. Parents designated the setting for the interview, and all participants had the interview in their home when their child on the autism spectrum was not present. Families were encouraged to have both parents available for the interview; yet, for a majority (70%) of the families, only one parent participated; of single parent interviews, eight were conducted with the mother-only and one was conducted with the father-only. Four families included both mother and father in the interview.

A total purposive sample of 13 families participated in this study; family characteristics are listed in Table 1. All families were headed by at least one biological parent. Eight (62%) of the families had a child on the autism spectrum in their teens

**Table 1** Family characteristics

Family	Parent(s) participating	Age of child (years)	Number of siblings
F1	Mother	15	2
F2	Mother	15	1
F3	Mother	4	0
F4	Mother	13	1
F5	Father	7	1
F6	Mother and father	13	1
F7	Mother	9	3
F8	Mother and father	5	0
F9	Mother	13	1
F10	Mother and father	15	3
F11	Mother and father	15	1
F12	Mother	6	1
F13	Mother	16	1

Age of child = child applies to the child on the autism spectrum

(i.e., 13–16 years of age), and five (38%) families had a child under age 10 on the autism spectrum. Eleven (85%) families had more than one child in their family, although each family had only one child diagnosed on the autism spectrum. No siblings were considered at risk for ASD.

The families in this study spanned a wide range of education and employment. All participants were over the age of 30. Education and employment information was collected for all participating parents in the interview. Ethnicity in this study was predominantly Caucasian ( $n = 10$ ), with a few families who identified as Hispanic ( $n = 2$ ) or mixed ( $n = 1$ ) (Table 2).

### Procedure

Limited research has examined the experiences of PA in community settings for families with a child on the autism spectrum. To understand the experiences of these families, a phenomenological approach was used. The aim of phenomenology is to understand the experience of participants within a phenomenon and the meaning that the participants' attribute to that experience (Lewis-Beck et al. 2003). Hermeneutic (interpreted by the researcher to gain insight into the experience) in approach, phenomenology is used to understand the perceptions of a participant's experience under a phenomenon and to reduce a phenomenon to its essence (Sparkes and Smith 2014). Phenomenology helps the researcher to understand what an experience is like and "differs from almost every other science in that it attempts to gain insightful descriptions of the way we experience the world pre-reflectively, without taxonomizing, classifying or abstracting it" (Van Manen 1990, p. 9). To capture the essence of the experience of community PA, semistructured interviews were conducted with the parent(s) of a child on the autism spectrum to collect

**Table 2** Family demographics

Family	Income	Education	Employment	Age	Ethnicity	Marital status
F1	\$30-49,999	CC	PT	< 40	Caucasian	Single
F2	> \$90,000	BA	FT(f)/FT(m)	< 40	Caucasian	Married
F3	\$30-49,999	Bachelors	Freelance/contract	30-39	Caucasian	Single
F4	> \$90,000	CC	FT(f)/SH (m)	< 40	Caucasian	Married
F5	\$30-49,000	AA/HS	FT(f)/FT(m)	30-39	Hispanic	Married
F6	> \$90,000	Some college	FT(f)/FT(m)	30-39	Caucasian	Married
F7	> \$90,000	BA	FT (f)/FT(m)	30-39	Caucasian	Married
F8	> \$90,000	CC	FT(f)/SH(m)	30-39	Caucasian	Married
F9	\$30-49,000	CC	SH	> 40	Mixed	Single
F10	> \$90,000	MA/MA	FT(f)/FT(m)	> 40	Hispanic	Married
F11	> \$90,000	MA	FT(f)/FT(m)	> 40	Caucasian	Married
F12	\$50-69,000	MA/BA	FT(f)/SH(m)	30-39	Caucasian	Married
F13	\$30-39,000	HS	SH	30-39	Caucasian	Single

CC community college, BA Bachelor of Art, HS high school, AA applied associates, *f* father, *m* mother, PT part-time, FT full-time, SH stay at home

information on the family's experiences. Each family completed one interview, and each interview lasted 30 to 40 min. The first author asked follow-up questions if a participant answered too briefly, helping to ensure that a depth of information was garnered from the interview.

Participants were interviewed in person, and interview questions were conducted in the same order for every family, with follow-up questions used to elicit more detailed responses when needed. Member-check meetings were held with five participants to ensure validity of the verbatim transcripts of the interview and to assess the trustworthiness that the themes derived from the data analysis were congruent with how the families perceived their experience.

Semistructured interviews are the most frequently used type of data collection method in qualitative research (Krogh and Lindsay 1999). As advised by Bevan (2014) and Smith et al. (2009), questions were broad, open-ended, and asked in the vocabulary of the respondent to ensure access; follow-up questions were asked to clarify or probe for further information when necessary. The aim of these questions was to gain a rich understanding of the experiences of these families and of the barriers they thought affected their family's participation in physical activity. The interview questions are provided in Table 3.

## Data Analyses

Interviews were audio taped and transcribed verbatim for analysis. Data were hand coded by the first author using a first-cycle coding method, looking for exploratory categories as described by Miles et al. (2013). Thematic analysis (TA) was conducted following Braun and Clarke's (2006) linear approach: (a) familiarization with the data, (b) coding, (c)

searching for themes, (d) reviewing themes, (e) defining and naming themes, and (f) writing up.

Frequencies of themes and subthemes are shown in Table 4. The first author identified subthemes and themes, and the second author reviewed these findings. Any differences in the interpretation were discussed and resolved.

## Results

Families who had a child on the autism spectrum discussed their experiences regarding physical activity in the community. The following four themes to PA were identified: (1) safety outside of the home, (2) lack of acceptance, (3) behavior affecting the family participation, and (4) limited opportunity for activity.

### Safety Outside of the Home

*Safety outside the home* was defined as anytime the family described an incident, situation, or environment they perceived as unsafe for their child and was a top concern across all the families in the current study. Many parents in the present study described the fear of their child running away or taking off and the constant need to be vigilant when out in public. Family 3 (F3) shared, "There's only certain parks we can go to because either the equipment is unsafe for him because he wants to try it . . . or he's an eloper so I have to go to parks that can contain him." Even families whose child was older at the time of the interview expressed concerns about wandering and elopement, indicating that the issue still caused anxiety: "He was a wanderer, and so there were serious issues in getting him to stay with us. So, there were just a lot of stressors attached to it" (F4).



**Table 3** Interview schedule

1. We will be discussing physical activity within the context of your family unit throughout the following questions. Can you please tell me what the term “physical activity” or “being physically active” means to you?
2. Opposite to that is being sedentary or physically inactive. Can you please describe to us what that means to you as well?
3. Do you think that being physically active is important? If yes: why? If no: why not?
4. What types of activities, physically active or sedentary, do you like to participate in? The other members of your immediate family?
5. Would you describe the members of your family as mostly active or mostly sedentary? Please explain your choice.
6. Do any members of your family participate in organized sports or physical activities?
7. Do you have a gym membership? If yes: how frequently do you go to the gym? If no: do you have a desire to attend?
8. In regard to family physical activity time, what activities does your family engage in together?
9. What do you feel affects the type of activity you as a family engage in?
10. Do you feel that having a child with ASD affects the type of activities your family can engage in together? If yes: how so?
11. (If other sibling/s) Do you feel having a child with ASD affect the type of activity your other child/ren participate in?
12. What is your perception of your child with ASD’s motor skills? (Must et al. 2015)
13. Does your child with ASD have siblings? If yes: how do you perceive their motor skills in relation to their sibling? Better? Worse? Please explain. (Must et al. 2015)
14. Are there physical activity experiences that you wish that your family participated in that they do not? If yes: what are those activities & why does your family not participate (time? Safety? transportation?) (Must et al. 2015)
15. Have physical activity experiences been mostly positive, mostly negative, or neutral throughout your life for you personally? Please explain your choice and give examples.
16. Have physical activity experiences been mostly positive, mostly negative, or neutral with your child with ASD? Please explain your choice and give examples.
17. When your family engages in physical activities, what is the usual level of vigor that you reach. For example, light sweat/slightly increased breath, medium sweat/increased breath, heavy sweat/rapid breathing.
18. As a family, do you feel as though you have adequate knowledge of ways to be physically active in this community? If no: what information do you feel is lacking? If yes: where do you mostly get this information?
19. Do you, as a parent, use physical activity as either a) a reward for performing an undesired task or b) punishment for not performing a requested action/behavior? For example: being allowed to go for a bike ride after completing nightly homework (reward) or being made to do push-ups if your child does not eat his dinner.
20. Does your family participate in physical activity with your extended family? Close friends? If yes: what types of activities do you perform with these groups? If no: can you explain why?
21. Is there anything else you would like to share with me/us about your experiences with physical activity?

Families also commented on the constant need to be on alert. F11 felt the need to “over plan everything” and “to see things from every angle.” F9 reported,

Wherever we are at, that’s [safety] number one for me. Because having a child that might always, you know, see something or whatever—there he goes. I really do worry. So, I pretty much have to stick with him like glue.

F8 shared a similar sentiment:

You have to pay attention at all times. So, I think the safety aspect of physical activity—it’s different. So, you know, when you have a son or daughter that’s 4 of 5 and they’re typically developing, you can teach them things like snakes and dogs and things like that. All these things that I think people take for granted. Our child doesn’t have the same built-in fear.

F5 shared a similar experience: “He’s very—he’s very tough. And I think sometimes he’ll just push the limits a little further than he probably should.”

Learning new skills in public is challenging, and families in this study expressed the special challenges they believed are specific to their families because of their child on the autism spectrum. F13 talked about the dangers associated with trying to ride a bike on trails in the park. In particular, although her son is capable and follows the park rules, if he sees someone else breaking the rules he has been trained to follow, it can be so overwhelming to him that it becomes a safety hazard for others. Other families echoed concerns with biking safety. F1 stated that their child on the autism spectrum “needs to be supervised because she doesn’t pay attention. She just doesn’t have the—she doesn’t really have the physical ability to, like, stay balanced, pay attention. So, it really limits what we can do together physically.” F12 also expressed concerns about biking: “We couldn’t all go for a family bike ride, and know he would stay on the sidewalk and be safe.” F10 shared biking safety issues as well. F6 shared a tactic that they have to employ to make biking safer for their child on the autism spectrum: “One of us has to walk because she can’t be trusted in traffic. So, somebody is walking alongside with her. So even then it’s not a full-on family activity. It’s difficult.”

One family (F7) described safety of physical activity differently. The family’s response focused on the issue of safety, or perceived safety, when the child on the autism spectrum is interacting with typically developed (TD) children:

We went to the gym. We went 3 or 4 days a week because it provided childcare, but then, when [our son] tried to attend on the first and second try, after the second time, they kicked him out because

**Table 4** Occurrence of identified themes and subthemes

Theme	Subthemes	Statement of subthemes by family
Safety outside the home	Supervision Fatigue/overheating Staff training Not good balance Wanderer	F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F12, F13
Lack of acceptance	Survival No judgment Programs for ASD (wanting) Better training for staff Extended family acceptance Meltdowns Kicked out of programs	F1, F3, F5, F6, F7, F8, F9, F12, F13
Behavior affecting the family participation	Overly verbal High volume Screaming Hitting Elopement Waiting is hard Meltdowns Motivation	F1, F2, F3, F4, F5, F6, F7, F8, F9, F12, F13
Limited opportunity for activity	Only 1 day a week Short duration Issues with daycare Activities not considered outings as outings because of challenges Crowded places Challenges waiting/self-selecting out if waiting Time and availability Support staff not available Parents not allowed to help Availability of programs Programs not a fit for ASD as they currently exist Needing to rent the whole place to accommodate Only for typical sibling	F2, F3, F5, F6, F7, F8, F9, F10, F11, F12, F13

they said he was not safe. He fell on top of another child; they felt he was aggressive because of his autism. So, then we couldn't go to the gym anymore.

The issues described above were consistent across families regardless of the age of the child on the autism spectrum. The perceived barriers were just as much a concern for families who had a 5-year-old as they were for families with a young teenager. It is also important to note that this was consistent across families regardless of the severity of ASD symptoms.

### Lack of Acceptance

*Lack of acceptance* was defined in this study as any time a family member identified feelings of being left out or judged by others. Families in this study described a general feeling of judgment from members in the community who do not have a child on the autism spectrum. Because of this perceived judgment, families would often go to gyms or public places at nonbusy times and avoid places where they thought their child might act out. Family 5 said,

When you have a child with special needs and is very outspoken and will be very verbal to a higher volume, some people find it really annoying. So trying to find a gym where people aren't gonna—where you're not going to disrupt everyone and management isn't going to come and say something where it's going to offend the parents. So often we'll just self-select out of it.

F3 described an experience of judgment as well:

We used to go to the mall and play there. And my son would do something and I'd have this group of moms judging me and not even knowing why and it wasn't even—it's not like he hit another kid or something like that. It's just like he might have screamed and thrown himself down. And so, the judgment that's out there, it's limiting. It's hard to want to jump in and play when you feel—when you have a judgment coming.

Families described a general longing for acceptance and wanting people to understand their experience. “You just want to have that feeling of like, getting it, rather than people staring at your kid when your kid's screaming in line” (F8). Families also said that acceptance in a setting (or hearing about it from another family) determined whether they would go to or return to a business or setting. “Depending on where we go or how people treat us while we're there is a huge factor in whether we'll go by or try right away” (F13). Family 9 has attempted to do a lot of activities in the community despite their son's challenges. When on a soccer team for TD children, she described her experience: “There wasn't a lot of support to have kids [like him] on the soccer team. I was like, why do I do this to him?” Echoing the experience of safety in the previous theme, the experience of acceptance and fear of meltdowns was shared across family experiences regardless of age and symptom severity.

## Behavior Affecting the Family Participation

*Behavior affecting the family participation* was defined as any mention of a behavior by the child on the autism spectrum deviating from the social norm or disrupting an environment in a way that caused discomfort to the family or those involved. All parents reported that their child on the autism spectrum's behavior affected the type of activity that their family could participate in. This behavior could be related to sensory concerns or behavior challenges commonly associated with the autism spectrum, such as a need for sameness and routine (Miller et al. 2015) or problems with transition (Cheak-Zamora et al. 2015; Williams 2015). F5 described their experience with their child as:

[affecting] everything. You have to consider everything, swings, animals—there is a lot that prevents us from going places and doing things that other families would just do on a normal basis. Just because . . . there's a large amount of screaming, and maybe if he's hitting his head or something . . . that may be something other people find alarming.

F6 shared similar behavior experiences. Their family discussed how they must manage going about visiting places and the amount of effort it takes to make an outing with the family successful.

[It's] contingent on how she deals with it. Her safety and behaviors. To the extent that, when we go to an amusement park, we have her in a wheelchair because she could have a meltdown where we have to remove her and if we're at the back of an amusement park—having to carry a kicking, screaming, biting child out 2 miles just isn't going to work.

This behavior also dictates the amount of planning that goes into a family outing or the expectations before an event. F8 described their experience:

It's definitely high stress. We're constantly just trying to keep him happy and in a calm place. And we really try to do everything a typical parent does. But it's a lot of work, and you know, sometimes you leave happy and sometimes you leave going. “My goodness! Why did we do that?” Trying to do typical things and then [it] just not, not working out—and it's overwhelming to him. And we think he should be interested in an animal at the zoo, but that's not what he's interested in. So, things like that can make it hard.

Waiting in lines is an event that can trigger behaviors as well (F7, F8). Families described the hardship and stress placed on the family when waiting in lines at the grocery store, amusement park, and waiting to take a turn in an athletic event with peers, such as baseball. The fear of this behavior happening in one of these settings is another barrier that will prevent families from participating in “normal” family functions and families described the need to “divide and conquer.” Often, parents must split between the child on the autism spectrum and their sibling (F6, F7). Because they could not attend the gym with their child on the autism spectrum, F7 would have the parents take turns working out, while the other parent sat in the car with the kids. Other families commented on outings and behavior as well; for instance, F4 reported:

It's really hard for us to get him out there, and then once we get out there we know we have to really restrict how far we go in so that we can make it back out without it being a negative experience for him and for all of us. So, we mentally have to gear up to do that.

Family 7 shared similar feelings when siblings want to go to the park and play, but the behavior of the child on the autism spectrum is impacting how long the family can stay: "He just wants to run away [at the park], and we end up chasing him and end up leaving, so it doesn't really work out a lot of the time." Finally, F3's experience summarized plainly many families inferred thoughts: "We don't go to places that have too many people; he doesn't do well in crowds." Although this theme is not a direct reflection of physical activity, the skills needed to participate in community PA are mentioned by parents repeatedly. For example, waiting in line, walking, and taking turns all require a minimal level of understanding and function. It could be argued, for some of these families, that basic day-to-day functions feel like physical activity and that the notion of participating in anything more structured would seem like a barrier to being active. To avoid potentially biasing the participants' responses, the researchers allowed the families to explore their experiences through their own definitions of physical activity (see Table 5).

### Limited Opportunity for Activity

*Limited opportunity for activity* was defined as any mention of programs or experiences not fitting the child's needs and/or the family itself being a challenge to participation or causing the child to "opt out." Families who have a child without a developmental disability engage in PA more easily than families who have a child with a disability engage in leisure activity (Solish et al. 2010). Parents of children without disabilities report that their participation is associated with greater health-related quality-of-life outcomes (Vella et al. 2014). Although families in this study understood the importance of being physically active and desired to do this in a community setting, they reported many challenges attempted to engage in PA. Family 13 shared the lack of programs for her 16-year-old son and how often they, "have to go play at the gym when the toddlers are playing," because there not appropriate programs for his age group. However, families in this study frequently participated in more individualized activities with their immediate family in the community or activities that were sensory in nature in their home, as shown in Table 6.

Families frequently discussed issues around availability of programs as well as training of staff. These families often participated in programs that were specific to individuals with a disability and as such were offered within a larger program for the public in a limited amount of time. Examples were an aquatics program that only had one class per week for children

**Table 5** Family definition of physical activity

Family	Definitions
1	"Moving your body on a regular basis, daily basis for a minimum period of time. 30 minutes to an hour or whatever. Just being physically active."
2	"Any sort of movement. Whether it's walking the dogs, going on a hike, going to the gym, if you have a mall person walk in the mall, head to the city doing some street walking pretty much any movement I consider physical activity."
3	"Physical activity would be anything that is not sitting on the couch. So anything outside, anything that gets your heart rate up."
4	"Any type of movement that stimulates your brain and body."
5	"Playing, running, jumping. Any sort of I guess fast paced movement."
6	"Anything that gets you moving."
7	"Up and moving. Outside, being active, not sitting. At least that's what it means to me."
8	"Moving anything...usually outdoors. Anything where your gross motor skills are moving."
9	"Being in shape and being physically able to carry out your day. Not just sports or going to a gym, but being able to carry out your day."
10	"Getting out. Doing something consistent."
11	"Exercise, stress relief, enjoyment, fun things."
12	"A certain number of minutes that gets your heart rate up, it could be intense."
13	"To get exertion. To use energy."

with a disability and a gymnastics program that only had one slot per month. Also, families shared that, when they had to choose between allowing their TD child to participate in an activity or accommodating the child with autism, they

**Table 6** Family activities

Family	Reported activities
1	Swimming, walks, dancing (at home to music)
2	Archery, swimming, walking dogs
3	Trampoline, walking in park, hiking
4	Swimming, walking outdoors, scooter
5	Trampoline, walking outdoors, swimming
6	Swimming, biking, fencing
7	Swimming, trampoline
8	Walking in park, swimming, trampoline, bike riding, ball play
9	Walking in park, ball play, tag
10	Horseback riding, taekwondo, swimming
11	Bike riding, swimming, gym, baseball
12	Swimming, walking, trampoline
13	Swimming, biking, hiking



frequently had to choose the latter, primarily because the child's behavior while waiting presented challenges. As described by Family 6, "Our daughter [not on the autism spectrum] wanted to do swim team. We researched it and decided we wouldn't do it because there is no way our other daughter [on the autism spectrum] could sit and observe by the pool and not get in. She wouldn't understand it. So, we didn't do swim team." Family 7 also reported discouraging their daughter [not on the autism spectrum] from swim team, "because it was one more thing on top of what our son [on the autism spectrum] needed, and he couldn't understand just sitting and watching." Additionally, staff often lacked the training or awareness to include the child on the autism spectrum in an activity with TD children or children with other disabilities. Even when their child on the autism spectrum could attend a session at a program, then the difficulty became "what to do with the TD child?" because there often was not a concurrently running program for the TD child to attend.

Although individuals on the autism spectrum are reported as being at higher risk for drowning than their TD counterparts (Committee on Injury, Violence, and Poison Prevention 2010), 11 of the 13 (92%) families in this study used swimming as a regular family activity. This activity frequently took place at the home of either the immediate family or close family friends. No families participating in this study reported participating in organized swimming. It is important to understand that, for the families in this study, even activities that were listed as team sports, such as baseball, were usually a home activity, such as playing catch or practicing pitching and hitting with a family member. All families expressed a desire to be more involved in PA with community groups but that, under current conditions, expanding beyond the reported activities (Table 6) would be too stressful or challenging. It is also important to note that, although the participants' communities offered organized sports for all of the ages—and that some of these programs, such as T-ball, aquatics, or adapted archery were specifically created for individuals with a disability—the families still found the barriers to participation too great to overcome.

## Discussion

It is not enough to tell families who have a child with a disability that they need to be physically active; these families need to be—and to feel—supported (Galpin et al. 2017). The aim of the present study was to understand how parents of a child on the autism spectrum experience participation in community PA. The results add to the growing understanding of the potential barriers that families confront when attempting to be physically active in their own community. An overarching theme in the findings was that families that have a child on the autism spectrum confront multiple barriers outside of their

own control to participating in community PA, specifically, safety outside the home, lack of acceptance in the community, behavior affecting the family participation, and limited opportunity for activity. This general finding is consistent with extant research on families that have a child with a disability in general (e.g., Buchanan et al. 2017; Colombo-Dougovito 2017; Obrusnikova and Miccinello 2012) that have used the socioecological model to understand factors influencing participation in PA. While previous research has highlighted several areas that may facilitate or limit physical activity, multiple studies (Ayvazoglu et al. 2015; Jones et al. 2017; Obrusnikova and Miccinello 2012) center the issue around the behavior of the child as a predominant barrier. While one theme from this analysis was centered on the behavior of the child, uniquely, these results highlight other areas of concern, such as lack of acceptance or limited program, that play an equal or more significant role. In fact, many of the behavioral barriers discussed, such as limited turn-taking and elopement, can be counteracted by appropriate accommodations and understanding staff.

## Finding Acceptance

Overall, the predominant struggles identified by families in this study appear to continue into adulthood for many individuals on the autism spectrum. A systematic review of social participation for adults on the autism spectrum (Tobin et al. 2014) identified limited access to social interaction and social experiences as themes for this population. If these families could receive support from the community to participate more in PA, they would not only receive the health benefits of exercise but also would likely strengthen their social relationships within the community. The latter is important because, among various other benefits, community connections are related to reduced stress, which has been shown to be particularly high in families (Brei et al. 2015; Galpin et al. 2017) and individuals on the autism spectrum (Simonoff et al. 2008).

Improved social connections and support might also help families find acceptance from—and feel more accepted by—community members, which may help to reduce the stigma of autism that families and individuals encounter, either implicitly or explicitly, in a variety of settings. Community support can facilitate the adjustment to a new, potentially more satisfying lifestyle (Stacey et al. 2018), with community activity leading to greater competence and continued participation, in addition to increased opportunity for social interaction and growth (MacDonald et al. 2013). Additionally, acceptance within the community might help abate other themes identified in the present analysis, such as safety concerns and limited opportunities for participation in community PA. Further, building acceptance and understanding of autism by those not directly impacted may allow for better programing development and

decisions, thus reducing the impact of any singular behavior on the family's PA engagement within community settings.

### Finding a Pathway to Engagement

Physical activity has the potential to provide a pathway to community engagement and acceptance given the right support. Increasing opportunities for families to be active could help children form habits that carry over to later years (Haegerle et al. 2017) and improve the likelihood of positive life satisfaction (Franke et al. 2018). Increased accessible opportunities could also limit some of the barriers faced by adults on the autism spectrum (Taliaferro and Hammond 2016), heighten engagement with community and other societal environments, such as school (Buchanan et al. 2017), as well as limit potential individual barriers, such as sensory issues. By creating strength-based supports and opportunities for activity for children on the autism spectrum, families will be less likely to feel socially isolated and have feelings of reluctance to engage in physical activity (Marggraff and Constantino 2018). Nichols et al. (2018) further demonstrate the positive impact of accessible opportunities on engagement in PA. Nichols et al. (2018) demonstrate that while accessible programs do not extinguish all the barriers faced by individuals on the autism spectrum, programs designed to meet the needs of individuals (such as Special Olympics) can help reduce overall impact of any individual behavior or sensory issue.

However, another finding of note in the present study was that, even when programs were designed for children with a disability, families of a child on the autism spectrum often stated that they were still “too much” for their children on the autism spectrum. This finding provides preliminary evidence of a need for purposeful, individual adaptations to programs for children on the autism spectrum, as opposed to homogeneous disability or, even, “autism friendly” environments. For example, parents in the present study reported that the water was too reflective for their child during the day, so they had to bring their child swimming at peak times (e.g., mornings or evenings), which led to longer wait times, a particular challenge for parents of children on the autism spectrum. The busier times also made it more difficult to obtain instruction and to receive attention from support staff who were trained specifically for children on the autism spectrum. Policy makers and program managers who are trying to make their programs more disability friendly would do well to add and even prioritize training for ASD because, too often, staff lack adequate training and knowledge to meet the needs of this population (Dillenburger et al. 2016).

Although certain behaviors of the child were identified as barriers to PA for families, it is often the lack of trained staff or access to opportunities that amplify potentially problematic behaviors. Despite its newness as a topic area in the literature,

exercise is continuing to emerge as a positive program and intervention tool to encourage PA (Dillon et al. 2017) and may provide a great amount of benefit (Healy et al. 2018) for individuals on the autism spectrum and their families. However, simply knowing the benefit of PA and the importance of engaging in PA is not enough for families to access these benefits and, ultimately, it is not enough to have programs that are listed as disability or “autism friendly,” yet are implemented without the input from families or individuals on the autism spectrum. Families and individuals on the autism spectrum must be included by program directors, managers, and staff in the development process because, despite the often unique needs of children on the autism spectrum, accessibility is often the biggest hurdle to engagement. Systematic modifications, including feedback from all stakeholders, are needed to ensure that the environment is friendly and accessible for families and their child on the autism spectrum. Without reducing the barriers for access, families will continue to struggle to access community physical activity regardless of frequency or severity of the behaviors of the child.

### Limitations and Future Research

At the time of this writing, this study offers one of the few insights into what impacts community PA engagement for families that have a child on the autism spectrum. However, several limitations to this study should be noted. First, small sample sizes limit the generalizability of the findings to other populations. However, qualitative data are meant to be thick in description, and there are no concrete criteria to determine saturation other than the researchers' judgment. Measures were taken to ensure saturation to the best of the researchers' ability, including follow-up questions, uninterrupted interview periods, and recruiting families until the same themes continued to reoccur with no new data being presented. Still, only one main interview was conducted for each family. This could have affected the type of information gathered by the researchers. To increase the opportunities to capture more detailed information from families, future researchers might find it advantageous to conduct multiple interviews over several sessions. Multiple data points would also avoid the burden of a long single interview and would allow the researchers to check for corroborative or contradictory information gained from previous responses.

Furthermore, the experiences of these families might capture a rather affluent perspective. The most recent statistics place the poverty line in California at \$24,000 (Public Policy Institute of California 2017); however, all participants in this study were well above this line. These families, arguably, had more resources to access PA opportunities than their peers from socioeconomically disadvantaged backgrounds. Yet, despite their affluence, families in this study still faced issues of access and acceptance in the community. Future studies should aim to

capture the experiences of a wider range of families, with a focus on the experiences of families that face financial and other challenges that could impact their ability to participate in PA.

Another limitation to this study is the absence of a minority voice. Of all states in the USA, California has the third largest Hispanic population, at 39% (Governor's Budget Summary 2016). However, only 15% ( $n = 2$ ) of the participants in the study were Hispanic and only 23% ( $n = 3$ ) of the participants identified as not Caucasian. Evidence suggests that no significant racial variations exist in the prevalence of ASD (CDC, 2016), but minority populations are underrepresented in ASD research (Hilton et al. 2010; Thomas et al. 2007). Future studies should aim to capture the voices of minority and other underrepresented backgrounds because their experiences might reveal unique experiences, challenges, strengths, and solutions. This study also relied on the families to provide their own definition of physical activity, and the researchers never presented a definition to the families. This might have influenced the participants' interpretation of this key term might differ from the overriding perspectives in the professional community; potentially limiting comparison to previous literature. How physical activity is defined should be considered in future inquiries, as there may be a lack of congruence between the definitions of physical activity of families and the academic community.

A final limitation of this study is that families in this sample were from a rural community in Northern California, an area that offers ample opportunities for families to participate in outdoor activities, such as hiking, biking, and swimming. The weather is also mild, with a long season of outdoor recreational availability, with many lakes and rivers shaping part of the region's culture. Future studies should examine the experiences of families on the autism spectrum in more urban areas and compare this experience to their more rural counterparts. Also, preferences for activities can vary by culture, region, or both, and although the experiences of the families in this study might be true for their area, families in other parts of the country and the world are likely to have different experiences with community PA.

Barriers to family participation in PA identified in this study can be understood through the lens of the socioecological model. Safety in the community (physical environment), lack of acceptance (interpersonal), behavior affecting family participation (interpersonal), and limited opportunity (community) each layer on influences that can make accessing physical activity in a community setting more challenging. If families are facing barriers to participation when their child on the autism spectrum is young, and this child does not have the same opportunities for activity as their TD peers, these barriers may continue into adulthood. Further, the physical activity environment around the family has the potential to overcome individual barriers to activity. For example, a program that exists in the community—that is appropriately staffed and designed to include children on

the autism spectrum that also provides opportunities for TD siblings—has the potential to overcome any behavior individually demonstrated by the child on the autism spectrum. By increasing the understanding of barriers, policy makers, program managers, and frontline workers might be able to begin to improve inclusion in physical activity within community settings at an earlier age, thus creating opportunities for families and individuals to establish patterns that may continue into adulthood, allowing individuals to lead potentially healthier, more active, and independent lives.

**Author Contributions** AJB led the design and execution of the present study, as well as performed the initial data analysis; she collaborated in writing the paper and editing the final manuscript. AMCD collaborated in the design and analysis of the study; he collaborated in the writing of the paper and editing the final manuscript.

## Compliance with Ethical Standards

**Conflict of interest** The authors have no conflicts of interest to declare.

**Ethics Statement** Chico, California State University provided the IRB approval for the study; this study has been performed in accordance with these ethical standards. All participants gave their informed consent prior to their inclusion in the study.

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# Exploring the Interaction of Motor and Social Skills With Autism Severity Using the SFARI Dataset

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## **Abstract**

Social communicative deficits and stereotyped or repetitive interests or behaviors are the defining features of autism spectrum disorder (ASD). A growing body of research suggests that gross motor deficits are also present in most children with ASD. This study sought to understand how pediatric ASD severity is related to motor skills and social skills. A multivariate analysis of variance analysis of 483 children with autism ( $N=444$ ) and ASD ( $N=39$ ) revealed a nonsignificant difference between groups. Results suggest little difference between severity groups on gross motor and social skills within the limited age range of the participants (about 5.6 years of age).

## **Keywords**

autism severity, gross motor skills, social skills, children, diagnosis

## **Introduction**

The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013) defines autism

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spectrum disorder (ASD) as a condition in which a person has “persistent deficits in social communication and social interaction across multiple contexts” and “restricted, repetitive patterns of behavior, interests, or activities. (p. 50)” Social skill deficits and repetitive behaviors are defining features assessed during diagnostic assessments on tools, such as the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2; Lord, Rutter, Di Lavore, & Risi, 2002; Lord et al., 1989) that evaluate level of impairment within these two characteristics.

Recent research (Liu & Breslin, 2013; Lloyd, MacDonald, & Lord, 2013; Staples & Reid, 2010) has demonstrated concurrent gross motor deficits present in many children with ASD. Liu, Hamilton, Davis, and ElGarhy (2014) compared motor performances of children with ASD and typically developing children and demonstrated significant delays in gross motor performance among those with ASD. Furthermore, in a review of 101 children with ASD, Green et al. (2009) found that 79% had definite movement impairments and another 10% were borderline for these problems. Thus, nearly 8 in 10 children with ASD demonstrate some movement impairment, leading some researchers to stress the importance of including motor skills intervention in early intervention programs for this clinical population (Lloyd et al., 2013). Others suggest adding an assessment of possible motor deficits to diagnostic screening, particularly since motor deficits are often present prior to social communicative delays (Liu, 2012).

Further evidence suggests that deficits in gross motor skills are related to social communication deficits; children with more significant motor skill deficits have more significant deficits in social communication skills (MacDonald, Lord, & Ulrich, 2013). The DSM-5 defines severity of ASD by areas of needed support (APA, 2013) such that more severe ASD is associated with more serious deficits and greater support needs in social communication and repetitive behaviors. More recently, early gross motor skill problems have been shown to predict later language problems in children who are ultimately diagnosed with ASD (Bedford, Pickles, & Lord, 2016). While underlying brain development mechanisms for gross motor skills share development mechanisms for social skills, variations in deficits between these domains and variations in severity as assessed by the ADOS remain unexplained, since gross motor and social skill deficits are usually compared separately with skill levels in typically developing, nonaffected peers or developmentally matched peers.

### *Purpose of the Present Study*

This study sought to answer the following questions: (a) What effect does ADOS-determined level of severity among children with ASD have on level of motor and social skills difficulties? and (b) How might motor and social skills differ across groups with different ASD severity?

## Methods

### *Dataset*

The SFARI Base is a central database of clinical and genetic information about families affected by autism and other neurodevelopmental disorders, provided as part of the Simons Foundation Autism Research Initiative (SFARI). The data included in this analysis were taken from the Simons Simplex Collection. These data are the result of collaboration between the SFARI and 13 university-affiliated research sites across North America. Active enrollment for data collection was ended in 2011.

### *Participants*

This dataset consists of a rigorously characterized sample of 2,644 simplex families, that is, each family has only one child with a diagnosis of ASD. Each of the affected participants and unaffected parents and siblings were given a wide variety of clinical assessments, in addition to contributing bio-specimen samples. Inclusion criteria limited affected participants to those between ages 4 and 17, meeting standard cutoff scores on the Autism Diagnostic Interview – Revised (ADI-R) and Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2), and with verbal ability of at least 24 months. In addition to these inclusion criteria, the SFARI had equally rigorous exclusion criteria including, but not limited to, no presence of other disorders (e.g., Fragile X or Down syndrome) or sensory or motor difficulties that would preclude valid use of the diagnostic instruments. Participants included in the present subsample also had available data used within this study as dependent variable data and a diagnosis of either autism or ASD (terms in use prior to the DSM-5) as reported by the ADOS or ADOS-2. A total subsample of 483 affected participants were participants in this study, divided into two further subgroups based on ADOS- or ADOS-2-determined severity as defined by: (a) those diagnosed with autism (i.e., more severe,  $N=444$ ) and (b) those diagnosed with autism spectrum (less severe,  $N=39$ ). Participant's ages ranged from 48 to 150 months with an average age of 66.3 months or about 5.6 years of age; mean age for participants diagnosed with autism was 66.5 months and mean age for participants diagnosed with autism spectrum was 63.9 months (groups were not significantly different in age,  $t(481)=1.152$ ,  $p=.250$ ).

### *Measures*

Two dependent measures were used in this analysis; a gross motor skills score and a social skills score. The raw composite score of each dependent measure was used in data analysis.



**Gross motor score.** The gross motor score was taken from a subtest of the Vineland Adaptive Behavior Scales, 2nd Edition (VABS-II). The VABS-II assesses functioning in four adaptive skills domains: Communication, Daily Living skills, Socialization, and Motor skill, as well as an optional fifth Maladaptive domain (Sparrow, Cicchetti, & Balla, 2005). The VABS-II has been used clinically to assess individuals who have a cognitive delay, and for children with a variety of neurodevelopmental problems, including Autism, Attention-Deficit/Hyperactivity Disorder, emotional/behavioral disturbance, learning disability, and visual and hearing impairments (Community-University Partnership for the Study of Children, Youth, and Families [CUP], 2011). The motor skill subtest is designed for ages birth through 6 years and for older individuals with motor handicaps (Frick, Barry, & Kamphaus, 2009). Item scores are obtained by reports from parents or teachers, through item ratings of *never*, *sometimes*, *usually performed*, *don't know*, or *no opportunity*; parent report was utilized in this analysis. Although the VABS is observational in nature the gross and fine motor subtests have been correlated to the Mullen Scales of Early Learning (MSEL) and the Peabody Developmental Motor Scales (Staples, Macdonald, & Zimmer, 2012). The VABS-II has demonstrated high validity through content and criterion-related validity, as well as principal component analyses, and reliability through split-half, internal consistency, test-retest, and interrater measures (Sparrow et al., 2005).

**Social skills score.** The Social Responsiveness Scale (SRS) was utilized as the measure of social skills; this measure yields a composite score from assessments of receptive, cognitive, expressive, and motivation aspects of social behavior, as well as autistic preoccupation (Constantino & Gruber, 2005). The SRS is an effective tool in capturing subtle aspects of social deficit associated with ASD and has high correlations with other ASD assessment measures, such as the Social Communication Questionnaire (SCQ) and the Children's Communication Checklist (CCC; Constantino et al., 2003). The SRS contains 65 items and utilizes reports from a parent or teacher; this analysis utilized parent report. Each item on the scale is rated from "0" (*never true*) to "3" (*almost always true*).

### Data Analysis

A two-group multivariate analysis of variance (MANOVA) was used in these data analyses to address differences in the multivariate means of social skills and gross motor skills (i.e., dependent variables) between the two severity groups (i.e., independent variable). Significant results were to have been followed by post hoc analysis using Roy-Bargmann step-down analyses on the prioritized dependent variable (i.e., social skills followed by gross motor skills), though no significant results were found.

## Results

Prior to analyses, data were screened for univariate and multivariate outliers and were examined for multivariate normality as well as for homogeneity of between group variance/covariance matrices. All variables were examined separately for the two grouping variables of autism and autism spectrum. No outliers or violations of normality were found within the univariate (standardized values greater than 3.29) or multivariate outcomes (utilizing a Mahalanobis Distance greater than 13.8). Box's test supported the equality of covariance matrices between groups, multivariate  $F(3, 52050.029) = 0.49, p = .69$ .

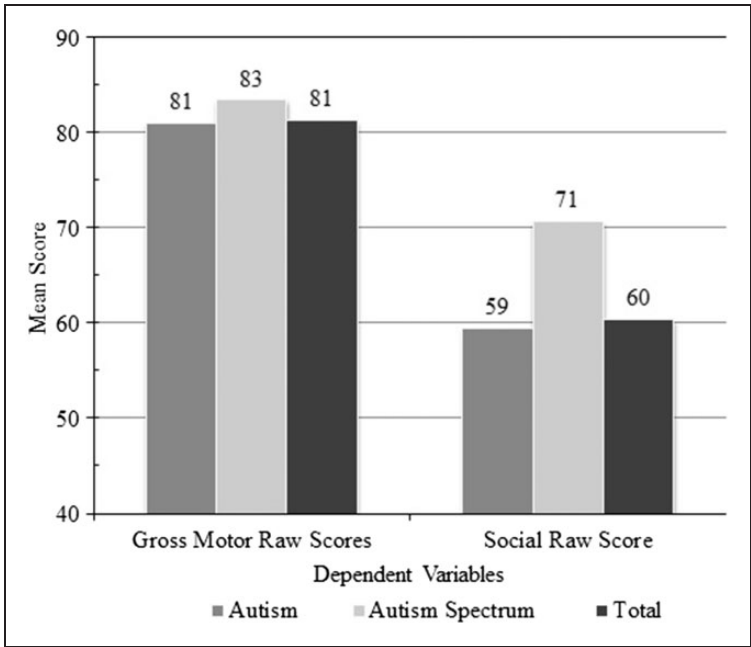
Wilk's criterion indicated that the combined dependent variables were not significantly related to severity of the autism diagnosis,  $F(2, 480) = 1.64, p = .19$ . Thus, the combined multivariate means of the two severity groups were not significantly different in terms of social skills and gross motor abilities. Results further revealed a very weak association between the severity of these groups and their gross motor and social skill scores, partial  $\eta^2 = 0.007$ , and, due to the nonsignificant results, no step-down analysis was conducted.

Analysis of the between-subject effects on univariate tests further revealed a nonsignificant difference between the groups on gross motor scores,  $F(1, 201.883) = 1.303, p = .25$  (See Table 2). Participants in the less severe group (autism spectrum) scored arithmetically higher ( $M = 83.31$ ) than those in the more severe (autism) group ( $M = 80.93$ ) (see Figure 1), but the  $p$  value was greater than an alpha of .05, and this arithmetic difference was not judged to be statistically significant. This nonsignificant difference was also seen in the social skill univariate evaluation,  $F(1, 4535.99) = 2.24, p = .13$ . While the less severe group ( $M = 70.62$ ) again scored arithmetically higher in social skills than the more severe group ( $M = 59.37$ ), as would be expected, differences were not statistically significant (see Figure 1). Effect sizes further demonstrate a very weak association between gross motor and social skills and group severity, partial  $\eta^2 = 0.003$  and partial  $\eta^2 = 0.005$ , respectively. Similarly, a post hoc analysis of the correlation between dependent variables revealed a very weak, nonsignificant association between the dependent variables,  $r = .08, p = .06$ .

## Discussion

The purpose of this study was to enhance an understanding of differences in gross motor and social skills among different groups of children diagnosed with autism or autism spectrum prior to the introduction of the DSM-5 that no longer differentiates these groups. A nonsignificant MANOVA result from data analysis of a relatively large data base suggests that there is no clear relationship between ASD severity level and motor and social skills in children with ASD. This sample was not directly compared with any control group of peers without ASD, making it difficult to ascertain whether a deficit is present in the performance of either gross motor or social skills. Yet, when comparing the

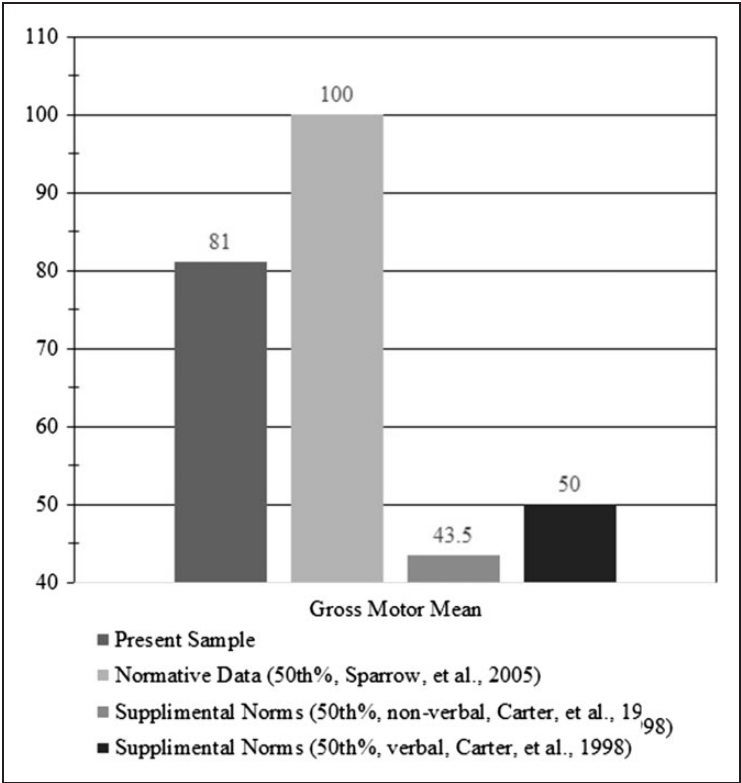




**Figure 1.** Sample means by group.

gross motor data of the present sample to normative data from the VABS-II (Sparrow et al., 2005), as well as data from a supplemental normative group with autism (Carter et al., 1998), it is evident that the present sample's data may not be an accurate picture of more typical motor deficits among children with ASD (see Figure 2). Using the VABS-II normative data ( $M = 100$ ,  $SD = 15$ ; Sparrow et al., 2005), the present sample's score is one standard deviation below the mean of the normative sample, which shows delay, but not necessarily a deficit. Conversely, when using supplementary norms for children with ASD (Carter et al., 1998), a score of 43/44 or 50, depending on whether or not the child was nonverbal or verbal, respectively, would place the child at the 50th percentile. A score of 72 or higher would place them at the 99th percentile, regardless of communicative ability. The present sample's mean (81), regardless of autism severity, would place them at the 99th percentile, demonstrating that the present sample may represent the highest end of performers among those with ASD. This high-functioning subset may have resulted from a participant selection process that excluded children with such severe motor skills they could not be assessed with the ADOS.

Furthermore, the difficulty in finding group differences may be due to a reliance on the ADOS or ADOS-2. While often considered the gold standard for autism diagnosis, this measure may not be sensitive enough, on its own, to detect



**Figure 2.** Sample, normative, and supplemental motor means.

differences in subsets of ASD; hence, the executive decision to consolidate sub-labels of autism under one ASD umbrella term in the DSM-5 (APA, 2013). This study provides evidence to suggest that—for diagnostic purposes—practitioners should utilize a battery of assessments to make an ultimate decision, as the ADOS scores (used in this analysis) were unable to detect known differences in social ability. In regards to motor skills, while it has been suggested that severity has an impact on gross motor ability (MacDonald, Lord, & Ulrich, 2014) and motor skill deficits may be hallmark to ASD (Flanagan, Landa, Bhat, & Bauman, 2012), perhaps differences in motor skills in more “severe” cases of ASD may be related to other mitigating factors, such as IQ, verbal communication, or motivation.

What is evident, however, is that these groups demonstrate similar performance on both the assessments. These findings are in contrast to previous research that found a link between level of autism severity and motor skills (MacDonald et al., 2014). Previous research demonstrating associations between gross motor

scores and social skills (MacDonald et al., 2013), as well as relationships of gross motor scores and autism severity (MacDonald et al., 2014) utilized different gross motor assessments than what were used in this analysis and accounted for the breadth of scores from the ADOS, instead of the dichotomous groups based on the composite scores from the assessment. MacDonald et al. (2014), in assessing the relationship of motor and social skills in children with ASD, utilized the Test of Gross Motor Development (TGMD-2). Using a sample of 35 participants (mean age 9.2 ( $\pm 2.5$ ) years) with ASD, MacDonald et al. demonstrated that object- control skills successfully predicted social communicative skills as indicated by calibrated autism severity scores (2013). In this analysis, overall gross motor scores did not demonstrate a significant interaction (MacDonald et al., 2013). The results from this analysis demonstrated that there is an interaction between social skills and motor skills; however, it is uncertain that motor skills are causing the interaction. In the current analysis, the gross motor measure was an overall measure and, perhaps, was not sensitive enough to detect the specific differences captured by the TGMD-2. Furthermore, in an analysis of motor skills and calibrated autism severity, MacDonald et al. (2014) utilized the gross motor quotient from the MSEL to analyze the differences within severity groups. In an analysis of 159 participants between the ages of 14 and 33 months, results showed children with lower fine and gross motor skills had higher calibrated autism severity scores (MacDonald et al., 2014). This result was one the first studies to demonstrate a direct relationship between motor skills and calibrated autism severity in young children with ASD (MacDonald et al., 2014). Perhaps the assessments utilized in the above studies are more sensitive, stand-alone assessments of gross motor ability than the gross motor subtest of the VABS-II. The nonsignificant result demonstrated in the present study may be attributed to the difference among the assessments used in prior research.

Additionally, the average age of children used in the SFARI database was approximately 5.6 years of age. Differences in populations may not have been great enough at this relatively young age. It has been suggested that, without intervention, delays and deficits in gross motor ability may increase with age (Lloyd et al., 2013; Staples & Reid, 2010). Perhaps in several years, the gap in gross motor ability between the more and less severe group may grow. While research on the longitudinal differences of motor development is lacking, Staples et al. (2012) suggest that when research on motor ability in ASD is looked at collectively, the gap between typically developing peers and individuals with ASD continually increases. Deficits within severity levels may continue to increase as well, although further research is needed to understand this issue. MacDonald et al. (2014) found a significant delay and difference in severity level among toddlers (aged 12–33 months); however, their analysis focused on severity as a continuum, whereas the present analysis focused on differences between severity groups in aggregate. The severity of ASD at very young ages may

provide important insight into differences between the levels of severity; however, there may be other confounding factors that impact the production of motor tasks at such young ages. Further, gross motor assessments of toddlers focus on underlying movement concepts, such as balance and coordination, whereas motor assessment of older children focuses on the production of skills. Perhaps severity of ASD has an impact on the balance and coordination of an individual, which ultimately will impact the production of skills. Within this present analysis, no differences were seen between the two severity groups; while both groups demonstrated delays, neither group was significantly different from one another on the production of motor tasks. This suggests that, perhaps, gross motor ability is impacted equally regardless of severity diagnosis and should not be a differentiating factor between levels of ASD severity, but treated equally within all children with ASD.

While there was no statistical difference between groups on gross motor and social skills, when looking at the means for each group on the dependent variables (Figure 1), the less severe group scored higher in each area. The differences in social skills resemble what would be expected when assessing each group for social communicative ability. Since diagnosis for ASD is heavily weighted on social communicative ability, the presence of lower social skills within the more severe group is in line with diagnosis. When looking at the means of the gross motor skills, the less severe groups performed slightly higher than the more severe group, which echoes research findings (MacDonald et al., 2014); however, in the present sample, differences were not significant. While this study provides further insight into how motor skills and social skills are affected by the severity of autism and ASD, there are several limitations to this analysis that are acting as potential hindrances toward a significant finding:

### *Uneven Groups in Sample*

In this analysis, there were many more participants in the more severe group (Autism), when compared with the less severe group (autism spectrum). While potentially hindering the MANOVA, this is likely to be a fair representation of the disproportionate number of children with the more severe diagnosis in the overall sample. Parents with children with more severe forms of ASD may be more willing to volunteer their child for research and be more willing to accept their child's diagnosis. Parents of children with less severe forms of ASD may not have had their child diagnosed because they are "keeping up with peers" and it is not yet an issue, or they are in denial of the disability itself and have not yet come to terms with their child's diagnosis. Future research should look to include individuals with all levels of diagnostic severities, even targeting those that are on the cusp of diagnostic eligibility.

**Table 1.** Descriptive Statistics by Severity Group.

	Autism (N = 444)		Autism Spectrum (N = 49)	
	Gross motor	Social	Gross motor	Social
M (SD)	80.93 (12.43)	59.37 (44.81)	82.90 (12.72)	65.38 (46.87)
Range	[51, 121]	[1, 166]	[56, 124]	[1, 155]
Kurtosis	−0.236	−1.260	1.624	−1.408
Skewness	0.220	0.342	0.611	−0.124

Note. Gross motor = dependent variable as a result from Vineland Adaptive Behavior Scales subtest; Social = dependent variable as a result from Social Responsiveness Scale; Range = minimum to maximum.

**Table 2.** Between-Group Univariate Output.

Variable	Value	F	df	p	Partial $\eta^2$
Gross motor skills	201.88	1.399	1, 483	0.254	0.003
Social skills	4535.97	2.242	1, 483	0.135	0.005

*Gross Motor Variable Not Sensitive Enough*

Table 1 shows that the standard deviation among gross motor scores among children in this study is small, compared with the variance seen in their social skills. This could be because the gross motor assessment on the VBAS-II was limited to a small number of items within only one subtest, whereas social skills data were from a more extensive assessment and were represented by a composite score of several subtests. Furthermore, the results from the VABS-2 are from parent report, which is not as reliable as a direct measure. Of course, more extensive assessments are difficult to obtain with large datasets of this kind, as they require more time, money, and effort in data collection. Another concern lies in the exclusion/inclusion criteria for recruitment, limiting participants to those that can perform motor tasks. Future research could benefit greatly by including these direct motor skills assessments within an overall assessment protocol. Furthermore, researchers could benefit by gaining an understanding of how gross motor ability is related to other measures within larger populations.

*Little Correlation Between Dependent Variables in This Dataset*

Typically, MANOVA analyses use moderately correlated dependent variables ( $r \geq .20$ ). In this analysis, a Pearson’s  $r$  result of .085 demonstrates a very weak

correlation and thus a very limited relationship between the two dependent variables. It remains unclear whether this is a function of the particular assessment tools used, a unique subsample of children with ASD, or a more marginal relationship between these neurodevelopmental skills among children with ASD than was expected. Further research is warranted to investigate these remaining questions.

## Conclusion

This study provides insight into problems associated with evaluations of gross motor and social skills severity for children with ASD. Our finding of no statistical difference between severity groups defined by the ADOS suggests that for young children (about 5 years of age) capable of taking the ADOS, there is little difference between ADOS-defined severity groups of “autism” and “ASD.” Further research is needed, utilizing varying assessment tools (and especially direct assessments of motor skills) with a broader range of diagnostic severity and over both a larger age range and over time to better determine how these variables may interact and change over time.

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## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## MOTOR PERFORMANCE

# Exploring the Effect of Gender and Disability on Gross Motor Performance in Kindergarten Children

Andrew M. Colombo-Dougovito

### Abstract

**Background:** Gross motor movement is a vital part of the growing process and ultimately plays a role in a person's ability to lead a physically active life. Researchers have analyzed the different ways in which individuals develop skills. At the heart of that discussion has been gender. Most recently, researchers have focused on the differences among various forms of disability. However, little has been done to understand how these variables interact with each other in the development of gross motor skills. **Objective:** Therefore, in this study I sought to explore the interaction of disability and gender on gross motor performance. **Method:** Utilizing a national dataset, the Early Childhood Longitudinal Study - Kindergarten Class of 1998–99 dataset (ECLS-K), I utilized a  $2 \times 2$  factorial ANOVA to understand the effects of gender and disability on gross motor score. **Results:** A large sample ( $N = 16,960$ ) was utilized to indicate a significant interaction effect of gender and disability, as well as significant main effects. Results suggest that both gender and disability have an effect on gross motor performance; specifically, boys with disabilities are at a higher risk for having low gross motor skills. **Conclusion:** The significant re-

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*sults from this analysis demonstrate that gender and disability have an effect on the gross motor ability of young children. In contrast to other literature, in this study female participants performed slightly better than male participants did, and in line with other research, in this research the group without disabilities demonstrated a better gross motor score than the group with disabilities.*

Gross motor movement stems from large muscle groups and whole body movement and is essential for all locomotor movement such as walking and running and for object-control movements such as throwing and kicking. These skills are typically attained and developed through early childhood and mastered as children age into adolescence (Davies & Rose, 2000). Gross motor movement is essential for daily functioning and for physical activity. Without proper development of these large muscle movements, future advancement to more complex motor movements or development of motor competence is difficult. Individuals with a limited or lower motor competence have been shown to have lower fitness levels when compared with individuals with an average motor competence (Fransen et al., 2014; Stodden et al., 2008). Early development of gross motor skills is vital to increasing the likelihood of continued physical activity.

Understanding individual difference in development is the best way to understand how to improve the development of skills. Motor deficits among various populations with disabilities are apparent with the research literature, when these individuals are compared with their peers without disabilities. In recent research, children with autism spectrum disorder (ASD) have shown significant delays in motor skill performance when compared to typical peers (Liu, Hamilton, Davis, & ElGarhy, 2014), as tested with the Test of Gross Motor Development (TGMD-2; Ulrich, 2000). Additionally, individuals with mild intellectual disabilities (ID) have been shown to perform poorly on fitness measures (muscular strength, muscular endurance) when compared with peers without ID (Frey & Chow, 2006). Limited muscular strength and endurance needed for gross motor activities can lead to a limitation of gross motor movements and therefore is concerning for the future possibility of lifetime physical activity. Furthermore, gross motor issues have been documented even in children with learning disabilities who have demonstrated similar development patterns, although behind their typical peers

(Westendorp et al., 2014). Outside of cognitive and developmental disabilities, children who are blind have shown lower locomotor ability and object control skills when compared to their sighted peers (Wagner, Haibach, & Lieberman, 2013). With individual evidence of the deficits of groups with disabilities, it is necessary to look broader to gain a better understanding of how individuals with disabilities vary from those without disabilities.

On the other hand, gender differences among boys and girls have not been as clearly defined. The recent literature has demonstrated differences between genders in locomotor and object control skills (Butterfield, Angell, & Mason, 2012; Crespo et al., 2013; Venetsanou & Kambas, 2011), as well as limited or no differences in locomotor skills (Goodway, Robinson, & Crowe, 2010). Early development of motor ability is dependent on the interaction between environmental and biological factors (Saraiva, Rodrigues, Cordovil, & Barreiros, 2013; Thomas & French, 1985; Valentini, Clark, & Whittall, 2015). Barnett, van Beurden, Morgan, Brooks, and Beard (2010) demonstrated that boys performed better on object control skills than did similarly aged girls. This was further evidenced in a study of 3–6-year-old children in which boys performed better in throwing for distance (du Toit & Pienaar, 2002). Du Toit and Pienaar (2002), in the same study, conversely demonstrated that girls performed better in hopping and balance on one leg. Furthermore, Kakebeeke, Caflisch, Locatelli, Rousson, and Jenni (2012) demonstrated girls performed higher than boys on a majority of balance-type gross motor tasks such as standing on one leg, walking on a beam, hopping on one leg, rising, running, and jumping up and down. Gender differences are evident across a magnitude of motor skills; however, there appears to be a trend that girls perform better on locomotor-type skills and boys on object control skills (Goodway et al., 2010; Lorson, Stodden, Langendorfer, & Goodway, 2013).

Few researchers have looked at how the interaction of gender and disability affect gross motor performance. Evidence suggests how the individual variables may affect gross motor performance; however, it is not clear how they work together. Therefore, the aim of this study was to explore the relationship of gender and disability on gross motor performance, in order to understand (1) How do gender and disability affect gross motor performance? and (2) If an interaction effect is occurring, which variable is accounting for the effect?

## Method

### Dataset

A sample from the Early Childhood Longitudinal Study - Kindergarten Class of 1998–99 dataset (ECLS-K; U.S. Department of Education, National Center for Education Statistics, 2001) was utilized in this analysis. This dataset provides a substantial amount of information on the children's status at entry to school, their transition into school, and their progress through eighth grade. The ECLS-K recruited children from public and private schools and from diverse socioeconomic and racial/ethnic backgrounds. Information was recorded on information from reading and math skills, to social/emotional skills, to fine and gross motor skills. Trained evaluators assessed children in their schools and collected information from parents over the telephone. Teachers and school administrators were contacted in their schools and asked to complete questionnaires. (Rock & Pollack, 2002). The original dataset contained over 18,000 variables and around 22,000 child participants (Rock & Pollack, 2002).

For this study, three variables were chosen for analysis: gender, disability, and gross motor score. A sample of 16,960 cases was used in this analysis. The sample included 58% White, 14.7% Black/African American, 17.5% Hispanic, 4.2% Asian, 1.7% American Indian or Alaskan Native, and 2.8% identifying as more than one race. Data were taken at the initial entry into school.

### Independent Variables

Two grouping variables, gender and disability, were used to break the sample into comparable groups. Each variable contained two levels. Gender was labeled as male ( $n = 8620$ ) or female ( $n = 8340$ ), roughly 50.8% and 49.2% of the sample, respectively. The disability group was designated as “yes” a disability is present ( $n = 2299$ ) or “no” the child has no disability ( $n = 14,661$ ), for 13.6% and 86.4% of the sample, respectively. In the case of the disability variable, project staff asked schools whether the child had an individual education plan (IEP), an individualized family service plan (IFSP), or a 504 plan; once children were identified as receiving special education assistance due to disability, project staff identified what accommoda-

tions were needed to be made to administer the direct child assessment batteries appropriately (Rock & Pollack, 2002). Considering the difference in sample size between the group with a disability and the group without, and considering the U.S. population as a whole, this sample is fairly representative of what would be expected. In this dataset, disability is a very dichotomous simplification of a heterogeneous group; however, the use of this variable allows for a global understanding of the differences of those with and without disabilities. Additionally, this was the only indication of this population within the dataset. The original collectors of this data did not go into depth into what specific disabilities the included children had. The sample for this study was limited to cases in which both independent variables were known; data were considered missing completely at random, as data was being analyzed secondarily, and missing data were independent of observed variables.

**Dependent Variable**

The gross motor score of participants was utilized as the dependent variable. The gross motor score is a summative score of a multitude of tests taken from outside assessments and utilized in aggregate for the dataset; assessment items combine jumping, balancing, hopping, skipping, walking backward, and a bean bag catch. Maximum scores for individual tests were between 1 and 2. Total scores ranged from a minimum of 0 to a maximum of 8 (see Tables 1 and 2). Only an aggregated gross motor score was included in the dataset; individual assessment items scores were not included. Individual testing items were taken from a multitude of assessment batteries; these focused predominantly on body control and coordination (e.g., balancing on one foot, hopping on each foot, skipping, and walking backward on a line; West, Dento, & Germino-Hausken, 2000).

**Table 1**  
*Descriptive Statistics of Gender*

Gender	<i>n</i>	Gross motor <i>M</i>	Gross motor <i>SD</i>	Kurtosis	Skewness
Male	8620	6.13	1.918	0.461	-1.016
Female	8340	6.64	1.645	1.116	-1.247
Total	16960	6.385	1.782		

**Table 2**  
*Descriptive Statistics of Disability*

Disability category	<i>n</i>	Gross motor <i>M</i>	Gross motor <i>SD</i>	Kurtosis	Skewness
Yes	2299	5.97	2.014	0.131	-0.901
No	14661	6.45	1.764	0.932	-1.177
Total	16960	6.21	1.889		

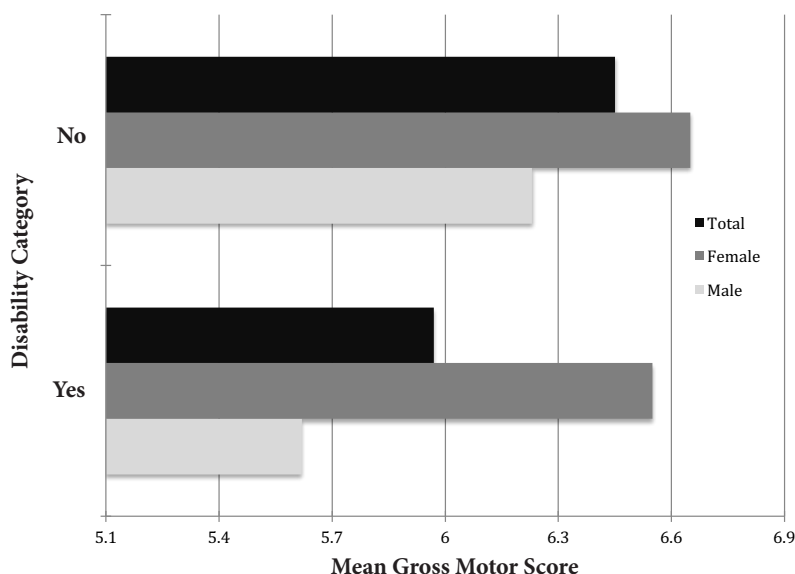
**Data Analysis**

The relationship of gender and disability on gross motor score was explored utilizing a two-way factorial ANOVA to analyze the interaction. The factorial ANOVA tested for any differences of between-subject effects of gender, disability, and the interaction of gender and disability. Prior to analysis, data were analyzed for univariate outliers through analysis of the histograms, skewness, and kurtosis as well as the standardized values ( $M < 3.29$ ) within groups. No outliers were identified; therefore, all 16,960 cases were used in the analysis.

**Results**

Descriptive analysis revealed female participants both with and without disabilities ( $M = 6.64$ ,  $SD = 1.645$ ) scored slightly higher than male participants ( $M = 6.13$ ,  $SD = 1.918$ ; see Figure 1). Similarly, the group without disabilities ( $M = 6.45$ ,  $SD = 1.764$ ) demonstrated a higher mean gross motor performance, than the group with disabilities ( $M = 5.97$ ,  $SD = 2.014$ ) (See Figure 1). Each of the groups demonstrated scores very close to the maximum possible of 8, demonstrating a potential ceiling effect.





**Figure 1.** Difference within gender and disability.

The factorial ANOVA resulted in a significant result within the interaction between gender and disability on gross motor score,  $F(1, 16956) = 39.424$ ,  $p < 0.001$ ,  $\eta^2 = 0.002$ , demonstrating a significant interaction effect of both gender and disability on gross motor ability. Furthermore, significant results were shown in the main effects between the gender groups,  $F(1, 16956) = 272.895$ ,  $p < 0.001$ ,  $\eta^2 = 0.016$ , and between the disabilities groups,  $F(1, 16956) = 75.672$ ,  $p < 0.001$ ,  $\eta^2 = 0.004$ , further showing a significant difference between each of the levels of both gender and disability. However, each of the eta-squared effect sizes reveals that gender and disability account for a very small amount of the variance.

Further, the effect sizes of the main and simple effects were measured with the guidelines outlined by Cohen (1977), and each group demonstrated a small effect. Main effects between the female and male group ( $ES = 0.285$ ) and the group without disability and with disability ( $ES = 0.254$ ) were small, demonstrating about a quarter standard deviation difference between the groups. The simple effect analysis of the female group without disabilities and the male group without disabilities revealed a small effect size ( $ES = 0.262$ ). A moderate effect size ( $ES = 0.492$ ) was shown in the difference of the

female group with disabilities and the male group with disabilities, demonstrating a relatively large difference between girls and boys with disabilities.

## Discussion

In this study, I sought to explore the relationship of the interaction between gender and disability on gross motor score. A factorial ANOVA demonstrated significant although very small main effects and a significant interaction effect. Results indicate that gender and disability play a role in the differences revealed in this analysis. Through this analysis, it can be suggested that both gender and disability have a factor in how a child develops motor skills. This result in itself is not surprising or overtly contrary to the commonly held beliefs that (1) boys and girls perform skills differently and (2) individuals with disabilities would have gross motor scores less than those of their peers without disabilities, but it does provide sufficient foundational evidence to warrant an inquiry into which gross motor skills are hindered because of the disability.

Moreover, these results provide contrary evidence to the previous research on gender, but more important provide a unique look at a young, large sample of boys and girls with and without disabilities. Results from this study suggest that gender and disability have some type of mitigating effect on the development of gross motor skills, but the exact effect within this analysis is difficult to ascertain. Furthermore, in this analysis the small effect sizes for the ANOVA suggest that other factors (e.g., age, race, or socioeconomic status) may explain the differences, as gender and disability account for less than 2% of the results. Previous research (Saraiva et al., 2013; Thomas & French, 1985; Valentini et al., 2015) has suggested that the differences in gender groups are caused by an interaction of social and biological factors, which often favor boys (Crespo et al., 2013). However, results from this analysis are taken from a sample of pre-pubescent children, so biological factors should be limited.

In a recent analysis of parent and child perceptions of fundamental movement skills, Liong, Ridgers, and Barnett (2015) found that parents' perceptions of girls' locomotor skills were significantly and positively associated with girls' actual locomotor scores ( $r = .48$ ). Parents had similar perceptions with boys' scores for object control skills ( $r = .58$ ). Evidence from this study suggests that par-

ents' judgment of skills indicates some level of stereotyping (Liong et al., 2015). Perhaps differences seen in young children are a factor of what children are expected to do, as well as encouraged to do. If young boys are encouraged to perform more stereotypical activities such as soccer and baseball, then they will likely be more proficient in the fundamental motor tasks associated with those skills. If girls are encouraged to participate in activities such as jump roping and hopscotch, then they will likely have a higher affinity to activities using balance and locomotion. These differences are evident within these results, as well as in previous research (Barnett et al., 2010; du Toit & Pienaar, 2002; Kakebeeke et al., 2012), as the motor assessment battery chosen for this assessment contained a majority locomotor and balance-type skills, with one singular object control task (catching a tossed bean bag). Within the assessment battery there were no other throwing or object control items, which, based on previous research, would favor boys. A lack of object control activities in the assessment likely attributed to the girls having a greater mean score regardless of disability. It also does not completely capture the skills necessary to be proficient in all gross motor movement.

Considering the differences shown between the group with and without disabilities, the results in this analysis are, again, what would be expected. This analysis allows for global understanding of the differences between those with and without disabilities; however, the effect of the disability is difficult to understand fully because all children labeled "with a disability" were included in this group based on the presence of an IEP. An IEP is not a detailed enough record when trying to understand why there are differences between these groups. Children with an IEP have this for a multitude of reasons, which stem from physical, cognitive, or behavioral disabilities, all of which have drastically different effects on their ability to learn and utilize knowledge. The database used for this study, by defining disability based on the presence of an IEP, may indicate the presence of limited opportunity, as with stereotyping between gender groups. The pressures to provide services within the IEP process and for schools to prioritize services (Whitby, Marx, McIntire, & Wienke, 2013) may lead to some children being given certain services (e.g., speech) over others (e.g., adapted physical education [APE] or occupational therapy [OT]). When schools prioritize and place more

emphasis on certain services, the child may have a limited opportunity to learn motor skills. Further, there may be a misunderstanding of the items taught in OT versus APE, with a belief that services are similar and therefore both are not needed. Research has demonstrated that deficits exist among children with disabilities in regard to motor ability; therefore, what may be evidenced in this result is that although biological factors may exist, perhaps it is also a limited accessibility (e.g., environmental factor) to learn tasks that is causing a difference.

There were simple effects with each group, and again, in this study girls outperformed boys in both groups regardless of having or not having a disability. However, what is prevalent is how much better the girls with disabilities performed than the boys with disabilities. The girls' mean gross motor score was nearly one half a standard deviation ( $ES = 0.492$ ) higher than the boys', indicating that not only is the presence of a disability having an effect on the motor ability of children, but gender is also having an effect. Results indicate that boys with disabilities are at a higher risk for having lower motor skills. It is difficult to discern whether the lower motor tasks are due to the type of assessment used or the type of disability. It can be discerned, however, that boys with disabilities are at risk; therefore, educators should be aware that this could occur and provide ample opportunity for practice so that these boys can reach the level of their peers.

Considering the practical application of these results, it is important to understand that although there are specific differences among boys and girls with and without disabilities, boys with disabilities performed lower than any other group. Further, children with disabilities demonstrated lower scores than did those without disabilities. The differences, however, are only accounted by a small amount from gender and disability, especially in young children. These differences may be further affected by variables not accounted for in this analysis. The race, age, or socioeconomic status of individuals may account for a greater amount of difference than gender or disability. Similar to Liong et al.'s (2015) results, these results indicate that parents and teachers should advocate and encourage the growth of all skills necessary for gross motor movement and provide opportunities for practice and development, especially for those with dis-

abilities. Moreover, teachers and parents can ensure that they focus on all skills sets, as the development of gross motor tasks allows for children to progress to the more complex movement needed to lead physically active lives. Future research should analyze the specific differences in gross motor skills of those with disabilities, to understand better what skills are hindered more by the disability.

## **Limitations**

The data included in this study were a selected sample from a much larger dataset and therefore outside of my control. Two practical issues limit the application of these results. The first is that limitation is the restricted factor of the disability category. The data provide a global look at the effect of disability, but they do not provide specific detail to understand individual differences in children. When the data were collected, no specific diagnosis was collected, which could encompass a variety of diagnoses. In the future, researchers should collect a variety of diagnoses to allow for a deeper analysis.

The second limitation was the gross motor assessment utilized. First, the assessment items were collected from a variety of other validated assessments and not validated on their own merit. Future research in which data are collected should include a validated assessment battery to ensure that the construct is covered by the associated test. This would ensure that the scores collected are a fair representation of the participants' gross motor ability. Additionally, the only data included were the aggregated gross motor composite scores. Including the scores for each item would allow for a deeper analysis of locomotor and object control skills. Although the scores demonstrated a significant result, the result provided little practical application because it did not allow for an in-depth analysis. Moreover, the variety of gross motor items were a collection from a variety of other gross motor assessments and may have favored the girls in this analysis because of the lack of object control-type skills. To gain a better understanding of how gross motor skills develop and to find how those skills appear in different groups, researchers should use large datasets that include a validated measure. By doing so, they will have the potential to understand how motor skills relate to other skills such as academics.

## Conclusion

The significant results from this analysis demonstrate that gender and disability have an effect on the gross motor ability of young children. Contrary to other literature, female participants performed slightly better than did male participants, and in line with other research, the group without disabilities demonstrated a better gross motor score than the group with disabilities. However, the grouping factors only accounted for a small amount of the variance between each group. Researchers should include other factors that may play a more vital role in the differences between these groups. Additionally, future research should include the individual testing items to allow for the ability to analyze which gross motor skills are having the greatest effect as a result of gender or disability. However, these results suggest that educators and parents can work to alleviate some of this difference by providing equal opportunities to practice all types of skills involved in gross motor movement. Further review of this interaction is needed, with a more sensitive gross motor measurement, as well as including diagnosis of each participant.

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# The role of dynamic systems theory in motor development research: how does theory inform practice and what are the potential implications for autism spectrum disorder?

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**Abstract:** Dynamic systems theory (DST) outlines three constraints (i.e. individual, task, and environment) that influence the emergence of behavior. These constraints interact with one another to self-organize and create a spontaneous behavior. For many researchers studying motor development, this spontaneous behavior refers to the production of motor movement. DST provides an explanation for the variability and spontaneous movement that occurs from individual to individual. While this theory is accepted as one of the major explanations of motor development, it is unknown how it is being utilized to inform the research on motor development or the development of interventions. In this review, the author found 18 instances in the literature where DST had been used to analyze, test, or manipulate motor patterns and movement. Overall, the studies report a positive effect from the manipulation of constraints with respect to a change in motor pattern. Only one study was found that sought to positively improve behavior through the directed use of constraints; the majority of studies sought to understand the influence constraints have on the production of movement.

**Keywords:** autism spectrum disorder; constraints; dynamic systems theory; motor development.

## Introduction

The coordination of the human body to produce movement is a complex, systematic process [1]. This occurs largely unnoticed by the individual performing the

movement and refers to the underlying processes of an individual's motor ability; often, the emergence, change, and growth of those abilities are considered motor development [2]. The idea of studying the dynamics of motor development in individuals is a research focus lacking great depth in understanding, relatively speaking in the context of research on human behavior. However, it has deep-seeded roots within larger fields of developmental research as far back as the late 1700s [3], including work from Darwin [4] and Shinn [5]. Early work in motor development was completed, primarily, by child psychologists in an attempt to comprehend the “nature versus nurture” phenomenon [6]. By the mid-20th century, motor development researchers seemed to have learned everything there was to know about motor behavior, and by the 1960s, researchers moved away from the biology of how motor movements were occurring toward more psychological aspects of cognition, language, and social development [7]. Nearly 30 years later, researchers reinvigorated motor development research, questioning the traditional views of how motor skills are thought to be attained and developed throughout the lifespan [8].

## A brief history of motor development

Clark and Whitall [9] suggested four clear divisions in the focuses and theories driving thought in motor development. These were the Precursor Period (1789–1928), the Maturation Period (1928–1946), the Normative/Descriptive Period (1946–1970), and the Process-Oriented Period (1970–present). In the most recent developmental period of research, the Process-Oriented Period moved from predominantly focusing on what an individual can do to how an individual can do it. Early thinking in this period focused on information-processing theory, which, stemming from maturational theory, suggested the human brain functioned similarly to a computer in that movement processes are called up by the brain for the body to perform [10]. Once an individual learns the process of a

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movement, that information is stored to be recalled when needed. Realistically, this discrete, linear development of the brain does not fully cover the complexity that is human movement [1, 11].

Thelen and Ulrich [11] questioned the neuro-maturational explanations of causation and cite the central issue with this prospective as limiting the scope of how movement is derived through behaviors arising from the interaction of many underlying subsystems and processes. While each discipline of thought has contributed multiple theories providing unique and crucial insight, often, these theories are focused on one singular aspect of development [12]. This growth of, typically, incompatible theories is as daunting to many development specialists as it is to practitioners attempting to use them, largely due to the little shared similarities [12]. An alternative theoretical explanation offers a multi-faceted approach to motor development and is referred to by a variety of terms, including coordinative structure theory, dynamical perspective, dynamical systems, dynamical pattern theory, ecological approach, or constrain-based/led approach [13], but is more predominately known as dynamic systems theory [14].

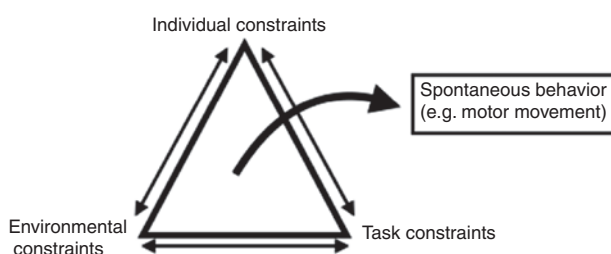
## Dynamic systems theory

The concept of dynamic systems is popular across a multitude of fields, including, but not limited to, mathematics, physics, astronomy, chemistry, meteorology, and the biological, cognitive, neurological, and social sciences [11], and most recently, in the fields of physical and occupational therapy. Dynamic systems theory (DST) [14, 15] suggests that a behavior occurs as the confluence resulting from interactions of the characteristics of the individual, environment, and task (see Figure 1). These are commonly referred to as constraints. Newell [14, 15] outlined that it was constraints that allowed for the coordination of a behavior within an individual and allowed that behavior to emerge. Often, when spoken of in the motor development

domain, this behavior is referred to as movement; however, the interaction between the three constraints could result in any form of behavior, not just movement.

It is from this framework that many developmental specialists studying motor behavior (see the collective published works of Jane Clark and Ester Thelen) in individuals have explained the complex coordination of all the influences on movement. The term individual is more common in recent literature over Newell's term organismic [14], mostly due to relating the theory to human movement as opposed to the general, bio-mechanical definition given by Newell. Individual constraints are often considered to be the structural (e.g. weight, height, etc.) and functional (e.g. motivation, attention, etc.) characteristics that a person possesses unique to him or herself [16]. Therefore, environmental constraints refer to everything that exists outside of the individual; for example, the temperature, time of day, space (e.g. inside or outside), or the surface of the floor/ground could all be considered environmental constraints [17]. Hutzler [18] takes environmental constraints a step further, including social (e.g. peer, parent, and professional attitudes and support) and physical barriers (i.e. accessibility). Lastly, task constraints encompass everything involved in the action itself. These constraints could include the directions of the task (e.g. keeping personal space), the movement goals (e.g. doing something very quickly or slowly), or the equipment being used [19]. Often seen as a negative term synonymous with restraints, constraints under DST are viewed neither as negative or positive but a neutral term referring to the influence on behavior (in this case, motor movement) to encourage the production, and over time, development of that behavior [19]. This seemingly has a greater appeal to understanding the complexities of human movement, as throughout the lifespan, new behaviors emerge, evolve, and, on occasion, dissolve [13], but most importantly, have difficulty manifesting themselves the exact same way twice [20].

Furthermore, DST [14] changes the focus of movement from being a program that is run or performed to an emergent behavior based on the coordination of the various degrees of freedom. By accounting for influences from the constraints within the individual, the environment, and the task itself, the body is able to coordinate movement. If the brain was left to control each of the degrees of freedom, humans would be limited to one singular movement or task at a time. Take walking from a concrete surface onto an icy surface, for example. If the brain was the sole provider of information for movement, by the time the brain recognizes what is occurring, the individual would have already fallen to the ground. In contrast, DST suggests that most action occurs within the



**Figure 1:** Newell's model of dynamic systems theory.

central nervous system, and based on the influence from constraints, explores all potential possibilities, settling on the most effective (i.e. attractor state) based on those constraints [21]. Thus, when the individual steps onto an icy patch, this new constraint alters the other constraints and the individual shifts his/her motion to remain at equilibrium (e.g. standing upright and moving forward).

DST builds upon research from Bernstein [22], which rejects motor movement as being a simple progression of one skill to the next. Bernstein defined movement in terms of coordination, the cooperative interaction of multiple body parts, and processes to produce a unified outcome [23]. Further, Bernstein ([22], as cited in Thelen [7]) argued that researchers must reject the notion of a one-to-one relationship of “neural codes, the precise firing of the motor neurons, and the actual movement pattern”. In order for movement to occur and for the body to coordinate the potentially infinite combination of muscles, nerves, cells, as well as body segments and joints, there must be external forces outside of the brain’s control influencing behavior and restricting the degrees of freedom [22]. According to Newell [14], constraints are how certain degrees of freedom (e.g. the possibilities of movement in any given system) are limited. Constraints act as vital limiters to movement and influence efficient, effective patterns of movement.

In DST, the spontaneous pattern formation that emerges from the interaction of constraints is considered to be self-organizing [1, 7, 24]. Self-organization is the body’s ability to find a stable pattern of movement based on the influence of constraints [20]; these stable states are often referred to as attractor states [7, 11]. An attractor state refers to the preferable pattern based on a set of constraints [7, 25], but it is not the obligatory pattern [1]. As the influence of constraints is a constantly evolving process, constraints evolve, gaining and losing importance in their ability to influence movement. Behavior (i.e. movement) is dynamic and adaptive; there are multiple, redundant pathways to reaching the same goal [26] and learning takes place through patterns emerging according to the affordances and constraints [18, 21]. Therefore, the changes in motor ability, within a dynamic systems model, are considered to be nonlinear with step changes being the norm [12], meaning that as one constraint changes, that constraint, in turn, affects the growth and influence of the other constraints, producing a new movement pattern [19, 27]. Additionally, not one subsystem of constraints holds privilege, nor contains all the elements for the skill [1]. Therefore, by changing one or more of the parameters of movement for an individual, DST predicts that subsequent adaptation of the remaining constraints

will be adjusted, resulting in a change in behavior [13, 25]. This provides a potentially more in-depth mode of modifying movement, than previous theories. Researchers and practitioners can evaluate the whole situation to better understand what is acting as a limiter within the movement and analyze what needs to be addressed through intervention.

## Implications for individuals with autism spectrum disorder

The individual influence from each constraint within DST offers insight into the motor development of every individual, but provides a particularly useful insight into the movement patterns of individuals with disabilities. Instead of looking at disability as a deficit that needs to be overcome, DST suggests that disability is simply acting as an individual constraint which is influencing that person’s movement [19]. By adjusting the viewpoint of disability, building motor skills becomes less about overcoming barriers and more on adapting constraints to encourage more efficient movement patterns. In understanding that one constraint influences another to allow for movement to emerge, by adjusting or modifying tasks or the environment, a practitioner or researcher can create a situation for a more appropriate motor movement to occur [28].

This idea may have great benefit in the area of autism spectrum disorders (ASD). Children with ASD have been shown to have motor development patterns that differ from typically developing peers [29, 30], as well as developmentally matched peers [31]. Further, delays in motor ability appear to occur early in development [32, 33] and become greater as they age compared to peers [34]. As motor development research is a relatively new focus of research in the field of ASD, it is generally lacking depth [35]. Much of the research has focused on understanding the general delay displayed by children with ASD (see Fournier, Hass, Naik, Lodha, and Cauraugh [36] for an overview); however, impairments do not appear to be totally universal [37].

An effective method for improving the motor abilities of children with ASD is lacking. As much of the research on ASD has focused on improving social communicative deficits and repetitive behaviors [38], the hallmark of ASD diagnosis [39], there has been little done beyond making modifications based on previous evidence-based practices [40] or modifications to better include children in activity [41], as well as to improve performance on motor assessments [42, 43]. While each of these is necessary, a dedicated intervention built on a sound theory is needed



to assist in building necessary skills so that children can be effectively included with peers, which will ideally increase the likelihood of sustained physical activity over time [44] and social opportunity [45]. Furthermore, interventions for young children with ASD may have a potential to help with language development [46].

DST may provide the guiding insight into how this intervention should appear and how constraints can be modified to make meaningful change in the motor ability of individuals. Although the efficacy of DST has not been formally tested, there are examples of how utilizing constraints has shaped behavior [20], even if those doing the work did not fully realize their inclusion of DST. By modifying constraints of a task or within the environment, an intervention based in DST has the ability to move past what typically limits instruction for children with ASD. Newell [14] suggested that ‘extreme manipulation’ is needed to further test the notions of the self-organization of coordination. Further, Newell and Jordan [15] recommended further research was necessary to understand how the theory worked and could be implemented.

## Purpose

As there is little known about how motor intervention research has been impacted by DST and a lack of motor interventions for ASD, a comprehensive literature review was conducted. The purpose of this review was to analyze how, if at all, DST is being used in motor intervention. Moreover, how is DST informing the practice of building interventions focused on the building of motor skills? Additionally, how has DST been altered to address the motor development needs of individuals with disabilities, specifically ASD? This review focused on published research literature on motor intervention and DST by describing study characteristics and any major findings.

## Methods

The following databases were searched for relevant studies: Academic Search Complete, Education Full Text, Education Research Complete, ERIC, Google Scholar, Physical Education Info, PsycINFO, ProQuest, PubMed, PubMed Central, SPORTDiscus, and ScienceDirect. Article references were searched for additional eligible studies. Studies were identified by searching each of the identified electronic databases and scanning reference lists of identified articles. The search included three lines of search words, including: (a) dynamic systems theory, ecological approach, constraint-led approach; (b) motor development, motor behavior, motor learning, motor skills, gross motor activities, fundamental motor skills; and

(c) youth, children, adolescents. Initial keyword searches analyzing the whole text for terms resulted in nearly 20,000 results; however, in review of these early searches, the author realized that the databases were returning articles simply mentioning ‘dynamic’ or ‘approach’, not the theory itself. As this review is focused on DST, it is likely that these terms would be included in the abstract, title, or keywords. So the first search term was limited to title, keyword, and abstract searches, while the remaining lines were left open to full text searches. This resulted in output that was much more focused to the purpose of this review. In order to account for any articles that were missed during database searches, search results were compared against articles citing Newell’s 1986 article.

## Inclusion criteria

Studies were included in this review if published in the English language in a peer review academic journal between 1986 and August 2015, in which motor tasks were the primary focus of the study and DST was referenced. Exclusion criteria for this study were publication in non-English, prior to 1985, in which motor tasks was not the primary focus and DST was not referenced. Additional exclusion criteria included unpublished theses or dissertations, and conference proceedings. Studies were limited to those post 1986, since this was the year in which DST was first introduced by Newell.

## Overview of articles included

The full search process produced a total of 368 articles. A further search of articles citing Newell’s article produced an additional 1246 articles. Of the 1561 articles found, 1483 studies were excluded for failure to meet the inclusion criteria; common reasons for excluding studies included article duplication, lack of dynamic systems references or theory, motor tasks not the outcome focus, domain outside of kinesiology (e.g. robotics or speech therapy), review or meta-analysis, and either practical or theoretical application of dynamic systems. After the initial search was completed, the author searched, full text, the remaining 78 qualifying articles for studies focusing of DST’s application to motor skills or motor development. Studies were included that had a defined motor intervention searching to build gross motor skills that was definitively influenced by DST. A total of 18 articles were identified that met all criteria and were included for analysis. See Figure 2 for procedure by which studies were selected. Further, Table 1 contains the essential characteristics extracted from each article; Table 2 outlines the main findings of each study.

## Results

### Study characteristics

#### Participants

Of the 18 studies, 5 (28%) focused on infants, 7 (39%) used children, 5 (28%) used young adults, and 1 (5%)

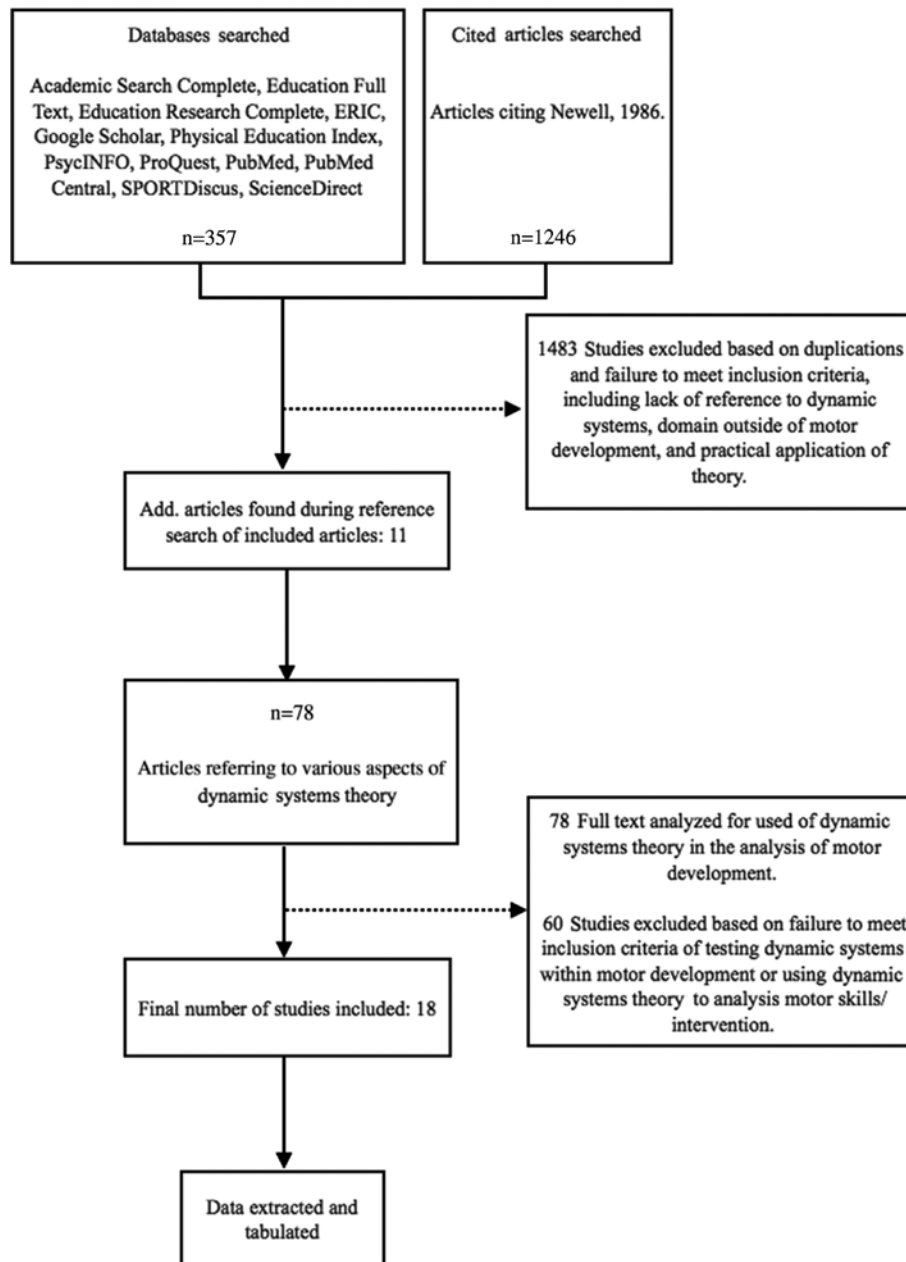


Figure 2: Flow of literature analysis.

used a mixed sample of both adults and children. Of the studies including children, ages ranged between 5 and 14, with the majority of children between 9 and 10 years of age. The studies with young adults focused on participants between the ages of 17 and 26. The mixed group study [52] utilized two separate groups, a young adult (ages between 19 and 25) and children (ages between 9 and 10); groups were analyzed separately, but visually compared for similarities in performance across age groups.

### Characteristics

The majority of studies, 56% (n=10), included children or young adults with no disabilities or health concerns. Twenty-eight percent (n=5) utilized either all participants with disabilities (n=3) or participants with and without disabilities for comparison (k=2). Two studies in which all of the participants had a disability [59, 60] utilized infants with Down syndrome; the other [62] used children with congenital spastic hemiparesis, but no other comorbidities.



Table 1: Study characteristics.

Study	Participants	Characteristics	Measure	Dependent variable	Aspect of DST analyzed	Design
Abney et al. [47]	One infant, 51–305 days old	N/A	Accelerometer, voice recordings, parent diary and questionnaire	Changes in limb and vocal activity patterns over time	Individual constraints	Case study
Astill [48]	20 Children, six girls, 14 boys M age=8.6 SD=1.0	10 with developmental coordination disorder (DCD) 10 without	Catching performance	Number of catches, inter/intralimb correlation	Task constraints	Experimental
Bennett et al. [49]	24 Children, 12 boys, 12 girls M age=9.65 years SD=0.23	Normally sighted, otherwise typically developing, poor catching performance	Catching performance transfer after practice w/ or w/o restricted vision	Catching score (0–5), number of catches, number of misses	Task constraints	Experimental
Clemente et al. [50]	11 Male soccer players. M age=17.91 SD=1.04	Experience in years: M=8.60 SD=1.52	Time within a 1 m <sup>2</sup> within a 20×20 matrix	Player trajectories, distance traveled, time of attack	Task constraints	Experimental
Farrow and Reid [51]	23 Primary school children. M age=8.0 SD=0.4	Limited or no tennis playing experience	Likert scale (1–7) on quality of components of rally performance	Rallying performance, hitting opportunity, success, and engagement	Task constraints	Experimental
Langendorfer [52]	Two separate groups: 34 young adults (17 male and 17 female, ages 19–25 years) and 43 children (23 male and 20 female, ages 9–10 years)	'Non-handicapped'	Throwing performance	Throwing accuracy only, accuracy and force, and force only	Task constraints	Experimental
Langendorfer and Robertson [53]	39 Children (22 boys and 17 girls) filmed at 5.7 year, 6 year, 7 year, 8 year, and 13 year	N/A	Velocimeter (ball velocity), developmental components	Pattern of truck, humerus, and forearm development over time	Individual constraints	Longitudinal
Liu et al. [54]	#1: eight young adults (no age or gender) #2: 11 young adults	N/A Healthy	Rotational speed of a roller ball (hand accelerometer data)	Rate per second	Environmental constraint	Exploratory
Maida and Mccune [55]	Six babies (four boys and two girls split evenly between two groups)	Three sighted, no other handicap, three congenitally blind (either totally or had minimal light perception)	Movement frequency counts at 5 s	Motor skills, prerequisite to crawling	Individual constraints	Exploratory
Ohgi et al. [56]	Six (three male and three female), 1-month-old babies	Japanese, healthy	Accelerometer	Limb acceleration (activity)	Spontaneous movements	Descriptive
Renshaw et al. [20]	Four right-handed batsmen (M age=21, SD=1)	High intermediate skill level	Time, measurements based on changes in location determined by body markers	Timing of swing relative to two conditions	Task constraints	Experimental
Stergiou et al. [57]	10 (seven male and three female) runners (M age=25.9, SD=N/A)	Healthy, running minimum 10 miles/week	Force plate, body markers placed on lower extremity	Change in jumping form based on height of obstacle	Task constraints	Experimental

Table 1 (continued)

Study	Participants	Characteristics	Measure	Dependent variable	Aspect of DST analyzed	Design
Sweeting and Rink [58]	116 Kindergarten and 2nd grade students	N/A	Distance	Standing long jump product score	Environmental constraints	Experimental
Ulrich et al. [59]	12 Infants (M age=13.2 months, SD=2.3)	Down syndrome, sitting independently	Coded steps (alternating, single, parallel, and double)	Steps taken and quality of steps based on context	Task constraints	Experimental
Ulrich et al. [60]	Nine infants (six female and three male), age 8–11 months	Down syndrome	Coded steps (similar to the above)	Number of alternating steps	Individual constraints	Longitudinal
Vernadakis et al. [61]	66 Elementary students, age 6–7 (36 male and 30 female)	1st and 2nd grade in Greece, no disabilities	TGMD-2 <sup>a</sup>	Increase of FMS	Task constraints	Experimental
Volman et al. [62]	12 Children between ages 8 and 14	Congenital spastic hemiparesis (mild or moderate)	PACES <sup>b</sup>	Goal-directed reaching movements	Task constraints	Experimental
Wu et al. [63]	15 Adults (seven men, eight women) M age=23.6 SD=3.9	Healthy, right-handed	Movement time, peak velocity (PV), time to PV, percent reach to PV, movement units	Reaching movements	Task constraints	Experimental

<sup>a</sup>TGMD, Test of gross motor development; <sup>b</sup>PACES, physical activity enjoyment scale.

The two studies comparing participants with and without disabilities [48, 55] included children with and without developmental coordination disorder and visual impairments (defined as either totally blind or minimal light perception), respectively. No studies included individuals with ASD. Three (17%) studies did not include enough information to ascertain the characteristics of the participants. In one of those studies [47], the participant was a 51-day-old infant at the commencement of the study; therefore, any physical disabilities would have been known. In another study [53], the data used was from an earlier collection in a previous study and aggregated to analyze longitudinally. It is likely that participant details were included in the original study; however, this was not referenced in this article. In the last study [58], children were included as intact classes; it is very likely that there were participants who have a disability, however, this information was not provided.

## Design

A variety of research designs were used in this analysis: twelve (67%) were experimental, two (11%) were exploratory, two (11%) were longitudinal, one (5%) was descriptive, and one (5%) was a case study. Of the studies that were experimental, all studies were focused on understanding the effect of a condition on an outcome variable. For example, in one study [21], researchers wanted to understand the effect of pitching condition (either machine or person) on the timing of each phase of a batter's swing.

## Aspect of DST analyzed

Across the included studies, all of the aspects of DST were covered; however, as others have suggested [15], task constraints were the most commonly analyzed in the included studies. Of the 18 studies, 11 (61%) analyzed task constraints or used task constraints to manipulate behavior. Four of the studies (22%) focused on individual constraints to understand the development of behaviors or how behaviors emerged due to changes in individual constraints. Of the remaining, two studies focused on environmental constraints and one study analyzed the overall spontaneous movement occurring in infants, not attributing it to any one constraint in analysis.

## Dependent variable

Each of the studies included focused on a change of behavior, whether it was a change in limb patterns ( $n=4$ ),

**Table 2:** Major findings.

Study	Major findings
Abney et al. [47]	Changes in vocalization were preceded by a period of higher variability. Limb activity increases; leg activity becomes more stable and repetitive with age, while arm pattern demonstrated an inverse relationship
Astill [48]	Changes in the task (i.e. ball thrown at midline, right, or left) changed the outcome for children with DCD. Children were much more likely to be successful, not only in catching the ball, but coordinating his/her limbs to catch, when the ball was thrown toward the midline or right side
Bennett et al. [49]	Participants demonstrated an increase in the number of catches and decrease in the number of misses, regardless of group. Practice performance varied the greatest under the varied visual manipulations
Clemente et al. [50]	The type of tasks (i.e. risk, neutral, or conservative) influenced the movement and time taken for the attacker. Attackers in a risk situation (e.g. team losing with time running out) drove the ball toward the goal and took a shot much quicker than attackers in other situations
Farrow and Reid [51]	A scaled court provided an increased performance, regardless of scaled ball size. Participants using the standardized adult conditions demonstrated decreased hitting opportunities, as well as lower success and engagement
Langendorfer [52]	Some throwers demonstrate different patterns to achieve different throwing goals. Male patterns showed greater change under different conditions. Age played very little role in the change of patterns
Langendorfer and Robertson [53]	Participants demonstrated commonalities in development in both order of developmental levels and common pathways of development; however, there were individual differences. Differences were attributed to the interaction of constraints for those particular emergences of patterns
Liu et al. [54]	Three levels of learners emerged; the most successful level of learning resulted in an S-shaped behavioral outcome, showing a sudden jump in performance. Another group demonstrated a much more level learning pattern and one group showed no performance increase. Different patterns of change are depended on the task dynamics and the learner
Maida and Mccune [55]	Individual differences in the pattern of development in many of the categories, however, demonstrated an underlying sequence with variations of length prior to advancement
Ohgi et al. [56]	Motor development in infants occurs through processes of self-orientation, suggesting a nonlinear system in contrast with the traditional view of infant behavior as simple reflexes. Infants' spontaneous movements are influenced by constraints capable of voluntary skilled movement
Renshaw et al. [20]	Swing patterns changed significantly between different environmental constraints
Stergiou et al. [57]	The height of an obstacle caused a change in patterns of behavior; however, the variability of the system remained constant, meaning that although the pattern changed, the internal factors adjusted to maintain as little deviation from a typical pattern
Sweeting and Rink [58]	Environmental instructions did improve performance, suggesting that the use of environmental tasks to elicit performance is a viable instructional approach, but should not be used exclusively or indiscriminately
Ulrich et al. [59]	Step patterns varied depending on the task constraint provided. Provides evidence of how future interventions could influence stepping behavior through manipulating the task
Ulrich et al. [60]	Infants with DS were able to perform alternated walking steps when supported, long before walking voluntarily. Lower body fat, scaled-up strength, and ability to move forward act as control parameters alternative walking
Vernadakis et al. [61]	Task modification provides a useful tool to build object control skills. Exergaming provides a more enjoyable method of improving skills, while resulting in similar gains to a typical face-to-face administration
Volman et al. [62]	Applying a functional task context elicited positive changes in the control of reaching movement of the affected arm of children with spastic hemiparesis. Treatment of children with spastic hemiparesis should focus on practicing functionally relevant skills (actions) instead of non-functional movements
Wu et al. [63]	Task conditions (e.g. size and location) have an effect on movement time, peak velocity, and the percentage of time-to-peak velocity. The accuracy of an individual may also be affected by the individual's constraints, not only by the object's size or location

walking pattern (n=3), aspects of throwing (n=2), catching performance (n=1), swing pattern (n=1), prerequisite motor skills to crawling (n=1), general fundamental

motor skills (n=1), jumping distance (n=1), tennis rallying (n=1), offensive soccer strategies (n=1), or walking gait (n=2). Only one study [61] utilized a standard assessment

battery; the remaining studies used either an accelerometer (22%), a count of frequency by coded behaviors (22%), timing (5%), a force plate (5%), walking pattern analysis (11%), or a product-oriented assessment (e.g. how many catches; 28%). Four of the studies, in addition to other outcome measures, utilized body markers to analyze how the joints and limbs changed in relation to one another [20, 57, 62, 63].

## Major findings

Each of the studies varied in their use of DST to explain the results or the interpretation of them. Overall, however, each of the studies in their own interpretation suggests a very strong influence of constraints on the motor movement of each of the included participants (See Table 2). Within infants, motor behaviors appear in a nonlinear fashion [56] with spontaneous movement becoming more stable and repetitive in the lower extremities, but with increasing variability within the upper limbs [47]. These findings suggest development is less reflexive during the early years and is driven by outside forces. The only anomaly within the infant studies was Maida and McCune's [55] study on patterns of movement in infants. However, when analyzing this study, it became clear that they used DST in the design of the study, but analyzed the data with a maturational lens looking to confirm the presence of stages of development.

Several studies [20, 52, 59, 60] utilized dynamic systems to manipulate behavior in order to understand the influence of constraints. In each of the studies, behavior (i.e. motor performance or motor movement) spontaneously changed to accommodate the added constraint. For example, Ulrich and colleagues [59] tested the walking patterns of infants with Down syndrome when walking on different surfaces. These included walking on Velcro with socks and bare-foot on a bumpy surface. Each of the surfaces influenced a different movement pattern within the infants, suggesting that the motor behavior can be influenced to improve outcomes of an intervention. Further, Renshaw and colleagues [20] analyzed the swing pattern of young adult cricket players. In this study, the swing pattern and timing was analyzed when participants were swinging at a ball bowled from a machine or a person. Findings suggest that the timing was faster when a machine was pitching. This study demonstrates the spontaneous influence an environmental cue can have on a behavior, even when the overall situation is similar.

Only one study focused on an intervention [61]. In this recent study, the authors compared two motor

interventions, one face-to-face and one exergaming (i.e. exercising to a video game), to a control group on the improvement of fundamental motor skills. The underlying premise of the intervention was developed around modifying the tasks of the skills to improve performance. By manipulating the task constraints for the individual, the authors demonstrated a significant improvement over the control group. There was not a significant difference in performance between the face-to-face and exergaming interventions other than enjoyment; participants in the exergaming group reported a higher enjoyment. Table 2 provides the major findings for each group.

Of the studies that included individuals with disabilities, the outcomes when utilizing constraints were positive. Ulrich and colleagues [59, 60] demonstrated a positive influence in the walking patterns when controlling for individual constraints and with imposed task constraints. Astill [48], with children with developmental coordination disorder (DCD), demonstrated the influence of certain task constraints for children with coordination issues. By controlling for where and how a ball is delivered, researchers saw an influence in the overall performance; suggesting that to improve success and performance, instructors should take task constraints into consideration. No studies were found that included children with ASD.

## Discussion

The focus of this inquiry was to understand how DST [14] has been utilized to understand motor development or build motor skills through the analysis of the literature by describing common study characteristics and detailing major findings. As a result, this analysis summary provides an empirical insight into how DST has been used in research of motor development. First, research has demonstrated a great variance of the interpretation and inclusion of dynamic systems within the study purpose, design, and interpretations. Second, research with dynamic systems has focused very heavily on the very earlier years (infancy) of development often to simply give an explanation of patterns of movement. Third, with the exception of one study [61], there is a lack of evidence that this theory is being used in motor interventions. Lastly, with regard to the relevance to individuals with ASD, no past studies have included this population and only a few studies have included individuals with disabilities.

Beyond the variance of sample size and purpose, the included studies suggest the foundations of DST

are present within the production of movement and give evidence for its use in improving motor skills and development. Ulrich and colleagues [59], in manipulating the surfaces of a treadmill, were able to manipulate the walking patterns of infants with Down syndrome. Further, the authors suggest that the results give evidence to the use of task manipulation to improve motor patterns. This evidence is further strengthened by Vernadikis and colleagues [61] in the intervention study utilizing task manipulation to improve motor skills. While the authors' ultimate goal was to understand the effects of exergaming in relation to a standard face-to-face intervention, this study provides strong evidence for utilizing task manipulation to influence and improve the motor skills of children. Whereas evidence is limited in the overall literature, the studies included provide positive support for the use of task manipulation in motor intervention. The studies included in this review further support the belief that task manipulations are the most common constraint to enact change [15], as over 50% of the studies included in this review assessed or used task constraints. Most commonly, studies utilized manipulations of equipment as a modification of a task [51, 52, 57, 59]; however, changes in the task instruction could also provide useful [50].

Individual constraints (4 of 18 studies) were included in looking to understand how movement is produced and, often, the development of early motor patterns in infants. As this is a difficult area to 'manipulate' within individuals, it is not surprising to see the lack of manipulation in this area. Ulrich and colleagues [60] manipulated the individual constraints of infants with Down syndrome by holding infants up while they 'walked' on a treadmill. In this study, infants when held demonstrated an effective, alternating walking pattern long before they demonstrated independent walking, demonstrating that a combination of individual constraints, like strength, can act as a rate limiter [7] preventing independent walking from occurring. Infants in this study were not able to produce a walking pattern until their leg strength, and likely balance, was scaled up to allow for independent walking. However, when the individual constraint of balance was manipulated, the walking pattern emerged in the infants. Manipulation of individual constraints can be fairly straight forward in infants, but to scale this for older population is slightly more difficult. A task analysis may provide insight into this issue [64–66]. A task analysis develops a breakdown of the skills in question from simple to complex, including everything needed to perform the skill. This may reveal that an individual is limited by strength when performing a basketball shot. A researcher or practitioner may then

focus on scaling up the individual's strength to allow for a more mature pattern to emerge.

Lastly, environmental constraints comprised the fewest studies included in this review. This result is surprising, given the popularity of structured teaching and influence of the environment demonstrated in psychology. However, the environment is typically considered in addressing behaviors such as on-task/off-task or time-on-task. It could be that the focus is so often on the task or individual that the environment is assumed to be of little effect or 'controlled'. However, in Newell's model [14], each area of constraint plays an equally vital role in the emergence of behavior. Any change in the environment could result in a varied motor pattern. This area is in need of further review to understand how an individual's pattern of movement is changed based on the environment. Sweeting and Rink [58] demonstrated an improvement in jumping performance by utilizing an environmental constraint teaching model; however, the authors suggest it be used in conjuncture with other teaching strategies, not as a standalone method.

In this review, about a third of the research studies (5 of 18) were done with infants as participants. As the origins of motor development begin in infancy, it is logical that a considerable amount of research would focus on these key developmental years. Additionally, infant development had been thought to be predominately reflex driven and predominately thought of in stages, mostly due to much of the earlier work of maturational researchers [67, 68]. However, few studies have gone beyond this age. From maturational research, there is an understanding that individuals develop throughout the lifespan and within each stage there are important skills to learn and develop [3, 69]. However, it is clear that many skills thought to occur due to maturation do not simply appear and need instruction [70]. Further, the variability between when individuals develop and how proficient they become at a skill does not fit in a maturational model. As several of the studies in this review have demonstrated, constraints retain influence as individuals age [52] and can have different effects on the emergence of movement patterns during the development process [53].

A finding that stands out in this review is the lack of intervention research done using DST as a framework, as there have been countless suggestive articles as to the relevancy of this theory to development and the need for research [71, 72]. One study [61] included in this review focused on the improvement of motor skills, not simply understanding the constraints' influence of motor performance. Several studies [20, 48, 52–54, 58, 59] focused on the influence of the constraint which resulted in an altered



performance. In this author's view, these are not dedicated interventions, as the researchers of those studies were not focused on designing improvement of skills, but on the influence of constraints; improvement happened as a result of the manipulation of the constraints, not due to any predetermined influence. The intervention designed by Vernadakis and colleagues [61] sought to improve object control (e.g. kicking, throwing, etc.) skills through using DST as a framework. This study provides an important example for the benefit in utilizing dynamic systems within an intervention.

Vernadakis et al. [61], to study the effects of an exergaming routine against a traditional activity (TA) group, developed two 8-week interventions. Both groups received the intervention twice per week for 30 min per session. No rationale was given for the length or timeframe; however, when looking at the intervention, it follows a typical physical education unit based on time per week and length. Within each intervention, critical elements of correct movement were imbedded into each lesson and a task analysis was done to inform the development of skills from simple to complex. Four lessons were developed for each intervention prior to beginning, but the rest were left open to allow for the flexibility to adjust to participant needs as skills emerged. In both interventions, the tasks were manipulated to encourage proper patterns of movement; within the TA group, equipment was also modified to further encourage new, appropriate patterns of movement. Ultimately, Vernadakis et al.'s goal was to test the potential validity of an exergaming motor intervention to a TA intervention to support the use of such an intervention. Unintentionally, or perhaps there was intention, the researchers provided strong evidence for the use of DST in the creation of intervention, as both interventions (i.e. exergaming and TA) demonstrated a significant improvement from a pre- to a post-test, when compared to a control. Further, pre-tests resulted in a non-significant difference between groups, but each group did show a delay in motor skills. This demonstrated that through DST, individuals with a motor delay can show a significant improvement over a short amount of time.

Vernadakis and colleagues [61] further demonstrate positive support for the use of dynamic systems in a motor intervention to increase motor skills; however, the authors also detail some of the potential issues in recreating this result. The researchers utilized a skilled, trained motor skills instructor to deliver instruction, as well as a task analysis to break the skill into a logical progression. Further, instruction was developed as the participants progressed, which is an important piece of this intervention. The instructors utilizing this intervention need to have the

ability to visually assess and make the judgment of when to adjust the skill to fit the needs of the participant. As the types of modifications were not included, it is difficult to understand the detailed adjustments the instructor, or the exergame for that matter, made. Future interventions will need to pay special attention to this piece of the intervention because, as DST describes, the modification of the constraint must be strong enough to perturb the attractor well for that skill [7, 13]. If the modification to the constraints is not powerful enough, individuals will simply return to the previous state of behavior.

With that being said, the study by Vernadakis et al. [61] is an encouraging outcome that is overdue and necessary to fully understand DST, as well as its effects on motor behavior [15]. This study provides an important step toward building more effective motor intervention for individuals with motor delays. As DST states that the influence of constraints allows for behavior to emerge from the central nervous system [7, 14, 73] without necessary input from the brain, this type of intervention could potentially be very beneficial for individuals with cognitive or pervasive developmental disorders, such as individuals with ASD. Children with ASD have demonstrated that a delay is occurring in their motor behavior and their movement patterns are different compared to peers [29, 30, 36]. DST may provide the framework for the manipulation of constraints in order to move past deficits in communication and social behavior, as the constraints influence behavior beyond the control of the brain and beyond the influence of instruction [74]. As Ulrich, et al. [59] demonstrated with infants with Down syndrome walking with different constraints on a treadmill, the type of constraint can spontaneously influence the change in motor pattern. As long as the constraint has enough influence and the correct influence, interventions have the possibility to influence a positive change in behavior.

While research was not found utilizing DST for populations with ASD, the included studies provide a solid foundation for its use in the future. **DST shifts the concept of disability from barriers that need to be overcome to individual constraints that influence behavior.** This not only allows for the understanding of the limitations individuals face when trying to produce movement similar to someone without that disability, but it also recognizes that the individual's disability may also positively influence a person's movement in a way that someone without the disability could not do. Of the studies that included populations with disabilities, each provides positive support that, through the concepts of DST, individual movements can be influenced into a more mature movement pattern. Lastly, although a minor finding in Vernadakis et al.'s [61]

study, an intervention built upon DST can provide positive support for individuals demonstrating a motor delay. As the evidence suggests that most individuals with ASD have a delay [36], providing an intervention by modifying constraints can have a potentially significant impact.

## Limitations

As the field of motor development and motor behavior has similar origins and similar theories, this study acknowledges the potential limitation in limiting its search to only DST to understand how the theory of constraints is driving motor development. Gibson's Ecological Model [75] is common among motor learning research and provides strong evidence toward the use of analyzing the environment and the perception of the individual with regard to motor skill. Further, Schmit's Schema Theory [76] is also widely used and accepted as a model of skill development. However, these theories are interested in discrete task learning, not on lifespan development as a whole. DST describes how the influence of constraints allows for a motor behavior to emerge on a discrete skill basis; however, it also describes development as a whole being nonlinear and occurring longitudinally. Therefore, this review focused on DST exclusively.

Further, the author recognizes that this list may not be encompassing of all research utilizing constraints to development motor skills, as to a point where much of the research is likely to include some form of task, environment, or individual manipulation or modification. However, they may not fully understand where the basis of those modifications is coming from or base them in DST. Wicke and Jensen [27] is an example of a study excluded from the review for lack of inclusion of Newell's DST; in this article, the authors describe dynamic systems from the viewpoints of several referenced articles pertaining to a dynamic systems approach, but because these are secondhand accounts of dynamic systems, it is difficult to ascertain the authors' understanding and the adherence to Newell's model of DST. The idea of dynamic systems stems from the early work of Bernstein [22] in describing the nonlinear dynamics of movement. Kugler et al. [77] furthered this work to formulate the modern trajectory of understanding movement coordination. From this initial study, different lines of research have taken a variety of viewpoints as to how this relationship exists, Newell's model [14] being one of them. In DST, according to Newell [14], there is an equal interdependent relationship between each of the constraints to spontaneously

organize in the form of a behavior; not all lines take this exact view point, although they are interested in the dynamics of coordination. This review was interested in how researchers have used the theory itself, as proposed by Newell [14], to inform practice; therefore, this article, among others, was excluded. A larger review is necessary to understand how constraints and dynamics outside of DST are being utilized in the bulk of research.

## Conclusion

Despite a limited number of empirical studies utilizing Newell's model as a framework for intervention, a number of articles have referenced DST as a potentially promising theory to guide intervention [71, 72]. This review provides an aggregated view of the research regarding DST and motor development; until this point, most suggestions have not included the entire body of research on this topic. In this review, only one intervention article was identified; the rest were interested in validating the idea of how constraints influence motor behavior. The intervention article was published very recently [61] and suggests a possible increase in the interest of motor development and the potential effect of DST. As demonstrated earlier, motor development research appears to occur in cycles, with each generation seemingly figuring out how everything works, to then later be addressed and improved upon. Newell and Jordan [15] stated that more research is needed to understand DST's place in the development of motor skills and potential use for intervention through the manipulation of constraints [72]. Despite the lack of research formally utilizing DST according to Newell [14], many articles provide suggestions as to how constraints can be used to modify performance [72] in a variety of populations, including patients recovering from strokes [78] to children with autism [79] and on skills ranging from swimming [80] to language development [81].

DST provides a practical view of how behavior occurs without attributing the occurrence to any one subsystem but an active and fluid interaction between multiple elements. This interaction currently best explains the nuances of behavior caused by individual variability. As far as motor movement is concerned, it is evident that this behavior occurs through the influences of more than just a neural, predesigned 'program'. Individual motor movement and development can be and is affected by the constraints present at the time. This interaction of constraints can be of potential benefit to researchers and practitioners looking to improve motor skills. As shown



in several studies [20, 52, 57, 59], a manipulation of just one constraint can cause a spontaneous reorganization of the other constraints to produce a new behavior. If done purposefully, the manipulation of constraints can provide a powerful intervention to influence motor movement for the better [61].

This type of intervention can be extremely beneficial for children with ASD, or any disability for that matter, as the modified constraint manipulates the behavior without a necessary influence from the individual. As children with ASD often display motor impairments, it is imperative that a motor intervention be developed to counteract this delayed development, as it could have repercussions for individuals with ASD in the future [82]. As the hallmark of ASD is a deficit in social communication [35], typical instruction and modeling have little effect on the motor output of the individual. DST provides a framework for influencing behavior beyond verbal instruction or physical interaction. By manipulating how the individual performs a task or the environment it is performed in, practitioners and researchers can have an influence on the motor output and, thus, work to build an intervention of modifications that influence a more efficient and mature movement pattern.

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# Adapted Physical Educators' Views Toward Educational Research



Friday, April 24, 2020



2:00 PM - 2:15 PM

*Salt Palace Convention Center - Convention Room 254 A*

## Abstract

**Background/Purpose:** Montgomery and Smith (2015) stated “University researchers often wonder why so few research findings seem to make their way into classroom practice, while K–12 teachers express frustration with how out of touch academic articles seem to be with the day-to-day realities of K-12 classrooms”. This sentiment extends to the general and adapted physical education setting. Yet, the use of evidence-based practices in practical settings is lauded as improving outcomes for those impacted by those practices. Using evidenced practices is even more important, when considering our students with the greatest needs such as those with disabilities. However, too often, adapted physical education (APE) teachers rely on trial-and-error than the academic literature to find educational practices (Colombo-Dougovito, 2015). Disputes the amount of research about the practices of teachers, little is known about how APE teachers perceive research.

**Method:** Therefore, the current study sought to examine APE teachers’ perceptions towards research. Sixty state and national general and adapted physical education associations were emailed a survey adapted from the National Center for Research Policy and Practice (NCRPP; Penuel et al., 2016).

This survey was developed to better understand school and district leaders' perceptions towards the usefulness of research. This survey was revised and refined by the research team—comprised of higher-ed faculty and APE practitioners—to better relate to practitioners. The final version of the survey had 43 questions total. Cronbach's alpha was used to determine the internal consistency between questions ( $\alpha = .89$ ). Spearman's correlations were used to analyze the correlations between each Likert style question and key demographic variables.

**Analysis/Results:** A total of 124 APE teachers completed at least 80% of the survey and were included in the present study. The participants comprised of 59.7% female ( $n = 74$ ) and had APE teaching experience that ranged from 1 to 41 years ( $M = 13.65$ ,  $SD = 9.7$ ). In total, 36 states and one US territory (Guam) were represented in this survey. Overall, findings indicated that a majority of participants indicated that they had conducted research ( $n = 76$ , 61.3%), with most participants mentioning it helped them learned more about a particular issue they were facing. Further, APE teachers had high perceptions of the relevance, credibility, and value of research. Though, the educational level of practitioners had a significant positive correlation with beliefs that research is “too impractical to be useful”, that researchers segregate themselves from practitioners and daily practice, and that research could be used to support any opinion.

**Conclusions:** Overall, APE teachers reported a high rate of engagement with research—including many whom conducted research—and that research has a positive impact on issues that may be most pertinent for their situation. Findings also demonstrate that a disconnect between researchers and APE teachers exist; especially when considering higher levels of education and experience. This study highlights the important role research plays in the practice of APE teachers; however, researchers need to provide research findings in a more practical way for teachers to translate to their own situations.

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## Session Details

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**CANCELLED** Task Modifications to Improve Motor Performance in Children With ASD

**Wednesday, Mar 15, 2017**

01:45 PM - 03:00 PM



**Location:** Convention Center, 202

### Description:

Children with autism spectrum disorder (ASD) face unique challenges in the physical education setting. In addition to the stereotypic behaviors, children with ASD demonstrate motor patterns that are much different than those of their peers. Utilizing dynamic systems theory, participants will learn practical strategies to: a) break skills into teachable components; and b) present simple task modifications/environmental cues to help students with ASD understand how to perform each component correctly.

### Intended Audience:

K-12

### Speaker(s):

**Andrew M. Colombo-Dougovito**

**Martin E. Block**

### Categories:

**Physical Education : Adapted Physical Education**



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## Sub Session Details

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Developing modifications for assessment in children with ASD: Preliminary results

**Friday, Apr 08, 2016**

05:14 PM - 05:27 PM

**Location:** Convention Center, 207 AB

### **Description:**

Mounting evidence has revealed a deficit in motor ability in children with Autism Spectrum Disorder (ASD) (Liu, Hamilton, Davis, & ElGarhy, 2014; Staples & Reid, 2010). In these and similar studies, researchers state modifications were necessary during the assessment to effectively ascertain the participant's ability. Recent research (e.g., Breslin & Rudisill, 2011) has demonstrated the benefit of using visuals during the assessment. However, what lacks, is general consensus of the methods necessary to modify the assessment to meet the needs of the participants. Therefore, the purpose of this study was to build an understanding of the modifications best suited to adapt motor assessments for children with ASD.

Using a random sample of 9 boys with ASD, this study compared the effects of three different protocols on the performance outcomes of two subtest items (throwing and hopping) of the Test of Gross Motor Development (TGMD-2). In this analysis, the traditional protocol for the TGMD was given to a control group (N=3), while two experimental groups, a task card group (N = 2) and a video model (N = 4), received alternative protocols. Data were collected on performance of the subtest items and overall assessment time. Additionally, participants were measured on understanding through a validity check following each trial. In addition to alternative testing protocol, experimental groups were given two acclimation days to understand how the environment might play a role in the testing procedure.

Analysis revealed no significant differences between groups on both performance and time; demonstrating little effect of the protocol on the overall performance of the motor task, as well as the time needed for assessment. However, there was a significant result in the overall validity check between groups when controlling for age,  $F(2, 6) = 5.437$ ,  $p = 0.045$ , partial  $\eta^2 = 0.644$ . Individual contrasts demonstrate significant differences in understanding between the control group and the experimental groups,  $t(7) = 2.604$ ,  $p = 0.035$ , however did not demonstrate a significant difference between the experimental groups,  $t(7) = 1.243$ ,  $p = 0.254$ .

Results from this analysis reveal, while visual aids had little effect on the overall motor performance and overall time of assessment, there was a greater amount of understanding from participants with the visual aids. Preliminary results provide evidence of the necessity to utilize visual aids when assessing individuals with ASD. Trends in performance and time demonstrate a small effect from the visual aids and warrant further inspection.

### **Intended Audience:**

Motor Behavior and Measurement

### Sub Session Speaker(s):

**Andrew M. Colombo-Dougovito**

**Luke E. Kelly**



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## Session Details

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Practical Strategies to Successfully Assess Children with Autism Spectrum Disorder

**Friday, Apr 08, 2016**

02:30 PM - 04:00 PM



**Location:** Convention Center, 211 CD

**Description:**

This session will provide PE teachers with specific strategies for modifying both formal and informal assessments for students with autism spectrum disorder (ASD). With an increased emphasis on assessment, and a rise in the prevalence of ASD, it is critical that teachers can adapt assessments to meet the needs of students with ASD. Session participants will learn practical strategies for modifying assessment specific to motor skill performance, FitnessGram, rubrics, checking for understanding, and peer assessments.

**Intended Audience:**

Elementary; Middle/High

### Speaker(s):

<b>Andrew M. Colombo-Dougovito</b>	▶
<b>Melissa Alexander</b>	▶
<b>Marty Douglas</b>	▶
<b>Sean Healy</b>	▶
<b>Kason O'Neil</b>	▶

### Categories:

<b>Physical Education Assessment</b>
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