Evaluation of the Rhythmic Arts Project, a Multi-Modal Rhythm-Based Perception and Action Intervention, in a School-Based Setting in Children with Autism Spectrum Disorders

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Abstract

The Rhythmic Arts Project (TRAP) curriculum integrates visual, tactile, auditory and speech experiences through rhythmic drumming actions to address life skills. We evaluated life skills before and after participation in TRAP in a school-based setting in children with Autism Spectrum Disorders (ASD). Participants were 23 children in grades 6-12 in a special education program for students with ASD. We administered the Pediatric Evaluation of Disability Index Computer Adaptive Test (PEDI-CAT) before and after they participated TRAP. Children showed significant increases in participation in daily activities, mobility status, cognitive and social skills, and responsibility after participation in TRAP. We did not have a comparison or control group, however we used a repeated baseline design to support that changes were generally not observed over the summer when children were not participating in TRAP. Our results represent a first step in evaluating the effectiveness of TRAP by systematically measuring changes in life skills.

Keywords: The Rhythmic Arts Project; education; curriculum; Autism Spectrum Disorders; perception-action; intervention

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The Rhythmic Arts Project (TRAP) educates individuals with intellectual and developmental disabilities by embracing a curriculum that encompasses rhythm as a modality to address basic life and learning skills, reading, writing and arithmetic. TRAP is a non-profit company with a mission to empower people with various disabilities to succeed in the world by integrating drums and percussion instruments as creative learning tools that address life skills and enhance the

mind, body and spirit. The TRAP methodology is based in a multi-modal rhythm-based perception and action approach. The approach combines visual, tactile, auditory and speech experiences through rhythmic drumming actions. The idea is to see, feel and hear the lessons and simultaneously speak the answers ("The Rhythmic Arts Project Website," n.d.).Although TRAP can be used for a broad population of individuals with intellectual and developmental disabilities, in this report we focused specifically on children with Autism Spectrum Disorders (ASD).

TRAP principles fit especially well with three evidence-based treatment principles for ASD: modeling, prompting, and visual supports ("California Autism Professional Training and Information Network Website," n.d.; "National Professional Development Center on Autism Spectrum Disorder Website," n.d.). For example, in TRAP these principles are addressed in the following way: Modeling: when the teacher provides demonstration of a desired behavior that results in skill acquisition through learner imitation (e.g., teacher will demonstrate spelling her name on the drum to the group of students). Prompting: verbal, gestural, or physical assistance that supports skill acquisition (e.g., teacher will use verbal encouragement to support the child using his or her hand to hit the drum). Visual Supports: visual display that supports independent skill use (e.g., teacher will hold up a picture of a drum with a hand on it to show the activity before the student is asked to hit the drum). Because TRAP methodology aligns with evidence-based treatment principles for ASD, we wanted to systematically evaluate its potential effectiveness as a school-based intervention to improve participation in children with ASD.

We used the Pediatric Evaluation of Disability Index Computer Adaptive Test (PEDI-CAT) for TRAP program evaluation. The PEDI-CAT is a standardized norm-referenced assessment applicable to children ages 3-20 years with physical and/or behavioral disability conditions ("PEDI-CAT website," n.d.). The PEDI-CAT measured the child's participation in 4 areas: daily activities, mobility status, cognitive and social skills, and responsibility. In this project we analyzed scaled scores. Scaled scores provide a way to measure a child's current functional skills and progress in these skills over time. Scaled scores are especially helpful in documenting improvements in functional skills for children not expected to exhibit or regain normative levels of functioning ("PEDI-CAT scoring website," n.d.).

The purpose of this investigation was to measure participation in four areas of function (daily activities, mobility status, cognitive and social skills, responsibility) before and after a year of TRAP intervention in middle and high school students with ASD. We used a repeated measures baseline approach to measure typical rate of change in the 4 areas of function before we introduced the TRAP intervention.

Methods

This research study was approved by the Ventura County Medical Center Institutional Review Board and conducted in accordance with the Declaration of Helsinki as revised in 2000. A parent or legal guardian signed a consent form prior to their child's participation. All students participated in TRAP as per their standard curriculum, however students for whom we had consent were additionally evaluated with the PEDI-CAT before and after participation in TRAP. TRAP intervention and the PEDI-CAT were completed by one teacher with 13 years of experience teaching this population and with 6 years of experience teaching TRAP.

Participants were 23 children (21 male, 2 female) in grades 6-12 in a special education program for students with ASD at Triton Academy in Ventura County, CA. Their teacher completed the PEDI-CAT at the beginning of June, at the end of one school year (Pre-TRAP 1). The PED-CAT was completed again approximately 3 months later, at the start of the next school year (Pre-TRAP 2). This repeated baseline design provided a measure of typical rate of change in the 4 areas of function evaluated by the PEDI-CAT before we introduced the TRAP intervention. Following the baseline PEDI-CAT assessments, students participated in 2 sessions of TRAP per week across the school year, from September through June. TRAP curriculum was followed ("The Rhythmic Arts Project Website," n.d.). The class progressed through the curriculum, from beginning to end, across the course of the school year. A summary of the number of sessions they participated in is shown in Table 1. A post-TRAP PEDI-CAT was completed in June (Post-TRAP), approximately 9 months after the baseline assessments were completed.

Participation in TRAP was evaluated by documenting each students' level of engagement and amount of help needed each week. Level of engagement was rated as low/engaged less than 25% of lesson (1), moderate/engaged 26-75% of the lesson (2), or high/engaged more than 75% of lesson (3) Amount of help needed was rated as none (0), low/less than 25% of time (1), moderate/26-75% of the time (2), or high/more than 75% of time (3).

Descriptive statistics were used to summarize data. The Kolmogorov-Smirnov test was used to assess data for normality. As data were not normally distributed, non-parametric statistics were used (Related-Samples Friedman's Two-Way Analysis of Variance) to test for significant changes in PEDI-CAT scores before and after TRAP. Paired t-tests were used to test for post-hoc differences. We used SPSS software (version 22, IBM Corporation, Armonk, NY) and an alpha level of 0.05 for all analyses.

Results

Participation

In general, participation was high for most children. Out of 76 possible sessions, most children participated in 70 or more sessions (see Table 1). Level of engagement tended to be moderate to high, while amount of help needed was variable (see Table 1).

PEDI Scaled Scores

Related-Samples Friedman's Two-Way Analysis of Variance were used to test for significant changes in PEDI-CAT scores across the 3 TRAP assessments (Pre-TRAP 1, Pre-TRAP 2, Post-TRAP). There were significant differences found for all four areas: daily activities, mobility status, cognitive and social skills, and responsibility ($p < 0.01$ for all).

Paired t-tests were used to test for post-hoc differences between each possible pair of 3 TRAP assessments (Pre-TRAP 1, Pre-TRAP 2, Post-TRAP) in each area: daily activities, mobility status, cognitive and social skills, and responsibility. There were significant increases found for all four areas between Pre-TRAP 1 and Post-TRAP and Pre-TRAP 2 and Post-TRAP. In addition, daily activities significantly decreased between Pre-TRAP 1 and Pre-TRAP 2 and cognitive and social skills significantly increased between Pre-TRAP 1 and Pre-TRAP 2. Group

results are shown in Table 2, with significantly different p-values identified in bold font. Individual results are shown in Figures 1-4.

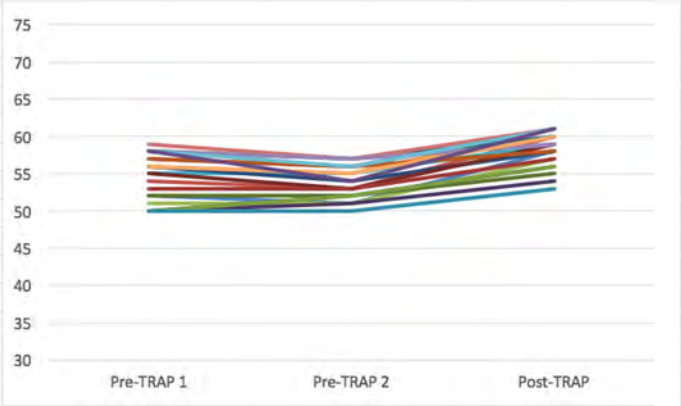

Figure 1. Pediatric Evaluation of Disability Index Computer Adaptive Test Scaled Daily Activity Scores. Each child is shown as a separate line across the 3 assessment time points: end of one school year (Pre-TRAP 1), approximately 3 months later, at the start of the next school year (Pre-TRAP 2), and approximately 9 months later after TRAP intervention (Post-TRAP). TRAP =The Rhythmic Arts Project.

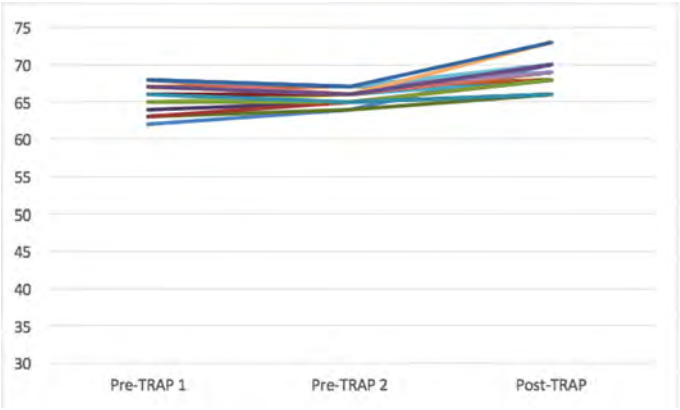

Figure 2. Pediatric Evaluation of Disability Index Computer Adaptive Test Scaled Mobility Status Scores. Each child is shown as a separate line across the 3 assessment time points: end of one school year (Pre-TRAP 1), approximately 3 months later, at the start of the next school year (Pre-TRAP 2), and approximately 9 months later after TRAP intervention (Post-TRAP). TRAP =The Rhythmic Arts Project.

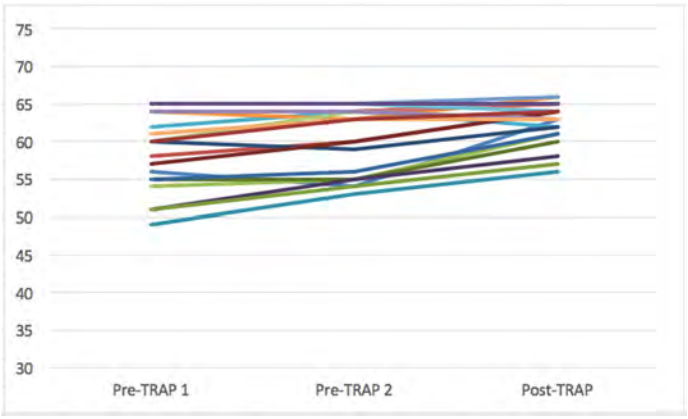

Figure 3. Pediatric Evaluation of Disability Index Computer Adaptive Test Scaled Cognitive and Social Skills Scores. Each child is shown as a separate line across the 3 assessment time points: end of one school year (Pre-TRAP 1), approximately 3 months later, at the start of the next school year (Pre-TRAP 2), and approximately 9 months later after TRAP intervention (Post-TRAP). TRAP =The Rhythmic Arts Project.

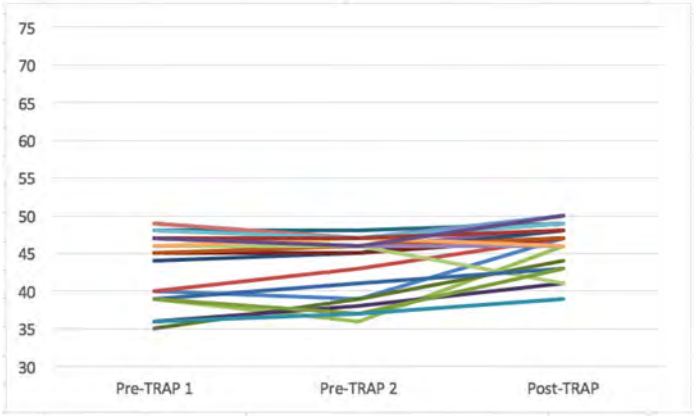

Figure 4. Pediatric Evaluation of Disability Index Computer Adaptive Test Scaled Responsibility Scores. Each child is shown as a separate line across the 3 assessment time points: end of one school year (Pre-TRAP 1), approximately 3 months later, at the start of the next school year (Pre-TRAP 2), and approximately 9 months later after TRAP intervention (Post-TRAP). TRAP =The Rhythmic Arts Project.

Discussion

Children participated in TRAP as a part of their standard curriculum for one school year in a special education program (grades 6-12) for students with ASD. They showed significant increases in their participation in daily activities, mobility status, cognitive and social skills, and responsibility after participation in TRAP. Our results support that TRAP may support gains in daily activities, mobility status, cognitive and social skills, and responsibility, however further, controlled research with a comparison group is needed. The results are reasonable, though, as TRAP goals include: self-awareness, attending skills, socialization, turn taking, verbalization, memory, differentiating between options (colors, sounds, etc.), sequencing, patterning, temporal organization, motor control, motor rhythm, and laterality. Further, TRAP principles fit especially well with three evidence-based treatment principles for ASD: modeling, prompting, and visual supports ("California Autism Professional Training and Information Network Website," n.d.; "National Professional Development Center on Autism Spectrum Disorder Website," n.d.).

Using modeling, prompting, and visual supports in TRAP could be achieved as described in the following two examples. For the first example, a child was asked to drum right (R), left (L), R, L and responded that she could not distinguish R from L. The teacher modeled the task and reinforced it with visual aids by displaying four quarter notes, labeled R L R L, one on each of four drums (see Figure 5). She prompted the child "Now it's your turn!". The child then successfully accomplished the task by simultaneously hitting the drum and saying, "right, left, right, left". She then received applause from the rest of the class.

Figure 5. Example of visual aids used to display four quarter notes, each worth one beat, labeled right (R), left (L), R, L. One note would be placed on each of four drums.

For the second example, a child was asked to identify the numbers placed on the drum by drumming highest (3), lowest (1), then middle (2). He hesitated. The teacher then pointed at the number cards (visual cues) and tapped on the drum indicating 3 and saying "highest" (modeling). She encouraged him verbally saying "Now it's your turn, drum highest, lowest, middle!" (prompting). He was then able to successfully complete the task, and his classmates cheered.

This is one of the first examples of a systematic evaluation of a school-based intervention. As a recent review article (Kasari & Smith, 2013) describes, "Although researchers have identified many promising teaching strategies and intervention programs for children with ASD spectrum disorder, research on implementation of these interventions in school settings has lagged. Barriers to implementation include incompletely developed interventions, limited evidence of their utility in promoting long-term and meaningful change, and poor fit with school environments. To overcome these barriers, interventions need to be detailed in manuals that identify key components yet allow for flexibility, and studies need to evaluate long-term, real-life outcomes. Innovative research strategies also may be important, particularly carrying out research on new interventions in school settings from the outset, conducting partial effectiveness trials in which study personnel administer interventions in school settings, using community-partnered participatory research approaches, and redesigning interventions in a modular format." Our study addresses these recommendations: the TRAP intervention is detailed in a manual that identifies key components yet allows for flexibility, our study evaluates long-term, real-life outcomes, and study personnel administered the intervention in a school setting using community-partnered participatory research approaches.

The TRAP multi-modal rhythm-based perception and action approach combining visual, tactile, auditory and speech experiences also fits with recent advances in understanding about the links between motor and other areas of the brain. The basal ganglia, which are typically associated with motor control (reward-based learning, sequencing, etc.), are also associated with human reasoning, adaptive function/behavior, and sensorimotor integration abnormalities (for review see (Leisman, Braun-Benjamin, & Melillo, 2014; Patel, Jankovic, & Hallett, 2014)). Their involvement has been described in many conditions, including attention deficit/hyperactivity disorder (Leisman et al., 2014), Parkinson's disease, dystonia, and Tourette's syndrome (Patel et al., 2014). In fact, a recent perspective article (Gordon, Jacobs, Schuele, & McAuley, 2015) describes, "Evidence for a role of rhythm skills in language development and language … (a) behavioral and brain data from adults and children, showing that prosody and other aspects of

timing of sentences influence online morpho-syntactic processing; (b) co-morbidity of impaired rhythm with grammatical deficits in children with language impairment; and (c) our recent work showing a strong positive association between rhythm perception skills and expressive grammatical skills in young school-age children with typical development." In regard to ASD, recent work (Tryfon et al., 2017) demonstrates that non-verbal rhythm synchronization is intact over the course of childhood development in children with ASD. Taken together, these results support the approach of TRAP to use rhythmic motor tasks combined as the basis for providing intervention. In future research, we would like to systematically explore specific underlying mechanisms of potential benefits from the TRAP program. In addition, we would like to expand to other populations of interest, for example persons with Down syndrome.

This study has several limitations. 1) We did not have a comparison program or no-TRAP control group, however we did employ a repeated baseline design to support that changes were generally not observed over the summer when children were not participating in TRAP. In fact, their daily activity scores decreased over this time period. It should be noted, however, that they were not in school across this time period, so any effect of school itself cannot be isolated from any effects of TRAP. Another area of future research could be exploring ways of expanding the program to allow for additional opportunities for practicing at home. 2) The program was assessed in a single setting with a single teacher, limiting generalizability. 3) The assessor of the PEDI-CAT was not blinded and therefore bias is possible. Blinding of the assessor was not feasible in this setting, and using a single assessor allowed us to avoid inter-rater reliability problems.

Conclusions

Children participated in TRAP as a part of their standard curriculum for one school year in a special education program (grades 6-12) for students with ASD, demonstrating that TRAP was integrated into the overall curriculum and schedule. We systematically evaluated participation in daily activities, mobility status, cognitive and social skills, and responsibility using the PEDI-CAT, an appropriate and valid measure. Our results suggest that TRAP may support gains in daily activities, mobility status, cognitive and social skills, and responsibility when provided as part of a special education curriculum.

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About the Authors

Beth A. Smith, PT, PhD, received her physical therapy degree from Boston University and worked as a clinician at University of Michigan Hospital before returning to school to pursue a PhD in the Developmental Neuromotor Control Laboratory in the School of Kinesiology at the University of Michigan, followed by a postdoctoral fellowship in the Balance Disorders Laboratory in the Department of Neurology at Oregon Health & Science University. Beth is currently Assistant Professor of Research in the Division of Biokinesiology and Physical Therapy at the University of Southern California, where she is the director of the Infant Neuromotor Control Laboratory.

Eddie Tuduri is the founder and director of The Rhythmic Arts Project. In 1990, The U.S. Committee for Unicef named Eddie volunteer of the year. In 1998. Eddie was voted Local Hero by the Santa Barbara Independent and presented with The Volunteer of the Year award by The Rehabilitation Institute at Santa Barbara. In April 2002 Eddie received the Citation Award for Therapeutic Recreation. In 2005, The Michael Landon Award was presented to Eddie by the California Governor's Committee, for accurately portraying people with disabilities in the media.

In 2009, Eddie received the Citizens for Peaceful Resolutions Earth Charter Award for his commitment to youth education and outreach. In 2010, Eddie won the Muriel Anderson Music For Life Alliance Award for supporting music education and providing instruments for children who may not otherwise enjoy the experience of making music. He received the Richard Lee Adelman Service Award in 2013, for outstanding contributions to the lives of individuals with disabilities. In 2013, he also received the Global Citizen Award from The Academia Cotopaxi Global Citizen award. This honor is bestowed on an individual who has made a significant contribution to the betterment of humanity in Ecuador and the world.

Emily Mostovoy has over 15 years of experience in education. She has held positions as school counselor, principal and Special Education Director. She has over 10 years of experience as a school administrator, the last 6 years as Special Education Director. She is an active member of Special Education Administrators of County Office (Past Chair 2017-2018). Her current title is Executive Director of Special Education, and she has been with the Ventura County Office of Education for the last 5 years. She was instrumental in bringing The Rhythmic Arts Project to Ventura County Office of Education.

Denise Pannell, M.S. has worked for the Ventura County Office of Education (VCOE) for the past 12 years. In 2007, she was one of the first teachers to help open Triton Academy which is a highly specialized school to serve students with Autism Spectrum Disorder (ASD). Denise continues to work as an education specialist and lead teacher at Triton and she has participated in collaborations such as Triton Advisory and Triton Academy Parent Association. Denise has been integral to the growth and opportunities provided to students at Triton. Her dedication and commitment to the program has allowed students to successfully transition to post-secondary opportunities but more so has guided support staff to become specialists in the education field. Denise works closely on committees such as the Transition Network Team (TNT) and with the Workability Coordinator through the Ventura County SELPA. Denise is also an Autism specialist and helps provide trainings within VCOE and county wide to teachers and families wanting to know more about services for students with ASD. Denise works collaboratively with specialists such as behaviorists, speech and language pathologists, occupational therapists, and with clinicians from Ventura County behavioral health to provide meaningful educational benefit and help give students the skillset needed to be successful when leaving her program.

Chris Landon, MD, FAAP, FCCP, CMD, is Director of Pediatrics at Ventura County Medical Center, Clinical Associate Professor of Pediatrics at Keck USC School of Medicine, and Clinical Assistant Professor of Family Medicine at UCLA School of Medicine. Dr. Landon developed the multi-disciplinary Pediatric Diagnostic Center serving children with special health care needs and their families, Landon Pediatric Foundation to support this work locally and globally, and is President of The Rhythmic Arts Project non-profit.