The Center for AAC&Autism™

Learn. Hope. Share. Succeed.™

Language Acquisition through Motor Planning (LAMP™) is a therapeutic approach based on neurological and motor learning principles. The goal is to provide individuals who are nonspeaking or have limited verbal abilities with a method of independently and spontaneously expressing themselves across environments. LAMP is designed to mirror neurological processes associated with typical speech and language development by pairing a consistent motor movement with consistent auditory feedback and a natural response while using a speech-generating device. LAMP also incorporates learning readiness and language instruction within activities that promote joint engagement. Vocabulary is taught across environments using multisensory experiences to enhance meaning, with the individual's interests and motivations guiding vocabulary selection. There are no cognitive prerequisites for implementing LAMP. Intervention can begin at the cause-and-effect level and systematically build upon the stages of natural language development.

LAMP Approach Research

1. Neno, C., Ellawadi, A., Cargill, L., Lyle, S. & David, A. (2016). Vocabulary Development in School-Age Augmentative and Alternative Communication (AAC) Users. Poster presented at the American Speech-Language Hearing Association Annual Conference, Philadelphia, PA.

   Summary: Researchers collaborated to design and study the effects of a fully immersive Language Acquisition through Motor Planning (LAMP)-based classroom. Eight participants were in kindergarten and first grade and spent two hours in a classroom co-taught by three speech-language pathologists and a special educator. The classroom focused on instruction of a set of core vocabulary words instructed across a variety of sensory and scientific/discovery activities. The immersive portion of this classroom took place in large-scale language around a SMARTBoard projecting the Words for Life language program that an adult would model the sequences of the vocabulary being used by the teacher.

   The findings of this study indicated an upward trend in total use and duration of use of the devices, total number of words used, and the frequency of different words used. The most significant data trend (compared to control classrooms) is that the greatest language use was shown after the program had ended indicating that this 8-week intensive program "set the stage" for further language growth.

2. Bedwani, M., Bruck, S, Costly, D. (2015). “Augmentative and Alternative Communication for Children with Autism Spectrum Disorder: An Evidence-Based Evaluation of the Language Acquisition through Motor Planning Programme. Cogent Education. 2(1). http://www.tandfonline.com/eprint/gZZtTTfzRYDBqZTsCxWq/full

   Summary: Eight participants received intervention with the LAMP approach and SGD for five weeks. All the children had received previous intervention prior to the study, (up to 9 years) yet only 25% of them were able to comment at the baseline assessment. At post-program assessment, all subjects showed significant vocabulary increase, all were requesting using a symbolic means of communication (on the device or using spoken language) and 100% of the children were developing social communication through commenting. Other social communication improvements were also observed in gaining attention (75%), expressing feelings (75%) and greetings (87%). All the children were independently communicating and were not restricted to vocabulary that had been taught to them. Although not the focus of the study, 75% of the children were observed to be using phrases on their device by week 5 of implementation and two of the children in the study were observed at the week 9–10 post-program assessment to be using words with multiple meanings in the right context.

   There were a range of other outcomes that parents, teachers and speech pathologists observed and reported including an increase in joint attention, interest, motivation and engagement with others, an overall increase in willingness to communicate and an overall increase in play and social communication. For some of the children, this was the first time they were able to communicate and participate in social situations. Behavior was also reported to have improved with a corresponding decrease in frustration as a result of improved expressive communication.

3. Pulliam, M. H. (2010). “The initial and renewed impact of an AAC device, using the LAMP approach, on an individual with autism spectrum disorder.” Master’s thesis. Arkansas State University, Jonesboro, Arkansas.

   Summary: Case study of a child who used the LAMP approach, then an alternate approach, and the LAMP approach again several years later. Vocabulary increase was only noted during the periods when the LAMP approach was implemented. The same study was published recently in a peer-reviewed journal, but they focused on the AAC device rather than the approach.

   Neeley, R., Pulliam, M. H., Catt, M., McDaniel, D.M. (2015). “The Impact of Interrupted Use of a Speech Generating Device on the Communication Acts of a Child with Autism Spectrum Disorder: A Case Study.” Education. 9:371-379.

4. Potts, M. and Satterfield, B. (2013). “Studies in AAC and Autism: The Impact of LAMP as a Therapy Intervention.” Prentke Romich. Web. 2 Jan. 2015. http://www.gatfl.gatech.edu/tflwiki/images/4/43/LAMP_Rsch_Article.pdf

    Summary: The seven children in this study, who ranged from age three to age seven, had a diagnosis of autism or pervasive developmental disorder-not otherwise specified (PDD-NOS) and complex communication needs (CCN). All seven were diagnosed with expressive-receptive language disorder. Four presented with severe/profound apraxia. Two were found to have dysarthria of speech. Each obtained a speech generating device (SGD) and received LAMP therapeutic intervention. Each child demonstrated communication progress. Language samples from six participants revealed gains as measured by mean length of utterance (MLU) within the first year. Other progress was noted in areas such as enhanced receptive vocabulary, spontaneous use of language, natural vocalization, and in the reduction of difficult behaviors and increase in shared attention.

    Findings Were Presented:

    Satterfield, B. & Halloran, J., (2013, June). Research Insights into LAMP (Language Acquisition through Motor Planning. Institute Designed for Educating All Students (IDEAS) Conference. (St. Simon’s Island, GA. June, 2013).

5. Stuart, S. and Ritthaler, C. (2008). “Case Studies of Intermediate Steps/Between AAC Evaluations and Implementation.” Perspectives on Augmentative and Alternative Communication, 17, 150-155. http://sig12perspectives.pubs.asha.org/article.aspx?articleid=1765951

    Summary: Informal case studies on two children who began using the LAMP approach with a Vantage SGD with a secondary evaluation/therapy center outside of the schools where they received primary services. Both children showed improvement in communication while using the LAMP approach. Difficulties with coordinating services with the primary team and modifications that were made to accommodate the primary team are discussed.

Research Specific to Motor Learning and SGDs

1. Dukhovny, E. Effect of Size-Centered vs. Location-Centered Grid Design on Aided AAC Productions. Poster session presented at American Speech and Hearing Association Conference; 2015 Nov 12-14; Denver CO.

    Summary: Learning of aided AAC displays frequently begins with several large icons, with icon size decreasing as more vocabulary is introduced (“size-centered design”). Another

approach introduces small icons from the start, with icon location maintained as new vocabulary is introduced ("location-centered design"). This ongoing study compares the effectiveness of these display designs with neurotypical adults. More subjects are needed but location-centered design is trending toward significance for accuracy and speed of access. Findings support using Vocabulary Builder in a complex communication system over providing limited vocabulary in an orientation that will change as language develops.

2. Dukhovny, E. and Gahl. S. (2014). "Manual motor-plan similarity affects lexical recall on a speech-generating device: implications for AAC users." Journal of Communication Disorders, 48, 52-60.

   Summary: Neurotypical adults were more successful with recall of motor patterns to access words on SGD when the motor patterns for those words were dissimilar, indicating that motor patterns play a role in access speed and recall. "This study provides initial support for the use of motor sequences in SGD-based language production…. If supported with further research findings, evidence of SGD-based motor plans for production will have significant practical clinical implications. Prior research in AAC design has focused primarily on facilitating visual search of the SGD interface by comparing the effectiveness of visual properties of the symbols on the grid, such as iconicity and use of color cues (Thistle & Wilkinson, 2009). Developing motor plan automaticity is a complementary and, in later stages of device use, possibly more efficient, approach to reducing the cognitive load of production (Grabowski, 2010). If SGD-based production quickly becomes automatic, as the current study suggests, one implication is that, with continued SGD use, location of symbols on a grid becomes more relevant to fluent SGD production than the internal visual characteristics of the symbols. Therefore, in planning SGD design and intervention, location of symbols on the AAC device, and the resulting motor plans for accessing symbols, must be taken into account along with visual considerations."

3. Thistle, J., Holmes, S., Horn, M. & Reum, A. (2018). "Consistent Symbol Location Affects Motor Learning in Preschoolers Without Disabilities: Implications for Designing Augmentative and Alternative Communication Displays". American Journal of Speech-Language Pathology, 1-8.

   Summary: The purpose of this study was to determine the effect of consistency of symbol location on preschoolers' speed of locating target symbols on an AAC display. The authors compared the effect of 2 display designs on the speed of locating target words by preschoolers without disabilities. 2 groups of 12 children, each with an average age of 4 years old participated in the study. The participants in the consistent group were asked to locate symbols on arrays that did not change, whereas participants in the variable condition utilized arrays where the symbols changed locations each session. The participants were asked to locate the symbols over 5 sessions, completing 9 trials per session. Regardless of group, participants had an average response time of 6.0 seconds during the 1st session. During the 5th session, participants in the consistent condition

had an average response time of 3.3 seconds, whereas participants in the variable condition had an average response time of 6.0 seconds. These results illustrated an advantage of consistent symbol location for preschoolers without disabilities and provided support for validating the application of motor learning principles to AAC display design for children.

References Supporting Components of the LAMP Approach

Readiness to Learn

Ashburner, J., Ziviani, J., & Rodger, S. (2008). Sensory processing and classroom emotional, behavioral, and educational outcomes in children with autism spectrum disorder. American Journal of Occupational Therapy, 62(5), 564-573.

Ayres, A. Jean (1983). Sensory Integration and the Child. Los Angeles: Western Psychological Services Csíkszentmihályi, Mihály (1998). Finding Flow: The Psychology of Engagement with Everyday Life. New York: Basic Books.

Ayres, J., Mailloux, Z., and Wendler, C. (1987). “Developmental dyspraxia: is it a unitary function?” Occupational Therapy Journal of Research, 7, 93-110.

Dunn W. (1997). Implementing neuroscience principles to support habilitation and recovery. In: Christiansen C, Baum C, eds., Occupational Therapy: Enabling Function and Well-Being. 2nd ed. Thorofare, NJ: SLACK Incorporated, 186-232.

Fredrickson, B. L. (2001). "The role of positive emotions in positive psychology. The broaden-and-build theory of positive emotions." American Psychologist. 56(3), 218-226.

Fredrickson, B. L., and Branigan, C. (2005). "Positive emotions broaden the scope of attention and through-action repertoires." Cognition and Emotion, 19(3), 313-332.

Kranowitz, Carol Stock and Miller, Lucy Jane, The Out-of-Sync Child: Recognizing and Coping With Sensory Processing Disorder, Revised Edition. Skylight Press. 2005

Lupien, SJ, Maheu F, Tu M, Fiocco A, Schramek TE (2007). "The effects of stress and stress hormones on human cognition: Implications for the field of brain and cognition". Brain and Cognition 65: 209–237.

Outters, V., Hepach, R., Behne, T., Mani, N. (2023). "Children's affective involvement in early word learning." Scientific Reports, 13(1), 7351.

Tomcheck, Scott D. and Dunn, Winnie. (2007). “Sensory Processing in Children with and Without Autism: A Comparative Study Using the Short Sensory Profile.” American Journal of Occupational Therapy, 61, 190-200.

Joint Engagement

Adamson, Lauren B., Bakeman, Roger and Deckner, Deborah F., (2004). “The development of symbol-infused joint engagement.” Child Development. 75: 1171-1187.

Adamson, Lauren B.; Bakeman, Roger; Deckner, Deborah F.; and Romski, MaryAnn. (2009). “Joint Engagement and the Emergence of Language in Children with Autism and Down Syndrome.” Journal of Autism and Developmental Disorder. 39(1): 84-96.

Bakeman R., Adamson L. B. (1984). “Coordinating attention to people and objects in motor-infant and peer-infant interaction.” Child Development. 55: 1278-1289.

Harris S., Kasari C, Sigman MD. (1996). “Joint attention and language gains in children with Down Syndrome.” American Journal on Mental Retardation. 100:608-619.

Kasari, Connie; Freeman, Stephanny; Paparella, Tanya. (2005). “Joint attention and symbolic play in young children with autism: a randomized controlled intervention study.” Journal of Child Psychology and Psychiatry. 47: 611-620.

Kasari, Connie; Paparella, Tanya; Freeman, Stephanny; Jahromi, Laudan B. (2008). “Language outcome in autism: Randomized comparison of joint attention and play interventions.” Journal of Consulting and Clinical Psychology. 76: 125-137.

Lewy, Arthur L. and Dawson, Geraldine. (1992). “Social stimulation and joint attention in young autistic children.” Journal of Abnormal Child Psychology. 20 (6): 555-567.

Moore, Chris; Dunham, Philip J. and Dunham, Phil. (1995). “Joint Attention Across Contexts in Normal and Autistic Children.” In Sigman, Marian and Kassari, Connie eds. Joint Attention: It’s Origins and Role in Development. London: Psychology Press.

Perra, O. & Gattis, M., (2012). "Attention engagement in early infancy." Infant Behavior and Development, 35(4), 635-44.

Salley, B., Sheinkopf, S. J., Neal-Beevers, A. R., Tenenbaum, E. J., Miller-Loncar, C. L., Tronick, E., Lagasse, L. L., Shankaran, S., Bada, H., Bauer, C., Whitaker, T., Hammond, J., & Lester, B. M. (2016). “Infants’ Early Visual Attention and Social Engagement as Developmental Precursors to Joint Attention.” Developmental Psychology, 52(11), 1721-1731.

Siller, Michael and Sigman, Marian. “The Behaviors of Parents of Children with Autism Predict the Subsequent Development of Their Children's Communication.” Journal of Autism and Developmental Disorders. 32: 77-89.

Consistent and Unique Motor Plans

Duffy, E. (1962). Activation and Behavior. Oxford, England: Wiley.

Gentile, A. M. (1972). “A working model of skill acquisition with application to teaching.” Quest, 17, 3-23.

Gonulal, T. & Loewan, S. (2018). Scaffolding technique. In J. I. Liontas (Ed.), The TESOL Encyclopedia of English Language Teaching (pp. 1-5). Hoboken, New Jersey: John Wiley & Sons.

Hebbs, D.O., (1949). The Organization of Behavior: A Neuropsychological Theory. Mahwah, NJ: Lawrence Erlbaum Associates.

Ferguson, Janice M. and Catherine A. Trombly. (1997). “The effect of added-purpose and meaningful occupation on motor learning.” American Journal of Occupational Therapy, 51, 508-515.

Higgins, Susan. (1991). “Motor Skill Acquisition.” Physical Therapy, 71, 123-139.

Jarus, Tal and Yael Loiter. (1995). “The effect of kinesthetic stimulation on acquisition and retention of a gross motor skill.” Canadian Journal of Occupational Therapy. 62, 23-29.

Keele, Steven W. (1968). “Movement Control in Skilled Motor Performance.” Psychological Bulletin 70, 387-403.

Keele, Steven W., Matthew Davidson, and Amy Hayes. “Sequential representation and the neural basis of motor skills.” Motor Behavior and Human Skill: a multidisciplinary approach. Jan Piek, ed. Champaign, IL: Human Kinetics. 1998. 3-27.

Lee, Timothy D., Laurie R. Swanson, Anne L. Hall. (1991). “What is repeated in a repetition? Effects of practice conditions on motor skill acquisition.” Physical Therapy 71, 150-156.

Levelt, Willem J. M. (1989). Speaking: From Intention to Articulation. Cambridge, Massachusetts: The MIT Press.

Meister, I. G., Wilson, S. M., Deblieck, C., Wu, A. D., and Lacoboni, M. (2007). "The essential role of premotor cortex in speech perception." Current Biology, 17, 1692-1696.

Schmidt, Richard A. (2003) “Motor schema theory after 27 years: reflections and implications for a new theory.” Research Quarterly for Exercise and Sport. 74, 366-375.

Schmidt, Richard A. and Lee, Timothy D. (2005). Motor Control and Learning: A Behavioral Emphasis. Champaign, IL: Human Kinetics.

Schmidt, Richard A. and Wrisberg, Craig A (2008). Motor Learning and Performance. Champaign, IL: Human Kinetics.

Sowers, D. J. and Wilkinson, K. M. (2023). “Demands associated with an augmentative and alternative communication system in relation to alternate forms of access for individuals with motor impairments.” American Journal of Speech- Language Pathology, 32, 37-54.

van de Pol, J., Volman, M. & Beishuizen, J. (2010). “Scaffolding in Teacher-Student Interaction: A Decade of Research.” Educational Psychology Review 22(3), 271–296.

Auditory Signal

Boddaert, N., Chabane, N., Belin, P., Bourgeois, M., Royer, V., Barthelemy, C., Mouren-Simeoni, M. C., Philippe, A., Brunelle, F., Samson, F. and Zilbovicius, M. (2004). “Perception of Complex Sounds in Autism: Abnormal Auditory Cortical Processing in Children.” American Journal of Psychiatry. 161: 2117 - 2120.

Courchesne E, Kilman BA, Galambos R, Lincoln AJ. (1984). “Autism: processing of novel auditory information assessed by event-related brain potentials.” Electroencephalography and Clinical Neurophysiology. 59: 238-248.

D’Ausilio, Alessandro, Pulvermuller, Friedemann, Salmas, Paola, Bufalari, Ilaria, Begliomini, Chiara, and Fadiga, Luciano. 2009. “The motor somatotopy of speech perception.” Current Biology. 19: 1-5.

Fadiga, L, Craighero, L, Buccino, G, Rizzolatti, G. 2002. “Speech listening specifically modulates the excitability of tongue muscles: a TMS study. European Journal of Neuroscience. 15(2): 399-402.

Feldman, J., Dunham, K., Cassidy, M., Wallace, M.T., Liu, Y., and Woynaroski, T.G. (2018). "Audiovisual mulisensory integration in individuals with autism spectrum disorder: A systematic review and meta-analysis. Neuroscience & Biobehavioral Reviews. 95, 220-234.

Le Bel, R. M., Pineda, J. Al, Sharma, A. (2009). "Motor-auditory-visual integration: The role of the human mirror neuron system in communication and communication disorders." Journal of Communicaiton Disorders, 42(4), 299-304.

LeDoux, Joseph. (2002)Synaptic Self: How Our Brains Become Who We Are. New York: Penguin Books.

Oberman, L., Hubbard, E., McCleery, J., Altschuler, E., Ramachandran, V., Pineda, J. (2005). "EEG evidence for mirror neuron dysfunction in autism spectrum disorders." Cognitive Brain REsearch, 24(2), 190-198.

Oberman, L., Ramachandran, V., Pineda, J. (2008). "Modulation of mu suppression in children with autism spectrum disorders in response to familiar or unfamilar stimuli: The mirror neuron hypothesis." Neuropsychologia. 46(5), 1558-1565.

Parsons, C. L., and La Sorte, D. 1993. “The effect of computers with synthesized speech and no speech on the spontaneous communication of children with autism.” Australian Journal of Human Communication Disorders. 21:12-31

Pinker, S. (1994). The Language Instinct: How the Mind Creates Language. New York: HarperCollins. Rowland, Benjamin A. and Stein, Barry E. 2007. “Multisensory integration produces an initial response enhancement.” Frontiers in Integrative Neuroscience. 1:4.

Russo, N., Foxe, J. J., Brandwein, A. B., Altschuler, T., Gnomes, H., and Molholm, S. 2010. “Multisensory processing in children with autism: high-density electrical mapping of auditory-somatosensory integration.” Autism Research. 3:1-15.

Schroeder, C. E., Smiley, J., Fu, K. G., McGinnis, T., O’Connell, M. N., and Hackett, T. A. 2003. “Anatomical mechanisms and functional implications of multisensory convergence in early cortical processing.” International Journal of Psychophysiology.” (50). 5-17.

Stein, B. E. 1998. “Neural mechanisms for synthesizing sensory information and producing adaptive behaviors.” Experimental Brain Research. 123:124-135.

Stevenson, R. A., Siemann, J. K., Schneider, B., C., Eberly, H. E., Woynaroski, T. G., Camarata, S. M., Wallace, M. T. (2014). “Mulitisensory Temporal Integration in Autism Spectrum Disorders.” The Journal of Neuroscience, 34(3), 691-697.

Tecchio, F, Benassi, F, Zappasodi, F, Gialloreti, L. E., Palermo, M., Seri, S, and Rossini, P. M. (2003). “Auditory Sensory Processing in Autism: A Magnetoencephalographic Study.” Biological Psychiatry. 54: 647–654.

Tsao, Feng-Mint, Liu, Huei-Mei, and Kuhl, Patricia K. 2004. “Speech perception in infancy predicts language development in the second year of life: a longitudinal study.” Child Development. 75: 1067-1084.

Vihman, M. M. and Nakai, S. (2003). “Experimental evidence for an effect of vocal experience on infant speech perception. In Proceedings of the 15th international congress of phonetic sciences (pp. 1017-1020). Barcelona.

Wagley , N., Lajiness-o’Neill, R., Hay, J.S.F, Ugolini, M., Bowyer, S.M., Kovelman, L, and Brennan, J.R. (2020). “Predictive Processing during a Naturalistic Statistical Learning Task in ASD.” eNeuro, 7(6), ENEURO.0069-19.2020; https://doi.org/10.1523/ENEURO.0069-19.2020

Westermann, Gert and Miranda, and Eduardo Reck. 2004. “A new model of sensorimotor coupling in the development of speech.” Brain and Language. (89). 393-400.

Wilson, S. M., Saygin, A. P., Sereno, M. I., Icaboni, M. (2004). “Listening to speech activates motor areas involved in speech production.” Nature Neuroscience, 7(7), 701-702.

Winstein, Carolee J. (1991). “Knowledge of results and motor learning – implications for physical therapy.” 71, 140-149.

Zelaznic, Howard N. (1996). Advances in Motor Control and Learning. Champaign, IL: Human Kinetics.