Matrix Training on a Mobile Application to Enhance Language Learning and Generalization in Minimally-Verbal Autism

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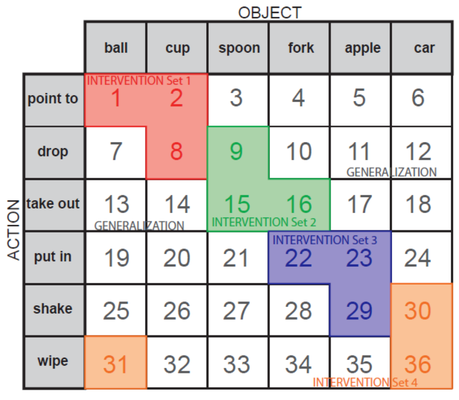
Background

- About 50% of individuals with autism spectrum disorder have severe speech and language impairments (Lord, Risi, & Pickles, 2004)
- Increasing use of augmentative and alternative communication (AAC), particularly speech-generating devices including mobile technologies
- Messages generated through AAC or minimal speech are mostly limited to one-word utterances (Schlosser & Wendt, 2008)
- Challenge to move minimally verbal learners from single-word requests to conventional language systems

Matrix Training

- Language intervention to systematically build up vocabulary and teach longer word combinations
- Generative approach to instruction, words are arranged in matrix format, some multiword phrases are taught and others develop without direct instruction
- Linguistic elements (e.g., nouns, verbs, etc.) are presented in systematic combination matrices, which are arranged to induce generalized rule-like behavior
- Example for a 6x6, action-object matrix:



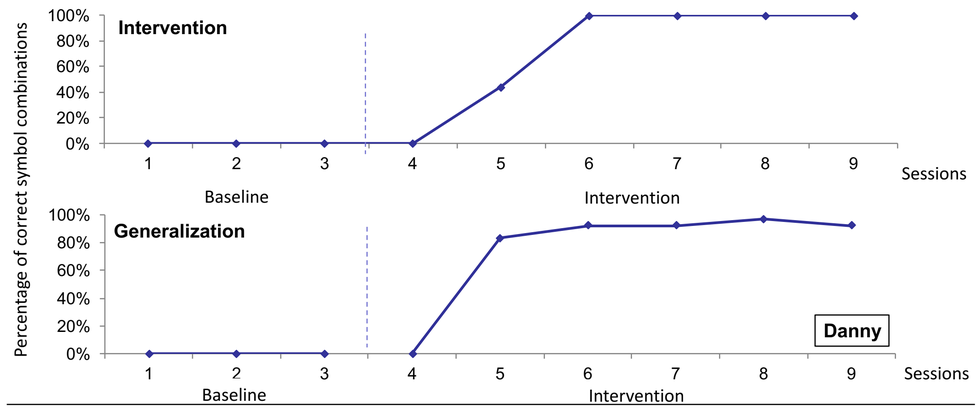
Objectives

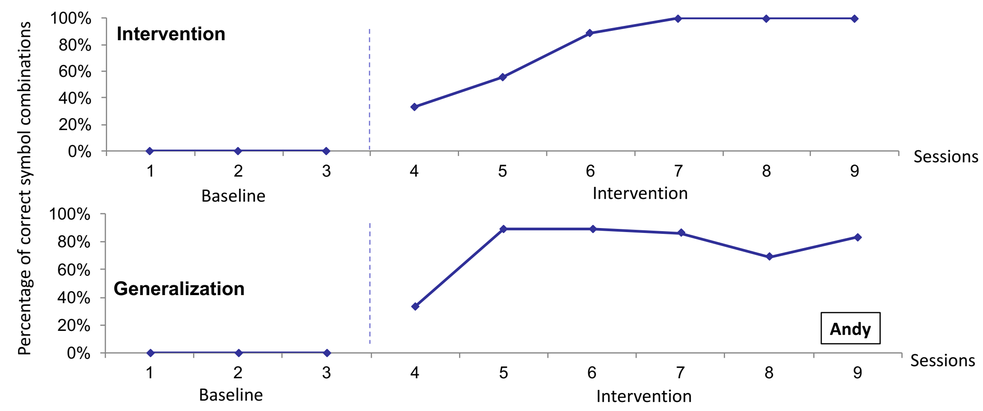
A mobile application, *SPEAKmore!*® was developed to carry out matrix training on a tablet device. Initial proof-of-concept data were collected to investigate:

1. Does language training with *SPEAKmore!*® facilitate production of action-object combinations on a tablet device?
2. Do newly learned skills generalize to untrained action-object combinations?

Proof-of-Concept Data

- Series of pre-experimental A-B single case designs were completed across sets of action-object combinations with generalization probes of untrained combinations
- Two students were taught action-object combinations on a 6x6 matrix with *SPEAKmore!*®: From total pool of 36 possible symbol combinations, the researcher created four different sets of three symbol combinations each that were actively taught
- Remaining 24 combinations were tested for generalization effects





- Participants demonstrated similar pattern of successful acquisition of symbol combinations during the intervention condition and subsequent generalization to untrained stimuli

- Magnitude of intervention effect was estimated using the Non-overlap of all Pairs (NAP) Index (Parker & Vannest, 2009):
  - Score from 0 – 65% indicates weak effects
  - Score from 66 – 92% indicates medium effects
  - Score from 93 – 100% indicates large or strong effects

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iPad with *SPEAKmore!*® App

- Video model delivers visual stimuli and prompts for response
- Expressive and receptive language assessment to determine current skill level
- Intervention mode: Instruction and error-correction on new symbol combinations
- Generalization mode: Testing generalization to untrained stimuli

Participants (Based on ADOS-2 and CARS-2 Scores)

Danny: Male, 12 yrs.	severe autism	highly echolalic, jargon, no functional, meaningful words
Andy: Male, 12 yrs.	severe autism	limited speech – vocalizations, gestures

Results and Discussion

Participant	Intervention NAP Effect	Generalization NAP Effect
Danny	92% (medium-strong effect)	92% (medium-strong effect)
Andy	100% (strong effect)	100% (strong effect)

- Results suggest matrix training through a mobile application may be a promising approach to teach new vocabulary, enhance semantic relationships and their generalization, and increase complexity of utterances for AAC users with severe autism
- To further investigate the robustness of this technology intervention, findings need to be replicated using (a) different language targets (e.g., agent-action, adjective-object combinations), (b) expansions from two-term to three-term semantic relations (e.g., agent-action-object), and (c) qualitatively different stimuli (e.g., animated icons vs. human video clip)
- Implementation of an experimental single-subject research design is the logical next step to generate evidence of a causal relationship
  - Generalization probes should investigate language generation without prompting through the application
- Future research may expand matrix training on mobile technologies to
  - Play skills and social skills training
  - Early literacy instruction
  - Teaching initial math skills