Combining Exchange-based Communication with Speech-output Technology: A Series of Experimental Investigations
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The Picture Exchange Communication System (PECS)
- Structured behavioral intervention program to teach use of visual-graphic symbols for communication (Bondy & Frost, 1994)
- Exchanged-based (versus selection-based) graphic symbol strategy: initially teaches to make requests by handing/exchanging symbols for desired items
- Often the initial choice for starting AAC intervention in learners with autism who have little or no functional speech for several reasons:

Traditional PECS Protocol
- Picture Exchange Communication System (PECS) (Frost & Bondy, 1994)
  - Phase I: Physical Exchange
  - Phase II: Expanding Spontaneity
  - Phase III: Picture Discrimination
  - Phase IV: Sentence Structure
  - Phase V: Responding to "What do you want?"
  - Phase VI: Responsive and Spontaneous Commenting

Speech-Generating Devices (SGDs)
- Portable, computerized devices producing synthetic/digitized speech output when activated
- Graphic symbols are used to represent messages, activated by finger, switch, headstick, etc., selecting a symbol from the display
- Advantages over non-electronic systems due to providing additional auditory stimuli for the learner via speech output:

SGDs (Cont.)
- Additional provision of speech output presented as (a) antecedent auditory stimuli (a.k.a. "augmented input"), and/or (b) consequence auditory stimuli (a.k.a. "feedback") may benefit learners with developmental disabilities
  - Gains in receptive and expressive language skills in adolescents with intellectual disabilities using SGDs (Romski & Sevcik, 1993, 1996)
- SGD may allow more independent form of communication (voice output understood by variety of familiar and unfamiliar comm. partners)
Open Questions

• Transition from PECS (low tech) to SGD (high tech) unclear
• Questions about children being able to complete later PECS phases, most often interventions stop at PECS III or IV (Schlosser & Wendt, 2009)
• Can AAC actually facilitate speech production (or in worst case scenario does AAC hinder speech?)
  – Very little data to suggest speech production gains and large variability across individuals (Schlosser & Wendt, 2008a)

Research Questions

• Practitioners/parents: after successful mastery of (initial) PECS phases, can the child move on to an SGD? (Grether, 2007)
• “…research into innovations to the PECS protocol is a laudable direction and should be continued using rigorous methodologies” (Schlosser & Wendt, 2008); Project goals:
  • Modify PECS protocol for implementation and transition to an SGD
  • Evaluate effects of modified PECS protocol on increasing requesting skills, social-communicative behaviors, and emerging speech
  • Evaluate effectiveness of a particular device for such purpose that is built upon PECS principles

Experimental Design

• Multiple Baseline Design across participants (Baer, Wolf, & Risley, 1968)
  – Intervention phase split into PECS phases and SGD phases, followed by maintenance phase
• Dependent measures:
  – Requesting skills: number of correct requests during 20-trials session
  – Social-communicative behavior: number of responses including eye contact, physical orientation towards comm. partner, positive affect via smiling/laughter
  – Emerging speech: word vocalizations or word approx.

Materials and Setting

• Traditional PECS book with PCS symbols for desired items
• Proxtalker - “sentence strip that actually speaks”: picture card is put on ProxTalker display → speak out the symbol referent in form of prerecorded digitized speech
  - Several picture cards can be combined to speak sentences
  - Symbols used were identical to PECS symbols
• Departmental Speech Clinic, 3 sessions per week
Reliability

- Second, independent observer scoring baseline and training sessions on all dependent measures for over 50% of sessions, yielding inter-rater agreement scores:
  - Requesting: IRR = 99%, range = 88–100%
  - Social-comm. behavior: IRR = 84%, range = 80–100%
  - Natural speech production: IRR = 98%, range = 80–100%
- Treatment integrity (TI) checklist to ensure correct protocol implementation
  - All trainers took official PECS Basic Training Workshop
  - Two student clinicians checked 33% of sessions yielding an average TI score of 98.5% (range 86-100%). Agreement between observers was $r = 1.00$ ($p < .001$).

Participant Characteristics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Gender</th>
<th>Dx</th>
<th>Communication Skills</th>
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</thead>
<tbody>
<tr>
<td>Subject A</td>
<td>9</td>
<td>male</td>
<td>severe autism</td>
<td>limited speech — word approximations; some PECS exposure; gestures</td>
</tr>
<tr>
<td>Subject Q</td>
<td>11</td>
<td>male</td>
<td>severe autism</td>
<td>mainly nonverbal with minimal word approximations; PECS exposure; gestures</td>
</tr>
<tr>
<td>Subject J</td>
<td>11</td>
<td>male</td>
<td>severe autism</td>
<td>nonverbal; minimal PECS exposure; gestures</td>
</tr>
</tbody>
</table>

Traditional PECS Protocol (Bondy & Frost, 1994)

(Preference Assessment)
- Phase I: Physical Exchange
- Phase II: Expanding Spontaneity

- Phase III: Picture Discrimination
- Phase IV: Sentence Structure
- Phase V: Responding to “What do you want?”
- Phase VI: Responsive and Spontaneous Commenting

Further Protocol Modifications

- In early PECS/ProxTalker phases I-III clinician repeats word one more final time when handing item, provides additional speech model
- More rigorous speech elicitation during phases IV-V:
  - Encourage speech while “reading” the device sentence strip: ... the trainer says, “now you do it”. The trainer points to the “I want symbol”, reading “I want”, then briefly pauses (~ 3 sec.) adding an expectant look to give the child a chance to say the word. If the child does say the word trainer gives extra praise and extra item (differential reinforcement).

Preference Assessment

- Parent interview to develop a list of potential reinforcers for further validation
- 6-8 food items were chosen from the list based on their general accessibility as the potential reinforcers
- Trial-based assessment was implemented to determine 4-5 reinforcers of equal value
Preference Assessment (cont.)

- Specific Procedures:
  1. A plate containing 1 potential reinforcer was presented in front of the participant
  2. The participant had 5 seconds to decide if he wanted to select the item
  3. After the decision was made or after the participant finished eating the item, a 2nd item was presented
  4. Each item was offered 5 times in a counterbalanced order
  5. The participant had to take the item from the plate and eat the item in order to count as a selection
  6. According to previous research (Pace et al., 1985), items selected above 80% (4 out of 5 times) were considered to be reinforcers

PECS Protocol: Phase I

- This is an early learning period where the child will use a single picture
- The child is prompted to pick up the picture card, reach to the communicative partner, and release the card into the partner’s open hand
- The communicative partner then gives the desired item to the child who is allowed to play with/eat the item for several seconds

PECS Protocol: Phase II

- The main component in communicative spontaneity is that the child will persist when no reaction to the initial attempt is given
- The child learns to reach farther and to walk to the communicative partner
**ProxTalker Protocol: Phase I**

- After the child completes the traditional PECS phases I & II, ProxTalker device training is introduced.
- A similar protocol is followed but appropriate modifications:
  - ProxTalker replaces PECS book.
  - No longer hand-to-hand exchange of picture cards, instead child is prompted to place picture cards onto device and activate.

**ProxTalker Protocol: Phase II**

- The device is placed in front of the child. Clinician entices the child with a preferred item from halfway across the room.
- Child learns to pick up device at one place and walks over to clinician at a different place to request desired item.

**ProxTalker Protocol: Phase III**

- The child is taught to discriminate between two and three pictures on the device while seated at the table across the trainer.
- Discrimination:
  - preferred vs. distracter item
  - preferred vs. non-preferred
  - two preferred items
  - three preferred items
- Correspondence checks to assess correct item selection.
ProxTalker Protocol: Phase IV

- This phase teaches the use of “I want” to make requests and create an initial sentence structure.
  - Child gradually learns to pick up “I want” picture card, place it on device sentence strip, and add card for desired item.
  - Has to speak item at the end.

ProxTalker Protocol: Phase V

- Phase 5 teaches the child to respond to the question “What do you want?” The goal is for the child to learn to provide an answer as soon as the question is asked.
  - End goal: child encouraged to request more spontaneously
  - Parallel to this phase: teaching of attributes (e.g., colors, shapes, amounts, etc.)

Effects on Requesting Skills
Effects on Social-Communicative Behavior

Effects on Emerging Speech

Speech Production Participant Q

Speech Production Participant J

Study Limitations
- Current protocol modifications end at PECS equivalent phase 5
- Generalization established across intervention agents (different trainers) but not across learning environments
- Technically, design allows to demonstrate effects of PECS-ProxTalker combination but not of ProxTalker alone
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EXPERIMENT 2: PECS VS. SGD

Research Questions
- Can you start directly teaching the ProxTalker (or similar SGD) within a modified PECS protocol?
- Replication with younger participants
- Evaluate the relative effectiveness of PECS vs. ProxTalker; Questions:
  - What are the comparative effects of each treatment modality on increasing:
    - Requesting (primary measure)
    - Social-communicative behavior
    - Natural speech production

Methods
- Design
  - multiple baseline across participants with an embedded alternating treatments design
- Materials
  - PECS book with PCS (picture cards)
  - ProxTalker SGD with same picture cards as PECS
- Setting
  - university-based therapy room (Nadia & Zeth)
  - home (Christian)
- Dependent Variables
  - requesting, social-communicative behavior, speech

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<th>Sex</th>
<th>DX</th>
<th>Communication Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christian</td>
<td>6</td>
<td>male</td>
<td>severe Autism</td>
<td>Very limited speech (less than 5 word approximations); some PECS exposure; gestures</td>
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<tr>
<td>Nadia</td>
<td>7</td>
<td>female</td>
<td>severe Autism</td>
<td>Nonverbal; some PECS exposure; few gestures</td>
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<tr>
<td>Zeth</td>
<td>10</td>
<td>male</td>
<td>severe Autism</td>
<td>nonverbal; no PECS exposure; gestures; 3 manual signs</td>
</tr>
</tbody>
</table>

Procedures
- Preference Assessment (Pace et al., 1985)
- Random order of Tx & counterbalanced
- Protocol:
  - BL: Both modalities were available
  - Phase 1: Child picks up picture card & gives to trainer 1 (or activates card on SGD)
  - Phase 2: Child picks up card/SGD, walks to trainer, & exchanges for reinforcer
  - Phase 3A: Child discriminates between pictures [distracter, non-preferred, 2 preferred, 3+ preferred] then requests item
  - Phase 3B: Child discriminates between 2 picture cards
  - Follow up: Continuation of phase & Tx with best results

Reliability Analyses
- Inter-rater reliability
  - 2nd, independent observer (trained graduate student) scoring across all sessions (>33%) yielded inter-rater reliability rates:
    - Requesting: 83-100% (M = 99%)
    - Social-Communicative Behavior: 80-100% (M = 95%)
    - Speech: 100% (M = 100%)
- Treatment integrity (TI) checklist to ensure correct protocol implementation
  - Trainers were graduate students, PECS trained
  - TI conducted on >33% of total treatment sessions
  - Trainer 1: 89-100% (M = 98%) / Mean agreement = 99%
  - Trainer 2: 50-100% (M = 94%) / Mean Agreement = 98%
More social-comm. behavior in phase 2 because of demands to locate trainer, thus increasing eye contact & proximity

Picture Discrimination cumbersome (phase 3A), may need to remain at 2-symbols level for some time

No speech gains with either treatment or for any participant - practitioners need to have realistic expectations of speech development

Conclusions

- Children can master both modalities -- contribution of modified protocol
- Pros and cons of each modality:
  - SGD is heavy for younger children & makes “distance and persistence” more difficult
  - Slightly less social-comm. behavior with SGD because participants were more interested in device features
  - Motivational value of SGD
  - Value of traditional PECS as back-up

Future Research Directions

- Replication with younger participants
  - How early in age can transition to SGD occur?
- Ongoing transition to PECS stage VI “commenting”
- What type of participant is a good candidate for transition, which one is not?
- Once a “mid technology” device such as the ProxTalker is mastered, what comes next?
  - Potential trajectory of moving along an intervention spectrum:
    - PECS (low tech) → ProxTalker (mid tech) → ? (high tech)
  - If speech is the focus: augmented input

Conclusions (cont.)
Future Research Directions

- Moving from Mid-Technology (ProxTalker) to High-Technology (iPad)

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Questions ???

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Disclosure Statement

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References

References (cont.)


