Effects of Animation: A Comparison of Two Graphic Symbol Sets

1,2Ralf W. Schlosser, PhD, 3Koul, R. K, PhD, 3Howard Shane, PhD, 3James Sorce, PhD, 1Lindsy Hotz, 1Kristofer Brock, 1Rachel Tempesta, 1Dorothy Moerlein, 1Sarah Schneck, 1Suzanne Flynn, 1Emily Laubscher, 1Jennifer Abramson, & 1Hollie Fadie
1Northeastern University
2Texas Tech University Health Sciences Center
3Children's Hospital Boston
4Massachusetts Institute of Technology

ASHA 2011, San Diego, CA

http://www.aac-rerc.com

Portions of the work in this presentation have been funded in part by the National Institute on Disability and Rehabilitation Research (NIDRR) under Grants #H133G1001987 & #H133G080011

Selected References


Acknowledgements

- This project (Award # H133G1001987), entitled “Do animations facilitate symbols understanding in children with autism? was funded by the National Institute on Disability and Rehabilitation Research (NIDRR) in the U.S. Department of Education’s Office of Special Education and Rehabilitative Services (OSERS). The contents do not necessarily represent the policy of the U.S. Department of Education, and endorsement by the Federal government should not be assumed.
- We would like to express our appreciation to the Directors and Teachers at various day care centers in Lubbock, TX and the Greater Boston Area along with the parents who graciously provided consent for their child to participate in this research.
- We also appreciate the assistance of Ashley Harmon with data collection.
Background
- Graphic symbols are a low-tech necessity for most aided AAC systems
- The “noun advantage” in graphic symbols (Shane & Weiss-Kapp, 2007; Schlosser & Sigafoos, 2002)
- Verbs and spatial prepositions are more difficult to represent graphically
- Recent advances in technology have created considerable enthusiasm for the potential benefits of animations to help represent these more difficult concepts

Background - Literature from related fields
- Tversky et al. (2002) reviewed evidence across a variety of fields to determine whether animation can facilitate understanding and learning.
- They concluded that animation may indeed be effective, but only if it is neither too complex nor too fast to be accurately perceived.
- They cautioned – the effects of animation per se can only be determined in comparison to graphics that do not change over time, as it is change with time that animation adds” (p. 250).

Background – Mineo et al., 2008
- Non-disabled preschoolers had to identify graphic/visual action representations from a 4-choice array
  - 1. animated video (based on realistic representations),
  - 2. animated line drawings (produced from human wearing reflective dots in gait lab)
  - 3. static line drawings (with disequilibrium cues),
  - 4. static line drawings (with movement cues).


Animated video of human


Results – Mineo et al., 2008

- Main effect for symbol format
  - Animated video better than others
  - Animated graphic better than static with disequilibrium cues
- Children identified more symbols as they got older

- Putting these results in context
  - Restricted to 24 actions (prepositions were not included),
  - Outcomes measured were concerned with identification only (naming guessability was not measured),
  - The most realistic representation was video-based (not graphic)
  - The graphic symbols used in this experiment were white on black line drawings or video (do not appear appealing to young children).
Background – Schlosser et al., 2011

- Non-disabled preschoolers had to guess (name) the meaning of 24 graphic representations of verbs and 8 prepositions and to identify a target from a 4-choice array
- Autism Language Program (ALP) Graphics Set
  - 1. animated
  - 2. static
- Within-group design
- DVs: Guessability, Name agreement, and Identification


Results – Schlosser et al., 2011

- Result indicate that
  - Animated symbols were more transparent than static symbols, although this was more pronounced for verbs.
  - Animated verbs were named more accurately than static verbs but there was no difference between animated and static prepositions.
  - Verbs were identified more accurately compared to prepositions but there was no difference between symbol formats.
  - Older children guessed, named, and identified symbols more effectively than younger children.

Background Descriptive Analyses

- Variable-specific criteria: Performing well
  - Guessability (G): >/= 70%; Name agreement (N): >/= 60%, identification (I): >/= 85%
- Across-variable heuristic criteria
  - Exceptionally: Met all criteria
  - Effectively: Passed I and G criterion, but failed N criterion
  - Adequately: Passed I criterion but failed N and/or I criterion
  - Inadequately: (a) Failed to meet each of the variable-specific criteria, or (b) Failed to meet identification criterion

Results indicated that the vast majority of the symbols performed adequately or better while a few did not.


Purpose of Research Study

- The purposes of this current study was to
  - Replicate the previous study
  - Compare ALP symbols with PCS
Participants

• Goal: 240 non-disabled children across three age groups (3, 4, and 5 years)
• English as first language
• Age-appropriate receptive vocabulary
• No vision or hearing difficulties

• Between group design

Design

- A 2 x 2 x 2 x 3 completely randomized factorial design
- Participants across three age groups (3-year olds, 4-year olds, and 5-year olds) were assigned randomly to
  - symbol type (PCS or ALP)
  - symbol format (Animated or Static), and
  - word class (Verbs or Prepositions).

<table>
<thead>
<tr>
<th>Three-year olds</th>
<th>Four-year olds</th>
<th>Five-year olds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PCS, Animated, Verbs</td>
<td>9. PCS, Animated, Verbs</td>
<td>17. PCS, Animated, Verbs</td>
</tr>
<tr>
<td>2. PCS, Animated, Preps</td>
<td>10. PCS, Animated, Preps</td>
<td>18. PCS, Animated, Preps</td>
</tr>
<tr>
<td>3. PCS, Static, Verbs</td>
<td>11. PCS, Static, Verbs</td>
<td>19. PCS, Static, Verbs</td>
</tr>
<tr>
<td>4. PCS, Static, Preps</td>
<td>12. PCS, Static, Preps</td>
<td>20. PCS, Static, Preps</td>
</tr>
<tr>
<td>6. ALP, Animated, Preps</td>
<td>14. ALP, Animated, Preps</td>
<td>22. ALP, Animated, Preps</td>
</tr>
<tr>
<td>7. ALP, Static, Verbs</td>
<td>15. ALP, Static, Verbs</td>
<td>23. ALP, Static, Verbs</td>
</tr>
<tr>
<td>8. ALP, Static, Preps</td>
<td>16. ALP, Static, Preps</td>
<td>24. ALP, Static, Preps</td>
</tr>
</tbody>
</table>

Materials

- Words - Verbs
  - A total of 24 verbs,
  - Generated from a list of 40 verbs that were found to emerge early in children’s lexicon (Humenlocher et al., 1983).
  - In selecting the 24 verbs, the following constraints were applied:
    - had to be represented in the ALP Animated Graphics Set and PCS set;
    - minimal pairs consisting of the same verb that can be transitive or intransitive were avoided (e.g., turn, bounce)

- Words - Prepositions
  - A total of 8 spatial prepositions
### Verbs & Prepositions

<table>
<thead>
<tr>
<th>Verbs</th>
<th>Prepositions</th>
</tr>
</thead>
<tbody>
<tr>
<td>blow</td>
<td>behind</td>
</tr>
<tr>
<td>bounce</td>
<td>in</td>
</tr>
<tr>
<td>carry</td>
<td>in front of</td>
</tr>
<tr>
<td>close</td>
<td>next to</td>
</tr>
<tr>
<td>cut</td>
<td>off</td>
</tr>
<tr>
<td>dance</td>
<td>on</td>
</tr>
<tr>
<td>draw</td>
<td>under</td>
</tr>
<tr>
<td>drop</td>
<td>out</td>
</tr>
<tr>
<td>eat</td>
<td></td>
</tr>
<tr>
<td>give</td>
<td></td>
</tr>
<tr>
<td>jump</td>
<td></td>
</tr>
<tr>
<td>kick</td>
<td></td>
</tr>
</tbody>
</table>

### Materials

- **Graphic symbols**
  - **Animated**: The 24 graphic symbols representing the above verbs and the 8 graphic symbols representing the spatial prepositions were taken from the ALP Animated Graphics set or from the PCS animated set.
  - **ALP Static**: developed from the animated symbols;
  - **PCS Static**: from their dictionary
- Symbol order was determined randomly.

### PCS- Prepositions - Static

“In”
PCS – Prepositions - Static
“Between”

PCS – Prepositions - Static
“Behind”

PCS – Prepositions - Animated
“In”

PCS – Prepositions - Animated
“Between”
PCS – Prepositions - Animated
“Behind”

PCS – Verbs - Static
“Dance”

PCS – Verbs - Static
“Close”

PCS – Verbs - Static
“Drop”
PCS – Verbs - Animated
“Dance”

PCS – Verbs - Animated
“Close”

PCS – Verbs - Animated
“Drop”

AAG* Symbol Library:
Autism Language Program (ALP)
Children’s Hospital Boston

With VIP-Teaching Language Concepts software

* ALP Animated Graphics
Animated example of ALP symbol for verb

Example of static ALP symbol for verb
Materials
• MacIntosh Desktop
• Delivery of Tasks
  – Powerpoint
  – Green slide preceded the symbol along with instruction to get ready
  – One symbol at a time (guessability) or 4 symbols at a time (identification)

Screening
• Receptive One Word Vocabulary Test
• Informal screening of receptive and expressive knowledge of experimental words
  – In order to qualify for inclusion in the experiment proper, the children have to demonstrate either receptive or expressive knowledge of the verbs and the prepositions.
Guessability Task

- Two familiarization trials
- Child is in front of the computer
- E starts slideshow
- Green screen appears and recorded voice says “get ready”
- One symbol is shown at a time
- Recorded voice says “What’s this?”
- Child expected to respond before the screen turns red (14 seconds)
- E provides 3 s ITI before moving to the next slide
- E provides intermittent nonspecific reinforcement.

Identification Task

- Two familiarization trials
- Child is in front of the computer
- E starts slideshow
- Green screen appears and recorded voice says “get ready”
- Four symbols are shown at a time
- Recorded voice says “Point to “X”.”
- Child expected to respond within 20 seconds/before the screen turns red
- ITI and feedback as before

Dependent Variables and Measures

- **Guessability**:  
  - Correct: if the child’s label corresponds to the label reserved for the symbol (or an appropriate synonym) by the research team within 14 s
  - Percentage of correctly guessed symbols
- **Identification**:  
  - Correct: if the child touches the symbol corresponding to the spoken name provided by the computer within 20 s
  - The percentage of correctly identified symbols

PRELIMINARY RESULTS - GUESSABILITY
Are animated symbols easier to guess than static symbols?

- Main effect for symbol format, F (1, 135) = 15.266, p < .001.

<table>
<thead>
<tr>
<th>SYMBOL FORMAT</th>
<th>MEAN</th>
<th>STANDARD ERROR</th>
<th>Lower Bound (95%)</th>
<th>Upper Bound (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animated</td>
<td>58.07</td>
<td>2.02</td>
<td>54.54</td>
<td>61.60</td>
</tr>
<tr>
<td>Static</td>
<td>46.15</td>
<td>2.35</td>
<td>41.86</td>
<td>50.81</td>
</tr>
</tbody>
</table>

- Interaction effect between symbol format and word class, F (1, 135) = 5.679, p = .019.

<table>
<thead>
<tr>
<th>SYMBOL FORMAT</th>
<th>WORD CLASS</th>
<th>MEAN</th>
<th>STANDARD ERROR</th>
<th>Lower Bound (95%)</th>
<th>Upper Bound (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animated</td>
<td>verbs</td>
<td>72.54</td>
<td>3.45</td>
<td>65.69</td>
<td>79.39</td>
</tr>
<tr>
<td></td>
<td>prepositions</td>
<td>45.69</td>
<td>2.99</td>
<td>40.81</td>
<td>50.57</td>
</tr>
<tr>
<td>Static</td>
<td>verbs</td>
<td>57.11</td>
<td>3.18</td>
<td>49.31</td>
<td>64.91</td>
</tr>
<tr>
<td></td>
<td>prepositions</td>
<td>40.53</td>
<td>3.57</td>
<td>33.48</td>
<td>47.62</td>
</tr>
</tbody>
</table>

Are older children better at guessing than younger children?

- Inferential Analysis Results
  - Main effect for CA, F (2, 134) = 6.685, p = .002.
  - Tukey’s Post Hoc Analysis
    - 4-year olds outperformed 3-year olds in all conditions (Mean difference 9.39, Standard Error = 3.64, p = .03)

<table>
<thead>
<tr>
<th>AGE</th>
<th>Mean</th>
<th>Std. Error</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>44.00</td>
<td>3.09</td>
<td>37.95 - 50.20</td>
</tr>
<tr>
<td>4</td>
<td>57.77</td>
<td>2.28</td>
<td>53.23 - 62.30</td>
</tr>
<tr>
<td>5</td>
<td>55.96</td>
<td>3.14</td>
<td>48.73 - 62.18</td>
</tr>
</tbody>
</table>

Which symbol set (PCS, ALP) is guessed more readily?

- Main effect for symbol set, F (1, 135) = 112.997, p < .001.

<table>
<thead>
<tr>
<th>Symbol Set</th>
<th>Mean</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALP</td>
<td>70.150</td>
<td>2.089</td>
<td>66.023</td>
<td>74.275</td>
</tr>
<tr>
<td>PCS</td>
<td>35.056</td>
<td>2.574</td>
<td>29.592</td>
<td>40.115</td>
</tr>
</tbody>
</table>

- Interaction effect between symbol set and word class, F (1, 135) = 38.882, p < .001.

<table>
<thead>
<tr>
<th>Wordclass</th>
<th>Symbol Set</th>
<th>Mean</th>
<th>Std. Error</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbs</td>
<td>ALP</td>
<td>69.351</td>
<td>2.812</td>
<td>63.788 - 74.912</td>
</tr>
<tr>
<td></td>
<td>PCS</td>
<td>54.903</td>
<td>3.777</td>
<td>47.415 - 62.391</td>
</tr>
<tr>
<td>Prepositions</td>
<td>ALP</td>
<td>70.949</td>
<td>3.071</td>
<td>64.857 - 77.041</td>
</tr>
<tr>
<td></td>
<td>PCS</td>
<td>54.732</td>
<td>3.483</td>
<td>48.250 - 61.215</td>
</tr>
</tbody>
</table>
Are PCS more readily identified than ALP?

- Main effect for symbol set, $F(1,135) = 29.465, p < .001$

<table>
<thead>
<tr>
<th>Symbol Set</th>
<th>Mean</th>
<th>Std. Error</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALP</td>
<td>90.006</td>
<td>1.634</td>
<td>86.768 - 93.244</td>
</tr>
<tr>
<td>PCS</td>
<td>75.905</td>
<td>2.019</td>
<td>71.904 - 79.906</td>
</tr>
</tbody>
</table>

- Interaction effect of symbol set and word class, $F(1,135) = 29.171, p < .001$

<table>
<thead>
<tr>
<th>WORD CLASS</th>
<th>SYMBOL SET</th>
<th>MEAN</th>
<th>STD ERROR</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>verbs</td>
<td>ALP</td>
<td>90.214</td>
<td>2.206</td>
<td>85.843 - 94.584</td>
</tr>
<tr>
<td></td>
<td>PCS</td>
<td>89.798</td>
<td>2.412</td>
<td>85.012 - 94.578</td>
</tr>
<tr>
<td>prepositions</td>
<td>ALP</td>
<td>89.798</td>
<td>2.412</td>
<td>85.012 - 94.578</td>
</tr>
<tr>
<td></td>
<td>PCS</td>
<td>61.880</td>
<td>2.745</td>
<td>56.234 - 67.099</td>
</tr>
</tbody>
</table>
Are older children better at identifying symbols than younger children?

– Main effect for CA, F (2, 134) = 5.07, p = .008.

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>MEAN</th>
<th>STD/ERROR</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>77.253</td>
<td>2.425</td>
<td>72.449 – 82.058</td>
</tr>
<tr>
<td>4</td>
<td>83.397</td>
<td>1.796</td>
<td>79.839 – 86.955</td>
</tr>
<tr>
<td>5</td>
<td>88.216</td>
<td>2.466</td>
<td>83.330 – 93.102</td>
</tr>
</tbody>
</table>

Discussion

- Replicates findings from previous study (i.e., ALP portion of the data)
- Extends the study of the role of animation to a second symbol set (i.e., PCS)
- Why are ALP symbols (in particular for prepositions) guessed more readily than PCS?
- Why does ALP do better with identifying prepositions than PCS?

Discussion

- AAG - ALP Animated Graphics – Strategy
  - Standard approach to all verbs and prepositions
    - Use a generic character acting on a generic object to portray all of the concepts in the symbol library
    - Animated actions unfold slowly and smoothly
    - Always show full body
  - Show the general “ness” of the concept, not a specific concrete instance.
**Future Directions**

- Complete data collection with non-disabled preschoolers and re-analyze the data
- Conduct descriptive error analysis
- Replicate the study with elementary age school children with Autism or PDD/NOS