Designing Effective Visual Scene Displays for Young Children

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Young children with CCN

- Young children with complex communication needs (CCN) are at risk in all aspects of their development
- Augmentative and alternative communication (AAC) offers the potential to enhance communication and support language development

Designing AAC systems that "fit" the needs & skills of young children

- AAC will only be effective if we design aided AAC systems that "fit" the needs & skills of young children with CCN
  - Well designed AAC systems will positively impact the user's communication effectiveness
  - Poorly designed AAC systems may negatively impact communication effectiveness

Components of aided AAC systems

- Aided AAC systems involve numerous components
  - **Display**
  - Selection technique
  - Output
- Display of the aided AAC system includes
  - Vocabulary /language concepts
  - Representations of vocabulary concepts
  - Organization and layout of these representations

The problem

- Currently clinicians and system developers are left to design AAC displays based on intuition
  - Critical need for evidence-based guidelines to support decision making & ensure effectiveness
- Two key questions need to be addressed
  - What types of displays should we use with young children with CCN?
  - What features should we include in these displays?

Goals of the presentation

- To share results of a series of research studies that have focused on improving the design of AAC displays for young children with CCN
  - Type of display
  - Characteristics of the display
- Discuss implications for clinical practice and system development

Type of display

- What type of display should we use with young children /beginning communicators?
  - Traditional grid display
    - Vocabulary concepts represented by isolated symbols organized in row column grid layout
  - Visual scene display (VSD)
    - Photos of naturally occurring events /scenes; vocabulary concepts embedded as hotspots within these scenes
- Different types of displays impose very different learning demands
  - Cognitive /linguistic processing
  - Visual processing

Research to guide decision making Type of display

- Four studies provide evidence suggesting that VSDs are more appropriate for young children than grid displays
  - Young children's understanding of isolated symbols versus symbols in context
  - Toddlers' performance with VSDs versus grid displays
  - Infants' visual preference /attention to VSDs versus grids
  - Effects of VSDs on young children's communication

Symbols in isolation versus symbols embedded in context

- Traditional grid displays require children to understand each symbol in isolation with limited contextual support
- VSDs present language concepts /symbols in context
- Light, et al. (2010) asked children to draw early emerging language concepts & to identify PCS
  - Typically developing children (ages 3-6) had difficulty understanding isolated symbols for early emerging abstract language concepts
  - They represented early emerging language concepts by embedding them in familiar contexts

Summary of results
(Light, et al., 2010)

- Young children did **not** initially understand traditional AAC symbols that represented abstract concepts in isolation
  - Isolated symbols in grids require additional teaching
- Young children represented these language concepts in very different ways than traditional AAC symbols
  - Embedded the concepts within context
  - Typically included depictions of entire scenes or events
  - Usually included familiar people, objects and experiences
  - Seldom included parts of objects or people in their representations
- Results suggest that young children may do better when language concepts are presented in context as in VSDs

Traditional grids versus VSDs

- Two studies comparing the relative effectiveness of traditional grids versus VSDs
  - Typically developing toddlers performed better using VSDs than grid layouts (Drager, Light, et al., 2003)
    - The children were asked to locate and select vocabulary concepts in 3 conditions
      - Visual scene displays (VSDs)
      - Grids organized taxonomically
      - Grids organized schematically
    - The children were more accurate locating & selecting vocabulary using VSDs than grids

Traditional grids versus VSDs

- Research underway to extend research to infants (Wilkinson, Light, Currall, et al., 2010)
  - What is the effect of VSDs versus grid displays on the visual attention of infants (6-12 months old):
    - Photo VSD
    - Photo grid
    - PCS grid
  - Procedures
    - Split screen presentation
    - Video & eye tracking technology to measure visual attention /interest

Use of VSDs by young children with CCN

- Previous research studies involved typically developing children
  - Provide developmental guidelines with respect to processing & learning demands of different displays
  - Results may not generalize to young children with CCN
- What evidence is there of the effectiveness of VSDs with young children with CCN?

Successful use of VSDs by young children with CCN

- Research by Light & Drager (2009)
  - Investigated the effects of AAC interventions using VSDs on the language & communication skills of infants, toddlers, & preschoolers with CCN
- Participants
  - Infants, toddlers, preschoolers
  - Children with CCN
    - E.g., autism spectrum disorders, cerebral palsy, Down syndrome, multiple disabilities, etc.

Results
(Light & Drager, 2009)

- All of the children
  - Were able to use VSDs upon initial introduction after their use was modeled
    - Initially they relied on VSDs
    - Later they learned to use grid displays as well
  - Learned to use VSDs to communicate a range of functions
    - Social routines & expressions
    - Comments
    - Expression of needs and wants

Results
(Light & Drager, 2009)

- The children demonstrated significant increases in their rate of turn taking after introduction of VSDs
- The children
  - demonstrated significant increases in their expressive vocabularies
  - acquired a range of semantic relations

Results
(Light & Drager, 2009)

- The children
  - used the VSDs to interact with familiar adults
  - used their systems as shared contexts to support interaction with peers
    - shared books, singing, play
  - used their systems independently to play /learn

Type of display
Summary of research results

- Preliminary evidence suggests that young children perform better with VSDs than with traditional grid displays
  - Children represent language concepts not as isolated symbols, but rather by embedding them in visual scenes
  - Infants seem to demonstrate greater visual attention to/ interest in VSDs than grids
  - Toddlers demonstrate better comprehension & use of VSDs than grids
  - Infants and toddlers with CCN were able to easily learn to use VSDs to participate within social interactions

Why are VSDs more appropriate for young children?

- VSDs capture the child's daily interactions
  - Replicate the contexts in which young children learn language & communication skills
  - Provide a visual support /scaffold for language use
- VSDs present language concepts within familiar contexts
  - Provide contextual support for children's understanding & learning of symbols

Advantages of VSDs for young children

- VSDs support access to language concepts via episodic memory not just semantic memory
  - Provide experiential cues to support symbol learning
- VSDs replicate events experienced by the child
  - Maximize familiarity - people, activities, toys
- VSDs provide motivating & interesting contexts
  - Stimulate social interaction

Advantages of VSDs for young children

- VSDs preserve the conceptual relationships between objects & people that occur in life
  - Support learning of symbols/functions
- VSDs preserve the visual relationships between symbols that occur in life
  - Preserve the location, proportionality of concepts

Advantages of VSDs for young children

- VSDs also offer visual processing advantages
- VSDs exploit the human capacity for rapid visual processing of naturalistic scenes
  - Scenes are our daily visual experience of the world
    - Visual processing of scenes occurs within first glance (Oliva & Torralba, 2007)
      - Overall context & constituent elements in scenes processed in 200 milliseconds or less
      - Context simplifies object discrimination & recognition
  - Visual processing & understanding of grids is more difficult /must be learned

Designing effective VSDs for young children

- VSDs vary significantly
- How do we design effective VSDs for young children to maximize their communication & language development?
  - What are the features of VSDs that are effective for young children?

Key features of VSDs
(from Light & Drager, 2009)

- Focus on people
  - Animated expressions
- Capture social interactions involving children
- Capture familiar motivating events /experiences
  - Contexts in which children learn language
- Support a range of vocab & communicative functions/ intents

Features of commercially available VSDs

- May not include people
  - Or include stick figures with no faces
- Often do not include social interactions
- May not include motivating events
- Support a limited range of vocabulary & communicative functions

Features of effective VSDs

- The VSDs used by Light & Drager (2009) were effective in facilitating language & communication development with infants, toddlers & preschoolers
- What were the features of these VSDs?
  - Included people in a central foreground position
    - People had animated facial expressions
    - Form of "visual motherese"
  - Captured motivating, familiar events /social interactions
    - These are the contexts in which children learn language
      - Play routines e.g., tickling, peekaboo, singing songs, building blocks, playing ball, playing cars/ trucks, playing telephone, blowing bubbles, etc
      - Shared books
      - Activities of daily living e.g., meals, snacks, bath, dressing

Why include people in VSDs?

- People are **the** central components in the social interactions that provide the foundation for language development
  - VSDs are designed to capture these interactions to facilitate language learning
- People have a powerful effect on our visual attention
  - From birth, infants are predisposed to attend to people, especially faces
  - Inclusion of people in VSDs serves to capture children's visual attention and interest

Effect of people in scenes on visual attention

(Wilkinson & Light, 2010)

- Questions
  - What is the effect of people in naturalistic scenes on visual attention /processing?
- Procedures
  - Presentation of photos representing naturalistic visual scenes
  - Use of eye tracking technology to measure where participants look and for how long
    - visual attention /interest

Results

(Wilkinson & Light, 2010)

- People in scenes attracted visual attention within first second of viewing
- People attracted more visual attention than other elements within scenes
  - Despite presence of multiple competing elements in scenes
    - Elements that are large, bright, and/or colorful
  - Even when the people were very small
    - Occupy only 2-5% of the scene
- Background attracted minimal attention
    - Viewers largely ignore the background

Inclusion of people
Implications for the design of VSDs

- VSDs of empty rooms /places with no people or VSDs of faceless people
  - May fail to capture or focus visual attention
  - May fail to capture the social elements that are integral to communication development
- VSDs that include people
  - Exploit innate visual attention to people
  - Capture the humans & social interaction that are central to communication development

Recommendations for designing aided AAC displays for young children

- Use VSDs as main communication displays for infants and toddlers
- Include people in a central foreground position
- Capture motivating, familiar events /social interactions in children's lives
  - Play routines
  - Shared book reading
  - Activities of daily living
- Make VSDs appealing to children
  - Motivating content, engaging characters, expressive output, sound effects, bright colors, etc.

Specific recommendations for VSDs for infants

- Represent familiar social interactions that
  - are motivating & appropriate for infants
  - do not require attention to other objects (just the adult, infant & system)
    - E.g., Social games
      - peekaboo, bye bye routines
    - Shared reading with simple books
      - E.g., Brown Bear
    - Singing simple songs line by line

Specific recommendations for VSDs for infants

- Include only a few vocabulary concepts
- Include large hotspots
  - Typically not yet pointing with index finger
- Use engaging voice output
  - lots of expression /sound effects

Specific recommendations for VSDs for toddlers

- Represent familiar social interactions that
  - are motivating & appropriate for toddlers
  - may include attention to other objects /toys as well as social interaction
    - E.g., Play activities
      - Blocks, bubbles, playdoh, cars/ trucks, dolls, tickling, tea party
    - Shared reading
      - E.g., Sharon Boynton books, Good night moon, etc
    - Singing action songs line by line
      - E.g., Wheels on the Bus, I'm a little tea pot

Specific recommendations for VSDs for toddlers

- Gradually increase range & number of vocabulary concepts
- Gradually increase number of hotspots
  - Decrease size of hotspots
- Use engaging voice output
  - Lots of expression /sound effects

Conclusions

- AAC systems offer young children potential tools to jumpstart their language & communication development
- AAC will only be effective if displays are well designed for young children
  - Use visual scene displays with infants and toddlers
  - Include people in central location in the VSD
  - Capture motivating social interactions in VSDs
    - These are the contexts in which children learn language

For further info visit http://aackids.psu.edu
Early intervention for young children with autism, cerebral palsy, Down syndrome & other disabilities

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