A comparison of two approaches for representing AAC vocabulary for young children

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Abstract

Purpose: Young children with complex communication needs often experience difficulty in using currently available graphic symbol systems as a method of augmentative and alternative communication (AAC). Information on young children’s performance with graphic representations based on this population’s conceptualizations of these vocabulary items may assist in the development of more effective AAC systems.

Method: This study developed Developmentally Appropriate Symbols (DAS) for 10 early emerging vocabulary concepts using procedures designed to address both conceptual and appeal issues for graphic representations for young children. Using a post-test only, between-subjects comparison group design, 40 typically-developing 2.5–3.5-year-old children were randomly assigned to receive a brief training in either of two different types of graphic symbol sets: (a) DAS or (b) Picture Communication Symbols (PCS), a commercially available graphic symbol system.

Result: Results of a two sample independent t-test provide evidence that children in the DAS condition correctly identified more symbols than children trained with the PCS symbols. There was no evidence of a preference between the symbol sets.

Conclusion: The results provide support for careful consideration of children’s use and understanding of language in developing AAC systems for young children.

Keywords: Augmentative and alternative communication (AAC), complex communication needs, symbol

Introduction

Binger and Light (2006) reported that ~12% of pre-school children who receive special education services have complex communication needs and experience difficulty in developing speech and language skills. This population includes young children with developmental disabilities (e.g. autism, cerebral palsy and Down syndrome) and acquired disorders (e.g. traumatic brain injury). For children with complex communication needs, the use of augmentative and alternative communication (AAC) systems such as communication displays, sign language and computerized voice output devices can support access to language and communication from an early age (Branson & Demchak, 2009; Light & McNaughton, 2012a; van der Meer, Kagohara, Roche, Sutherland, Balandin, Green, et al., 2013).

Early access to language is critical, because childhood is commonly a period of rapid linguistic development (Fenson, et al., 1994). This acquisition of speech and communication in the early years enables children to build social relationships, express needs and wants and support conceptual development (Light, 1997; Light & Drager, 2007; Light & McNaughton, 2014).

Like their typically-developing peers, young children with complex communication needs must have the opportunity to learn language and access a wide variety of desired vocabulary (Barker, Akaba, Brady, & Thiemann-Bourque, 2013; Branson & Demchak, 2009). Vocabulary items can be conceptualized as existing on a continuum, from highly concrete to highly abstract. The term concrete vocabulary refers to vocabulary that can be seen, felt or touched (e.g. tree, bird or flower), whereas the term abstract vocabulary is used for things and properties of things that are more general or conceptual and harder to establish through sensori-motor experiences; for example, the concepts more or big (Clark, 2003). To communicate competently, young children who use AAC need access to a wide range of concrete as well as abstract linguistic concepts.
One way to provide access to this vocabulary is to provide graphic symbol representations for these vocabulary items (Ganz, Goodwyn, Boles, Hong, Rispoli, Lund, et al., 2013; van der Meer et al., 2013). To use graphic symbols to communicate, AAC users must not only recognize the relationship between the graphic representation and the linguistic concept it is meant to represent, but also be able to use the symbol in different situations to communicate a variety of communicative intentions. While it is relatively easy to represent concrete vocabulary, it is more difficult to represent abstract concepts. Just as vocabulary items can be coded on a continuum of abstraction (i.e. concrete to abstract), vocabulary representation can be coded on a continuum of transparency. For example, photographs and line drawings of specific items, whose meaning and relationship to the referent can be identified easily, are considered highly transparent. Highly symbolic representations that bear little or no apparent relationship to their referents (e.g. a printed word) are considered to be low in transparency (Shane, Laubscher, Schlosser, Flynn, Sorce, & Abramson, 2012).

Past research provides evidence that transparency has an impact on symbol identification and learning (e.g. Fuller & Lloyd, 1987; Mirenda & Locke, 1989; Mizuko, 1987; Musselwhite & Russello, 1984). Researchers suggest that typically-developing children between the ages of 2–5 years can more easily learn graphic symbols which are relatively more transparent (e.g. Picture Communication Symbols (PCS)) when compared with more symbolic representations which are less transparent (e.g. Blissymbols, PicSym and Rebus [e.g. Mizuko, 1987; Musselwhite & Russello, 1984]). There is also clear evidence that for those symbol systems which contain a mix of transparent and symbolic representations, graphic representations of vocabulary concepts that are concrete (and often more transparent), such as nouns, are easier to learn and identify than abstract vocabulary, such as verbs and descriptors (e.g. Bloomberg, Karlan, & Lloyd, 1990; Mizuko, 1987), which often are depicted with more symbolic (and less transparent) representations. Due to the need to provide representations for both concrete and abstract vocabulary and the resulting use of highly symbolic representations, most current symbol sets have been found to be difficult for very young children to learn and use (Light & Drager, 2002, 2007).

A child’s use of a vocabulary item is strongly embedded in the child’s personal understanding of a concept and will differ from that of an adult (Light, Drager, Curran, Hayes, Kristiansen, Lewis, et al., 2005; Light & Drager, 2007). Current AAC systems frequently represent abstract linguistic concepts using symbolic representations based on adult conceptual models for a particular vocabulary item and often require metalinguistic skills for interpretation. For example, the Picture Communication Symbol (PCS) for who is an oval shape (representing the outline of a face, but with no facial features such as eyes, nose or mouth), with a question mark in the middle of the face (see Figure 1). As a result, current AAC systems may not be meaningful for young children, who may struggle to see the relationship between the graphic symbol representation and the linguistic concept (Light & Drager, 2012; Light, Worah, Bowker, Burk, Drager, D’Silva, et al., 2008).

In an attempt to improve graphic symbol representations for young children, Light and colleagues (Light et al., 2008; Lund, Miller, Herman, Hinds, & Light, 1998) investigated young children’s conceptualizations of frequently occurring vocabulary items. They asked typically-developing children between the ages of 4–7 years to draw 10 abstract early emerging concepts (all gone, big, come, eat, more, open, up, want, what and who). The children were then asked to provide verbal descriptions of their drawings. The researchers then compared the drawings with a commercially available symbol set, PCS, which is typically rated high on transparency in comparison with other symbol sets (e.g. Bloomberg et al., 1990; Mizuko, 1987).

Light and colleagues found a number of interesting differences between the children’s drawings and the PCS. The children’s drawings were grounded in personal experiences; typically involved interactions between familiar individuals; were rich in detail and embedded in scenes; and featured complete depictions of objects and persons. For example, in their drawings to represent the concept who, children frequently drew a picture of a child and an adult standing close together, with the child pointing to a person in the distance; in describing the picture the children would say that the child was asking the adult, “who is that?”. In contrast, the PCS often made use of partial objects and persons, which were presented without a supporting context, included arrows to focus attention, and made use of linguistic markers (e.g., a question mark, as in the previously discussed example of the PCS for who). In discussing this mismatch between current AAC symbol sets and children’s representa-
tions, Light and Drager (2002, 2007, 2012) emphasized the need to investigate representations that may be more appropriate for young children by designing AAC graphic symbols that are more congruent with young children’s understanding of these concepts. The use of graphic symbols that are more easily understood by young children may also be learned more easily and better support successful use with peers (Light et al., 2005).

The purpose of this study, therefore, was to investigate the identification performance of young children with symbols developed using a new approach to representing vocabulary items (Light & Drager, 2002, 2007; Light et al., 2008). The goal was to see whether the use of Developmentally Appropriate Symbols (DAS), created using guidelines suggested by Light and colleagues, would result in improved identification and enhanced preference, in comparison with a commercially available symbol set (PCS). More specifically, this study addressed the following questions:

a. Which symbol set (DAS or PCS) is more accurately identified by young children?
b. Which symbol set (DAS or PCS) is preferred by young children?

Method

Experimental design

This study implemented a post-test only, between subjects comparison group design with random assignment of participants to one of two identification conditions: the PCS set or the DAS set. The independent variable in this study was the graphic symbol condition (PCS or DAS). There were two dependent variables: (a) the accuracy with which young children identified the graphic representations in the two symbol sets following a brief training; and (b) the preference for the two symbol sets as reported by the young children.

Participants

Forty typically-developing children, 19 boys and 21 girls between the ages of 2.7–3.5 years old ($M = 3.1$), who were attending pre-schools in a university town in the northeastern US, participated in the study. All participants met the following selection criteria: (a) spoke English as the primary language in the home; (b) had no identified sensory, speech, language, cognitive or physical disabilities; (c) scored within 2 SD of their chronologically age appropriate score on the Peabody Picture Vocabulary Test ($M = 118.1$, $SD = 10.44$; Dunn & Dunn, 2007); and (d) had parental consent to participate. The participants were randomly assigned to one of the two conditions: Picture Communication Symbols (PCS) or the Developmentally Appropriate Symbol Set (DAS), with 20 participants in each group.

Materials

Target concepts. Representations for 10 early emerging concepts were investigated in the study: all gone, big, come, eat, more, open, up, want, what and who. These vocabulary items were chosen for three main reasons. First, there was a beginning research base to assist in developing representations for these concepts, as earlier studies that explored the drawings and descriptions of early emerging concepts in typically-developing children investigated these concepts (Light et al., 2008; Lund et al., 1998). Second, these are all early emerging concepts; children typically acquire them between the ages of 1–2 years (Bloom, 1991; Bloom, Merkin, & Wootten, 1982; Ninno, 2001). Third, all the concepts with the exception of eat are abstract and difficult to represent pictorially. Action words (e.g. come, open, want) are cognitively more complex than nouns as they label the relationship among objects (Gillette, Gleitman, & Lederer, 1999). Descriptors (e.g. all gone, big, more, up) refer to attributes of objects and people and require metalinguistic abilities (Cazden, 1976). Questions, such as what and who, relate to identities of objects and people that are transient (Rowland, Pine, Lieven, & Theakston, 2003) and, therefore, require relevant syntactic structures and sufficient cognitive processing resources to hold the questioned object or person in mind as the question is considered (Gillette et al., 1999).

Symbol sets. Each concept was represented using the two graphic symbol sets that were investigated in the study: (a) a commercially available symbol set, Picture Communication Symbols (PCS), and (b) the Developmentally Appropriate Symbol Set (DAS), a set of 10 symbols developed using guidelines suggested by Light and colleagues (Light & Drager, 2002, 2007; Light et al., 2008; Lund et al., 1998).

The PCS set was chosen as it is a widely used and frequently researched symbol set (e.g. Light et al., 2008; Lund et al., 1998; Mirenda & Locke, 1989; Mizuko, 1987). In addition, researchers (e.g. Mirenda & Locke, 1989; Mizuko, 1987) consider the PCS set relatively easy to learn when compared to other graphic symbol sets, such as Picsyms and Blissymbols. The PCS library consists of over 10,000 simple line drawings and symbols to represent words and short phrases (Mayer-Johnson, 2008).

The development of DAS was guided by the suggestions of Light and colleagues (Light & Drager, 2002, 2007; Light, Page, Curran, & Patkin, 2007; Lund et al., 1998) as well as factors identified as having an influence on the recognition and appeal of pictures (e.g. Bang, 1991a, b; Pitz, 1993).

Development of DAS. Two bodies of literature guided the development of the DAS graphic symbols: (a) information on conceptual considerations for
representing vocabulary and (b) appeal issues for creating children’s illustrations.

With respect to conceptual issues, the graphic representations were based first and foremost on the descriptions provided by young children for these concepts in past studies (Light, 2007; Lund et al., 1998). In addition, based on the existing literature, six conceptual issues were considered: (a) concreteness, (b) familiarity, (c) context, (d) wholeness, (e) colour and (f) focus (Callaghan, 1999). The goal was that all of the graphic symbols addressed key conceptual issues and contained whole people, objects and activities that: (a) were embedded in familiar and observable activities and settings and (b) used colour and size to emphasize the main character(s) and/or object(s).

The appeal issues considered in developing the graphic symbols were derived from research on enhancing AAC technologies for young children (e.g. Light & Drager, 2002, 2007; Light, Drager, & Nemer, 2004; Light et al., 2008; Lund et al., 1998) and suggestions for creating bright, colourful and appealing illustrations for young children (e.g. Bang, 1991a, b; House & Rule, 2005; Pitz, 1963). The three appeal issues considered were: (a) familiarity, (b) colour and (c) shape. The graphic symbols addressed appeal issues by including three key features: (a) activities and events in which young children participate, (b) bright colours and (c) the use of smooth shapes and smiling faces (wherever possible).

**Generation of DAS graphic symbols.** A graduate student in the Art Department at a large northeastern university generated the graphic symbols used in the study. As part of the development process, the researcher worked closely with the illustrator, providing both the general guidelines (based on Light et al. (2008) and provided in the Supplementary Appendix to be found online at http://informahealthcare.com/doi/abs/10.3109/17549507.2014.987817), as well as individualized feedback for each illustration to ensure that the drawings addressed the identified conceptual and appeal issues.

**Evaluation of DAS graphic symbols representations.** Two steps were taken to ensure that the illustrations met the identified conceptual and appeal guidelines. First, two experts who had more than 20 years of research and teaching experience in the field of AAC reviewed the illustrations by comparing DAS to the specific descriptions for the vocabulary as described in Light et al. (2008), as well as the general guidelines developed as part of this study. The illustrations were modified based upon their suggestions.

Second, 20 students recruited on a voluntary basis from a large northeastern university rated both symbol sets on the six conceptual issues (i.e. concreteness, familiarity, context, wholeness, colour and focus) and three appeal issues (i.e. familiarity, colour and shape). The 20 volunteers, 15 females and five males between the ages of 20–35 years ($M = 22$), were provided with booklets containing instructions for rating the symbols. Results of this experiment indicated that overall 85% of the DAS and 28% of the PCS were judged as meeting the conceptual criteria and 91% of the DAS and 37% of the PCS met the appeal criteria.

**Training and testing materials**

**Training materials.** Twenty graphic symbol cards were prepared, one for each of the above-mentioned vocabulary items, 10 cards for each symbol set. The symbol cards had the symbol printed on one side and the name for the concept printed on the other. All the cards were printed in colour on 2.5” × 2.5” squares and covered with contact paper.

**Testing materials.** Two 8” × 14” pages were prepared, one for each symbol set. Each page had 10 vocabulary items, with five vocabulary items in a row, set at a distance of ~ 0.5” from each other. The vocabulary items were printed in an alphabetical order. Both sheets were printed in landscape format and covered with contact paper.

**Procedures**

Each child participated in one session, which was conducted in a quiet location at the day-care setting. During the experiment the participant and the experimenter were seated at a child-sized table.

**Training.** The experimenter ensured that the participant was visually attending to the experimenter before presenting the symbol cards. During the training session, the experimenter presented one symbol card at a time. The experimenter put a symbol card in front of the participant, named it and provided a brief example of how the graphic symbol was related to the concept. The experimenter then asked the participant to touch the card. For example, on presenting the PCS symbol for *all gone*, the experimenter said, ‘*All gone*, this is *all gone*. The bowl is empty; the food is *all gone*. Touch *all gone*’. The experimenter waited for the participant to touch the symbol card. If the participant did not respond by pointing to the item within 5 seconds, the experimenter prompted the participant by saying, ‘Touch the (target referent)’. The experimenter praised the participant for touching the symbol card. If the participant did not touch the symbol card, the experimenter gently lifted the participant’s hand and put it on the symbol card.

**Identification task.** To determine accuracy of identification the experimenter laid a symbol sheet (either DAS or PCS) on the table. She pointed to the symbols on the page and said, ‘Now I want you to look
at the pictures. See all the pictures on this page? After the participant had looked at the sheet, the experimenter began the trials.

For each trial, the experimenter selected a card at random from the cards used in the training. The experimenter read the word on the back of the card and instructed the participant, ‘Touch (target item)’. If the participant did not respond by pointing to an item within 5 seconds, the experimenter prompted the participant by saying, ‘Touch (target item)’. If the participant did not respond by pointing to the item within 5 seconds, the experimenter gave a third request and said, ‘Touch (target item)’. If the participant did not respond to the third request within 5 seconds, the trial was coded a non-response. The experimenter provided immediate feedback on accuracy (including corrective feedback, as appropriate) for correct, incorrect and non-response turns.

Preference task. The assessment of preference followed immediately after the assessment of identification. To assess which symbol set (one familiar, one unfamiliar) was judged as preferable to the participants, the experimenter laid both of the assessment pages with the symbol sets in front of the participants, with a distance of ~2 cm” between the two sheets. The experimenter pointed to the two symbol sheets, one at a time, while saying ‘Look at these pictures, and look at these pictures. Which pictures do you like?’ If the participant pointed to a symbol sheet, the experimenter moved the selected symbol sheet in front of the participant and removed the other symbol sheet from the table. She then asked the participant, ‘What do you like about these pictures?’ The placement of the symbol set sheet to the left and right of the participant was counterbalanced across the preference trials.

Procedural integrity. Prior to data collection, the research assistant was trained in data collection procedures until 100% of the steps in the procedural checklist for instruction were completed correctly. Next, 20% of the sessions were randomly selected and reviewed (Kazdin, 1982) by a colleague who had an advanced degree in Special Education. Dividing the total number of accurately delivered steps by the total number of steps required and multiplying by 100 calculated the procedural reliability. The result was 99% (range 95–100% across the sessions).

Measures

Data collection. The collection of data took place in a quiet room allocated by the pre-school. Each session lasted for ~15–20 minutes, including the time used to administer the PPVT with the child. All the sessions were videotaped, during which time the video camera was mounted on a tripod stand and remained stationary.

Response scoring. Accuracy. A response was scored as correct if the symbol selected matched the target vocabulary item requested by the experimenter. A response was scored as incorrect if it did not match the target vocabulary item requested by the experimenter. A response was scored as ‘no response’ if a child did not respond after three requests (i.e. the initial request and two additional requests) to respond.

Preference. The second dependent variable was the child’s selection of a symbol set during the forced choice activity designed to determine preference. The participant’s verbatim explanation for selecting the symbol set was recorded and transcribed.

Reliability. To evaluate the accuracy with which the researcher recorded the children’s responses, a graduate student randomly selected and reviewed 20% of the video-taped sessions (Kazdin, 1982). Reliability was evaluated for eight sessions (out of a total of 40 sessions). Reliability was calculated by dividing the number of agreements by the sum of agreements, disagreements and omissions (Kazdin, 1982). Reliability was 100%.

Results

Accuracy of identification

The mean and standard deviation for the number of correct participant responses for the two symbol sets (DAS and PCS) were calculated and are presented in Table I. Results of the two-sample Independent t-test comparing the performance of the children in the DAS condition (M = 16.3, SD = 0.3) to those in the PCS condition (M = 11.5, SD = 0.48) provided evidence of a statistically significant difference in favour of the DAS condition, t(38) = 3.39, p = 0.002. Expressed as a percentage, children were 82% accurate in the DAS condition and 58% accurate in the PCS condition. Participants performed better on all

| Symbol set | DAS, n (%) | PCS, n (%) |
|------------|------------|------------|
| All gone   | 18 (90%)   | 16 (80%)   |
| Big        | 19 (95%)   | 14 (70%)   |
| Come       | 17 (85%)   | 9 (45%)    |
| Eat        | 19 (95%)   | 18 (90%)   |
| More       | 14 (70%)   | 8 (40%)    |
| Open       | 20 (100%)  | 14 (70%)   |
| Up         | 19 (95%)   | 11 (55%)   |
| Want       | 17 (85%)   | 7 (35%)    |
| What       | 7 (35%)    | 5 (25%)    |
| Who        | 13 (65%)   | 13 (65%)   |
| Mean       | 16.3 (82%) | 11.5 (58%) |

* 20 children provided responses for each symbol set.

DAS, Developmentally Appropriate Symbols; PCS, Picture Communication Symbols.
Table II. Correct responses for vocabulary items grouped by word category.

| Symbol set | DAS | PCS |
|------------|-----|-----|
| Action words | 90% | 60% |
| Descriptors | 88% | 66% |
| Questions | 50% | 45% |

Table III. Participant preference for symbol sets.

| Training set | DAS | PCS | No preference |
|--------------|-----|-----|---------------|
| DAS          | 5 (25%) | 13 (65%) | 2 (10%) |
| PCS          | 17 (85%) | 3 (15%) | — |
| Total (mean) | 22 (55%) | 16 (40%) | 2 (5%) |

Discussion

As in past research, the results of this study provide evidence that traditional symbol representations are poorly recognized by children (Mizuko, 1987; Musselwhite & Ruscello, 1984), even when provided with a brief period of training. Symbol representations that attempt to incorporate identified best practices (including making use of young children's conceptual knowledge) may significantly improve symbol identification: children who received limited training with the DAS significantly outperformed children who were trained with the PCS. Although the creation of representations that are congruent to young children's conceptualization is a complex and challenging process, there was a clear pattern of improved performance with the graphic symbols that were based upon children's conceptualizations for those vocabulary items and that incorporated principles of representation and appeal as described in the existing research literature. The study did not find evidence of a preference between the two symbol sets; however, this may be an artifact of the training and data collection procedures. In the forced choice comparison for preference, the children were most likely to select the symbol system for which they had not received training, which may be evidence of a novelty effect.

Identification

The results of the study indicate that the DAS set ($M = 82\%$) was easier to identify than the PCS set ($M = 58\%$). The DAS set was identified with greater accuracy across all categories of words (i.e. action words, descriptors and questions) and across all vocabulary items except for who (children identified who with 65\% accuracy in both the DAS and PCS condition). Even with minimal training, representations based on the identified conceptual and appeal issues were learned at relatively high levels of accuracy.

One factor that may have contributed to the children’s improved performance on the DAS may be the close relationship between the DAS graphic symbol and children’s conceptualization of that specific vocabulary item (Light et al., 2008). The guidelines used in the development of the DAS graphic representations were directly based on children's reported conceptualization of the vocabulary item, as described in the research by Light et al. (2008). In addition, the DAS graphics were created with attention to the issues identified as important to children’s understanding of representations, notably issues of concreteness, context, familiarity, wholeness, colour and focus (Drager, Light, Speltz, Fallon, & Jeffries, 2003; House & Rule, 2005; Light et al., 2007; Lund et al., 1998; Pitz, 1963; Stephenson, 2007; Wilkinson & Jagartoo, 2004).

Identification of semantic classes. For both of the symbol sets, action words (i.e. come, eat, open and
linguistic concepts (Clark, 2003). It may also reflect the challenge faced in graphically representing abstract concepts for questions provides an indication of the accuracy of learning symbol sets (Mizuko, 1987).

The children’s difficulty in identifying representations for questions provides an indication of the challenge faced in graphically representing abstract linguistic concepts (Clark, 2003). It may also reflect the fact that there is some evidence to suggest that 2-year-olds make errors in producing wh-questions and continue to make errors for some time (Stromswold, 1995).

**Identification of concepts.** Within the symbol sets, some concepts received higher recognition scores and appeared easier to identify than others. Within the DAS set, the abstract concept representations that obtained the highest learning scores were open, big, up and all gone. Strong performance by the children was expected, because the DAS drawings accurately captured young children’s conceptualizations of the concepts (Light et al., 2008). For example, the majority of the participants in the Light et al. study conceptualized open as ‘a door, window or house’. In creating guidelines for the DAS graphic symbol, the researcher asked the artist to include the children’s conceptualization of the concept and to address issues of context, familiarity and wholeness by adding two characters on either side of an open door. The resulting graphic was identified by 100% of the children in this study. While similar approaches were taken with all of the vocabulary, this approach appeared to work particularly well with vocabulary that could be represented in images that provided a familiar context (e.g. big, up and all gone).

For the DAS set, the questions what and who and the representation for more received the lowest identification scores. It is also interesting to note that all three of these items are used in a wide variety of contexts and are difficult to represent with any single contextually relevant image. Although an attempt was made to generate these representations based on the information provided by the children’s drawings and description in the Light et al. (2008) study, the children in the Light et al. study drew four different types of pictures to illustrate each of these vocabulary items.

In the PCS set, the participants found the representations of what, want and more the hardest to identify. The PCS representations for these concepts were abstract and had little resemblance to children’s conceptualizations and descriptions (Light et al., 2008). For example, the PCS for want is a picture of two hands reaching for a box; none of the participants in the Light et al. study drew a pair of hands reaching out for a box in order to represent that concept. These representations were also rated poorly by the college students (ranged between 7.5–27.5%), that is not meeting the criteria of context, familiarity, concreteness, wholeness, focus, colour and shape.

**Preference**

Although previous research on developing appropriate technologies for young children (Light & Drager, 2007; Light et al., 2004, 2008) have suggested that AAC technologies that are appealing may ease learning of AAC symbol sets, to date no study has looked at preference for symbol sets among young children. The results of the study provides evidence that it may be challenging to collect information on preference with this population; the participants may have found it difficult to respond to the questions ‘which pictures do you like better?’ and why? There is evidence to suggest the comprehension of questions forms such as which and why develop a later age than what and who (Bloom et al., 1982; Rowland et al., 2003). The participants’ responses (and in some cases, non-responses) provided an indication that they may have struggled with the questions and found them difficult to answer. It must also be acknowledged that some participants may not in fact have had a preference—two participants did not respond to the preference question and seven participants did not provide a verbal explanation for their choice.

Another interesting finding in preference was the relationship between the participants’ training in a particular symbol set and their response to the preference question. A majority of the participants selected as preferred the symbol set for which they did not receive training. This finding was surprising, as the literature suggests that children are more likely to choose pictures that are familiar (House & Rule, 2005). There is research evidence to suggest that young children struggle with preference questions and their answers may not be reliable, as issues such as novelty may play a role in the preference selections (Blakemore, LaRue, & Olejink, 1979). This novelty effect was evident in the participants’ responses, as one participant remarked, I like these pictures better because they are new after indicating his preference by selecting a set for which he had not received training.

**Limitations**

Although this study makes a contribution to the current knowledge concerning graphic symbols sets for young children, there are a number of limitations to the study. First, this study included typically-developing children; while the use of children without disabilities is recommended as a first step in the investigation of new approaches to AAC intervention, in order to address underlying cognitive and
language development issues (Drager et al., 2003; Mizuko, 1987; Musselwhite & Russello, 1984), future research should include children with developmental disabilities to insure that the findings are generalizable to the target population.

Second, the study included only a very small number of early emerging concepts. The 10 concepts that were investigated in this study do not capture the breadth of children's early vocabulary acquisition and growth. This may have had an impact both on the rate of learning (there was a reduced learning set) and in the errors produced by the children (there was a reduced response set). It is possible, for example, that some of the children in this group were so young that they were still learning to make appropriate generalized use of who and what as vocabulary items in everyday interactions (Stromswold, 1995).

Third, the training provided to the participants did not necessarily replicate the processes typically involved in learning to use AAC. The children participated in only one training session and then immediately participated in a trial. It is unclear whether these activities appropriately replicate a typical learning task for children with complex communication needs. Finally, the assessment task did not replicate a typical communication activity. In the study children selected a symbol in response to a prompt 'show me (target item)'. This is an identification task and may not provide a close approximation for a communication act. Using pictures to communicate involves a number of skills such as formulating the message, locating the representation/s on the display or device, accessing the representation/s and communicating the message (Beukelman & Mirenda, 2013). This skill, especially when children are presented with a large number of symbols from which to choose, is much more complex than the identification task that was assessed in this study (Drager et al. 2003).

Future research

The results of this study provide some initial evidence that creating graphic representations based on children's conceptualizations has a positive impact on children's identification of graphic symbols. Future research should examine whether the representations investigated here can be used in a variety of contexts. For example, the DAS representation of more was a child asking for more cake, but children using this representation must be able to use it to indicate more TV or more hugs. In addition, creating representations for some of the vocabulary items, especially questions (what and who), was still a challenge. Future research should focus on better understanding children's conceptualization and use of concepts such as what, who and more, so that graphic representations can better match children's conceptualizations for these words. The challenge here would seem to be that of striking a balance between the provisions of a context that would ease learning, while still incorporating a degree of abstraction so that the representation can be used in a variety of situations.

With respect to the collection of preference data, the results of this study provide evidence that it may be necessary to identify other ways to evaluate preferences with very young children. For example, the use of eye tracking technology appears to be a promising approach to better understanding the features of AAC that attract and hold a young child's attention (Wilkinson & Light, 2011; Wilkinson & Mitchell, 2014).

Another important line of research related to the current project is the exploration of Visual Scene Displays as a method of creating communication supports for beginning communicators. In this approach, a photograph of the child participating in a familiar routine is programmed into the child's communication device, so that if the child touches a hot spot on the photo, the device speaks a word. For example, a photo of the child playing bubbles with a parent could be placed on the device—when the child touches the bubble in the photo, the device would speak 'blow a bubble'. The Visual Scene Display (Light & McNaughton, 2012b) approach embodies the core principles examined in this study of embedding language representations in familiar and observable activities and settings, being colourful and emphasizing the main character(s) and/or object(s). Results to date provide evidence that a Visual Scene Display approach provides a promising approach to providing access to language for young children and other beginning communicators (Wilkinson & Light, 2011; Wilkinson, Light, & Drager, 2012). Future research should consider ways in which AAC systems can be designed to reduce learning demands for beginning communicators and practitioners can be supported in the development of AAC displays that incorporate the key design principles examined in this study. For example, research is needed to investigate the language demands of vocabulary presented in grid display layouts for young children and the impact of alternative layouts (e.g. Visual Scene Displays) that may be easier to use (Light & McNaughton, 2012b; Wilkinson & Mitchell, 2014).

Summary

This study provided an investigation of young children's identification and reported preference for two symbol sets: a commercially available set (PCS) and a set developed using information children's conceptualization of the target vocabulary items (DAS). Children's identification performance was significantly better with the DAS set. There was no difference in reported preference; however this finding may be influenced by the manner in which preference data was collected. In developing AAC displays for young children, clinicians should
consider the importance of supporting access to vocabulary by using graphic representations that incorporate familiar activities and people and are visually appealing. Future research should examine ways to incorporate children’s conceptualizations of vocabulary items in the representation of linguistic concepts.

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Supplementary material available online

Supplementary Appendix.