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Comparing the Transparency of Verbs across Two Graphic Symbol Sets

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Abstract

The purpose of this investigation was to compare the transparency of verbs across two graphic symbol sets (Picture Communication Symbols and SymbolStix) frequently used in augmentative and alternative communication (AAC). In order to determine which set represents verbs most transparently, both typically developing children and children with documented speech/language impairments, age 6 to 8 years, were given a forced-choice identification task for both symbol sets. The task required participants to identify their perception of the correct symbol for a named referent verb when given the choice between four symbols. Results indicated that participants were significantly more likely to choose the expected target of the SymbolStix set as opposed to the Picture Communication Symbol set. Findings of this investigation may have clinical implications for children who need picture/symbol boards or booklets to facilitate their communication. Directions for further investigation are discussed.

Introduction

Communication is an essential part of human life; without it, we are unable to express our ideas, feelings, wants, and needs. While most individuals communicate through natural speech, some individuals are incapable of communicating through oral means, and must rely on modes of augmentative and alternative communication (AAC). As stated by the American Speech-Language-Hearing Association (ASHA), "AAC involves attempts to study and when necessary compensate for temporary or permanent impairments, activity limitations, and participation restrictions of persons with severe disorders of speech-language production and/or comprehension, including spoken and written modes of communication." (Beukelman & Mirenda, 2005, p.4).

In AAC intervention, communication is compensated for or enhanced through the use of many different modes. These modes can be divided into two broad categories: aided symbols and unaided symbols. As described by Lloyd and Fuller (1986), aided symbols are those that require some type of external assistance, aid, or device (e.g. objects, pictures, and orthographic systems), while unaided symbols are those that do not (e.g. gestures, natural speech, vocalizations, and facial expressions). While a symbol is traditionally defined as anything that represents something else, it is important to understand that in the field of AAC, this conventional definition has been expanded. Fristoe and Lloyd (1979) explain, "*Symbols,* used to represent objects, actions, relationships, etc., can be spoken, graphic, or manual. While spoken symbols are conveyed through the auditory-vocal modality, graphic and manual symbols are conveyed through the visual modality" (Lloyd & Fuller, 1986, p.167).

Graphic symbols, which are among the most effective and frequently used forms of aided communication, are two-dimensional, line-drawn representations of objects, activities, or concepts (Beukelman & Mirenda, 1998). A large variety of graphic symbol systems and sets are available for use with AAC systems. Some symbol sets include stick figures, some include

pictures of manual signs, and still others include letters coupled with a given symbol (See appendix A for examples of symbol sets used in AAC). Because of the large variety of symbol sets, interventionists have a difficult task of selecting the set that is most appropriate for a certain individual. In addition, there are many variables that must be considered before selecting a specific set of symbols.

For example, the symbol set's ease of acquisition has been identified as an important factor to consider (Clark, 1981, Musselwhite & Ruscello 1984, Mizuko 1987). Fristoe and Lloyd (1979) have hypothesized that the more iconic a symbol is, or the more it is visually representative of its referent, the easier it can be learned. Iconicity is generally described on a continuum in which symbols are classified as transparent, translucent, or opaque. Transparent symbols fall at one end of the continuum, opaque symbols fall at the other, and translucent symbols fall in the middle. Transparent symbols are those in which the referent can easily be determined, even in its absence, while opaque symbols are those which are arbitrary and no symbol-referent relationship can be perceived, even when the referent is known (Fuller and Lloyd, 1991). Translucent symbols are those in which a symbol-referent relationship can be guessed when some information about the referent is provided. (See Appendix B for examples of the transparent-translucent-opaque continuum.) Others have defined transparency as how easily a symbol can be identified when no additional cues (i.e. written labels and verbal hints) are provided (Musselwhite and Ruscello, 1984). Transparency, therefore, becomes an important factor for AAC users and communication partners who are non-reading or new to the use of symbol sets.

In the field of AAC, the "iconicity hypothesis" that the closer a graphic symbol represents its referent, the more easily an individual can determine what it represents has clinical validity and is generally supported by the literature (Schlosser & Sigafoos, 2002). Blissymbols (Bliss, 1965), first developed as an international communication system, can be described as

"highly stylized printed characters that are not recognizable on first encounter" (Clark, 1981, p.46). When compared to more iconic symbol sets, such as Picture Communication Symbols (PCS), Rebus, or Picsysms, Blissymbols are typically found to be less transparent and learnable for both typically developing individuals (Clark, 1981; Musselwhite and Ruscello, 1984; Ecklund & Reichle, 1987; Mizuko, 1987; and Bloomberg, Karlan, & Lloyd, 1990) and atypically developing individuals (Mirenda & Locke, 1989; Mizuko & Reichle, 1989). Refer to appendix A for examples of the symbol sets discussed.

Sevcik, Romski, and Wilkinson (1991) and Schlosser and Sigafoos (2002) provide exhaustive literature reviews that summarize the results of symbol comparison studies relative to the iconicity hypothesis. When analyzing the current research, it becomes apparent that the literature supports the idea that the more iconic or transparent a symbol set is, the easier it is learned. A review of the literature also reveals, however, that, "studies in support of iconicity have generally focused on nouns; if a few words of other parts of speech were included, they were not analyzed separately," (Schlosser & Sigafoos, 2002, p.102). Not all parts of speech are as easy to represent via graphic symbols as nouns. Verbs, for example, are especially difficult to represent transparently because graphic symbols are two-dimensional and static. As mentioned, only a few studies concerning AAC and graphic symbol sets focus on iconicity and verbs, and fewer studies yet, compare the transparency of verbs across more than one graphic symbol set. The purpose of this study, then, is to compare representations for a number of verbs across two graphic symbol sets to determine which set may represent certain verbs most transparently.

The graphic symbol sets used for comparison in this study were Picture Communication Symbols (PCS) and SymbolStix. PCS, created by Mayer-Johnson in 1981, is a graphic symbol set that now consists of over 10,000 line-drawn representations of various words and phrases. Available for the use on numerous AAC devices, and translated in 44 different languages, PCS is one of the most commonly used symbol sets in the field of AAC (Mayer-Johnson, 2008).

SymbolStix were originally designed by News-2-You for use on its weekly, online newspaper, *News-2-You*. *News-2-You* is described as being "the world's first and only current events publication for beginning readers and children with special needs" (www.symbolstix.com). SymbolStix are now available for commercial use for AAC boards and devices (e.g. Tobii Communicator 4, AMDi Overlay Designer Pro, Viking VS Communicator). Its library consists of over 4,000 different symbols. However, because SymbolStix are used for the *News-2-You* online newspaper the set is continually updated with current event symbols, unavailable on any other symbol set. The Symbolstix symbol set, therefore, is a newer symbol set compared to Picture Communication Symbols (PCS). The research questions of interest were the following: (1) do young children perceive the labels of graphic symbols representing verbs any easier with PCS or Symbolstix, and (2) do young children take any longer to choose labels for graphic symbols representing verbs with PCS or Symbolstix?

Method

Participants

Participants for this study included 32 children (13 females and 19 males) ranging from ages 6;1 to 8;8 . At this age, children are typically old enough to pay attention and remain motivated to participate in a picture identification task. In addition, children at this age have some literacy skills, which means they are able to understand and use fairly arbitrary graphic symbols in the form of the alphabet. Both of these attributes are important for understanding graphic symbol systems used in AAC.

Typically developing children (n=23) and children with documented speech/language impairments (n=9) comprised the group of 32 participants. Children who were considered "typically developing" were recruited from a recreational summer program sponsored by Mount Pleasant Parks and Recreation. Completion of a survey by the children's parent/guardian provided evidence of typical development. Questions from this survey asked parents to verify

that their child spoke English as his or her primary language, had hearing, vision, speech/language, and cognition all within normal limits, and had a lack of familiarity with both of the symbol sets used in this study.

The children that were identified as having documented speech/language impairments were participants of the Summer Specialty Clinic (SSC) at the Carl's Center for Clinical Care and Education located at Central Michigan University. A review of the participant's most recent speech/language reports indicated documented deficits either in speech or, language, or a combination of the two. In addition, a review of these reports also revealed that each participant spoke English as his or her primary language, had hearing and vision within normal limits, and had a lack of familiarity with both of the symbol sets used in this study.

Materials

The verbs chosen for this study were gathered from a number of different sources. These sources included stimuli from the *Receptive One Word Picture Vocabulary Test, 2nd Edition* (ROWPVT—2) and the *Peabody Picture Vocabulary Test, 4th Edition* (PPVT—4). In addition, word lists from Beukelman, Jones, and Rowan, (1989), and Moe, Hopkins, & Rush, (1982) cited in Mizuko, (1987) were used in the selection of verb referents. To be considered for this study, however, a specific verb needed to be available in the repertoire of both PCS and SymbolStix sets. In total, 20 verbs were chosen as the test stimuli. See appendix C for a list of the target words and foils used in the test stimuli.

The stimuli were programmed into the DynaVox Series V speech generating device. For each symbol set, there were 24 pages (2 example pages, 20 unique verbs, and 2 repeat verbs). Each page displayed one target symbol and three foils from the same symbol set. Of the three foils, one was a verb while the remaining two were nouns. The foil verb was one that was similar to the target verb, and the foil nouns were ones that were associated with the target verb (See Appendix D for an example of the target word and foils). The symbols were displayed in a 4 X 1

grid arrangement, and each symbol was approximately 1.5 inches by 1.5 inches. In addition, a 'start' button was located on each page. When the 'start button' was activated by the investigator, the device spoke the target word, "telling" the participant which word to select. For this experiment, the voice was set to "Heather" (SAPI4), a female voice from Acapella group of synthesized voices contained on the DynaVox Series V. This voice was an adult female with an accent representative of the sample population (American mid-west). The data logging feature of the Dynavox Series V was activated for each experimental session in order to record the time in minutes, seconds, and fractions of seconds between the time the 'start' button was activated by the investigator and the participant activated the symbol of his/her choice. When the participant chose the symbol on the touch screen, the next page of symbols was programmed to appear automatically.

The first two pages were examples which, allowed the individual to practice before the actual experiment began. The remaining items consisted of 20 pages of target verbs (not used in the practice situation) and two pages of repeat verbs in order to test for intra-subject reliability. The word labels were removed from each symbol to prevent the participants from using the written labels to identify the symbols. The location of the target symbol among the three foils varied from page to page and was different for each symbol set.

It is important to note that each symbol set contained multiple symbols for one referent. PCS, for example, has both stick-like symbols and picture-like symbols that vary in gender and color that represent one referent, for a number of referents. SymbolStix provide both color and black-and-white versions of each symbol and, often, multiple symbols for each referent. To allow for better comparison, traditional picture-like PCS symbols (i.e. those that were not stick-like) were chosen as target symbols. Of the PCS symbols, those that had the least amount of detail and displayed people performing the action (as opposed to the action alone being depicted) were chosen. In addition, when provided the choice between color or black-and-white symbols,

the investigator chose the colored option. Appendix E provides examples and further explanation for symbols chosen as the target symbol when the symbol set provided more than one symbol per referent.

Procedure

Both symbol sets were used with each participant. In one experimental condition, the PCS symbols were presented first, and in the other condition, the SymbolStix symbols were presented first. The participants were assigned to an experimental condition, so that half of them were tested using the PCS symbols first, and half were tested using the SymbolStix symbols first. This was done to eliminate any bias for order of symbol set presentation. The testing session lasted about 20-30 minutes, and each participant was tested individually. The participant and the investigator were seated at a table with the DynaVox Series V device directly in front of the participant. The investigator presented the participants with directions for completing the experimental task. Each participant received the following instructions:

> Many people who cannot speak, use pictures like these [symbols shown on the first example page] to talk to their families and friends. All they have to do is point to the picture of the word they want to say. I want to know which pictures you would use to say certain words. I am going to show you four pictures at a time. Next, I will press the start button and the machine will say a word. I want you to touch the picture you would use if you wanted to say that word. It is important that you choose just one picture.

After the instructions were given, the investigator asked the participant if he or she understood. If the participant did not understand, the investigator talked the participant through the first example page, giving him or her step-by-step directions. Most participants understood the directions immediately and did not need further explanation. Those who needed step-by-step direction, however, indicated understanding after the first example. When the participant indicated understanding, the investigator proceeded with the remaining example/practice items.

The investigator presented the participant with one screen at a time, and then activated the ‘start’ button to have the device say the target referent. The participant had to touch one of

the four symbols (presented in a 4 X 1 array) that he/she perceived as matching the spoken referent. For example, if the target referent was the word “jump”, the examiner would activate the start button, the device would say “Jump,” and the participant would touch the symbol he or she would use to say “jump”. The stimulus could be repeated upon the participant’s request, and the repeat request was recorded on the data sheet. If the participant did not respond, the investigator prompted with, “If you wanted to say (target referent), touch the picture you would use.”

After one symbol set was completed, the test procedure continued, using the other symbol set. Directions were not provided for the second symbol set because the task remained the same. The data logging feature of the DynaVox series V was activated before each test session and deactivated after each test session. Each symbol was coded in such a way that upon reviewing the data log, the investigator could accurately identify when the start button was activated and when the participant’s symbol of choice was activated. This allowed the investigator to use the data-logging time codes to measure the amount of time (in seconds and fractions of seconds) that it took for each participant to select the symbols he or she perceived as correctly matching the spoken referent.

Results

There were two dependent variables of interest in this study. The first variable was the match between what the manufacturers of the symbol-sets intended as a depiction of a specific verb and the participants’ choice for the symbol representation of that specific verb. This variable was known as accuracy selection of the expected target symbol. The second dependent variable was the reaction time from when the spoken referent was presented to the selection of a symbol on the touch screen. Thus, this variable was known as reaction time. To determine which symbol set the children found most transparent, the mean number of symbols selected that matched the

expected target symbol for each symbol set was calculated and compared. The mean amount of time it took for the participants to select the symbols for each set was also calculated and compared.

The data were formatted for a paired sample t-test and run on Statistical Package for the Social Sciences (SPSS) to compare the means of the variables tested to determine any statistically significant differences. Table 1 displays the calculated mean number of symbols selected that matched the expected target symbols for the 22 items tested (accuracy) as well as the mean number of (unexpected) foil symbols selected according to foil category of noun and verb, for each symbol set.

Results of the paired sample t-test indicated a significant difference between the accurate target choices between the two symbol sets ($p < .05$). The mean data presented in Table 1, reveals that the expected targets of the SymbolStix symbol set were identified more often than those of the PCS symbol set. In addition, a paired sample t-test was run to compare the differences in the 'unexpected' (or inaccurate) symbol choices for each of the foil categories (nouns and verbs). In other words, if the participants did not choose the 'correct' or 'expected' target, which foil were they more likely to choose? The data show a significant difference between the foil symbol selection (nouns vs. verbs) for both the PCS and the SymbolStix symbol sets ($p < .05$ for paired sample t-tests for both PCS and SymbolStix). When a symbol other than the expected target symbol was selected, the participants tended to select a foil that was one of the related nouns significantly more often than the foil that was a verb, for both PCS and SymbolStix.

The reaction time data were also formatted for a paired sample t-test to determine whether the total mean reaction time was significantly different between the two symbol sets. Mean reaction time data are presented in Table 2. While the mean reaction time for PCS was longer than the reaction time for SymbolSix, results indicate that this difference was not statistically significant ($p = 0.2$).

When analyzing reaction time data, however, it is important to note that the investigators developed the following conventions relative to reaction time data due to occasional anomalies by the participants in using the touch screen:

1. If the participant needed a repeat of the word, the start time was recorded as the first time the word was produced (i.e. from the first "start" for that target word on the log file);

2. Occasionally the participant touched the screen with too much force causing it to jump ahead an item or two. In this case, the start time was recorded when the correct stimulus item was produced, after going back to the correct page;

3. Occasionally the participant touched the picture, but not hard enough for the machine to register it, causing the participant to touch it again.

Therefore, in these instances, the reaction time may be longer than the actual time it took for the participant to respond.

Reliability

Intra-subject reliability was calculated by comparing the total number of participants who chose the same symbol upon the first and second occurrence of the repeat verbs and the total number of opportunities the participants (as a whole) had to select the repeat verbs. Since there were 32 participants and each set had two repeat verbs, there were a total of 64 opportunities for the participants to choose the same symbols for the first and second occurrence of the repeat verbs. The formula (C/64) X 100 was used to calculate the reliability, where C is the number of participants who were consistent in their symbol selection for the two repeat verbs. Intra-subject reliability for PCS was 65% while intra-subject reliability for SymbolStix was 64%. These low percentages could be due to the fact that many of the participants indicated to the examiner that

they realized that some of the words were repeated. This realization could have caused the participants to doubt their choice on the first occurrence of the symbol.

Discussion

The purpose of this study was to determine which of two graphic symbol sets (PCS or SymbolStix), six to eight-year-old children find most transparent or guessable. SymbolStix were found to be more transparent than PCS for the verbs investigated in this study. On average, expected SymbolStix were chosen significantly more often than expected PCS symbols. What is it about SymbolStix, then, that make them more transparent as a group than PCS? Because this study sought to determine *which* symbol set was most transparent and not *why*, only speculations can be made.

In general, certain SymbolStix represent certain verb-type words better than PCS, and children, for whatever reason, were able to form better associations with SymbolStix and the verbs they represented than they were with PCS. Perhaps the simplicity of SymbolStix symbols led to their increased transparency. The stick figures and objects in the SymbolStix symbol set typically contain less detail and less color than those of PCS. The use of clothing, for example, and multiple colors may be distracting to some children. In addition, lack of clothing does allow more attention to be placed on the body position of the figures in order to depict certain actions (e.g. jump, talk). Because the SymbolStix symbols were made up of simple black lines, the action aspect of the symbol may have been more salient to the children. In general, the SymbolStix figures appeared to emphasize the actions of the figures, rather than the characteristics of the figures themselves. "Look" is a good example of this concept. For SymbolStix, the symbol for "look" contains a line-drawn face, whose rather large eyes are "looking" in a specific direction. The main focus of the symbol is the figure's face and its action ("looking"). On the other hand, the PCS symbol for "look," depicts the top half of a person with

a red shirt on with his hand up over his eyes, in a profile stance. In some respects, this symbol places more emphasis on the figure's body stance and not its eyes. That notion could be the reason why more participants failed to choose the expected PCS symbol for "look" than the expected SymbolStix symbol for "look." In fact, for PCS, over half of the participants chose "magnifying glass" for look. In this symbol, the glass is placed directly over the figure's eye, which may have lead participants to choose that symbol over the expected symbol.

It is possible that the foil choices provided for "look," as well as the rest of the target symbols, were a factor in the participants' symbol selection choice. Many of the related nouns and verbs used as foils could very well be used to represent the target verb. For example, the noun foils for the verb 'jump' were a jump rope and a trampoline. The foil choices may have been too similar, either confusing the participants, or causing them to choose a probable symbol, but not one that was the "best" choice. When looking at the unexpected symbols that were chosen most often in each set, this possibility seems probable. For example, well over half of the participants chose the unexpected symbol, "yell," when prompted with, "talk," for the PCS symbol set. The PCS symbols for, "talk" and, "yell" may have differences that were too subtle for six to eight-year-olds to decipher. The same thing can be said for the differences between, "give" and "take" and "know" and "understand" for both symbol sets, and the differences between "build" and "make" for SymbolStix.

Furthermore, it is possible that children strongly relate certain objects (i.e. nouns) with certain actions (i.e. verbs) and that these associations are stronger than representations of the action itself in graphic symbol form. As the data revealed, significantly more nouns than verbs were chosen when an unexpected symbol was selected as a match to the target referent. "Hit" is a perfect example of this. The PCS symbol for "hit" is a rather translucent symbol, depicting the whole body of a person in profile stance, with his arm out and hand up against a brown square

that is about shoulder height to the figure. Most participants, however, did not choose this expected symbol when prompted. In fact, all but 10 selected the symbol of a “baseball bat”. In addition, the PCS symbol for, “book” was also chosen by over half of the participants, when prompted with, “read.” And in regards to both symbol sets, “trampoline,” “scissors,” and “present” were often chosen when prompted with “jump,” “cut,” and “give” respectively.

To date, no research has been published on the transparency and the ease of acquisition of SymbolStix. Therefore, it is difficult to compare the results of this study with those of previously published articles. As previously stated, though, many published works in the field of AAC do support the idea that the more transparent a symbol is, the easier it can be learned or recalled (Clark, 1981, Musselwhite & Ruscello, 1984, Mizuko, 1987, Mizuko & Reichle, 1989, and Bloomberg , Karlan, & Lloyd, 1990). It could be speculated, then, that if SymbolStix verbs were compared with the verbs of more opaque graphic symbol sets, a larger number of SymbolStix verbs would be accurately identified in a recall task.

The previous studies of Mizuko (1987), Mizuko and Reichle (1989), and Bloomberg, Karlan, and Lloyd (1990) compared transparency and ease of acquisition across both graphic symbol sets and word category (i.e. nouns, verbs, and descriptors). Utilizing typically developing three-year-old children, Mizuko (1987) compared the transparency and ease of learning of Blissymbols, PCS, and Picsyms for symbols representing certain nouns, verbs, and descriptors. Results were similar to those of the present study, indicating significant differences between PCS verbs and the verbs of another graphic symbol set (Picsyms). When Mizuko and Reichle repeated the 1987 Mizuko study using adult participants with intellectual impairments, significant differences were not found between the verbs of the graphic symbol sets compared. These findings do not support the findings of either the present study or of the earlier Mizuko study. The population of the Mizuko and Reichle study differed from the present study since the

majority of the participants in the present study were typically developing (72%). Bloomberg, Karlan, and Lloyd (1990) used college students and a seven-point Likert-type scale to determine the comparative translucency of five graphic symbol sets (Blissymbolics, PCS, Picsyms, PIC, and Rebus), as a whole and across word classes. While no significant difference was found between the verbs of PCS and the verbs of one symbol set (Rebus), significant differences between the verbs of PCS and the verbs of other symbol sets were found (i.e. PCS vs. PIC vs. Picsyms vs. Blissymbols). Therefore, when college students were used, and the task was not a forced choice task, results of the comparison between PCS and other symbol systems provided both support and contradictory evidence when compared to results of the present study.

Another factor examined in this study was reaction time. No significant difference was found between the amount of time it took for the participants to choose SymbolStix and the amount of time it took them to choose PCS. The fact that there was a significant difference in accuracy between the two symbol sets but not a significant difference in reaction time can be related to a variety of different factors. First, both symbol sets were presented in succession; as soon as testing on one symbol set was complete, the testing on the next symbol set began. Logistics of the presentation made it so there was most likely no perceived difference from one set to the other. This fact may have blurred any differences in the two symbol sets because the participants were in the rhythm of choosing the symbols, one after the other.

In addition, both PCS and SymbolStix are thought to be relatively transparent symbol sets and many of the participants, commented on how “easy” the task was. Because none of them had ever been exposed to the symbol sets used in this study, they had no concept of which symbols were actually the expected symbols for each spoken referent. Furthermore, they were made to understand that they could choose whichever symbol *they* thought best matched the spoken referent. These combined aspects eliminated any pressure to perform, or even to be correct, from

the participant. Therefore, the participants rarely spent much time contemplating over which symbol to choose.

Suggestions or Future Research

These findings lead to further questions. First, how do other parts of speech (i.e. nouns and descriptors) compare across the symbol sets compared in this study? Information regarding transparency of other parts of speech would provide information on the transparency of the symbol sets as a whole. An investigation of this topic, using additional symbol sets is also something to consider. It is already fairly well established that transparency for nouns can be fairly high, therefore, what would be the relative transparency for other parts of speech for specific symbol sets? For example will most symbol sets have a relatively lower level of transparency for verbs than descriptor (adjectives/adverbs) words? Also at what level of abstractness will a noun be more difficult to depict? Second, how do other graphic picture-like symbols compare to SymbolStix, and how do the stick-like PCS symbols compare to SymbolStix and the picture-like PCS symbols? And most importantly, does the iconicity hypothesis hold true in regards to verbs depicted by SymbolStix? Since SymbolStix verbs were found to be most transparent, in theory, they should be easier to learn than PCS verb symbols. An investigation on the "learnability" of SymbolStix compared to PCS symbols would be an important area for further research.

Another area of future research would be to examine the way in which children select certain graphic symbols or even why they select certain symbols. While completing the test session, many children re-verbalized the target word after it had been spoken by the DynaVox voice. Others used self-talk, making comments about the symbols before choosing the symbol they perceived as matching the spoken referent. One child, for example, made comments on how a knife is used to cut and how a book is used to read, before he chose "knife" and "book" for

"cut" and "read". Another child made a connection between the PCS symbol for "climb" and her life experiences. She noted that her school playground "had one of those," meaning the school playground had a climbing apparatus that looked similar to the one in the PCS symbol for "climb". It would be interesting to gain more insight on children's own reasoning for symbol selection. Such information may help symbol set manufacturers develop symbols that could be more easily understood by children, especially those with different life experiences.

Furthermore, given the re-vocalization and self-talk of some of the students, it would be interesting to continue this study on the population of children who cannot speak intelligibly and for whom these symbols may be an actual way of communicating. Even though there were some children included in this study with documented speech and language impairments, there were not enough to draw any separate conclusions regarding that population.

Summary

This study examined the iconicity of verb depictions by a relatively new graphic symbol set (SymbolStix) and compared it with a well established, commonly used graphic symbol set (PCS). Children chose significantly more expected verb targets with the SymbolStix symbols than with the PCS symbols. This may have some clinical implications due to the fact that the simpler the symbol was, the more likely the six to eight-year-old children believed it depicted a specific verb. It must be cautioned, however, that symbols that are too simple (e.g. Blissymbols) are considered to be abstract and opaque. When symbols are too simple, a symbol-referent relationship cannot be easily perceived. Too much simplicity can also lead to the difficulty to discriminate between symbols that have subtle differences. Ruscello and Musslewhite (1984) explain this when giving possible reasons why Blissymbols were found to be less transparent than Rebus and Picsyms in their study. They state that, "A group of related Blissymbols (e.g. personal pronouns) appears very similar, with only minor differences, thus posing a possible identification problem. This characteristic, is found, to a somewhat lesser extent, in the Picsyms

system also, but is not a major feature of the Rebus system" (p. 27). This not only speaks to opaqueness that can result from too much simplicity, but it also speaks to the consequences of using foils that are too similar.

In conclusion, there appears to be some sort of balance between complexity and simplicity that make symbols most transparent to children. It may be possible, that the manufacturers of SymbolStix have found that balance, at least compared to PCS verbs. Furthermore, while more research is needed to confirm the findings of this study, there may be other symbol systems that may better depict certain terms than those symbol systems that have been commonly used.

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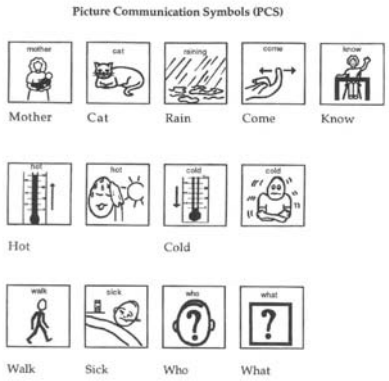
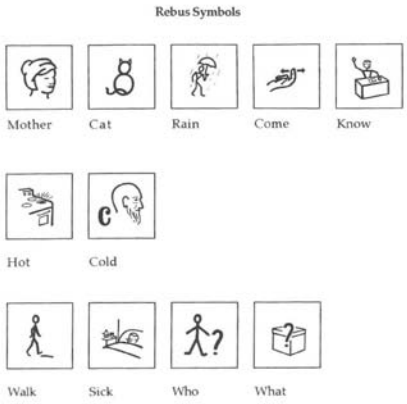
Appendix A

Examples of Different Symbol Sets



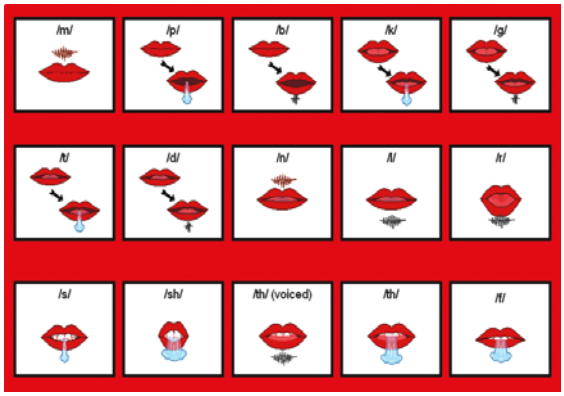
Glennen & DeCoste, 1997 p. 118

Glennen & DeCoste, 1997 p. 117



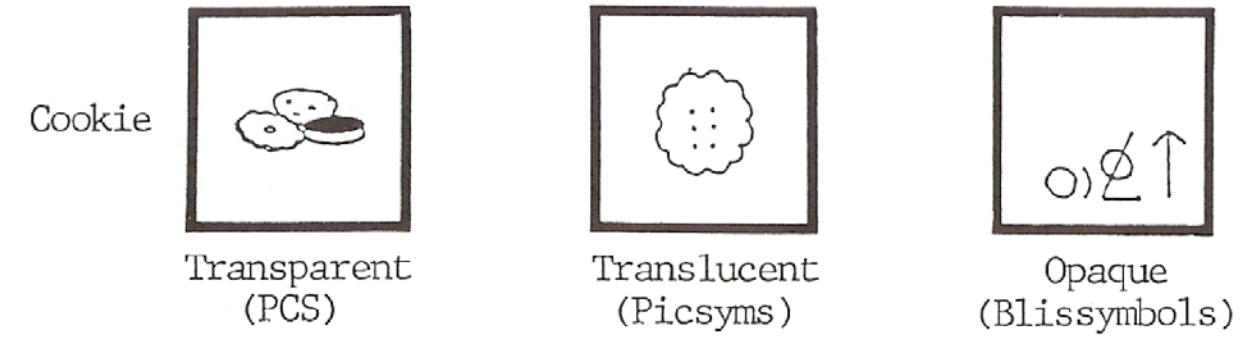
Glennen & DeCoste, 1997, p. 120

DynaSyms



Appendix B

Examples of Graphic Symbols along the Iconicity Continuum



Source: Reichle, York, & Sigafoos, 1994, p. 8

Appendix C

A List of Target Words and Foils Used in this Study

Target Words	**Foils**
Example 1: Sit‡†	Lie down, Chair, Bed
Example 2: Stand‡†	Walk, Tennis shoes, Couch
Jump®	Run, Trampoline, Jump rope
Eat®‡†	Drink, Dinner, Fork
Hit†	Bandage, Bat, Squish
Come‡	Whistle, Dog, Follow
Look‡	Binoculars, Listen, Magnifying Glass
Make‡	Build, Wood, Clay
Play‡	Ride, Toys, Playground
Climb†	Walk, Latter, Stairs
Talk†	Lips, Phone, Yell
Cut*‡†	Rip, Knife, Scissors
Know‡	Teach/teacher, Understand, Student
Spill*	Glass, Pour, Floor
Give‡	Present, Take, Flowers
Dance®	Sing, Shoes, Play (Theater)
Help	Cane, Lifeguard, Serve
Tickle‡†	Hug, Hands, Feather
Read®†	Listen, Book, eye-glasses
Kick®†	Throw, Boots, Foot

Write†	Pencil, Letter, Draw
Wash‡	Dust (v.), Hose, Sponge

Source:

*ROWPVT-2 ®PPVT-4

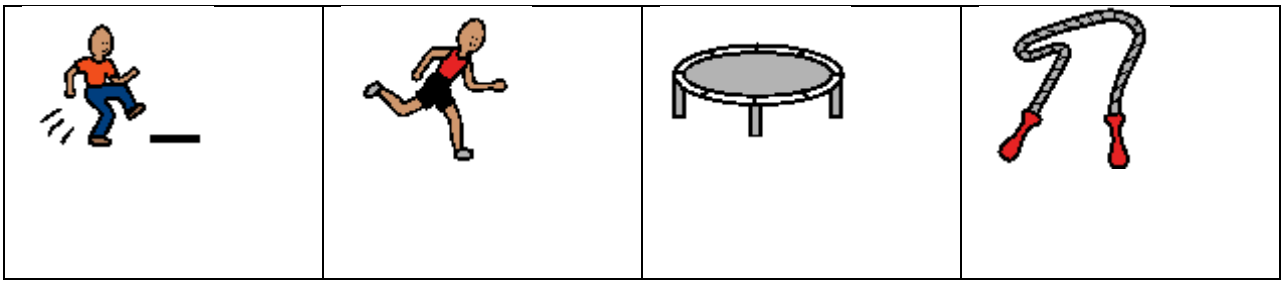
‡Beukleman, Jones, & Rowen, (1989)

† Moe, Hopkins, & Rush, (1982)

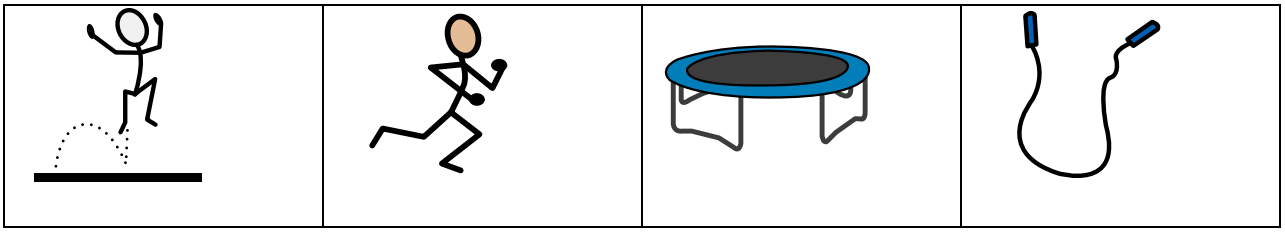
Appendix D

Examples of “Jump” Test Pages for PCS and SymbolStix

Picture Communication Symbols (Copyright 2006,Mayer-Johnson, LLC, Solona Beach, CA)



SymbolStix (Copyright 2009, N2Y, Inc.®)



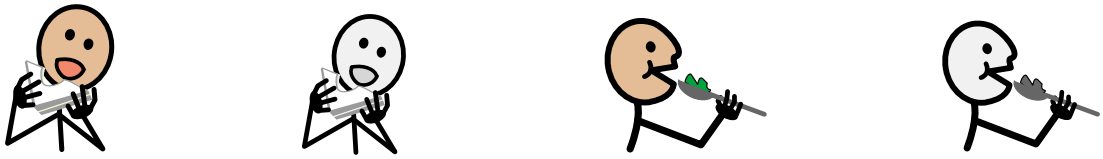
In the example provided, the target symbol is “jump”, located in the first square on the left. The three foils that follow are symbols for, “run,” “trampoline,” and “jump-rope” respectively.

Appendix E

Rationale for Symbol Targets when Multiple Symbols Were Available for a Word in a Symbol Set

Out of the available PCS symbols for “eat”, the first symbol on the left was chosen as the target symbol. Rationale: 1) this symbol is not a stick-figure, so it will be less likely to be confused with Symbolstix, 2) it has color, 3) it is the symbol with the least amount of detail among the picture symbols for the verb.

Out of the available SymbolStix symbols for “eat”, the first symbol on the left was chosen as the target symbol. Rationale: this symbol is in color and it is dissimilar to the target PCS symbol for “eat”.



Out of the available PCS symbols for “spill” the first of these symbols was also be chosen as the target symbol. Rationale: it depicts a person performing the action (the person is spilling the liquid) instead of depicting only the action itself (the liquid spilling).

Out of these available SymbolStix symbols for “spill”, the first one was chosen as the target symbol because it is in color.

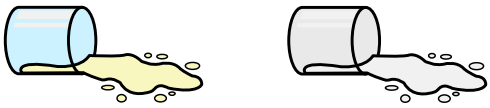


Table 1

Mean Number of Expected Symbols Identified per Symbol Set and the Mean Number of Unexpected Symbols Identified, According to Foil Type

	Expected	Unexpected	
Symbol Set	Target Symbol	Foil Noun	Foil Verb
PCS	11.94	6.62	3.44
SymbolStix	14.44	4.69	2.87

Table 2

Mean Reaction Time for Symbol Selection

Symbol Set	Reaction Time (in seconds)
PCS	80.88
SymbolStix	77.28