Translucency Ratings of Blissymbols over Repeated Exposures by Children with Autism

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Abtract

The use of graphic symbols forms an integral part of augmentative and alternative communication (AAC) strategies, particularly for pre-literate children. Although some studies have indicated that typically developing children and those with autism are able to learn symbol meanings with multiple exposures to graphic symbols, little is known about how children with autism rate the degree to which the symbol represents its referent (translucency) with repeated exposures. The purpose of this study was to describe the translucency ratings of children with autism over three consecutive exposures. Twenty-two children with autism participated in a Blissymbol translucency task that included 40 symbols. The Blissymbol task was modified from Bornman, Alant, and du Preez (2009), who explored the translucency of Blissymbols with typically developing children. Findings of this study indicated statistically significant differences in total translucency ratings of the Blissymbols by the children with autism between Day 1 and Day 3 (medium effect size) with Day 3 yielding more positive ratings than Day 1. No single Blissymbol showed statistically significant differences over the days. Findings are interpreted and further implications for research are discussed.

Keywords: *Autism; Blissymbol; Translucency; Repeated exposure*

Introduction

Graphic symbols are frequently used with children with autism to provide them with additional visual input to facilitate communication and learning. The use of iPads and other technologies has recently also escalated students' exposure to different types of visual symbols for learning and interaction (e.g., Flores et al., 2012). Most intervention approaches with children with autism focus on drill and practice. In spite of such exposures to visual symbols, however, very little is yet known about how children with autism relate to visual symbols. For example, although some research has been conducted to understand what children with autism see when shown a symbol (iconicity), there has been little if any research into determining whether these children are able to see greater resemblances between labels and graphic symbols through repeated exposure without explicit training. We were, therefore, interested in understanding how children with autism intuitively process symbol-referent information, in order to provide interventionists with guidelines for effective teaching potentially.

The iconicity scale describes the degree of resemblance between a symbol and a referent and includes the terms *transparency* and *translucency*. Transparency refers to the extent to which a symbol is guessable, while translucency depicts the ease with which a symbol is recognized once the context within which it is used is known (Lloyd, Fuller, & Arvidson, 1997). For example, when individuals are aware that symbols represent items used in a bedroom, it might be easier for them to recognize that a symbol depicting a rectangle represents a pillow rather than a geometric symbol. The relationship between symbol and referent, therefore, is dynamic and can be influenced by various factors, including frequency of exposure to the symbols, knowledge of the context in which the symbols are used, and familiarity with the referent. It might be hypothesized that more exposures to symbols might facilitate the identification of increased perceived similarities between referents and symbols. The time needed for an individual to identify correctly the meaning of a symbol is typically referred to as the learnability of the symbol. Learnability, among other factors, is dependent on not only the nature of the symbols, but also the individual characteristics of the learners (e.g., experiences and cognitive abilities, type of instruction provided). Deregowski (1973), for example, found that people from non-western rural contexts who were not regularly exposed to line drawings increased their recognition of line drawings with single exposures once they were told what the pictures depicted. They were able to identify similarities between line drawings and their referents with relative ease. This ability to perceive increased similarities between symbols and their referents may reflect an intuitive cognitive process that enhances individuals' ability to make sense of graphic symbols. A more systematic understanding of individuals' abilities to intuitively increase the perceived resemblance between symbol and referent with repeated exposures to stimuli may, therefore, enhance understanding of the process of learning graphic symbols.

Although the use of graphic symbols forms an integral part of augmentative and alternative communication (AAC) interventions, relatively little is known about how children derive meaning from graphic symbols over time. To date, graphic symbol studies have investigated how individuals make sense of visual information in two principal ways. First, they have focused on how visual information is displayed, for example, by using dynamic grid displays of isolated AAC symbols or visual scene displays (e.g., Drager, Light, Curran-Speltz, Fallon & Jeffries, 2003; Wilkinson, Light, & Drager, 2012). Second, they have focused on how single AAC symbols are perceived and learned. These latter studies have included investigation of issues like iconicity (Fuller & Lloyd, 1991, 1992), cultural familiarity with symbols (Alant, 2005), and learnability (Schlosser, 1997). More recently, studies have examined the effect of animation on learning of AAC symbols (Fujisawa, Inoue, Yamana, & Hayashi, 2011; Schlosser et al., 2012). However, none of these studies have investigated the impact of multiple exposures to symbols on perceptions of the symbols. Systematic investigation of how the ratings of perceived iconicity by children with different abilities change with multiple exposures to graphic symbols is, therefore, lacking. Whereas learnability of symbols is concerned with the ability to learn the meaning of symbols and thus to identify the number of trials needed for successful learning, translucency focuses on the individual's intuitive ability to perceive similarities between symbols and their referents without explicit instruction.

There is a significant body of literature supporting the iconicity hypothesis (e.g., Fuller & Lloyd, 1991; Hurlbut, Iwata, & Green, 1982; Mizuko, 1987; Mizuko & Reichle, 1989; Schlosser & Sigafoos, 2002), which indicates that symbols with greater degrees of iconicity are more easily learned. The iconicity of Blissymbols is of particular interest in the current study. Blissymbols is a meaning-based symbol system developed by Charles Bliss (1965). It consists of 120 key symbols that are combined to create over 2000 basic symbols. Blissymbols are used by people with communication difficulties in over 33 countries.

Since the 1970s, Blissymbols have been used to aid communication of children with little or no functional speech (McNaughton, 1985). Mirenda and Locke (1989) compared the transparency of objects, photos, and line drawings using a match-to-sample task with individuals with autism and other developmental disabilities. They found a hierarchy of symbol transparency from easiest (objects and color photographs) to difficult (line drawings and Blissymbols). Similarly, Kozleski (1991) observed the effects of iconicity on graphic symbol learning in four individuals with autism. The results indicated that all participants required fewer trials to learn symbol sets that had higher degrees of iconicity. More recently, however, Angermeier, Schlosser, Luiselli, Harrington, and Carter (2008) conducted a study involving four students with autism or pervasive developmental disorders between the ages of 6 and 9 years to investigate the effects of iconicity on requesting with the Picture Exchange Communication System (PECS), a training system to teach children to use picture cards to communicate spontaneously with others (Bondy & Frost, 1994). They observed that their participants did not benefit from symbols that bore more resemblance to their referents during the first two phases of PECS instruction. Very little difference was also noted between the two experimental conditions which used Picture Communication Symbols (PCS, Johnson, 1981) and Blissymbols. The authors, however, conceded that it was logical that symbol iconicity might not play a major role in learning during the first two stages of PECS, because the students in their study were not required to identify single symbols within an array of other symbols. The first two PECS stages merely focus on one symbol at a time in exchange for one object. The authors do suggest that an effect of the iconicity principle on PECS Stage III learning might be more feasible and should be further investigated.

Wendt (2009) pointed out that, although studies using graphic symbols with children with autism have been conducted since the early 1980s, evidence-based guidelines for intervention with children with autism remain scant. For example, Arthur-Kelly, Sigafoos, Green, Mathisen, and Arthur-Kelly (2009); as well as Koul, Schlosser, and Sancibrian (2001), cautioned that the impact of visual supports on children with autism can be compromised or enhanced by a range of factors. Therefore, a better understanding of how children with autism process graphic symbols seems pertinent to refining existing intervention strategies.

For example, Happé (1999) argued that children with autism have a distinctive cognitive style that leads to strengths and weaknesses in performance. The theory of weak central coherence (Frith, 1989) described information processing in children with autism as dominated by detail-focused processing. According to this theory, specific features are retained at the expense of global configuration and contextualized meaning (Happé, 1999, p. 217). It is not uncommon to find reports in the literature (Belmonte, 2000; Smith & Milne, 2009) that children with autism are distracted by detail in pictures, which could compromise their ability to understand the central meaning of graphic symbols.

The fields of visual cognitive science and neuroscience provide a growing body of research on factors that can influence visual cognitive processing of visual images (e.g., symbols and naturalistic or integrated scenes). As individuals with autism have been reported to demonstrate superiority in a range of visual search tasks (see, for example, Joseph, Brandon, Connolly, Wolfe, & Horowitz, 2009), it might be expected that they would perform particularly well in locating information with a visual display. However, the opposite could also be plausible, in that individuals with autism might have more difficulties with visual displays due to their tendency to focus narrowly or in an overly selective fashion on details and not on more global display features (Liss, Saulnier, Fein, & Kinsbourne, 2006; Mann & Walker, 2003). Visual cognitive processing may differ in children with autism compared to peers without disabilities. Within this perspective, it might be argued that the use of graphic symbols that are minimalistic in nature (e.g., Blissymbols) rather than more visually complicated or detail-focused (e.g., PCS) could be beneficial in helping children with autism to extract critical features central to the meanings of symbols. As previously noted, however, the association between symbol and referent is highly influenced by not just visual processing, but also factors specific to the experience and orientation of the individual. Research is required to investigate the perceptions of graphic symbols by children with autism.

There are at least two sets of factors that may impact on the ability of the individual to extract meaning from symbols. The first relates to bottom-up processing (Chen & Zelinsky, 2006; Lamy & Egeth, 2003; Wolfe, Butcher, Lee, & Hyle, 2003) which refers to the stimulus-driven, involuntary processing associated with neural activity. Examples of features that are primarily processed bottom-up are size, color, orientation, and motion. The second set of factors relates to top-down processing, which is user-driven, under intentional control, and associated with higher-level cognitive functioning. Task requirements, verbal instructions, memory, and training strategies may all impact top-down processing. Any visual task typically includes a combination of top-down and bottom-up processing. Of interest in the current study was the extent to which children with autism are able to integrate bottom-up processing of features of Blissymbols with top-down processing of symbol meaning to enhance their perceptions of similarities between symbols and references and thus impact their ratings of translucency. To complete this task, participants would need to first associate the label of the symbols with their referents, in order to allow them to identify similarities; and then make judgements to indicate the extent of the similarities perceived.

Bornman, Alant, and du Preez (2009) conducted a study of typically developing children and found that, in this group, implicit learning took place after three exposures to the same Blissymbols on consecutive days. Over time, the children reported more resemblances between Blissymbols and their referents as a result of exposure without explicit instruction. These findings confirmed those of a prior study by Basson and Alant (2005) that used PCS symbols with typically developing preschoolers. As no studies were found reporting on the performance of individuals with autism and their responses to repeated exposures to graphic symbols, the current study endeavored to investigate whether the degree of translucency rated by children with autism changed as a result of repeated exposures to Blissymbols. Specific research questions included were: How do individuals with autism rate the translucency of Blissymbols over 3 days? What is the effect of repeated exposures (Days 1–3) on the translucency ratings of Blissymbols overall by individuals with autism? What is the effect on the ratings of individual Blissymbols?

Method

Design

The study utilized a within-subjects design to investigate the effects of exposure (Day 1 to Day 3) on the translucency ratings of 40 Blissymbols by 22 participants with autism. The independent variable was the number of exposures (Days 1–3) and the dependent variable was the participants' translucency ratings on a Likert-type scale. Individual Blissymbols was also treated as a factor in the within subjects design.

Participants

The participants in the study were 22 children with autism from a school for individuals with autism in South Africa. Selection criteria were (a) a diagnosis of autism, (b) mental age between 6 and 8 years, (c) at least one year in the school prior to testing to ensure familiarity with the school context, and (d) ability to understand concepts tested in the study and the Likert-type rating scale, as measured by successful completion of pre-testing procedures. All participants were diagnosed with autism by a team of experts including a psychologist, a registered psychometrist, an occupational therapist and a speech-language pathologist using the DSM IV. Description of severity was based on (a) the degree of obsessive and stereotypical behaviour as well as the interests and activities of the students, (b) the quality of their communication (verbal and non-verbal) as well as language ability, (c) the quality of social interaction including non-verbal behavior, purposes of communication and degree of enjoyment derived from social interaction. Mental ages (combined verbal and nonverbal scores) were assessed for the purpose of the study according to the Junior South African Individual Scale (Human Sciences Research Council, 1992), which is frequently used in South Africa for this purpose. The scale measures the mental ages of individuals between 3 years and 7; 11 (years; months). The mental age criterion was set in consultation with the teachers, to ensure that the participants understood the translucency rating task. Mental age of the participants ranged from 6–8 years ($M = 7{,}1$; $SD = 0.4$) and chronological age ranged from 9; 5 to 20 years ($M = 13{,}9$; $SD = 3.0$). As it turned out, all of the students who fell into this category relied on natural speech to communicate. Even though these participants were not using AAC for expression, this study could provide (a) information on how individuals with autism perceive graphic symbols, as a means of enhancing our understanding of the strengths and limitations of using Blissymbols for receptive language development; and (b) a reference point from where the perception of Blissymbols by children with autism who use AAC could be further understood. Eighteen of the participants were male and four were female. Home languages included Afrikaans (45%); English (23%), and five different African languages (32%). The school provided bilingual instruction in English and Afrikaans. All participants were tested in their language of instruction. Those participants who spoke an African language received instruction in English and thus were tested in English. Socio-economic status was described by the school at admission according to income and was reassessed at the time of the study. Please see Table I.

All students had been in the school for at least one year at the time of testing. None of the students had been exposed to Blissymbols. The Makaton system was used in the school mainly as visual support for instruction. As all of the participants in this study used natural speech, their exposure to the symbols was limited to visual schedules.

Pre-testing Procedures. All students had to pass the pre-testing training procedures in order to be included in the study. These procedures included a test to determine comprehension of all the concepts included in the research task and ensure students' understanding of the Likert scale (1 = *not at all like*, 2 = *a little like*, 3 = *a lot like* and 4 = *exactly like*) to be used for the rating of translucency. Comprehension of concepts was tested by asking the student what was meant, for example, by each word: "What is a glass?" or "What does it mean to be careful?" Criteria for correct responses were determined a priori and post hoc. After the testing of each student, teachers were consulted to confirm and score the students' responses. Final scoring reflected a consensus between the tester and the teacher. The participants had to demonstrate comprehension of all 40 test words in order to participate in the study.

Teachers were asked to review the concepts with the students. The students participated in pre-testing to ensure their understanding of the Likert-type scale items used to obtain translucency ratings. Specifically, they were shown an overlay of various graphic symbols (e.g., a *CIRCLE*) depicting various stages of symbol completion (e.g., half a semi-circle, a semi-circle, three quarters of a circle, and the full circle). Instructions were the same as those used in the main study, for example,the tester, holding the symbol for *CIRCLE* says, *This is a circle. Does this look not at all like, a little like, a lot like, or exactly like a circle?* Students had to respond

Table I. Description of the Participants.

Participants	Home language	Diagnoses & severity	SES	Gender	Chronological age	Mental age	Formal school years	Years in current school
1	E	ASD Moderate	M	Male	16; 9	7; 7	10	10
2	Sp	ASD Moderate	L	Male	17; 11	7; 2	10	10
3	A	ASD Moderate	M	Male	16; 0	7; 4	9	9
4	A	ASD Moderate	M	Male	9; 5	6; 4	3	1
5	A	ASD Moderate	M	Male	10; 6	7; 0	4	4
6	Z	PDDNOS mild	M	Male	13; 9	6; 11	6	3
7	E	ASD Moderate	L	Male	14; 4	7; 5	8	1
8	A	ASD Moderate	M	Male	14; 4	7; 6	7	7
9	A	ASD Moderate	M	Female	12; 10	7; 2	6	2
10	A	ASD Moderate	M	Female	14; 9	6; 11	7	1
11	Z	ASD Moderate	L	Male	14; 4	7; 6	8	8
12	Set	ASD Moderate	M	Male	12; 11	6; 3	8	8
13	A	ASD Moderate	M	Male	12; 4	7; 8	5	5
14	Ns	ASD Moderate	L	Male	11; 11	7; 2	4	4
15	E	ASD Moderate	M	Male	10; 4	6; 8	4	1
16	Sp	ASD Moderate	M	Male	20;1	7; 0	5	5
17	E	ASD Moderate	M	Male	10; 8	7; 7	4	1
18	Ss	ASD Moderate	L	Female	16;3	7; 8	9	9
19	A	ASD Moderate	M	Male	17;3	7; 9	10	10
20	A	ASD Moderate	M	Male	18; 7	6; 7	11	3
21	E	ASD Moderate	M	Female	10; 6	6;10	3	3
22	A	ASD Moderate	M	Male	12; 3	6; 11	5	5

Notes: Home Language: A, Afrikaans; E, English; Z, IsiZulu; X, IsiXhosa; N, IsiNdebele; Ns, Sesotho sa Leboa (Northern Sotho); Ss, Sesotho (Southern Sotho); Sp, SePedi; Set-SeTswana; Sw, SiSwati; V, TshiVenda; Ts, TsiTsonga.
Socio-Economic Status: H, High (800,000 + per annum); M, Middle (200,000–800,000 per annum); L, low (unemployed or less than 200,000 per annum).
Diagnoses: ASD, Autism Spectrum Disorder; PDDNOS, Pervasive Developmental Disorder Not Otherwise Specified.

by pointing to the corresponding bar on the bar chart to indicate the Likert rating. There were five pretest symbols and students had to respond correctly on the Likert rating scale for all five of the pre-testing questions (see Supplementary Appendix A to be found online at http://informahealthcare.com/doi/abs/10.3109/07434618.2013.813967).

Materials

Blissymbol Stimuli. The research task required the participants to rate the translucency of 40 Blissymbols. For the current study, the Blissymbol rating task consisted of 40 Blissymbols randomly selected from the data as reported in du Preez (2006). The 40 Blissymbols comprised 17 symbols from a possible 31 symbols that were rated high in translucency, 19 from a possible 31 symbols that were rated low in translucency, and four out of seven symbols that displayed significant differences on translucency ratings over the 3 days of exposure in the du Preez study. Another four symbols were added from the list in du Preez for training purposes in the beginning of each data collection session. Blissymbols were presented on individual 3×2 in (7.6 cm $\times$ 5.08 cm) cards with the gloss written on the back of each card. The 40 test symbols were shuffled for randomization before each testing procedure started.

Translucency Scale. The Blissymbol rating task was modified from a study by Bornman et al. (2009) that explored the translucency of 93 Blisssymbols with a group of typically developing Setswana-speaking children (aged between 6 years and 7; 11) . Bornman et al.'s study was based on an earlier study by Quist, Lloyd, van Balkom, Welle-Donker, and Vander (1998), who conducted a cross-cultural comparison between Dutch and American children in relation to their iconicity ratings of Blissymbols. The task required the individuals to rate the degree to which symbols represented their referents. A bar chart indicating four previously described options was used to assist the participants in rating the translucency of each Blissymbol (see Supplementary Appendix A to be found online at http://informahealthcare.com/doi/abs/10.3109/07434618.2013.813967). This rating scale differed from the one used in the Bornman et al. (2009) study in two ways: First, teachers at the school suggested that, instead of using symbols of faces (smiling, neutral, sad) as in Bornman et al. (2009), the researchers should use a bar chart to indicate the degree of likeness due to difficulties that participants might experience in identifying emotions on graphic symbols (Balconi & Carrera, 2008). Second, because there seemed to have been a potential ceiling effect in the data of Bornman et al. (2009), a 4-point, rather than a 3-point, rating scale was used. A response was accepted when the student pointed to one of the bars on the chart used to represent the rating.

Procedures

Permission was obtained from the relevant authorities to conduct the study. Consent forms were compiled and ethical clearance was obtained from the University of Pretoria. The procedure was conducted in the two languages of instruction in the school, which were English or Afrikaans. Decisions regarding which language to use with each participant were based on teacher recommendations and home language. The translation procedure used was a combination of blind-back translation, review committee, and pre-test procedures as described by Bracken and Barona (1991) and Brislin (1980). The main researcher (who was fluent in both English and Afrikaans) did the initial translation of the English words into Afrikaans. Thereafter, the Afrikaans words were provided to two independent translators who translated them back into English. Minimal disagreements were recorded, and the final word list was based on consensus between translators. Finally, the local speech-language pathologist and a teacher at the school were asked to rate the equitability of the Afrikaans and English terms. After this process was completed, the students' understanding of the concepts was tested during pretesting procedures.

To ensure procedural compliance, two research assistants (a qualified teacher who was not working at the time and a graduate student), both of whom were fluent in English and Afrikaans, were also trained in the procedures. All test interactions were recorded for procedural reliability. Data were obtained over three consecutive days for each participant. The study was conducted over a period of 3 months.

Participants were tested individually. Each task was approximately 20 min in duration. Testing was conducted in two separate rooms on the school site, which were usually used for extracurricular activities. Participants were brought to and from the testing location by an aide who worked at the school. Both research assistants as well as the researcher made frequent visits to the school before testing started to ensure familiarity with the children. Each test administrator was presented with printed stepwise instructions to guide them through the pre-training, as well as testing procedures, to increase procedural reliability.

Each participant received training prior to the translucency rating data collection task, in order to ensure that they understood the instructions for using the translucency rating scale. Training involved a recapitulation of the pre-testing procedures to ensure participants remembered and could identify the four options correctly. Training continued until it was clear that the student understood the instructions. Thereafter, the student was exposed to four training Blissymbols. For example, the fieldworker first showed the symbol *DOWN* to a participant and said, *This is down*; then, pointing to the four options on the bar chart, asked, *Does this look not at all like, a little like, a lot like, or exactly like down to you*? The participant was required to point to the bar on the chart to respond. As the participant pointed to the bar on the chart, the tester verbalized and recorded the number of the bar next to the symbol to facilitate reliability checks on the responses recorded. The tester then moved as quickly as possible through all the Blissymbol questions. Testers were instructed to allow enough time (at least 15 s) between each test question to prevent participants from impulsively indicating specific choices. If a participant responded verbally, he or she was asked to also point to the relevant bar chart before the response was recorded. At the end of the test, students received a variety of stickers as a reward. If the participants showed signs of becoming restless, additional rewards were used to keep them on task. The markings on the recording forms were transferred to the scoring sheet after each session.

In all, 20% of the tests conducted were randomly selected and rated for procedural reliability. This process involved a stepwise list of items representing the scripted procedures that needed to be followed during pre-training, as well as testing procedures. For example, pre-training involved the following steps: (a) Show bar chart and explain meaning, (b) provide four test items, (c) provide pre-training on four Blissymbols with appropriate rate of administration, and (d) provide instruction that the testing is to start. Pretraining was followed by stepwise items for each question: (a) labelling of the symbol; (b) identification of the scale; (c) pointing instruction/response; (d) verbalization of response for recording; and (e) 15s latency, followed by the next symbol. Inter-rater procedural reliability testing was conducted by the researcher and one independent rater. Reliability was calculated by determining the percentage adherence to the steps during pre-training and the forty test items. Inter-rater reliability scores were averaged and ranged between 100% for pre-training and 98% for test items.

Dependent Variable

The dependent variable was the individual translucency ratings for each Blissymbol. If children gave a verbal response, they were asked to also show the tester the response on the chart. The choice indicated on the bar chart was recorded as the participant's response. If a student indicated two choices, the first response was recorded; however, this happened very infrequently because students were reminded of the instructions during the pre-testing questions. Two independent coders recorded the ratings and checked reliability of all responses. Correspondence between the spoken option and recorded responses of the Likert scale was 100%. Frequencies and percentages of participants were calculated for each translucency rating for each Blissymbol as well as mean translucency ratings across symbols.

Data Analysis

A Friedman Analysis of Variance test was used to determine the difference between ratings of the 40 symbols by the children on each of the 3 days of testing. This non-parametric test provides the same information as a repeated ANOVA, but was deemed necessary due to the use of ordinal data from the Likert scale and the small sample. The analysis was done by comparing the mean translucency rating of the symbols for each participant for each of the days. As the translucency ratings across symbols do not necessarily represent equal interval data, the use of the mean ratings was supplemented by the use of percentages and frequencies of participants who chose each rating category.

Results

Blissymbol Ratings over Three Days

Table II presents the total frequency and percentages of participants for the four translucency ratings across the 40 Blissymbols over the 3 days of testing. The participants' responses were relatively evenly spread across the scale, with the least number of overall ratings occurring for "a lot like"; a decrease is notable in ratings for "not at all like," and an increase in the ratings of "exactly like" over the 3 days.

The mean ratings for each participant over all of the symbols per day were calculated to compare the ratings over the 3 days using a Friedman two-way analysis of variance (See Table III). There was variation across the participants' ratings. Although 16 of the 22 participants (73%) showed increases in their overall ratings from Day 1 to Day 3, six of the participants (27%) showed decreases in their translucency ratings of the same period.

The analysis of variance showed a statistically significant difference at the .05 level ($p = 0.0366$, medium effect size; $d = 0.37$) only between day 1 and day 3. Friedman post hoc tests were automatically done by the BMDP package using the Z stat. Subsequent Fisher

Table II. Frequencies of the Respondents for Each Translucency Rating across the Blissymbols over Three Days (Percentage in Parentheses).

		Ratings: Looks like the word			
Day	Not at all	A little like	A lot like	Exactly like	Total
1	252 (28.64)	211 (23.98)	178 (20.23)	239 (27.16)	880 (100.00)
2	223 (25.34)	212 (24.09)	205 (23.30)	240 (27.27)	880 (100.00)
3	194 (22.05)	203 (23.07)	205 (23.30)	278 (31.59)	880 (100.00)
Total	669 (25.34)	626 (23.71)	588 (22.27)	757 (28.67)	2640 (100.00)

Table III. Mean Translucency Ratings across the 40 Blissymbols for Each Participant for the 3 Days.

	Mean translucency ratings		
Participants	Day 1	Day 2	Day 3
1	2.18	2.25	2.25
2	1.88	2.25	2.25
3	2.83	2.95	3.00
4	2.43	2.73	2.83
5	2.93	3.03	3.10
6	2.68	2.65	2.88
7	2.15	2.00	2.55
8	2.68	2.48	2.65
9	2.83	2.60	2.58
10	2.70	2.90	3.03
11	2.63	2.83	2.75
12	3.13	2.98	3.03
13	2.15	2.70	3.00
14	2.98	2.55	2.93
15	1.60	1.65	1.73
16	2.50	2.85	3.05
17	3.35	3.68	3.65
18	1.85	1.70	1.70
19	1.83	1.95	1.88
20	2.53	2.48	2.55
21	2.05	2.23	2.80
22	2.28	2.15	2.03
Mean	2.46[a]	2.53[ab]	2.65[b]

Note: Means with different superscripts differ significantly at the .05 level.

tests revealed no significant changes in the translucency ratings of individual symbols over the 3 days. The significant differences in ratings between Day 1 and Day 3, therefore, reflect a general increase in the translucency ratings over all symbols.

As previously noted, Table II showed a systematic increase in the overall ratings of the symbols over the 3 days for "a lot like" and "exactly like," with a decrease in percentage ratings for "not at all like." Table IV describes these tendencies in more detail in relation to specific symbols. From Table IV, it is evident that a mean of 56% of the participants' ratings were consistent (using the same point on the Likert scale) between Day 1 and Day 3. A mean of 29% of the ratings demonstrated increases between these days on the Likert scale (i.e., participants saw more similarity), while a mean of 15% of the symbol ratings showed a decline (i.e., the children saw less similarity between Day 1 and Day 3); thus, the majority of the ratings of the symbols stayed consistent between Day 1 and Day 3. No individual symbol showed an increase in translucency ratings across a majority of the participants. Only 7 of the 40 symbols showed gains in ratings for at least 40% of the participants from Day 1 to Day 3. These were toothbrush, teeth, black, pants, grandmother, and hold.

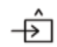
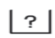
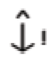
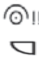
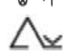
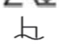
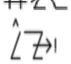
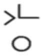
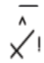
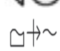
Discussion

The aim of this investigation was to describe the translucency ratings of graphic symbols by a group of children with autism over repeated exposures. Although the difference between ratings on Days 1 and 3 was statistically significant (medium effect size), this difference represents an overall pattern rather than significant differences on ratings of specific symbols.

Unlike the current study, in the masters study by du Preez (2006) with typically developing children, there were seven symbols identified that showed statistically significant differences over three exposures. As three of these symbols (living room, money, and hold) were repeated twice in the same test (i.e., a total of six exposures), these symbol ratings cannot be compared to data of the current study which provided only three exposures. Only four symbols (4.6%) – animal, bird, pig, and swimming pool – out of a potential 87 symbols (excluding repeat symbols) showed significant differences in translucency ratings over the 3 days in the du Preez study. Unlike the typically developing children in the du Preez study, the majority of the children with autism in the current study did not show increases in their translucency ratings for these four symbols over the 3 days; less than 37% of the children showed increases in their ratings for these symbols (i.e., 36% for animal and bird, 31% for pig, and 23% for swimming pool). Regardless of the students' familiarity with the concepts (referents), participants in the current study did not change their translucency ratings of individual symbols significantly during three exposures to the symbols, although their overall ratings across the 40 Blissymbols did increase.

This finding can be interpreted in different ways. First, the participants might have become more accustomed to the look of the Blissymbols with repeated exposures, which may have led to more positive ratings of the symbols on the translucency scale over time; this would likely have been the result of assimilation rather than specific understanding of the symbol referent relationship (i.e., translucency). Second, this finding may show the importance and the lasting effects of a person's first exposure to a symbol, in that the iconicity of the symbol may play a potential role in creating impressions of similarity that then remain relatively robust for children with autism over subsequent exposures. Third, because Blissymbols are based on principles of minimalism, they have less visual detail. This could have affected the ratings because fewer visual cues were available to facilitate the perception of increased resemblances between symbol and referent over time. However, the notion that more detailed graphic representations will be easier to identify assumes that more detail in graphic symbols would have a positive impact on the perception of similarities between referent and symbol, which is not necessarily the case. More detail could be distracting to children with autism due to weak central coherence (Frith, 1989). Future research is required to investigate these effects. Fourth, the fact that participants did not change their ratings of specific symbols significantly over three exposures may indicate that they had difficulty relating to the task as a whole.

Table IV. Frequency and Percentages of Rating Changes between Day 1 and Day 3 for Each Symbol.

Stimuli			Rating changes between Day 1 and Day3 (percentage)		
#	Blissymbol	English	Increase	Consistent	Decrease
5		Glass	5 (22.73)	15 (68.18)	2 (9.09)
6		Table	7 (31.82)	14 (63.64)	1 (4.55)
7		Toothbrush	9 (40.91)	13 (59.09)	0 (0.00)
8		Eye	3 (13.64)	11 (50.00)	8 (36.36)
9		Fork	4 (18.18)	15 (68.18)	3 (13.64)
10		Curtains	5 (22.73)	16 (72.73)	1 (4.55)
11		Teeth	9 (40.91)	8 (36.36)	5 (22.73)
12		Moon	2 (9.09)	19 (86.36)	1 (4.55)
13		Scissors	7 (31.82)	14 (63.64)	1 (4.55)
14		Enter	5 (22.73)	14 (63.64)	3 (13.64)
15		Girl	4 (18.18)	12 (54.55)	6 (27.27)
16		Soup	8 (36.36)	10 (45.45)	4 (18.18)
17		Heart	4 (18.18)	16 (72.73)	2 (9.09)
18		Question	3 (13.64)	18 (81.82)	1 (4.55)
19		Fall	7 (31.82)	9 (40.91)	6 (27.27)
20		Hear	4 (18.18)	13 (59.09)	5 (22.73)
21		Alike	5 (22.73)	14 (63.64)	3 (13.64)
22		Black	10 (45.45)	8 (36.36)	4 (18.18)
23		Room	9 (40.91)	8 (36.36)	5 (22.73)
24		Careful	5 (22.73)	10 (45.45)	7 (31.82)
25		Cheese	8 (36.36)	11 (50.00)	3 (13.64)
26		Bring	2 (9.09)	12 (54.55)	8 (36.36)
27		Foot	8 (36.36)	11 (50.00)	3 (13.64)
28		Toilet	5 (22.73)	12 (54.55)	5 (22.73)
29		Flower	7 (31.82)	15 (68.18)	0 (0.00)
30		Pants	9 (40.91)	11 (50.00)	2 (9.09)
31		Sneeze	8 (36.36)	11 (50.00)	3 (13.64)
32		Grandmother	9 (40.91)	9 (40.91)	4 (18.18)
33		Policeman	6 (27.27)	15 (68.18)	1 (4.55)
34		Elbow	5 (22.73)	12 (54.55)	5 (22.73)
35		Food	8 (36.36)	13 (59.09)	1 (4.55)
36		Chop	6 (27.27)	12 (54.55)	4 (18.18)
37		House	5 (22.73)	16 (72.73)	1 (4.55)
38		Animal	8 (36.36)	12 (54.55)	2 (9.09)
39		Bird	8 (36.36)	12 (54.55)	2 (9.09)
40		Pig	7 (31.82)	12 (54.55)	3 (13.64)
41		Living-room	6 (27.27)	9 (40.91)	7 (31.82)
42		Money	8 (36.36)	11 (50.00)	3 (13.64)
43		Hold	9 (40.91)	10 (45.45)	3 (13.64)
44		Swimming pool	5 (22.73)	10 (45.45)	7 (31.82)
Mean			252 (28.64)	493 (56.02)	135 (15.34)

Cognitive flexibility is required to identify more perceptual similarities of symbols to their referents over time; the children with autism in the current study may not have had this flexibility. Due to the link between translucency and learnability, the ability of students to perceive more resemblances over time could be particularly important in predicting ease of symbol learning for communication.

The instructions used in the study (i.e., the verbal labelling of the symbols), provided the referent for the graphic symbol explicitly, but there was no additional explanation of the symbol or context provided. The top-down information provided may have helped the participants integrate the graphic features of the symbol with the mental or cognitive representations of the referent stored in their memories. Although there is conflicting evidence in the literature on the top-down processing of children with autism (e.g., Bowler, Gardiner, Grice, & Saavalainen, 2000; Lopez & Leekam, 2003), Müller and Nussbeck (2008) confirmed the positive role that labelling has on the development of conceptual relations between symbols and referents. Although they specifically referred to the labelling of objects and the association between the label and the object, the labelling of a symbol may also have a similar effect, as it may evoke the map of cognitive representations attached to a concept and so facilitate perception of overall resemblances between symbol and referent; however, change may be gradual, as suggested by the differences in frequency of responses to the different Likert scale items (not at all like, a little like, a lot like, and exactly like) over time. These changes culminated in a statistically significant difference in overall ratings of the Blissymbols between Day 1 and Day 3, but not in the ratings of specific symbols. Perhaps the time period of the study was too short; with further time and an increased number of exposures perhaps the participants would have more fully developed the association between individual symbols and their referents and would have perceived greater similarities.

Discussion of Specific Symbols

The participants' ratings of individual symbols between Days 1 and 3 are discussed in this section by focusing first on the nature of the consistent ratings of symbols followed by the increases (gains) and decreases in translucency ratings for specific symbols over the 3 days.

Consistency in Ratings over Day 1 and Day 3. From Table IV, it is evident that the majority of the Blissymbols were rated the same on Day 1 and Day 3; thus, the majority of the participants did not see any increase in similarity between the symbols and referents for these symbols over Days 1 and 3. The symbols with the highest consistency (i.e., more than 60% of participants rated them consistently at Day 1 and Day 3) were moon (86%), question (82%), curtains (73%), heart (73%), house (73%), glass (69%), fork, (68%), flower (68%), policeman (68%), table (64%), scissors (64%), enter (64%) and alike (64%). The lowest consistency in ratings (i.e., less then 40% of participants rated them consistently) were for symbols representing teeth (36%), black (36%) and room (36%); for these three symbols, more than 40% of the participants increased their translucency ratings from Day 1 to Day 3.

It is important to point out that the specific Likert ratings representing the consistency between Day 1 and Day 3 were not the same for the symbols across participant; there was variability across the participants (see Supplementary Appendix B to be found online at http://informahealthcare.com/doi/abs/10.3109/07434618.2013.813967 for more detail on the consistency of the translucency ratings of the participants for each of the symbols). However, regardless of the specific Likert rating used, these students for the most part did not change their initial impression of the similarity between the symbol and the referent. The highest frequency of consistency in relation to a specific Likert rating (n = more than 10) was in the category of exactly like (for the symbols table, moon, heart, and question), with policeman being the only symbol consistently rated as not at all similar to the referent.

Increase and Decrease of Translucency Ratings over Days 1 and 3. Table IV shows that the highest percentages of gains in translucency ratings for specific symbols between the days were between (a) 40–45% for black (45%), room (41%), teeth (41%), toothbrush (41%), pants (41%), grandmother (41%) and hold (41%); and (b) 31–36% for cheese (36%), foot (36%), food (36%), animal (36%), bird (36%), money (36%), pig (32%), flower, (32%), sneeze (32%), table (32%), fall (32%), scissors (32%), and soup (36%).

The highest percentage of decrease on ratings between Days 1 and 3 were between (a) 32– 36% for eye (36%), bring (36%), living room (32%), careful (32%), and swimming pool (32%); and (b) 22–27%: girl (27%), fall (27%), hear (23%), room (23%), toilet (23%), elbow (23%), teeth (23%). Symbols in common between the highest increase and decrease listings were fall, room and teeth. Clearly there was variability across the participants not only in their ratings, but also in the direction of the changes in ratings over time for some symbols. The reasons for the increase and decrease in ratings on the same symbols are difficult to ascertain. One can speculate that perhaps the perceptual orientation of the children on that day (e.g., less attention to specific detail) might have contributed to the outcome, or that other intrinsic variables may have come into play. It is interesting to speculate whether alternative AAC symbols (e.g., more dynamic visual image of the referent) might have contributed to greater consistency or to more variable rating outcomes. Future research is required to investigate this issue.

The Impact of the Task

Overall translucency ratings of the symbols did increase significantly between Day 1 and Day 3, albeit with a medium effect size. This finding supports the notion that the participants reported increased similarity between the symbols and their referents overall after repeated exposures. Cognitive flexibility in the perceived similarities between some symbols and referents was thus displayed in the changes in the ratings of the participants. However, it is equally important to take note of the high number of symbol ratings (56%) that remained consistent over Days 1 and 3.

It is important to reflect on the nature of the task and its potential impact on the participants' performance. The task used in the current study required participants to first identify similarities between the symbol and the referent (e.g., showing the symbol for *ROOM* and stating *This is a room*) and then to rate the level of resemblance to the Likert scale items by indicating whether it looked not at all like, a little like, a lot like, or exactly like the referent. To complete the task, participants had to focus on creating an association between the label and the referent for a sufficient amount of time, to allow them to make a judgement in relation to the level of resemblance between the two. Although the pretest was intended to ensure that the participants understood the task and were able to complete the rating, it is possible that the complexity of the task (the combination of the two steps) led to participants' not spending sufficient time to focus on the association between the label and the referent before making the judgement. Littlejohn (2007, p. 4), for example, referred to "peripheral processing" in explaining the treatment of information (message) in an uncritical (more fleeting) way. This type of peripheral processing results in more superficial interconnections between propositions and is less likely to effect change in contrast to "central processing" which evaluates information in a more elaborate and critical way. Although the latency period between questions did allow participants time to re-orient before responding to the next item, the combination of a two-step process into one instruction could have impacted participants' performance on the task.

Implications for Practice

In this study, children with moderate levels of autism showed a statistically significant difference in translucency ratings of Blissymbols overall between Day 1 and Day 3 (medium effect size). However, more than half of the participants' ratings were consistent for Day 1 and Day 3, with participants maintaining their initial ratings despite repeated exposure to the symbols. This consistency in translucency ratings has implications for practice because it could allude to a persistence in maintaining first impressions of visual symbols, which might impact quite negatively on the learning of new symbol meanings. Although there was an overall increase in translucency ratings, these differences did not reflect increases in the ratings of specific symbols. In comparing these findings to those of the Bornman et al. (2009) study, the children with autism in the present study tended to rate the translucency of Blissymbols lower; they saw fewer similarities between the symbols and their referents overall than did their typically developing peers.

The results of this study have important implications for practice. Although children with moderate autism reported more resemblances between graphic symbols (Blissymbols) and their referents over time, these increases did not extend to the associations between specific symbols and their referents. Ease of learning of graphic symbols might therefore be slower for children with autism than for their typically developing peers with more dependence on direct instruction. Although there was variability among the participants in relation to the specific translucency ratings allocated to symbols, the consistency with which the ratings were maintained for many of the symbols by many of the participants over Days 1 and 3 was noteworthy. Therefore, additonal effort may be required to assist students with autism to acquire the meaning of new symbols.

Limitations and Recommendations for Further Research

Although this study provides preliminary information that may assist in planning symbol instruction for children with autism, there are a number of limitations that must be considered, as well as a number of recommendations for further study to advance understanding.

In order to ensure they would be able to comply with requirements of the task, all of the participants in the study had to have a mental age of between 6 and 8 years. Because they were also able to speak, the findings of this study cannot be generalized to children with autism who have little or no functional speech. It would be important to replicate this study with children with moderate to severe autism and who are unable to speak. In addition, this study used the DSM-IV for the diagnosis of autism. As children with autism are a heterogeneous group, the additional use of the ADOS (Lord, Rutter, DiLavore, & Risi, 2002) and comprehensive assessment of receptive language skills could provide further insights into potential differences in language, cognition, and visual perception between subgroups of children with autism that may impact translucency ratings and, ultimately, symbol learning.

The comparison between the findings of this study and those of Bornman et al. (2009) suggests potential differences between how typically developing children and those with moderate autism rate translucency of symbols. Investigations focused on the response time of individuals for each item could add valuable evidence regarding information processing and potential differences in their orientation to the task. Breaking down the instructions used in the study, by encouraging participants to focus first on the association between the label and the referent before judging the level of resemblance, might further illuminate findings.

Statistically significant differences in translucency ratings between Day 1 and Day 3 were noted. However, these differences reflected overall changes, not increases in the ratings of specific symbols. The nature of these overall changes in translucency ratings is nevertheless important in deepening understanding of how children with autism relate to graphic symbols over time. Future research is required to elucidate these effects. This study showed a high number of consistent ratings of individual symbols over Day 1 and Day 3. Although there were some increases and decreases in the ratings of symbols by the participants, it is difficult to understand in more depth, the reasons for these changes. More systematic analyses of the visual characteristics of symbols (bottom-up characteristics), together with contextual and experiential factors (top-down features), must be conducted in order to analyze the changes in translucency ratings over time.

The current study used Blissymbols because of the minimalistic nature of these symbols; it is possible, however, that this could have impacted results. Replication of the study using other types of graphic symbols (e.g., symbols with more visual cues) could be important to further illuminate the process of translucency rating by children with autism. A study aimed at exploring the number of exposures necessary per symbol to reach a plateau in translucency ratings could yield important additional information relevant to symbol learning in children. It may be of interest to further investigate performance with Blissymbols as well, as these symbols allow the investigation of participants' ability to use and combine symbol elements generatively so as to derive new symbol meanings. For example, a more systematic selection of Blissymbols, obtained by identifying specific semantic elements in different combinations, could facilitate further understanding of how children with autism extract semantic rules from visual symbols.

In the current study, pre-training was provided to ensure participants understood the Likert scale. This training included the use of symbols in various stages of completeness (see Supplementary Appendix A to be found online at http://informahealthcare.com/doi/abs/10.3109/07434618.2013.813967) to refer to the different points on the Likert scale. However, there is a difference between complete and incomplete symbols as used in the pre-training and the degree of similarity (likeness) as used in this study. Although it may be unlikely that this mismatch in tasks influenced the outcomes of this study, a closer approximation between the pre-training task and the actual translucency task would be desirable.

Finally, a systematic replication of this study using comparative groups of participants with autism, intellectual disabilities, and typical development could be most revealing in highlighting similarities and differences in translucency ratings between these populations.

Acknowledgements

The authors would like to thank the Unica School for Children with Autism for their willingness to participate and support this study. Rina Owen's assistance with the statistical analysis of this study is acknowledged with gratitude.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Financial assistance for this study from the National Research Foundation (NRF) in South Africa is also hereby acknowledged. Opinions expressed in this article is that of the authors and do not represent policy of the NRF.

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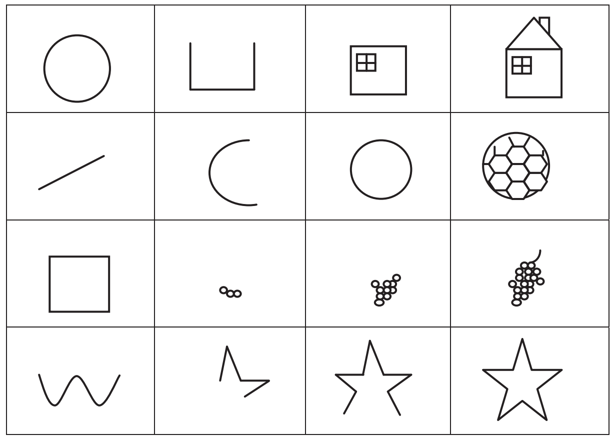
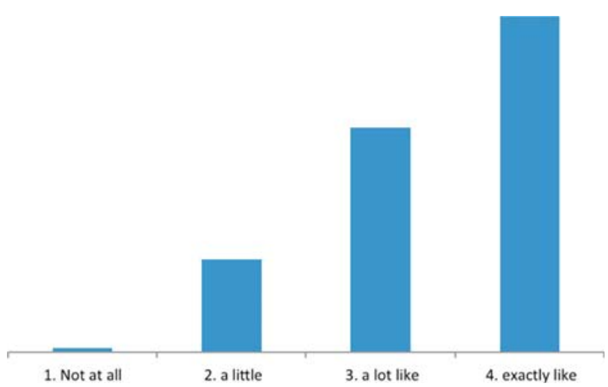
Supplementary material for Alant E et al. Translucency Ratings of Blissymbols over Repeated Exposures by Children with Autism. Augmentative and Alternative Communication, 2013;29(3):272–283.

Supplementary Appendix A. Visual Overlay for training and the Likert scale items: *not at all like*, a *little like*, *a lot like*, *exactly like*.





Supplementary Appendix B. Rating Consistency over 3 Days for Each Symbol.

Stimuli			Number of consistent choices over 3 days					
#	Blissymbol	English	Not at all	A little like	A lot like	Exactly like	Total	Percentage
5		Glass	0	2	5	5	12	54.55
6		Table	0	2	1	10	13	59.09
7		Toothbrush	6	1	1	2	10	45.45
8		Eye	0	1	1	6	8	36.36
9		Fork	0	0	1	9	10	45.45
10		Curtains	1	0	3	9	13	59.09
11		Teeth	2	2	0	2	6	27.27
12		Moon	0	1	1	17	19	86.36
13		Scissors	2	0	4	1	7	31.82
14		Enter	1	0	1	7	9	40.91
15		Girl	2	3	2	0	7	31.82
16		Soup	0	2	4	2	8	36.36
17		Heart	0	0	2	12	14	63.64
18		Question	0	0	2	14	16	72.73
19		Fall	3	1	0	3	7	31.82
20		Hear	1	0	2	5	8	36.36
21		Alike	3	3	1	6	13	59.09
22		Black	6	1	0	1	8	36.36
23		Room	3	2	0	0	5	22.73
24		Careful	4	0	1	1	6	27.27
25		Cheese	2	5	1	1	9	40.91
26		Bring	2	0	1	3	6	27.27
27		Foot	4	2	1	2	9	40.91
28		Toilet	3	4	0	1	8	36.36
29		Flower	2	7	0	0	9	40.91
30		Pants	6	1	1	0	8	36.36
31		Sneeze	6	0	0	4	10	45.45
32		Grandmother	4	0	2	0	6	27.27
33		Policeman	12	0	0	0	12	54.55
34		Elbow	3	1	3	1	8	36.36
35		Food	9	1	0	0	10	45.45
36		Chop	6	1	0	3	10	45.45
37		House	0	6	3	2	11	50.00
38		Animal	9	1	0	0	10	45.45
39		Bird	5	4	0	0	9	40.91
40		Pig	4	3	2	1	10	45.45
41		Living-room	0	2	0	2	4	18.18
42		Money	3	1	1	5	10	45.45
43		Hold	6	1	0	1	8	36.36
44		Swimming pool	3	1	1	2	7	31.82