The Effect of Augmented Input on the Auditory Comprehension of Narratives for People with Aphasia: A Pilot Investigation

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Abstract

Augmented input is the strategy of supplementing expressive language with visuographic images, print, gestures, or objects in the environment. The goal of augmented input is to facilitate comprehension of spoken language. The purpose of this study was to evaluate the relative effectiveness of two different augmented input conditions in facilitating auditory comprehension of narrative passages in adults with aphasia. One condition involved the communication partner (clinician) of the adult with aphasia actively pointing (AI-PP) out key content words using visuographic supports. The second condition involved no active pointing (AI-NPP) by the communication partner (i.e., attention was not drawn to the visuographic supports). All 12 participants with aphasia listened to 2 narratives; 1 in each condition. Auditory comprehension was measured by assessing participants' accuracy in responding to 15 multiple-choice cloze-type statements related to the narratives. Of the 12 participants, 7 gave more accurate responses to comprehension items in the AI-PP condition, 4 gave more accurate responses in the AI-NPP condition, and 1 scored the same in both conditions. These differences were not statistically significant ($p > .05$). Communication-partner-referenced augmented input using combined high-context and PCS symbol visuographic supports improved response accuracy for some participants. Continued research is necessary to determine partner involvement with and frequency of augmented input that improve auditory comprehension.

Keywords: AAC; Aphasia; Augmented input; Comprehension; Narratives; Written-choice communication strategy.

Introduction

The communication needs of people with aphasia are wide-ranging and often complex (Jacobs, Drew, Ogletree, & Pierce, 2004), and may persist despite therapy (LaPointe, 2011). People with aphasia face a number of communication challenges that include “comprehending what others say, creating ideas, retrieving words and sentence structures, or executing the motor movements to speak” (Garrett & Lasker, 2013, p. 405). These challenges inhibit participation in communicative exchanges with others (Beukelman, Hux, Dietz, McKelvey, & Weissling, 2015; Carlsson, Hartelius, & Saldert, 2014) and in desired vocational roles. Involvement in decision-making may also be reduced (Wallace & Bradshaw, 2011). Impairments in auditory comprehension are distinct challenges for people with aphasia and can contribute toward feelings of frustration and increased dependence on caregivers (Wallace, Dietz, Hux, & Weissling, 2012). People with aphasia may need communication supports to foster increased comprehension and to promote effective participation in communicative interactions (Wallace et al., 2012).

Augmented input refers to any linguistic, visual, or other communication supports employed by the communication partner to facilitate message comprehension in a person with receptive spoken language impairment such as aphasia. These strategies may increase the saliency of the information presented (Garrett & Huth, 2002; Garrett & Lasker, 2013; Wallace et al., 2012). Wallace et al. (2012) argued that the use of augmented input provides information redundancy; hence, it reduces the cognitive load required to do a task and activates prior stored knowledge, all to improve auditory comprehension. Augmented input provides the necessary context for people with aphasia to extract essential information that is needed to successfully comprehend auditory input (Wallace et al., 2012). Augmented input strategies include (a) the communication partner’s use of written words, gestures, or visuographic images, such as line drawings or photographs to enhance comprehension of the topic/message (Garrett & Lasker, 2013; Griffith, Dietz, & Weissling, 2014; Wallace et al., 2012); (b) supports for auditory and reading comprehension; and (d) the involvement of communication partners.

Augmented input is included as one element of the communication partner strategy, Written-choice Communication Strategy. The Written-choice Communication Strategy is a conversational technique in which the communication partner provides the person with aphasia written-word choices to support their expressive communication (Garret & Beukelman, 1995; Lasker, Hux, Garrett, Moncrief, & Eischeid; 1997). This strategy includes the employment of augmented input, in that the communication partner provides written keywords while simultaneously providing spoken language. Previous research by Garrett and Huth (2002) and Lasker et al. (1997) supports the effectiveness of Written-choice Communication Strategy using augmented input in facilitating expression of intended messages.

In addition to the Written-choice Communication Strategy, visuo-graphic images have also been shown to increase auditory and reading comprehension accuracy in people with aphasia. These images may have high, low, or no contextualization and may differ in terms of level of personalization (Dietz, Hux, McKelvey, Beukelman, & Weissling, 2009; McKelvey, Hux, Dietz, & Beukelman, 2010; Wallace et al., 2012). High-context photographs are visuographic images that “depict situations, places or experiences that clearly represent relationships and interactions among important people or objects” (Hux, Buechter, Wallace, & Weissling, 2010, p. 644). Low-context images primarily identify people or objects in an appropriate environment setting without interaction between the subject of the image and the environment. No-context images, however, depict isolated people or objects against a neutral background. It is argued that high-context images (i.e., containing contextually rich information) improve comprehension for individuals with aphasia because they lessen the resource allocation and working memory demands placed on these individuals (Wallace et al., 2012). Images with little contextual information necessitate the formation of additional content to explain or understand the associated event and relationship. High-context images rely on visuo-cognitive abilities and autobiographical memory rather than on linguistic processing skills as the foundation of message representation (Beukelman et al., 2015). The former skills are usually preserved in people with aphasia (McKelvey et al., 2010). High-context images, in contrast to no- and low-context images, are believed to enable people with aphasia to better understand the messages conveyed, while also providing a basis for establishing a shared communication space between the individual and his or her communication partners (Beukelman et al., 2015).

The use of high-context photographs is also beneficial in augmented input to support reading comprehension. Dietz et al. (2009) reported that these photographs facilitated the comprehension of narratives in people with non-fluent aphasia, as determined by the response to questions that test concrete and inferential content within each passage. In a follow-up study, Dietz, Knollman-Porter, Hux, Toth, and Brown (2014) confirmed the effectiveness of photographs in enhancing reading comprehension in people with aphasia. Indeed, their findings contradicted results reported by Rose, Worrall, Hickson, and Hoffman (2011), who reported that participants with aphasia performed comparably on reading-comprehension tasks with no visual support and with visual supports comprising photographs or line drawings. The differences may have been due to methodological differences across the studies. For example, Rose and colleagues (2011) examined comprehension of sixth grade-level passages, whereas Dietz et al. (2009) used second grade-level passages.

Brennan, Worrall, and McKenna (2005) explored the effects of aphasia-friendly formatting on the reading comprehension of people with aphasia and investigated whether aspects of these formats used in isolation improved reading comprehension. Brennan et al. confirmed that people with aphasia comprehend aphasia-friendly paragraphs with significantly more accuracy than paragraphs without such formatting. Although the participants comprehended significantly more paragraphs when a simplified vocabulary, large print, and large white spaces were used. No significant differences were found between paragraphs with and without pictures, although the pictures used in Brennan et al. used iconic symbols as visuo-graphic supports. Although transparent, iconic symbols may be more opaque in meaning than photographs and hence provide less context to the meaning of the paragraph (Dada, Huguet, & Bornman, 2013).

In summary, the use of augmented input strategies during comprehension tasks may increase information redundancy, thereby enabling people with aphasia to better comprehend the information (Wallace et al., 2012). Previous studies have primarily focused on evaluating effectiveness of augmented input strategies on reading comprehension rather than on auditory comprehension (Dietz, Ball, & Griffith, 2011; Dietz et al., 2014). These supports are similar to the supports used for auditory comprehension and aim to provide redundancy of content (Dietz et al., 2011; Dietz et al., 2014). Thus, determining the type, condition, communication partner involvement, and amount of visuographic support that facilitates auditory comprehension in people with aphasia is important for advancing evidence-based intervention for this group. Accordingly, the purpose of this study was to evaluate the relative effectiveness of two different augmented input conditions in facilitating auditory comprehension of narrative passages in adults with aphasia. One condition involved the communication partner (in this study a clinician) actively pointing (AI-PP) to key content words using visuographic supports. The second condition involved no active pointing (AI-NPP) by the communication partner (i.e., attention was not drawn to visuographic supports).

Method

Participants

Purposive sampling was used to recruit and select the participants, using two methods: (a) contacting private speech-language pathologists who specialize in the treatment of aphasia, and (b) contacting a non-governmental organization that offers stroke support groups. The following pre-determined criteria was used to select participants with: (a) aphasia secondary to a left cerebral vascular accident; (b) mild-moderate auditory comprehension difficulty as determined by a score of 4 or above on the auditory-verbal comprehension subtest of the Western Aphasia Battery (WAB) (Kertesz, 1982); (c) aphasia for a minimum of 6 months post-incident; (d) English language proficiency; (e) no history of language or cognitive disability prior to cerebral vascular accident (CVA); (f) normal or corrected vision and hearing; and (g) the ability to answer questions using the Written-choice Communication Strategy Screening Test (Garrett & Beukelman, 1995) with 100% accuracy. Visual perceptual skills were assessed using a cancellation task in which participants were required to scan 10 words and cross out a word each time it appeared.

Approval for the study was obtained from the ethics committee of the University of Pretoria. Written permission was obtained from private speech therapy practices and from a non-governmental organization. To ensure that people with aphasia had the opportunity to give informed consent, the information was written with aphasia-friendly principles in mind and included visual aids to enhance understanding. The communication partner was present to

Table 1

Participant Descriptions

Participant	Age	Gender	Education	Months post CVA	Comprehension score	WAB classification	WAB Aphasia Quotient
1	89	Female	< Grade 9	6	6.3	Mild Broca's aphasia	52.2
2	59	Male	Grade 11	10	8.25	Mild Broca's aphasia	69.5
3	59	Male	Undergraduate degree	45	6.45	Mild Broca's aphasia	60.7
4	36	Male	Grade 12	11	8.1	Severe Broca's aphasia	25
5	54	Male	Undergraduate degree	43	6.25	Mild Broca's aphasia	62.1
6	76	Male	< Grade 9	93	7.2	Moderate conduction aphasia	49.4
7	73	Female	< Grade 9	27	5.5	Moderate Broca's aphasia	38.6
8	47	Male	Postgraduate degree	23	7.65	Mild Broca's aphasia	60.1
9	53	Female	Grade 12	7	8.95	Moderate Broca's aphasia	47.5
10	67	Male	Postgraduate degree	27	6.15	Moderate Broca's aphasia	36.3
11	68	Male	Undergraduate diploma	155	5.45	Moderate Broca's aphasia	44.7
12	86	Female	Grade 12	16	8.65	Mild anomic aphasia	84.1

Note. CVA = Cerebrovascular accident; WAB = Western Aphasia Battery.

observe the person with aphasia giving informed consent and was requested to verify that he or she understood the study and had given consent without being coerced (Penn, Frankel, Watermeyer, & Muller, 2009). Once consent was given by both the individual with aphasia and his or her partner, 16 individuals were screened to determine if they met the pre-determined selection criteria. Only 12 participants met the inclusion criteria, and information about participants is presented in Table 1.

Materials

Narratives. The two narratives used in the study (The Lost Wallet and The Lost Dog) were developed and balanced for equivalence by Wallace et al. (2012). Each narrative contained five active-voice sentences, two main characters, a problem, and a solution. The narratives were balanced for number of words (75) and Flesch-Kincaid grade level (range: 5.2–5.5). Minor changes were made to vocabulary for the narratives to be culturally appropriate for the South African population. For example, the word “purse” was replaced with the word “handbag” to ensure that the participants were familiar with the terminology. An example of the original narrative is available in Wallace et al. (2012).

High-context images. Two high-context photographs from Wallace et al. (2012) associated with each narrative were used as pre- and during-task stimulation. The color photographs were non-personalized in nature and appeared on a laminated sheet of paper. Each photograph measured 13.5 x 10.5 cm.

No-context images. Three speech-language pathologists independently read each narrative and devised a list of content words that consisted of nouns, verbs, and “others” (adjectives, prepositions, and question words). Of the 75 words in each narrative, 33 words from Narrative 1 and 38 words from Narrative 2 were identified as content words. A total of 70% of the content words from each narrative were represented using the no-context Picture Communication Symbols[1] (PCS) images that were selected as they are widely used in the South African context (Dada, Murphy, & Tönsing, 2017). The percentage of content words depicted using PCS was based on the work by Dada and Alant (2009), who found that, for children with little or no functional speech, augmented input provided at 70% improved comprehension of target vocabulary items. A total of 24 color PCS images for each narrative were selected from the Boardmaker Online[2] library. The final images appeared in color on a laminated sheet, with 12 images per page and each image measuring 6 cm x 4.5 cm. Some images were used more than once within a single story. Figure 1 shows an example of the PCS images.

Figure 1. Example of no-context PCS images

Comprehension items. The comprehension items used the Written-choice Communication Strategy (Garrett & Beukelman, 1995), in which 15 cloze-type statements with four response options associated with each narrative (e.g., Ms. White was in (a) book store; (b) grocery store; (c) clothing store; or (d) pharmacy) were used to assess participants' comprehension of the narrative. Participants pointed to the choice they deemed to be correct, and the researcher would then circle the answer indicated by the participant. These items were developed and used by Wallace et al. (2012). A passage dependency index was calculated for each narrative and its associated comprehension items (Wallace et al., 2012) to ensure that the items truly measured comprehension related to the particular narrative.

Procedures

Research design. A within-subject design was used to determine the relative effects of the two augmented input conditions on participants' auditory comprehension of the narratives. This design allows for each participant to be exposed to every condition in the experiment (Barlow & Hayes, 1979; Charness, Gneezy, & Kuhn, 2012; Schlosser et al., 2013). Counter-balancing by means of alternation of the narratives and conditions was done to control for order and carryover effects (Barlow & Hayes, 1979).

First, the participants were shown a high-context photograph and the no-context PCS images as pre- and during-task stimulation. The researcher informed the participant that the images gave some information about the narrative that was about to be read. The pre-task stimulation lasted one min. to ensure consistency of exposure to the task across participants. Both the high and no-context PCS images remained in front of the participant during the reading of the narrative as during-task stimulation in both the AI-PP and the AI-NPP conditions. The researcher read the first narrative twice at a similar rate. During the AI-PP condition, the researcher simultaneously read the narrative and pointed to the corresponding no-context PCS images, which represented 70% of the content words in each narrative. During the AI-NPP condition, the researcher did not point to the no-context PCS images while reading the narrative; however, both the high-context and no-context PCS images were still available for the participant.

After the researcher had completed the narrative reading, the comprehension items were introduced. The researcher read each comprehension item aloud twice, and simultaneously pointed to each of the response options. The participants indicated their response by either pointing to the desired option or saying the option aloud. The researcher repeated the participant's choice and then circled it before moving on to the next comprehension item. After completion of all 15 of the comprehension items related to the narrative, the researcher removed the items and the high-context and the no-context PCS images from the table before commencing with the next narrative.

Procedural integrity. The researcher read from a script and used a checklist when conducting the experiment to reduce discrepancy across participants. The experimental tasks were video recorded (Schlosser, 2002). A postgraduate therapist viewed 40% of the video recordings and evaluated the treatment integrity in the two conditions of using the treatment integrity checklist and the script. Procedural integrity (McMillan & Schumacher, 2010), expressed as a percentage, was calculated by dividing the number of correct steps by the total number of steps (130) and multiplying by 100. Procedural integrity was high, at 98.5%, indicating good procedural consistency (McMillan & Schumacher, 2010).

Data collection reliability. Data from the biographical questionnaire, the WAB, and comprehension items were captured on a Microsoft Excel© spreadsheet. A research assistant was asked to independently code and transfer 30% of the data into a Microsoft Excel© spreadsheet, yielding 100% agreement.

Results

The results of the study are presented according to (a) accuracy of responses during the AI-PP and the AI-NPP conditions, and (b) comparisons between the AI-PP and AI-NPP conditions.

Accuracy of Responses in the AI-PP and AI-NPP conditions

In the AI-PP condition, participants obtained an average response accuracy of 65.56%, and in the AI-NPP condition they obtained an average response accuracy of 56.67%. The response accuracy scores during the AI-PP condition ranged from 4 to 14 ($M = 9.83$, $SD = 3.38$), while the response accuracy in the AI-NPP condition ranged from 2 to 13 ($M = 8.50$, $SD = 3.18$). Participants obtained an average response accuracy of 61.11% across both narratives and conditions ($M = 9.16$, $SD = 3.28$). Figure 2 illustrates individual participant performance across both conditions. Of the 12 participants, seven (Participants 1, 2, 3, 4, 7, 8, and 10) received higher accuracy scores in the AI-PP condition, four (Participants 5, 6, 9, and 11) received higher accuracy scores in the AI-NPP condition, and one (Participant 12) obtained the same scores in both conditions.

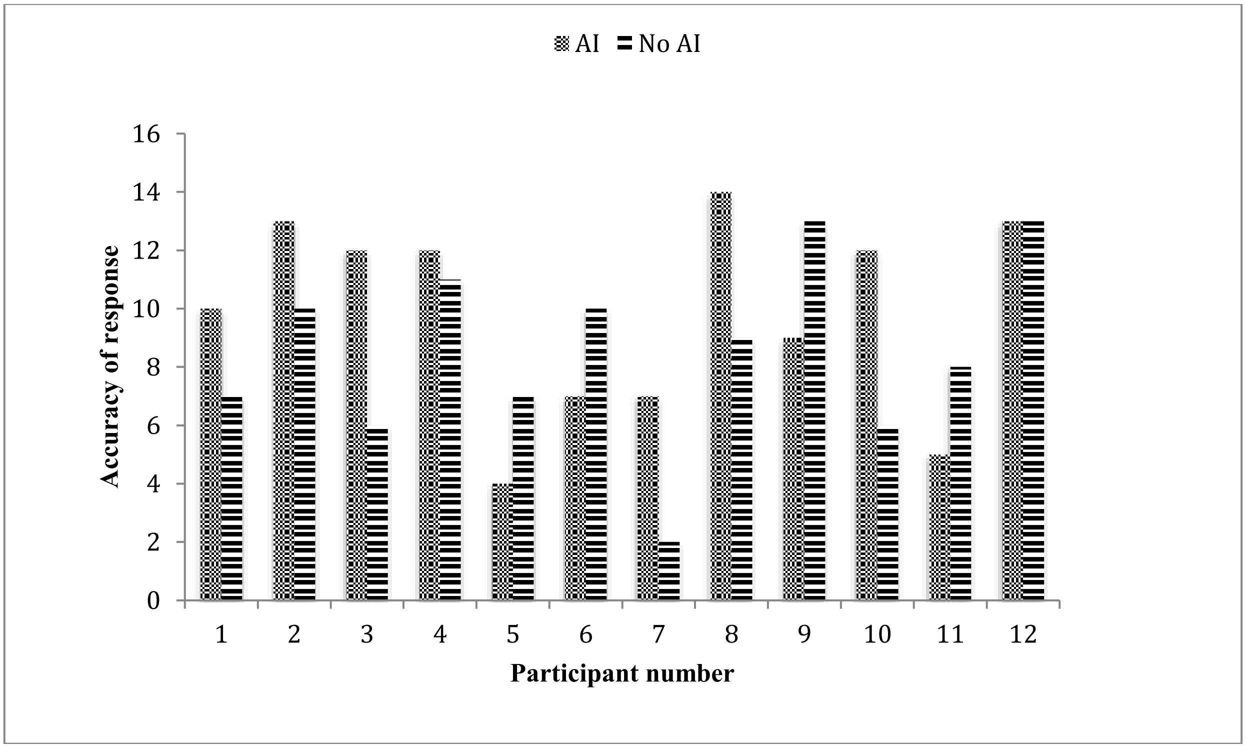

Figure 2. Individual participant performance across both conditions

During the AI-PP condition, Participants 5, 6, 7, 9, and 11 (*n*=5) had accuracy scores below the mean, and Participants 1, 2, 3, 4, 8, 10, and 12 (*n*=8) had accuracy scores above the mean. Participant 8 had the most accurate responses for the AI-PP condition; Participant 5 had the least accurate responses. Both of these participants had mild Broca's Aphasia; however, Participant 5 had a lower score on the auditory verbal comprehension subtest of the WAB than Participant 8. Those participants who scored below the mean for the AI-PP condition had moderate aphasia, except for Participant 5, who had mild aphasia. Those who scored above the mean had differing severities of aphasia: five with mild aphasia, one with moderate aphasia, and one with severe aphasia.

Comparison between the AI-PP and AI-NPP Conditions

For the AI-NPP condition, Participants 1, 3, 5, 7, 10, and 11 (*n*=6) had accuracy scores below the mean; and Participants 2, 4, 6, 8, 9, and 12 (*n*= 6) had accuracy scores above the mean. Participants 9 and 12 had the highest number of accurate responses during the AI-NPP condition; and Participant 7 had the lowest. Participant 9 and 7 had moderate Broca's Aphasia, and Participant 12 had mild Anomic Aphasia. Participant 7 had the second-lowest overall score on the auditory-verbal comprehension subtest of the WAB and also scored the lowest number of accurate responses in both conditions, as well as among all participants. Of the participants who scored below the mean during the AI-NPP condition, three had mild aphasia and three had moderate aphasia, while those who scored above the mean had differing severities of aphasia (three with mild aphasia, two with moderate aphasia, and one with severe aphasia).

A paired *t* test was run to rule out the order effect as half of the participants received the AI-PP condition first followed by the AI-NPP condition and the other half received the experimental conditions in the reverse order. Results indicated that there was no significant order effect ($t_{(11)} = -.498$, $p > .05$) indicating that presentation order had no effect on the performance of the participants. The means for the first and second experimental conditions were 8.83 (*SD* = 2.79) and 9.41 (*SD* = 3.72) respectively. Another paired *t* test was conducted to compare the relative effect of the two augmented input conditions on auditory comprehension. Results indicated no significant difference between the two conditions ($t_{(11)} = 1.201$). Although the mean scores on AI-PP condition were higher than on the AI-NPP condition, the differences were not statistically significant.

A regression analysis was conducted to determine whether the Aphasia Quotient (AQ) scores on the WAB (Kertesz, 1982) predicted response accuracy for the two experimental conditions. The results of the regression indicated that AQ scores did not predict response accuracy ($R^2 = .121$, F (2, 9) = .621, p >.05). Specifically, neither performance on AI-PP

(b =.157, p >.05) nor on AI-NPP (b = .808, p >.05) was a significant predictor of accuracy.

Discussion

This study presents a preliminary step in the investigation of how augmented input might facilitate auditory comprehension of narratives for people with aphasia. The findings of this study support and expand upon the results of Wallace et al., (2012) specifically providing additional information about communication partner/clinician emphasis during augmented input. The results of the study will be discussed in terms of (a) prior exposure to AAC, (b) different types of images, and (c) individual differences.

Prior Exposure to AAC

In this study, 71.43% of the participants who achieved higher accuracy scores in the AI-PP condition had exposure to AAC prior to the study. Approximately 50% participants who did not benefit from the AI-NPP had no exposure to AAC prior to the study. Of the seven participants (1, 2, 3, 4, 7, 8, and 10) who had a higher number of accurate responses to comprehension items in the AI-PP condition, five (2, 3, 7, 8, and 10) had prior exposure to AAC during their speech therapy intervention. This exposure may have contributed to these participants benefiting more from the communication partner emphasis of the no-context PCS images used as augmented input than those who did not have previous exposure to AAC. Prior exposure is not required for successful use of augmented input; however, it may result in immediate improvements in performance when introduced to augmented input. Additionally, prior exposure introduces the possibility that the participants had exposure to non-context PCS symbols, and thus had previous knowledge of the symbols used in this study. Linguistic competence was particularly important for the current study, as the participants would need to understand the language code of the AAC system (in this case the no-context PCS images used as augmented input) to effectively benefit from it (Light & McNaughton, 2014). Existing literature states that simply providing an AAC system does not make individuals competent communicators; detailed instruction and training are essential for successful understanding and implementation of any AAC device or system (Beukelman & Mirenda, 2013). Therefore, researchers and clinicians may need to consider the influence of any prior exposure to or instruction in the use of augmented input in determining the outcomes of implementation.

Use of Images

This study made use of two augmented input strategies that involved presenting high-context photographs and no-context PCS images simultaneously. During the experimental task, the high-context photographs were placed in front of the participants as pre- and during-task stimulation but were not referred to during the narrative reading and this might have impacted on the results of this study. Recent research suggests that high-context photographs improve both reading and auditory comprehension for some people with aphasia (Dietz et al., 2014; McKelvey et al., 2010; Wallace, Hux, Brown, Knollman-Porter, 2014). This is based on the notion that these images lessen the resource allocation and working memory demands placed on the individual with aphasia. The information is not only contextually rich but also adds to redundancy of the material, thereby allowing the person with aphasia to focus on interpreting the narrative rather than deciphering the words (Wallace et al., 2012). The high-context photographs also provide a basis for establishing a shared communication space between the individual and his or her communication partner (Beukelman et al., 2015). However, because the high-context images were not referred to during narrative reading, participants may not have sufficiently understood their potential benefits. As previously mentioned, existing literature suggests that detailed instruction and training (Wallace et al., 2012) are essential for successful understanding and implementation of any AAC device or system (Beukelman & Mirenda, 2013). Nonetheless, it is still possible that some participants in the current study used the information derived from images to support their comprehension.

Individual Participant Characteristics

In the present study, the participants' AQ scores on the WAB (Kertesz, 1982) did not predict their response accuracies for the two conditions. The results are similar to the findings from previous research (Brennan et al. 2005; Rose et al. 2011; Wallace et al. 2012) finding no significant differences between different supports and no relationship between performance patterns across the different conditions and independent variables such as aphasia severity. To determine a greater consistency in terms of which comprehension supports most benefit individuals with aphasia, research should aim to include participants with similar types and severity of aphasia (Dietz et al., 2014).

Clinical Implications

The present study revealed that supporting narrative auditory comprehension tasks with high-context images and no-context PCS images (pre-task and during-task) might facilitate improved auditory comprehension of narratives for some people with aphasia. The variability of participants' performance suggests that clinicians should carefully evaluate a variety of supports in different combinations of augmented input strategies before making recommendations for the communication partner. The unique contribution of this current study is the evaluation the potential benefits of using either one or two types of augmented input simultaneously (high context photographs and no-context PCS symbols) as well as considering communication partner involvement.

Overall, this study is a preliminary step in investigating how communication partner/clinician emphasis in augmented input can facilitate some improvements in auditory comprehension of narratives for people with aphasia. Participants with less severe auditory comprehension difficulties had a more accurate response overall than participants with more severe difficulties. Inferential statistics indicated no significant difference between the two conditions; however, the majority of participants (58.33%) had more accurate scores during the AI-PP condition.

Limitations and Future Directions

This study is limited by its small sample size of only 12 participants. Findings from previous studies (e.g., Dietz et al., 2009) also indicated that a small sample size and varied language skills may have contributed to lack of significance in the findings. Additionally, the strict selection criteria to target a very specific population of people with aphasia made participant recruitment a challenge. Therefore, the results of this study have limited generalizability and caution should be used in interpreting the results.

Repeating the study with a larger sample of adults and controlling for aphasia type and severity may assist in determining what forms of augmented input best support people with different types and severities of aphasia. The relationship of prior AAC exposure (i.e., specifically as prior exposure relates to strategies used within the study); time post-stroke to participants' performances; and the use of varied amounts of AI- PP to facilitate understanding of narratives also warrants further research. Studies using multiple baseline line design across various narratives would provide more nuanced information on the role of varied dosage levels of AI-PP on narrative comprehension.

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End Notes

[1] PCS is a product of DynaVox Mayer-Johnson, Sweden, www.dynavoxtech.com/company/

[2] Boardmaker is software product of Mayer-Johnson, USA, https://mayer-johnson.com/