



Evaluation of the Language Acquisition through Motor Planning (LAMP) program with children with autism spectrum disorders (ASD)

Autism Spectrum Australia (Aspect)
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Background

It is estimated that 30 to 50 per cent of individuals with an autism spectrum disorder (ASD) do not use functional speech (Peters & Gillberg, 1999; National Research Council, 2001). In order to address this difficulty, professionals working with children with ASD often introduce alternative and augmentative communication (AAC) strategies in order to optimise communication (Johnston et al, 2004).

It is estimated that 30 to 50 per cent of individuals with an autism spectrum disorder (ASD) do not use functional speech.

The National Standards Report recently produced by the National Autism Centre lists AAC as a treatment for ASD that is emerging and cannot be discounted as an effective treatment at this point in time (National Autism Centre, 2009). Yet although the use of AAC with individuals with ASD is becoming common practice, it is recognised that there is little quantitative data to support such treatments (Hill, 2006). Furthermore, researchers have indicated that there are still questions that need answering with regard to the effectiveness of using AAC with people with ASD (Mirenda, 2001; Schlosser & Blischak, 2001). This calls for more high quality research in the area.

The National Standards Report lists technology-based interventions for children with ASD as having emerging evidence. Some of the reasons that computerised AAC systems in particular are being considered as potentially beneficial for children with autism include:

- » the consistent voice output message produced, which possibly complements the preference that many children with autism have for sameness;
- » the visual nature of the communication system, which possibly complements the well documented preference of children with autism for visual information;

- » the physical method of prompting that can be used to assist a child to use the device, which potentially reduces the issue of overreliance on difficult to fade verbal prompts that are commonly described as a major barrier to spontaneous communication;
- » the clarity of the message produced, which possibly minimises the impact of unclear speech on a child with autism's communication partner.

The Language Acquisition through Motor Planning (LAMP) program (Halloran, 2012) is marketed as a program that develops communication for individuals with autism spectrum disorders through the use of high-tech alternative and augmentative strategies. While there are a number of programs that provide a specific set of guidelines for developing the communication of children with autism through low-tech AAC systems, such as Picture Exchange Communication System (PECS), LAMP is the only program that provides specific guidelines and teaching strategies for introducing high-tech AAC with children with autism.

The LAMP program is described as being particularly beneficial for children with autism, because of its heavy emphasis on motor planning. The use of consistent motor patterns is advantageous because it:

- » decreases the need to learn the meaning of a symbol: this is particularly important when only five per cent of words frequently used by toddlers are picture producers (Banajee et al., 2003);
- » results in more automatic and therefore faster communication over time (e.g. touch typing); and
- » reduces the cognitive demands associated with continually analysing and choosing from different symbol sets.

The LAMP program has been developed in association with the Prentke Romich Company (PRC). PRC developed the electronic communication devices that are utilised in the LAMP program. These devices are loaded with Minspeak software that was developed by Semantic Compactions Systems. Minspeak supports the use of consistent motor patterns through:

- » a small set of consistently located icons;
- » a large vocabulary that is accessible through short motor sequence;
- » a vocabulary that is expandable without changing motor patterns.

Aside from the unique use of the high-tech AAC device, the LAMP program incorporates many elements that are proven methods for increasing the communication of children with autism. These include following the child's lead; providing therapy when the child is in the optimal arousal zone; creating an opportunity for communication; establishing an interaction; and having a consequence for communication.

To date, there is very little rigorous evidence supporting the effectiveness of the LAMP program. A small scale research project was completed through Autism Spectrum Australia (Aspect) in October 2010, providing positive outcomes in the short time it was implemented. The current project sought to build on those results and extend the understanding of the theory and methodology and how this could be applied within the Aspect service context.

Aim

The aim of the current research was to assess the level of improvement and generalisation using the Vantage Lite with LAMP methodology, when implemented in the client's natural environments. The research also aimed to explore whether participation in the LAMP program led to improved communication behaviour in the sample of children with autism.

The aim... improvement and generalisation using the Vantage Lite with LAMP methodology, when implemented in the client's natural environments.

Participants

The participant group for this study comprised nine children in an Aspect early intervention or Aspect School setting, each of whom had a diagnosis of autism spectrum disorder.

Three of the children were involved in a Aspect Building Blocks early intervention program, while the remaining six attended an Aspect school (three at the Central Coast and three at the South Coast).

The participants were selected based on each therapist's professional judgement, taking into account other methods of intervention that had been previously trialled. Most of the children had a communication system in place, that may not have been used consistently or spontaneously (these included non-verbal or symbolic methods). In addition, consideration was given to the families' willingness to be trained and participate in the research. The children were aged between four and 12 years.

The participant group for this study comprised nine children in an Aspect early intervention or Aspect School setting.

All participants completed the intervention and follow-up, for the duration of the research, except for one family, who had a family emergency near the completion of the research. The data collected from this family's involvement has not been included in the results and data analysis, as post assessment and maintenance measures were not able to be completed.

Method

On selection of the nine children and families that would participate in the research, each family received individual training in LAMP and Minspeak theory, and practical training in using the Vantage Lite, provided by their speech therapist. Similar formalised training was also provided at the two participating schools for the teachers who were going to be involved in implementation of the research.

All therapists involved had previously attended 2 group and 1 individual training session, as well as receiving ongoing virtual training and support. Training was provided internally and externally, through 'The Centre for AAC and Autism' in the United States, and through Liberator Australia in Adelaide, who provided training in use of the Vantage Lite device, and ongoing technical support. Regular teleconferences were also completed throughout the research, to discuss and compare data among the therapists, troubleshoot difficulties that had arisen and plan and problem solve together.

The children were observed across two environments (home and school) over a period of 14 weeks in total.

Table 1: Organisation of the research

Week 1	Weeks 2 - 3	*Weeks 4 - 8	Weeks 9 - 10	Weeks 11 - 12	Weeks 13 - 14
Training	Pre-assessment	Implementation	Post-assessment	Maintenance measures	Maintenance period

* These weeks are represented as weeks 1-5 in the discussion and graphs below.

Baseline data, collected across home and school environments, consisted of:

- » Aspect Building Blocks Communication Checklists - expressive and receptive
- » Interests Inventory (LAMP specific)
- » LAMP Summary form (LAMP specific)
- » Parent/teacher questionnaire
- » Aspect Building Blocks Spoken Language Assessment
- » Sensory questionnaire (optional - to gather more information about the child's sensory needs).

Over the following five consecutive weeks, structured and non-structured sessions took place, teaching and implementing use of the Vantage Lite, using LAMP methodology.

The structured sessions involved structured teaching, including focus words, prompting, strategic movement onto next level (e.g. from one to two word phrases). The non-structured sessions were any other time the device was used in the child's natural settings to communicate. Prompting and vocabulary selection were still used in these sessions to maximise success and generalise outcomes.

A child led approach was used in all sessions, whether structured or unstructured, in accordance with the LAMP approach, with an aim to maximise motivation, and successful use of the device. For example, if the child was highly motivated by bubbles, coke, DVD, or trampoline, these activities were used to elicit focus language (such as 'more, go, drink').

Therapists, teachers and parents completed regular data collection for both the structured sessions and informal, non-structured sessions, comprising a data log, progress notes and weekly summaries. The data log was broken into sections, with a focus on

vocabulary and use of focus words, level of prompting, spontaneity, and time spent on activities.

On the completion of the implementation stage, the children were observed in their two main settings for post-assessment measures (at home and school).

The device was then left with the families for 2 more weeks, with no structured intervention from the therapists, and maintenance measures completed at the end of this period.

Pre and post-assessment and maintenance sessions were video-taped, where possible, for accuracy of observation, results and documentation. Only in one case, was video footage limited within the child's school setting due to confidentiality of other children, and hence data was collected in situ.

A child led approach was used in all sessions, whether structured or unstructured, in accordance with the LAMP approach.

Results

In the tables detailing the treatment outcomes for each child reference is made to the use of two and three word phrases. It should be noted that the children are creating these phrases from the single words stored in the device and that there are not pre-determined phrases programed in Minspeak.

Case 1 - PM

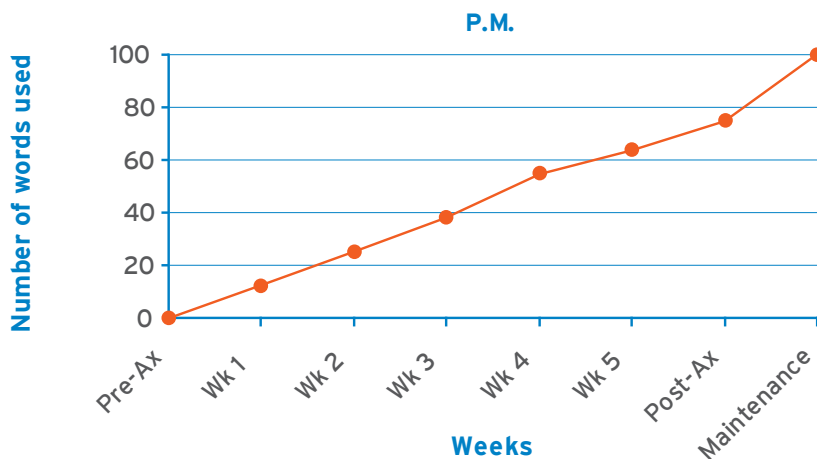
Age/sex	6 year old boy.
Therapy history	Has been on Aspect Building Blocks caseload for 3years - received 1 year of group therapy and 2 years of fortnightly home-based speech therapy.
Types of communication systems previously implemented	Spoken language, picture exchange, signed English.
Level of accomplishment	Inconsistent use of all systems - continues to need sabotage and prompting to use above systems.
Main setting where LAMP was implemented	Home.

Expressive language

Intentionality	PM was using symbolic communication mainly to request and protest, at the pre-assessment, with pre-intentional and intentional communication for other functions such as refusing & greeting. He developed more symbolic communication at post-assessment and maintenance across the functions of communication, using both spoken language and the device at a single word and phrase level.
Vocabulary use	PM moved through use of the Vantage Lite to express himself for the range of functions mentioned, at a rate of single word to 2 word phrases in a session (prompted to spontaneous use); 3 word phrases in a week (prompted and spontaneous); and use of up to 12 words in the first week of implementation. PM's vocabulary using the device increased as follows - wk2 up to 25wds; wk3 - up to 38wds; wk4 - up to 55wds (including name, age, phone number); wk5 - up to 64wds; maintenance - greater than 100 words, including description (colours, numbers); food items; emotions; places; actions/verbs; animals; social language/ identifying information. The language used was both introduced through teaching and discovered spontaneously, and hence used with initial prompts or completely spontaneously.
Functions of communication	Prior to implementing use of the Vantage Lite, PM was mainly requesting using objects and gestures, using some single words or phrases, and visual supports when prompted. He was commenting inconsistently, and mainly gaining attention, refusing or protesting by using less preferred behaviours. After implementing the Vantage Lite, PM was using spoken language at the phrase level to request, comment, refuse, gain attention, and express feelings. He was also using spoken language to greet and farewell with inconsistent verbal prompts.
Length of utterances	PM moved through use of the Vantage Lite to express himself at a rate of single word to 2-word phrases in a session (prompted to spontaneous use); and 3 - word phrases in a week (prompted and spontaneous). By the end of the research he was using phrases both to express himself using spoken language and through use of the Vantage Lite device.

Case 1 - PM

Development of spontaneous communication using the device



(Numbers were counted at the structured sessions and represent use of words on the Vantage Lite)

Receptive language

Level of instructions	PM was able to follow 1-part directions in and out of routine, 2-part sequential directions, and was acquiring 3-part direction with prompts, at the pre-assessment stage. This was consistent across the research with a decrease in reliance on prompts as mentioned.
Level of prompts	PM's main changes were in moving from more supported means of following directions to responding to photos or verbal prompt only.
Responding to questions	PM was able to respond to 'yes/no, what, which one, where' questions with gestures, photos or verbal prompts, and was acquiring an understanding of 'who' questions, at pre-assessment. This continued to be consistent throughout the research, with an increase in responses to questions provided verbally only. PM was able to respond to social questions about himself after implementation of the device, such as 'What is your name? How old are you? Where do you live? What is your phone number?' both verbally and using the device.
Understanding language	PM was able to understand a variety of words and information at pre-assessment, including preferred/non-preferred food/items/people, comments about surroundings and changes in routines, and greetings. He moved from needing more visual/object prompts to responding to verbal prompts alone.

Case 2 - MB

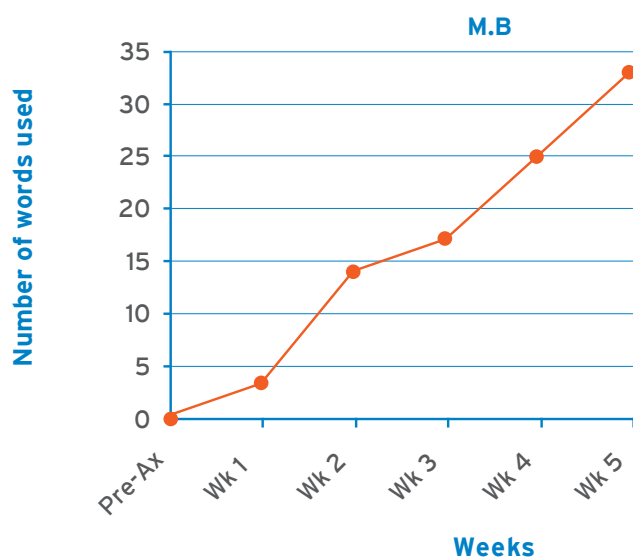
Age/sex	4.5 year old boy.
Therapy history	MB has participated in private occupational and speech therapy programs and ABA in home programs. He currently attends an Aspect school 5 days per week.
Types of communication systems previously implemented	Spoken language, picture exchange, Proloquo2go on the iPad, signed English.
Level of accomplishment	Inconsistent use of all systems - continues to need sabotage and prompting to use above systems.
Main setting where LAMP was implemented	School setting with family present.

Expressive language

Intentionality	Prior to implementing the use of the Vantage Lite, MB was very much in the pre-intentional communication stage, moving into the intentional stage for requesting, with support. At the post assessment and maintenance stages, he was using symbolic communication, using the device, or spoken language to request and use other functions of communication. MB was using spoken language both spontaneously and using echolalia.
Vocabulary use	MB showed an increase in use of spoken language through echolalia responding to the voice output on the Vantage Lite. This was consistent at maintenance; MB was continuing to greet by repeating 'hi/bye' or refuse by repeating 'no' or indicating 'finish' on the device, as well as using language in the other areas mentioned. His vocabulary use on the device also increased, at a rate of almost 15 new words by the second week of implementation, then 3 - 5 new words each week. These words were used both with initial prompts and then spontaneously.
Functions of communication	MB was initially mainly communicating to request and refuse using behaviours, gestures, objects, he had about 5 words he used in echolalia; used his own sign for 'more', and visuals were being introduced in the home. He also greeted mum through a kiss, and would show feelings with movement or smiles. With implementation of the Vantage Lite, MB was using more symbolic language across the communication functions, through use of the device at a single word and 2 - 3 word phrase level.
Length of utterances	MB continued to use single words for spoken language, however, was able to generalise use of language with the device, increasing to 2 - 3 word utterances. Although, the majority of his spontaneous use was using single words, he was able to use 2-word phrases from the second week of implementation.

Case 2 - MB

Development of spontaneous communication using the device



Receptive language

Level of instructions	MB moved from understanding mainly 1-part directions in or out of routine with physical prompt, gestures, objects, repetition or environmental prompts, to understanding directions involving prepositions and attributes, using physical support, objects or repetition. This was consistent at maintenance.
Level of prompts	MB relied on all levels of prompting (physical, gestural, symbolic, verbal and environmental) to follow instructions prior to and post-implementation of the device, however, there was reported improvement in this area with routine activities at home and school, at the maintenance stage.
Responding to questions	MB moved from only understanding the question 'which one?' with the use of a 2 object choice, to responding to 'what, which one and where' questions with gestures, object, repetition, or environmental prompts for 'which one?' Again this was consistent at maintenance stage.
Understanding language	His understanding of words and information in his surroundings did not change significantly. MB could respond to his name verbally; preferred people/food/ items using objects or verbal repetition; and comments about changes in his routine with physical support, gestures or objects/photos. This was consistent throughout, with a change in ability to greet and make choices using the device post implementation and at maintenance.

Case 3 – JW

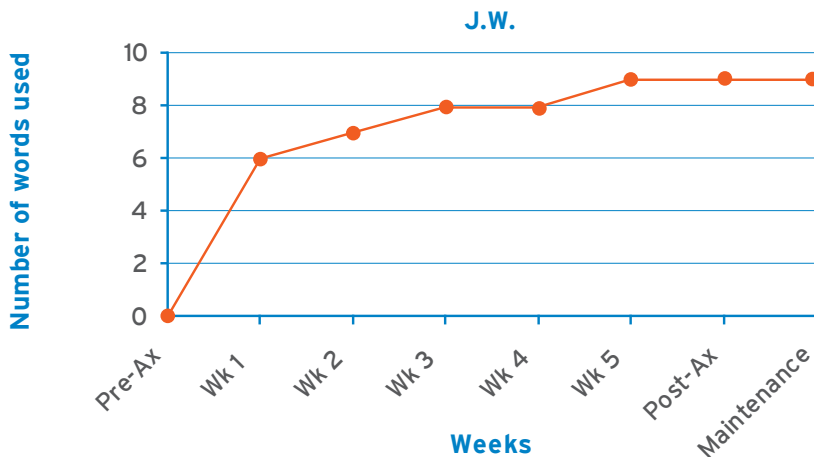
Age/sex	6 year old boy.
Therapy history	Private speech and occupational therapy, ABA intensive in home program, chiropractic input, bio medical treatment (i.e. gluten and casein free diet, methyl B12 injections, natural chelation, hyperbaric oxygen chamber treatment, and probiotics). He now attends an Aspect school 5 days a week.
Types of communication systems previously implemented	Picture exchange.
Level of accomplishment	Single word level (4 words), however has generalised the use of the words across settings and people.
Main setting where LAMP was implemented	School and home.

Expressive language

Intentionality	When JW started the research, he was mainly in the pre-intentional to intentional stage of communication. He was starting to use some visuals or single words to request actions/objects, or greet/farewell. At the post assessment and maintenance stages JW had become more intentional and had generalised use of his symbolic language (requesting), as well as using the device to request for these needs consistently.
Vocabulary use	JW moved from using 5 single words at home and one at school to having about 9 words he used consistently. These words were expressed using sign or picture exchange to start with, and 4 more words were added to his vocabulary using the Vantage Lite device. JW used the word 'play' for more than one meaning, e.g. 'play DVD' vs 'play with me' which is consistent with the goal of the LAMP philosophy - for children to understand the variety of meanings of words.
Functions of communication	JW was using most functions of communication, at the pre-assessment, including requesting actions and objects, protesting using behaviour, gaining attention, greeting and farewelling with gesture or word. At the post and maintenance assessments, JW was requesting actions, objects and help using spoken word, picture exchange and use of the device. He was also pointing towards things to comment, attempting to express feelings by requesting 'hug' on the device, and continuing with the other communication functions mentioned.
Length of utterances	JW stayed within the single word length of utterances; however, there were many changes in the intentions of his communication, joint attention and interest and motivation to communicate.

Case 3 – JW

Development of spontaneous communication using the device



Receptive language

Level of instructions	Prior to starting the research, JW was able to follow 1-part routine and non-routine directions with some level of prompts. At post-assessment and maintenance, JW had moved on to 2-part sequential instructions, and required less physical support to follow the 1-part instructions.
Level of prompts	At pre- assessment JW could follow 1-part routine instructions with non-symbolic, symbolic or verbal support, and needed physical support and non-symbolic prompts to follow non-routine instructions. At the end of the research, JW was following 1-part non-routine instructions using symbolic and verbal prompts as well, and 2-part sequential instructions with physical, non-symbolic and symbolic prompts.
Responding to questions	JW was unable to respond to any question types at the pre-assessment stage. He moved on to being able to respond to 'which one?' questions, when given a choice, using symbolic and verbal prompts. This was consistent at maintenance stage.
Understanding language	At the beginning of the research, JW could respond to his name or greeting and names of preferred foods or items verbally. He used physical support, non-symbolic prompts (gestures) or symbolic prompts (visuals) to respond to unfamiliar items or make comments about his surroundings. He moved on to understanding information as well as comments about changes in his routine, and routine and non-routine past and future events, using the same levels of prompting as for the former.

Case 4 – AG

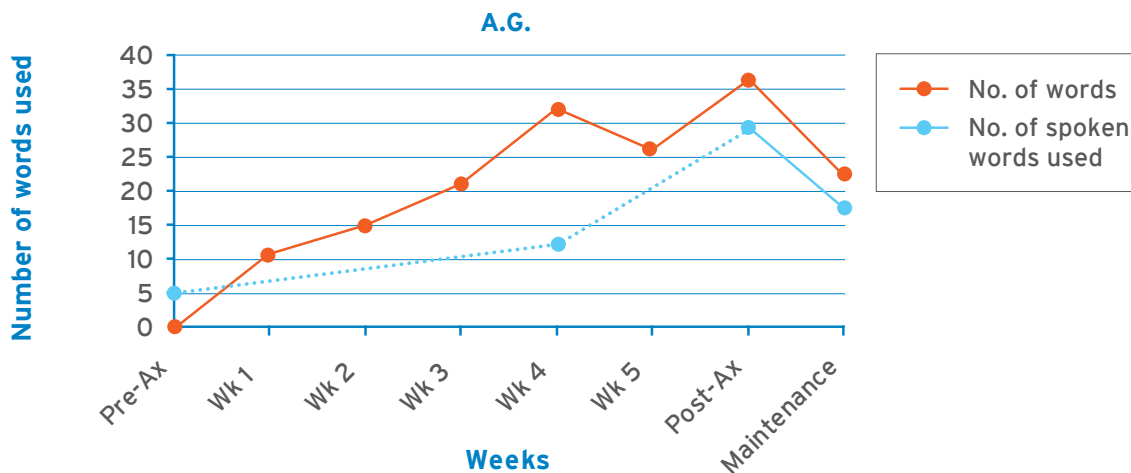
Age/sex	11 year old male.
Therapy history	Access to Speech Pathology intervention at school. Nil private therapy.
Types of communication systems previously implemented	Verbal, some picture exchange.
Level of accomplishment	Inconsistent use of verbal language (articulation errors), needs prompting to use verbal skills. He uses picture exchange at school but not at home.
Main setting where LAMP was implemented	Mainly at the school in 1:1 setting; joint session also occurred with mum, as well as a home-visit and phone collaboration, to support use of the device at home.

Expressive language

Intentionality	At the pre-assessment AG was reported to use intentional and symbolic communication to request his needs and wants. At the post-assessment and maintenance stages, AG had moved to communicating more consistently using symbolic communication for a variety of functions, both using spoken language and the Vantage Lite.
Vocabulary use	At the pre-assessment, AG was reported to attempt a handful of common words he used at home, including drink, yoyo (yoghurt), toilet, help, hurt, wait, milk, shop etc. (although his articulation was not always accurate). By the post-assessment and at maintenance, he was using a mixture of spoken speech and vocabulary on the Vantage Lite to request desired objects. For example, he was reported to request animals by locating them on the device first and then either pressing the device or verbalising request. AG was also reported to be using vocabulary on the device he had not previously used, such as 'moustache' (during Mr Potato Head) and asking a question 'Could I drive?' which he had never asked previously. AG showed an understanding of multiple meanings of a word, by using the word 'drive' in 3 different contexts. During implementation of the device, AG went from using 7 words in session 1, to about 20 words in session 5, including a variety of animals and colours that he was requesting spontaneously using the device.
Functions of communication	AG initially presented with use of language to request actions, objects and help; protest, gain attention, greet/farewell with prompts, and show some feelings (e.g. through saying 'sorry'). He progressed to being able to use all the functions of communication more symbolically, and commenting both verbally and using the device.
Length of utterances	At the pre-assessment, AG was mainly using single words and vocal attempts, with some 2 word phrases. He continued to use a variety of single words, as well as an increased number of 2-word phrases, including 'want x', 'that one', the question 'could I drive?' and greeting a variety of people by name i.e. 'Hi x'.

Case 4 - AG

Development of spontaneous communication using the device



Note: The dotted line shows an average increase over these weeks, as no data was taken during these periods.

Receptive language

Level of instructions	At the pre-assessment AG could follow 1-part routine and non-routine directions with prompts, and some instructions involving prepositions (in/on) and attributes- specifically colours. At the post-assessment he was also responding to 2-part sequential instructions.
Level of prompts	AG initially responded to non-symbolic prompts (such as pointing), symbolic prompts (visuals), verbal repetition and environmental prompts to follow these instructions. He progressed to being able to respond to directions more consistently using symbolic prompts and verbal repetition.
Responding to questions	AG was initially able to respond to 'what' questions, verbally, and 'which one?' questions using objects. This was consistent throughout the research, and AG moved on to responding to 'which one?' questions with a photo prompt.
Understanding language	At the pre-assessment, AG showed an understanding of a variety of language including familiar and unfamiliar/preferred food/people/places, and comments about his environment or change in routine, mainly using visual supports to assist his understanding, or verbal repetition. At post assessment he had generalised an understanding of this information when presented verbally or with a visual support.

Case 5 – JB

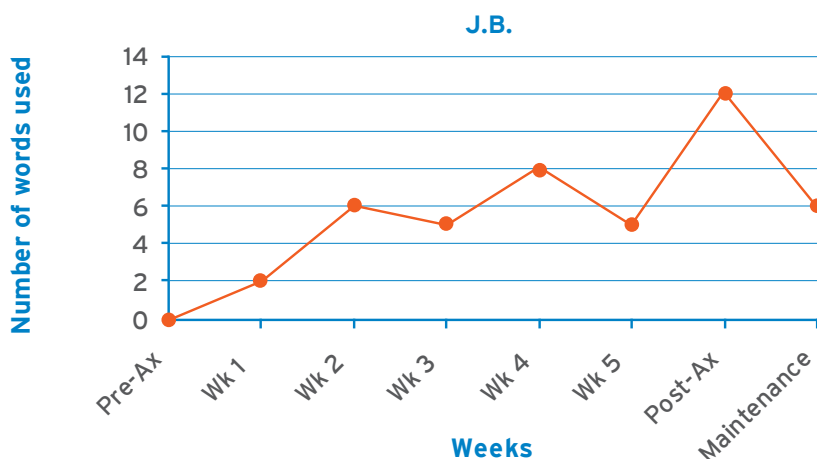
Age/sex	12 year old boy.
Therapy history	Had private therapy with Aspect Building Blocks prior to starting at school. Since starting with Aspect School in 2007 has not had individual speech therapy.
Types of communication systems previously implemented	Picture exchange, some signing.
Level of accomplishment	No symbolic level of communication.
Main setting where LAMP was implemented	Mainly at the school in 1:1 setting; joint session also occurred with mum, as well as a home-visit and phone collaboration, to support use of the device at home.

Expressive language

Intentionality	At the pre-assessment, JB was using pre-intentional and intentional communication to get his needs met. He was mainly communicating by hand-leading, use of objects, self injury (biting the back of his hand) or standing in close proximity to others. At the post assessment stage, JB's communication had changed significantly. He was using symbolic communication through the Vantage Lite to communicate for all functions of communication, as well as making some vocal attempts.
Vocabulary use	As JB was at the non-symbolic stage of communication prior to implementation of the Vantage Lite device, he had no consistent vocabulary use. JB went on to use the device to request a range of single words functionally and spontaneously, such as "eat, play, puzzle, more, go ,toys, turn, want, hug,chips". He also used it to request "help; sandwich, toilet, go away, mine" with partial physical prompts. JB was also observed to use some verbal utterances after modelling from the device e.g. " I want" "toa"(toast),"ch" (chips); "choc" (chocolate). These changes were consistent at maintenance, where JB also presented with some new words. JB increased his symbolic vocabulary by about a dozen spontaneous words during the time of the research.
Functions of communication	At the pre-assessment stage JB was using non-symbolic means to communicate most functions of communication, specifically- requesting objects and some actions, protesting, gaining attention, greeting and expressing emotion. By post assessment and maintenance stages he was communicating all these functions using the Vantage Lite, as well as commenting and requesting help. One of the most significant improvements for JB was his ability to communicate socially with a wider range of people, and to use the device to request hugs, take turns with others.
Length of utterances	JB mainly moved on to use of single words consistently. He was also using some phrases, such as 'I want x' to request, both using the Vantage Lite and spoken attempts, and 'go away' to protest. These are significant improvements for JB.

Case 5 - JB

Development of spontaneous communication using the device



Receptive language

Level of instructions	JB can follow one part routine directions without prompts. For non routine directions and those involving prepositions he requires a mixture of verbal and gesture or picture support.
Level of prompts	JB requires a total communication approach to assist with receptive language. As his focus and anxiety levels fluctuate the level of support required also fluctuates. Mostly JB can understand personal information with verbal and picture support. For non preferred information he will require object and non symbolic support. At school he needs physical prompts combined with picture to support to understand changes to routines. Post assessment JB was able to understand simple directions like "pack away" with the use of the Vantage Lite.
Responding to questions	Inconsistent response to verbal questions. He responded to routine questions like "who's here today" routine. Following intervention his response to questions was more consistent. He responded to questions about choice e.g. which one.
Understanding language	JB's understanding of language is severely affected by his delayed auditory processing skills. Prior to intervention he required a high level of prompting to elicit a response to a verbal instruction, greeting or comment e.g. verbal repeats, physical prompts, and direct requests for a response i.e. "look at me." Following the use of the Vantage Lite an improvement in auditory processing was observed, which assisted in increasing his understanding of language. JB was observed to press the text bar to repeat a message and then he would either repeat the word or give a gesture that indicated he had understood the device e.g. smile or laugh. The tone of the device seemed to really assist with this skill. This lead to a greater understanding of a variety of language functions and an ability to participate in turn taking games and non routine events, which previously he had difficulty with.

Case 6 - RM

Age/sex	6 year old male.
Therapy history	RM has been attending private speech and occupational therapy weekly for 4 years, and a variety of different symbolic communication methods were trialled with him, including the Picture Exchange Communication System (PECS), sign and spoken language. He responded well to PECS, but not to signing. He has participated in 200 hours of ABI, 2.5 years of therapeutic listening, music therapy and weekly swimming lessons. He has also attended 3 years in various early intervention services, and preschool. RM is a competent user of picture exchange and only recently began to use spoken language in October 2011.
Types of communication systems previously implemented	Spoken language, picture exchange.
Level of accomplishment	Using both systems consistently.
Main setting where LAMP was implemented	School and home.

Expressive language

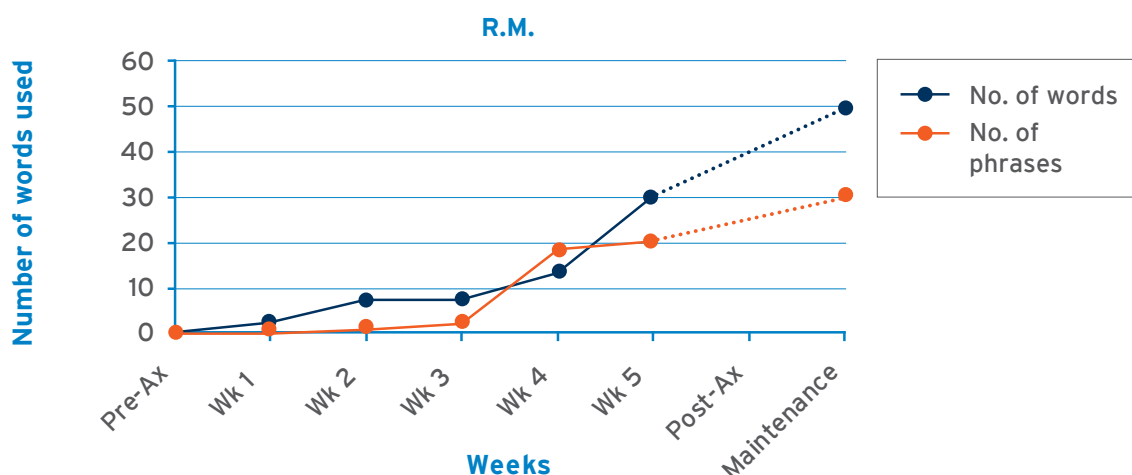
Intentionality	At the pre-assessment stage, RM was in the intentional and symbolic levels of communication. He mainly communicated his needs and wants using gestures, single words and some repetitive phrases such as 'I want x' or 'help me y.' RM was also using visual supports to request needs, and less intentional behaviours to express emotion. At the post-assessment and maintenance stages, RM was still using both intentional and symbolic communication, however, with more meaningful and consistent symbolic communication. RM was using both his spoken language and the Vantage Lite device to communicate using longer sentences & increased vocabulary.
Vocabulary use	At the pre-assessment, RM had some words and phrases that he used inconsistently, often with verbal prompts. He mainly requested preferred actions or objects from familiar people in his environment. When the Vantage Lite was initially introduced, 2 words were focused on, and RM was able to make one spontaneous attempt of 'go' after many prompted trials. By the second week he had moved on to 7 new words and 1 phrase, with 32 spontaneous requests. His vocabulary increased at the following rate during implementation of the Vantage Lite, and using the device in structured sessions: Wk3 - same vocabulary, 1 phrase and 19 spontaneous requests; wk4 - 6 new words, 16 new phrases of 2 - 3 words in length and 117 spontaneous requests; wk5 - 7 new words spontaneously used without prompting (including emotions and colours), continued use of phrases and 122 spontaneous requests. By the maintenance session, RM was spontaneously using about 50 words and 30 phrases or sentences to request and comment, both using the Vantage Lite, and attempting to imitate with spoken language.
Functions of communication	At the pre-assessment, RM was using most functions of communication to communicate in some way (intentionally or symbolically). He was requesting actions/objects/help; commenting, protesting, greeting, gaining attention, and expression emotion using behaviour (pre-intentional communication). By the post-assessment and maintenance stages, RM was using all of the above functions, as well as requesting for clarity and expressing emotions, using both the Vantage Lite and spoken language, i.e. using a symbolic means of communication.

Case 6 - RM

Length of utterances

RM went from using single words and a couple of inconsistent phrases, to using phrases and sentences more consistently, both with the Vantage Lite and spoken language attempts. RM was using complex sentences to request specific information such as 'I want mummy to help' as well as to express a variety of feelings and using description, such as specific colours e.g. 'I want blue balloon.'

Development of spontaneous communication using the device



Note: The dotted line shows an average increase over these weeks, as no data was taken during these periods.

Receptive language

Level of instructions	At the pre-assessment, RM was following a variety of instructions, with different level of prompting. He was able to follow 1 part routine and non-routine instructions; 2 part sequential instructions and instructions involving attributes, with lower level prompts. He needed more support to follow 3 part instructions and instructions involving prepositions. At post- assessment and maintenance, he was more consistent with following the different levels of instruction, and with less support.
Level of prompts	As noted, RM went from needing some physical support, non-symbolic and symbolic prompts, verbal repetition and environmental prompts, to responding to instructions more consistently in natural context. He continued to need symbolic support (objects or visuals) for 2 part unrelated and 3 part instructions.
Responding to questions	At pre-assessment, RM was able to respond to yes/no questions, which one? What, Where, and Who questions in context, with familiar people, and with non-symbolic or symbolic support. He moved on to being able to respond to all of these questions with only verbal repetition, or in natural context.
Understanding language	At pre-assessment, RM was able to understand a variety of language including responding to his name, names of familiar and unfamiliar food/items/people, comments about his surroundings or change in routine, comments about past or future events, with symbolic prompts or verbal repetition. This was consistent with post- assessment and maintenance measures, and RM moved on to respond to his name and names of familiar and unfamiliar food/items/people with less support, with verbal prompt and natural context.

Case 7 - TK

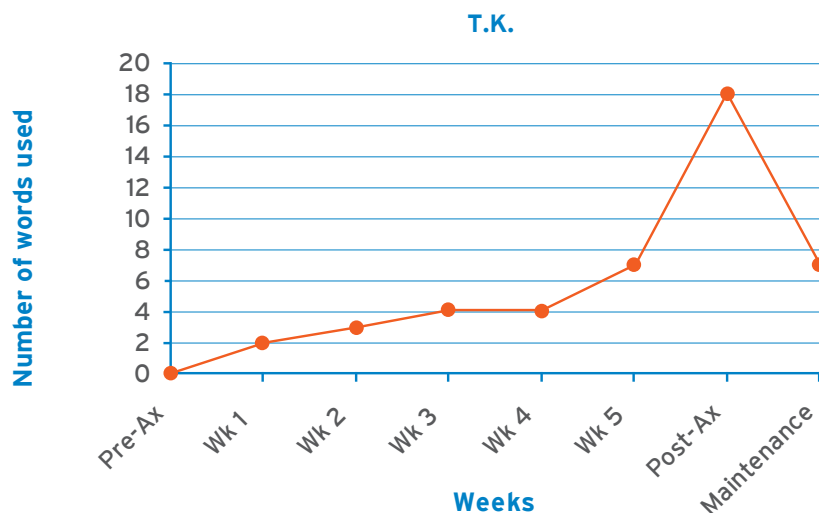
Age/sex	6.5 year old boy.
Therapy history	Currently attends private therapy once a fortnight.
Types of communication systems previously implemented	Picture exchange, Proloquo2go on the iPad, and natural gesture.
Level of accomplishment	Uses mostly physical means to communicate.
Main setting where LAMP was implemented	School.

Expressive language

Intentionality	TK was in the pre-intentional stages of communication, moving into the intentional stages. He used behaviours, gestures and objects to indicate needs and wants. Following the implementation of the LAMP, TK was able to use symbolic means to request "eat", "more", "drink", "go", "stop" and "help" with prompts and environmental cues.
Vocabulary use	Prior to intervention, TK was predominately non verbal. He used some vocalisations (e.g. squeals, consonant/vowel babbles and some laughter) to accompany alternative communication style. By the end of the research TK was able to use the device to spontaneously request more, eat, go and stop. He did tend to play with the device and would often press go and stop quickly and giggle to himself.
Functions of communication	TK would greet people with a 'hi 5' and a smile. With prompting he could say hi on the device. He demonstrated his feelings through gestures and physical methods. With implementation of the Vantage Lite, TK was using more symbolic language across the communication functions, through use of the device at a single word level. TK's sensory needs fluctuated his arousal level fluctuated and often this effected his ability to communicate with the device. At times he only wanted to bang on the device.
Length of utterances	TK was still predominately non verbal; however there was an increase in vocalisations after the use of the device. He was observed to vocalise "mu" after a request for "more" with the device.

Case 7 - TK

Development of spontaneous communication using the device



Receptive language

Level of instructions	<p>TK responds well to a mixture of routine, picture symbols, verbal requests and gestures to follow directions (routine and non routine). He will respond to changes in routine e.g. his mother will say we are going to Nanna's and he will go and get his shoes.</p> <p>He will respond to 'what' questions and 'which one' when related to personal choices e.g. what do you want? Which one do you want? by selecting the desired object or board maker symbol.</p> <p>Often TK doesn't wait for an instruction in routine events at school e.g. he will put everyone's chairs at the table after morning circle because he knows table work is next. His level of receptive language skills remained consistent pre and post LAMP intervention.</p>
Level of prompts	<p>TK responds to a mixture of prompts. With familiar items and routines he responds well to verbal prompts. For changes in routines and new information he responds well to pictures and verbal prompts.</p>
Responding to questions	<p>TK responds to want, which and routine who questions with verbal, picture and objects support. He relies heavily on environmental and natural context for support. His ability to respond to and demonstrate an understanding of questions was unchanged throughout the intervention.</p>
Understanding language	<p>At pre-assessment, TK was able to understand a variety of language including responding to his name, names of familiar and unfamiliar food/items/people, comments about his surroundings or change in routine, comments about past or future events, with symbolic (picture or gesture) prompts or verbal repetition. This was consistent with post-assessment and maintenance measures.</p>

Case 8 - TD

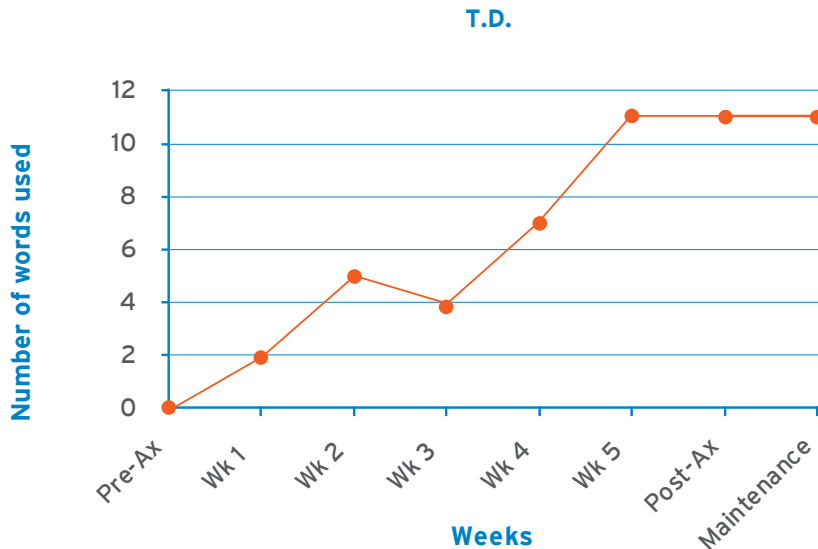
Age/sex	Female, age 5.9 years.
Therapy history	Has been accessing the Aspect Building Blocks service for 3 years - received 1 year of group therapy and 2 years of home-based speech therapy, intermittently. Received 6 months of intervention from Autism Behaviour Intervention (ABI), NSW.
Types of communication systems previously implemented	Picture exchange, gesture/sign, vocalisations for certain words/phrases. Follows a visual schedule for the whole day with minimal assistance.
Level of accomplishment	Consistent and spontaneous user of picture exchange, however can become extremely frustrated, and demonstrate physical behaviour, when cannot communicate ideas through picture exchange. Able to consistently use 1 - 2 vocalisations for certain words e.g.: 'iwa' for 'I want'; 'hhhhh' for 'help'.
Main setting where LAMP was implemented	Home and school.

Expressive language

Intentionality	TD presented at the intentional stage of communication development at the beginning of the research (e.g. hand leading, gestures) but also could communicate symbolically through picture exchange. She also used behaviour to express frustration. She is now mostly using symbolic methods to communicate through the use of her Vantage Lite device.
Vocabulary use	Prior to the research, TD was at single word level and using nouns only by asking for 'things' i.e.: food, toys, sensory equipment. TD is now able to express various two word semantic combinations to request preferred activities e.g.: agent-action "Go Dad", Action-object "want orange". She is now able to use some negatives e.g.: 'stop' with auditory and visual cues.
Functions of communication	Prior to the research, TD was only using the requesting function, to ask for 'things'. TD's use of symbolic communicative functions have increased from primarily requesting, to social functions (requesting a 'turn') and protesting, however she still benefits from some structured sessions to practice social functions and protests. She is beginning to use the icon 'stop' to protest as a preference rather than physical behaviour (screaming, hitting, biting), but still benefits from visual and auditory prompts to use it independently.
Length of utterances	Prior to the research, TD was at single word level for nouns only (picture exchange). TD is now at phrase level, and is more flexibly putting two and three words together to create different phrases.

Case 8 - TD

Development of spontaneous communication using the device



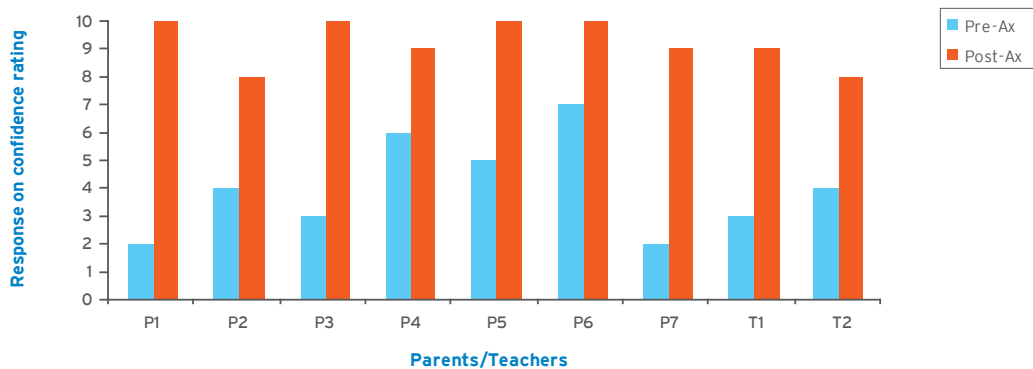
Receptive language

Level of instructions	Prior to the research, TD could follow routine and non routine one step directions. She could follow 2-part sequential instructions with symbolic prompts (photos), and occasionally follow 2-part unrelated instructions with symbolic prompts (photos). She is still responding to the above directions and benefits from visual supports, but understands more verbal instructions for words that are used on her Vantage Lite. She responds to more single word instructions to cue her to select certain vocabulary on her device.
Level of prompts	TD responded to non-symbolic, symbolic, verbal and environmental prompts to follow instructions. Her need for full physical prompts reduced to visual, auditory and partial physical prompts toward the end of the research.
Responding to questions	TD will respond to familiar 'what' and 'want' questions with symbolic (picture) or verbal prompts i.e.: 'What do you want?' or 'Which one?' with symbolic (photo) visual supports. This is consistent with her current questioning skills, however she has now generalised her ability to answer 'what do you want' questions to answer what she wants with her device.
Understanding language	TD can understand her name, and the names of familiar/preferred people, places and objects. She can understand names non-preferred items when given (photo) visual support, and verbal prompts. TD can understand her daily routine at home and at school and consistently and competently follows a daily visual timetable for each. She understands changes in routine when given symbolic (photo visual schedule) prompts.

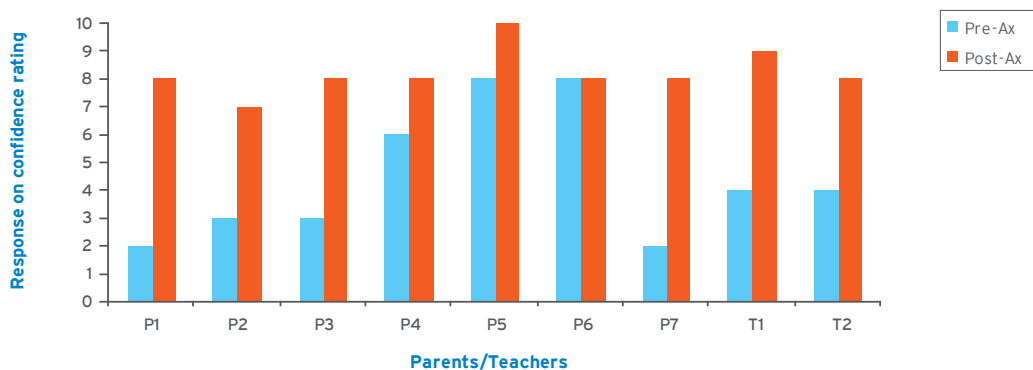
Parent-teacher analysis

The following graphs show the results of the parent (P) and teacher (T) responses to the surveys, pre-assessment and post implementation. Questionnaires were completed after training the parents and teachers in use of the device, hence, some of the pre-assessment results were already high (specifically for question 3).

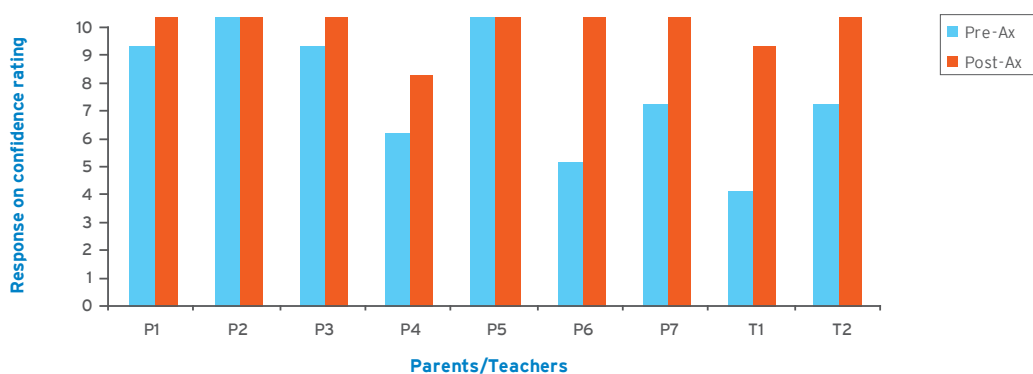
1. How confident do you feel implementing the device?



2. How confident do you feel teaching another person?



3. How confident do you feel that the device will help your child?



Data analysis/discussion

The aim of the current research was to assess the level of improvement and generalisation using the Vantage Lite with Language Acquisition through Motor Planning (LAMP) methodology. The results indicate an improvement for all participants, whether in use of symbolic communication, vocabulary, length of utterances, spontaneous use of language and independence, as well as in other areas such as general interest, motivation and social interaction.

The results indicate an improvement for all participants...

Although these gains differed in the level of increase or change for each participant, there were changes and improvements seen for all participants. This change was seen to be confirmed and reported by their caregivers, teachers or the speech pathologist involved.

The greatest gains and outcomes seen from the results of implementation of LAMP, through the Vantage Lite, were improvements in expressive communication. All participants increased in their development of symbolic communication or increased consistent use of symbolic communication. Four out of the eight participants went from being mainly in the pre-intentional/intentional stages of communication, to using intentional and symbolic communication, through the Vantage Lite, while the other four participants who were already using both intentional and symbolic communication, increased their use of symbolic communication across the functions of communication, and as a consistent method of communicating. Although half of the participants were using some symbolic communication prior to LAMP being implemented, this was limited for all of them or was not being used consistently. For example, participants previously using a picture exchange symbolic communication system were restricted to a type of vocabulary (e.g. food items) or a function of communication, e.g. requesting, only.

In relation to functions of communication, all the participants were communicating to request their needs in some way prior to the research (this could have been using a pre-intentional behaviour, gesture, or symbolic method of communication). Prior to the research 87% of participants were using a method

of communication to protest; 62% were able to gain attention, greet and farewell or express feelings using some sort of communication or physical behaviour (e.g. hugging another person). Only two of the participants (25%) were commenting in some way, at the pre-assessment. At the post-assessment and maintenance stages, all the participants were requesting using a symbolic means of communication (device or spoken language) and 100% of participants were developing social communication through commenting. This is a significant increase (75%) and outcome for such an improvement within three months of use of the device. Other improvements in functional communication were an increase of 75% of participants developing communication to gain attention and express feelings, and 87% (7/8 participants) using communication to greet or farewell others. Again, this is a significant area of change for these children, as an increase was not only seen in requesting but in social communication such as commenting, gaining attention, greeting/farewelling and expressing feelings. The significance of this is that all of the participants had had previous intervention, ranging in degree and number of years (up to nine years) yet only 25% were able to comment prior to participating in the research, whereas these changes were seen within the three months in which the device was implemented.

Parents of participants also noticed and expressed the significance of this change. K, JB's mother, reported that the device allowed JB (who was now 12 years old), to be more involved in family interactions, and said *"It is the best thing JB has ever done for his communication."* It should also be highlighted here, that one of the aims of the research was to assess the level of generalisation using the Vantage Lite with LAMP methodology, when implemented in the client's natural environments. This comment supports that use of the device, allowed for generalisation into different situations within JB's home environment, without specific structured teaching at these times.

Another mother, G, (AG's mother), reports that the use of the device allowed AG to be able to chat to a greater number of family members and visitors to the house, and that this increased his enjoyment and success at social interactions. Again, AG is an 11 year old participant, who had previous intervention and support, but implementation of this device using LAMP methodology resulted with a positive outcome and generalization in the short amount of time it was taught.

Another increase in expressive communication measures was in the range of vocabulary and the length of utterances used by participants. Results are both in terms of vocabulary and utterances communicated using the device, or using other symbolic communication, such as spoken language. Although the rate and level of increase differed for each case, there was an increase in use of vocabulary for 100% of participants. Fifty per cent of participants had up to 10 words by session five; while the other 50% had greater than 30 words being used spontaneously on the device, by session five (three of these had a vocabulary of between 40 to 65 words at this stage). Again, this can be seen as a significant increase, as these results were shown within five weeks of structured and unstructured teaching opportunities. Although it is known that these words continued to be used and maintained at post assessment and maintenance stages, an overall word count is not provided at these stages, as this was not an element of the data collection and evidence is inconsistent. Also, it should be noted that although there is a fluctuation in the number of words used session by session, this would be related to the interest and motivation of the participant in that session, and hence, a word already taught at a session, may not have been used at a subsequent session, due to a lack of interest or motivation in that activity on that day (this can be seen specifically in the graphs for JW, JB, TD).

Another increase in expressive communication measures was in the range of vocabulary and the length of utterances used by participants.

It should be highlighted that for PM and RM, maintenance measures show a consistent increase in vocabulary without continued structured teaching sessions, and these participants were constantly discovering new vocabulary to use in the device, that was not chosen or taught by an external person. The significance of this is in line with the philosophy and strengths of LAMP, indicating that communicators using LAMP methodology are able to spontaneously discover and use language and vocabulary that is important and useful to them, as in typical language development, without having to be shown or taught every word. This also shows an increase in independence, spontaneous communication and generalisation of language use, which again were aims of the research. For example, L., PM's mum, noted on a weekly basis, between structured sessions, that

PM was requesting functional needs himself, such as 'bath, reading a book' and commenting that the 'school bus' had come or was coming, in the mornings, before being picked up. One of the teachers reported "They are using new words that no one has taught them" showing a spontaneous, natural development of words that are meaningful to the child. Also, JW's mum reported 'Even though he has only mastered the

One of the teachers reported
"They are using new words that
no one has taught them..."

two buttons 'Eat' and 'Play' he is ready to move on to the next level with these buttons; actually requesting items that he wants. 'Eat Biscuit' or 'Eat Sandwich' etc' again, showing the functionality of the language developed with the device. It should also be noted that the type of vocabulary that was spontaneously developed was varied, not only focussing on nouns, but verbs/ action words e.g. eat, drink, open, ride, jump; adjectives such as colours, size; feelings such as happy, hungry; and social language, language associated with safety, such as address and contact number, birthday, and responding to how are you, with 'I'm fine'. Again, this highlights the use of generalised and varied language using the Vantage Lite, compared to language that may be limited with use of other communication methods due to vocabulary being restricted to vocabulary thought to be needed to communicate.

Another important belief and outcome of the LAMP philosophy, is the importance of people understanding the multiple meanings of words e.g. that 'bath' could be a noun, meaning the actual bath, compared to a verb, as in to take a bath or wash. We see this with AG, who was reported to use the word 'drive' in three different contexts, showing a generalisation of the meaning of this word. Also, JW's mother reports 'He also tries to carry the machine outside so that he can press 'play' to get me to go outside to push him on the swings. Also I have noticed that he is pushing 'play' for me to press play on the DVD machine...' which showed an understanding of the multiple meaning of words. This is an example of how communicators can be taught to use specific vocabulary in multiple ways, which again can be restricted in other communication approaches, or when this philosophy is not understood, encouraged or focussed on. This is another way that language can and should be generalised with communicators, and the outcomes of the research have shown to be consistent in this way, even on a small scale.

When analysing the data in reference to the levels of prompting needed or used for participants to use language spontaneously on the device, it can be seen that for all participants there was an ability to move to using a focus word spontaneously, within one teaching session. This means that although physical prompts were used to introduce a new word, participants were able to use this word spontaneously by the end of the structured session. This varied for participants and not all words introduced in one session were then used spontaneously, however, all participants were using at least one word spontaneously in each session. The rate at which words were used spontaneously was not analysed, and again, for participants this varied between working their way down the prompting hierarchy for some, or only needing some prompts and then using the word spontaneously, for others. The prompting hierarchy that was used was: full physical prompt → partial physical prompt → gesture → spontaneous use. The amount of prompting needed would also be affected by the level of motivation and interest in an activity/ stimuli for each participant and on each day, which is a variable that we did not control for. This outcome is in line with both the aim of the research and the aim of the LAMP philosophy, increasing generalisation and independent use of language to communicate desired messages.

The prompting hierarchy that was used was: full physical prompt
→ partial physical prompt → gesture
→ spontaneous use.

Another measure that was analysed in the results was the participant's length of utterances. Although LAMP does not encourage a rushed focus on development of phrases until use of core single words is developed and generalised, it was seen that 75% of participants were using phrases by week five of implementation. The rationale for this reasoning from the LAMP philosophy is:

1. for strong motor patterns to be developed, before teaching new motor patterns, so that they can become ingrained and more natural and spontaneous in use;
2. this follows a natural process of language development;
3. it allows the child to learn the meaning of individual words so that they can put them together to express themselves, rather than using phrases with no knowledge of the meaning of individual words; and

4. it allows the child with auditory processing issues to 'hear' the individual words.

However, the results indicate that participants were able to develop the use of phrases from an early stage, even those who were completely non-verbal prior to implementation. For example, 12 year old JB was completely non-verbal prior to implementation of the device and in the pre-intentional communication stage. With implementation of the device, not only did he move to using symbolic communication, but he also developed use of some phrases such as 'I want x' and 'go away'. He was also able to use spoken language to verbally repeat words and phrases produced via the voice output of his Vantage Lite device. This is a significant outcome for JB and his mother K. noted the following about implementation of LAMP through the device:

...participants were able to develop the use of phrases from an early stage.

"The LAMP program has been exceedingly beneficial for JB. JB is non verbal and after using the LAMP device program, (he) has begun structuring a sentence together for requesting verbally... ..It has been his voice. It has also given him further confidence in being heard and listened to...."

Another example is RM, who started using complex sentences to request specific information with the device, such as 'I want mummy to help' or 'I want blue balloon'. Although RM was previously using some words and phrases to communicate, these were often still reliant on verbal prompts, and the use of the device enabled RM to increase sentence length and complexity.

In analysing the changes or development of receptive language outcomes, for most participants, the changes were not as significant or in as broad an area. The main increases observed were in a greater understanding of the meaning of words, less reliance on physical prompts for understanding, and a greater understanding of abstract information (i.e. information related to past and future, not only present). A few participants showed a greater understanding and ability to respond to questions, such as MB and PM. Two participants showed more dramatic outcomes than others in receptive language, e.g. 12 year old JB who initially had very little understanding of language using verbal information alone, and relied on physical prompts and verbal repetition to support understanding, was described to have improved in

his auditory processing post implementation of the device, and was not needing as many prompts or verbal repetition to understand. Another example was 11 year old AG, whose mother G. reported she observed an increase in AG's comprehension level and understanding of "no" and changes to routines. For example, one day AG kept requesting to go to the shops. She had told him "no" they weren't going and he was having a meltdown. She then used the device to say "no shops" and AG accepted it and the meltdown stopped.

As well as direct communication outcomes, there were a range of other outcomes that parents, teachers and therapists observed and reported. These included an increase in joint attention, interest, motivation and engagement with others, and an overall increase in willingness to communicate. For example TK's mother reported

"During the LAMP trial we have noticed a huge improvement in TK's willingness to communicate. We feel that the device could be a "voice" for our non verbal son, who is trying so hard to express his needs and desires. I was shocked that in such a short period of time, that he 1) learned to use the devices, and 2) that he attempted to communicate and use the device appropriately. Very positive experience indeed!"

There was an overall increase in play and social communication, and for some participants, this was the first time they were able to communicate and participate in social situations. For example K. (JB's mother) reports 'the device is allowing JB to be more involved with family interactions'. The changes in play skills were both in an increased interest to play and interact with another, as well as an increase in repertoire and flexibility of play skills. For example, TD's mum reported

"Just wanted to drop you a quick line and tell you how well T is going with the device. I have a little girl who WANTS to play now.... she is bringing us balloons, blocks and using the device to request turns. I am so excited. She is starting to babble an awful lot too..... that little toddler babble that makes no sense at all and it is just lovely to hear.....Thank you again for including her in this trial!!!!!"

She had previously been reported to avoid social interactions with peers and engage in physical and sensory play with her parents, as well as occasionally engaging in functional play but preferring to play alone. Also,

'AG's play skills were becoming more functional over the course of the intervention. In the first sessions, his play skills with animals would involve lining them up in a straight line. By the end of the sessions he

was placing them in different patterns and I suspect would allow for more natural play supports to be introduced (e.g. fences, food buckets).'

Four and a half year old MB, also showed an increase in play skills and interest in engaging with others. He went from playing alone and having a limited interest in play, to being described as now being able to

'request preferred activities in the school and home setting. He shows shared enjoyment with adults during play and uses several means to communicate he wants a turn or for the adult to take a turn. He will laugh and play for an extended period of time (10 - 15 minutes per activity) for a variety of activities.'

Behaviour was also reported to improve, with decreased levels of frustration. This was especially the case for TD, who was initially reported to become extremely frustrated and demonstrate physical behaviour, when she was unable to communicate her ideas through picture exchange. These were reported to include screaming, hitting, biting, and often crying. After implementing LAMP, her parents report a reduction in her frustrated behaviours and she can now protest using the device in structured activities. Her teacher also reported "we hardly hear her screaming

"She realises now that she has this power to communicate".

anymore" and "She realises now that she has this power to communicate". MB was also described as having shown a significant decrease in frustration levels and an increase in attention, post implementation of the device and LAMP philosophy. There was also a reported increase in motor skills, and fine motor skills, in manipulating the buttons on the device to get a message across. Many children started at a lower stage on the device, with fewer pictures on the screen, so that they could find, identify and discriminate the keys easily, however, all the participants were using the suggested 84-sequence level prior to completion of the research.

Another reported outcome was in the development of reading and academic skills, in the case of six year old, RM.

In analysis of the parent/teacher surveys, it can be seen that 100% of respondents indicated an increase in confidence using the device and teaching another person to use the device, post implementation. The responses for the question regarding how confident

they felt that the device would help their child/student were quite high to begin with 70% of respondents giving a rating above five pre-implementation. This was assumed to be related to the survey being completed post-training of the respondents, and hence, positive outcomes were anticipated from the start.

It should also be noted that all eight parents, out of the 8 participants who completed the research, requested support in completing an application for a fully funded device, so that they could continue the implementation and develop their children's communication, on completion of the research. Again this shows a positive outcome and expected continued improvements for their children.

Some quotes from parents include:

- » *'JB really took to the LAMP device and was capable of using it for its intended purpose. Further usage and opportunity would improve results.'* (K.)
- » *'I don't know what we will do if PM isn't able to keep the device- I'm worried what will happen to his behaviour.' And 'this is the best thing that has ever happened to us.'* (L)
- » *'I do believe that J really needs this device (or similar) to communicate. This device has given him a little bit more control over his confusing environment. Thank you for letting J take part in the project and as you know we would be interested in getting funding for the device.'*
- » *'Thanks again for all your hard work. It is truly appreciated. We are thrilled with the results and that R was able to participate in the research.'*

Therefore, it can be clearly seen that the results of this research, supports the question regarding the effectiveness of using AAC with people with an ASD (Mirenda, 2001; Schlosser & Blischak, 2001), and adds to the knowledge of why AAC systems are potentially beneficial for children with Autism, (The National Standards Report). Effective teaching of motor plans, using the LAMP theory, can be seen to allow for

'JB really took to the LAMP device and was capable of using it for its intended purpose. Further usage and opportunity would improve results.' (K.)

increased storage and retention of symbolic information, resulting with more automatic communication over time, and reducing the cognitive demands associated with analysing and choosing from different symbol sets, as described by LAMP (Halloran and Emerson, 2006; Halloran and Halloran, 2012).

Limitations

Having completed the implementation stage of the research, and in analysing, and looking back over the initial proposed plan, it became apparent that there were limitations/variables to the research, or things that could have been improved upon.

One of the biggest uncontrolled variables was the participation of four different therapists, implementing the research across different settings.

One of the biggest uncontrolled variables was the participation of four different therapists, implementing the research across different settings. Although all therapists were provided with the same amount of training, and similar ongoing support (this was often on a need basis) implementation of LAMP procedures and philosophy may have differed from therapist to therapist. The initial proposal indicated regular video taping of sessions that would be provided to the LAMP instructors in America, for monitoring and feedback, as well as shared between therapists for intra-rater reliability and to increase fidelity; however, it became apparent that this was not logistically viable during implementation.

There were restrictions both with all therapists not being able to video every session (without this becoming a distraction or the focus), as well as time and technological restrictions with video footage being sent to America for feedback within the time-frame of the research. However, although this was seen to be a variable in the research, results indicate that this did not have a substantial effect on the outcomes of participants, and outcomes were still consistent across the range of participants and variety of settings.

It can also be argued that gaining consistent results across the different settings and when administered by different therapists, highlights the effectiveness of the LAMP approach, since both these uncontrolled variables had little impact on the positive outcomes obtained. This also supports the aims of the research, in assessing the level of generalisation of improvement, when LAMP was introduced in the client's natural setting. Another thing that allowed for greater control of this variable was the regular occurrence of teleconferences between the therapists, allowing for cross-communication and support.

Other limitations were in the choice of data collection tools in their ability to provide more specific and measurable changes in quantitative results, rather than changes mainly being evident qualitatively. The expressive and receptive communication checklists were specific to information gathered on the actual day the checklists were completed. No other variables were factored in that may have affected communication and participation on this day, which meant that subjective data were obtained, making it difficult to show progress across time and across other aspects of communication.

Another limitation was in the time provided and selected for implementation of the research. On completion of the research it became apparent, especially in the school environment, that the beginning of the year, or first term of school, was not a good choice of time to implement the research. Both teachers and therapists reported that the 'first term was not a great time to be introducing devices'. All teachers were new to these students and they were trying to settle all children in to the class 'and there was little time to implement additional services.' They would have liked to be doing this in Term 2 when they knew the students better and the routines were more established. One teacher said 'Term 1 is very difficult to implement something new as MB was a new student in a new class. The classroom goal was to understand the classroom routine and to transition. Term 2 would have been better.'

Other limitations with implementation in the classroom setting were the attraction of the device to other students in the class, wanting to take and use the device, or have a turn. Also, the difficulty with the classroom set-up made implementation difficult in the classroom. Some therapists were able to take the clients out for some 1:1 sessions at different times throughout the week and, one said 'I feel this is where the most gains in skills were made.' The number of participants within one class was a challenge, as one therapist reported 'in retrospect four children across two classes was probably too big a commitment with the rest of my caseload.'

For the participants that were mainly provided with structured sessions at school, it was also suggested that it may have been better to begin with implementation and training at home, and then gradually generalise implementation into the classroom, or have more joint sessions with the parents in the classroom. Again, this would be to increase consistency of implementation and knowledge of LAMP philosophy across participants and users of the device. Looking at the data that was collected over the weeks, in between sessions, this supports this suggestion, as greater data collection was completed by the family where the structured sessions were completed in the home, and consequently, this child showed the greatest outcomes in number of words used on the device (PM).

A further limitation was in individual and family circumstances and changes during the time of the research, for which we could not control. Other than the family that was unable to complete the research, JB's circumstances, were also brought to our attention, as they may have affected his outcomes. These circumstances included things such as changes in medication, increased anxiety, staying at respite care and staff there not being receptive to use of the device in that setting, sickness and being off school, behaviour of other children in his classroom affecting teacher's ability to implement use of the device. TD also had an accident the week before starting the research, and broke her arm, and had to have it in a cast during the implementation of the device. These are all factors that affected the efficiency of implementation and use of the device.

The above limitations should be considered during any future planning of a similar research project and in reading the results and outcomes of this research project.

Future directions

There are several directions that future research could take. One of these is the implementation of the device on a larger scale, with anticipation of providing more rigorous results. The draw back with this suggestion is our ability to access sufficient devices to extend the intervention. A second suggestion would be to have a control group to be able to compare the groups, e.g. one group using the Vantage Lite with LAMP methodology, while the other group having visual supports alone implemented as a means of communication.

Research could continue to focus on more specific aims and outcomes, such as a comparison of how age, gender, level of communication prior to

implementation, degree of ASD versus intellectual disability, would impact on outcomes of using the device, and whether there would be greater gains from one group over another.

Long term follow up and collection of data would allow for evaluation of maintenance and long term outcomes with implementation of the device for communication, social interaction, engagement and independent life skills. Aspect is committed to continuing to support and investigate outcomes using LAMP methodology and aims to purchase devices for use Aspect wide, to be able to trial the device with different children, prior to suggesting their use to parents, in line with the Aspect Comprehensive Approach (ACA) and best practice outcomes.

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The therapists who have been involved in the research are also committed to educating and building capacity of others within the organisation and in the area of ASD and disability regarding these outcomes. There are plans to both present at relevant conferences and publish the results and data in journal publications. Conferences could include AGOSCI, APAC and the Speech Pathology Australia (SPA) conferences in 2013. The first presentation of the data will be at the Aspect Research Forum on 4 April 2013 in Sydney.

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The Aspect vision for research

Aspect is committed to improving the lives of individuals with ASDs through service provision and evaluation for continuous improvement. As the largest ASD-specific service provider in the country and one of the largest in the world, Aspect is well positioned to facilitate and conduct such evaluation. Aspect undertakes and supports research to evaluate Aspect's and other programs, practices and interventions in order to provide improved services and interventions for children and adults with ASDs. Aspect also promotes research at state and national levels and facilitates tertiary students' research. As our aim is to develop our knowledge of what can be done to support individuals with ASDs, research findings will also make a significant contribution to the field of international research into ASDs. Aspect requires ongoing funding to support these key initiatives and is always keen to talk to potential new partners and donors.



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