Prentke Romich Company's

Procedure Manual for the Language Activity Monitor

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Please Note:

Instructions for setting up the LAM with your device and a computer are in the *LAM Box Instructions* manual. If your device has the LAM software built in, the instructions for setting up the LAM are in the operator's manual for your device.

Procedure Manual
for the Language Activity Monitor

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Foreword and Acknowledgement

Our professions' futures depend
on the effectiveness of our treatments,
not on our impressions of their effectiveness.

Jeri A. Logemann, ASHA President
ASHA Leader, March 14, 2000

AAC clinical intervention recently has begun to benefit from the availability of automated AAC performance measurement tools. These tools, starting with the language activity monitor (LAM), have provided the data necessary to practice AAC as a science. The LAM function is now available as a device to add to older AAC systems, as software to run in a computer, and as a built-in feature in modern high performance AAC systems. The development of these tools and notions on how to use them are continuing to evolve. In addition to the information contained in this manual, readers are advised to consult the web sites of Prentke Romich Company and Edinboro University of Pennsylvania. Contact with the principal investigator and research coordinator is invited.

This work has been supported in part by a grant to Prentke Romich Company from the National Institute for Deafness and Other Communication Disorders of NIH.

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AAC Best Practice using Automated Language Activity Monitoring

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ABSTRACT
AAC automated language activity monitoring (LAM) tools are making practical for the first time the collection, editing, and analysis of language data gathered during structured sessions or from interactions in the natural environment. Implications are significant in the areas of clinical intervention, outcomes measurement, and research.

INTRODUCTION
Since the emergence of the field of AAC, professionals, family members, and consumers have agreed that the desire to communicate is the primary reason for using an AAC system. In fact, the goal for AAC is to provide the system and services that result in the highest level of personal achievement for the people who can benefit from the use of an AAC system (Hill & Romich, in press). Little research is available based on the actual communication of people who rely on AAC. Further, the AAC clinical intervention process seldom takes into consideration in an objective way the use of the AAC system between periodic therapy sessions. Conventional methods of monitoring AAC system use are based on personal observation and video or audio recording with subsequent observation, timing, and/or transcription. The cost of this approach is high because of the human time investment and the availability of the data is untimely. Consequently, professionals seldom collect data on the actual daily environmental use of AAC systems by consumers.

Determining the effectiveness of clinical intervention requires evidence. With few, if any, exceptions, clinicians providing services to people who rely on AAC have not had the luxury of time necessary to obtain language samples from actual use of the AAC system in the natural environment. The obvious solution to this situation is the automation of the language data collection and analysis processes. There have been some efforts made in this area, all integral to specific communication or writing systems (Miller, et.al., 1990; Ahlsen & Stromqvist, 1999; Copestake and Flickinger; 1999). Some commercially available AAC devices have included limited features that monitor use, but until now none have incorporated time information.

LANGUAGE ACTIVITY MONITOR (LAM)
Romich and Hill (1999) are in the process of developing and testing the function of language activity monitoring. Work has been done on two configurations. Modern high performance AAC systems now include LAM as a standard built-in internal feature. For older AAC systems that have a serial port representation of what is spoken, an add-on LAM device is available from Prentke Romich Company. The LAM function records each language event (one or more letters, words, phrases, sentences, etc.) from the AAC system and attaches a time stamp. The data stored in the LAM over time is then periodically uploaded to a computer for editing and

analysis. This uploading process can happen without custom computer software and the data can be transmitted as an email attachment or saved on a floppy disk for transmission or transport to a different location for analysis.

COLLECTING LANGUAGE SAMPLES

Language samples can be gathered using various techniques in structured sessions. These include picture description, interview, narrative, and conversation. In addition, samples can be gathered in the long term (days or weeks) in the natural environment.

PROCESSING RAW LAM DATA

The raw LAM data must be uploaded into a computer for editing and analysis. Presently, the HyperTerminal program which is part of Windows is being used for this. The use of a standardized reporting protocol provides for universal compatibility with computer-based applications (Hill & Romich, 1999). Below is an example of how the raw LAM data looks once uploaded into HyperTerminal:

20:37:00 "I need "
20:37:05 "*[VOLUME UP] * "
20:37:06 "*[VOLUME UP]* "
20:37:07 "*[VOLUME UP]* "
20:37:14 "something "
20:37:16 "to drink "
20:37:19 "i"
20:37:20 "m"
20:37:24 "m"
20:37:28 "ediately "

Once the raw LAM data is in HyperTerminal the text can be copied, pasted and edited in a word processing document. The final product is a language transcript that can be used for analysis. The above utterance example would look as follows after being edited:

I need something to drink immediately.

ANALYZING LAM DATA

After LAM data is uploaded into the computer and the raw data has been edited, the text is analyzed using standard and/or custom vocabulary and language analysis software applications. Various parameters to be analyzed could include:

- vocabulary diversity
- frequency counts
- spelling versus whole word access
- morphological usage
- lexical or semantic usage
- syntactic structures
- developmental levels.

LAM data analysis at the time of this writing has been based on the Systematic Analysis of Language Transcripts (SALT) (Miller, 1983). The time required to upload, edit, and analyze a two hour language sample of over 100 utterances from a high-end user takes approximately 15-20 minutes using these procedures. Simpler analysis, such as word searches, may take only a few minutes. The development of LAM tools to support editing and analysis will reduce analysis time significantly. Table 1 is based on SALT analysis of data from a two hour language sample collected from an intermediate user in the natural environment.

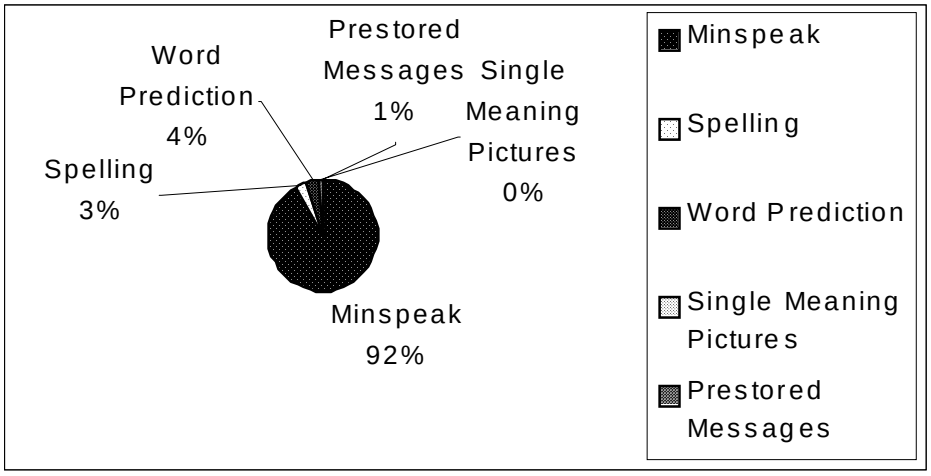
Table 1: SALT analysis

Language Analysis Feature	Results
Total number of utterances	116
Mean length of utterance (MLU)	4.92
Number of different word roots	190
Total main body words	571
Type Token Ratio	.33

To satisfy needs other than those addressed by standard language analysis programs it may be necessary to develop custom applications or use manual methods to analyze the LAM data. Examples of this could be analysis of use of particular vocabulary items since the previous therapy session, calculation of communication rate using the time stamps, methods used for language representation (single meaning pictures vs. spelling vs. semantic compaction), and error rates and types. Table 2 reports data collected from a high end user after two hours of recording in the natural environment.

Table 2: Language Representation Methods

Language Representation Method	Number of Words	Percentage
Total word count	766	100%
Total Minspeak words	707	92.3%
Total whole messages	1	0.8%
Total single-meaning pictures	0	0%
Total spelled & predicted words*	53	6.90%
Total spelled words	23	2.99%
Total predicted words	30	3.90%
Predicted /(spelled + predicted)	30/53	56.6%
Total letter codes	0	0%



PRIVACY

One important issue in the use of any recording device is privacy. Both the LAM device and the internal LAM function provide for disabling the recording. It is strongly recommended that people whose communication is being monitored be clearly informed and that public use of recorded communication be anonymous. The LAM report header starts with the warning:

***** CAUTION! *****
The following data represents personal communication.
Respect privacy accordingly.

SUMMARY

Current best practice in AAC implementation emphasizes communication outcomes based on a team selecting outcomes from a functional curriculum model (Blackstone, 1990; Hill, 1996; Gray, 1998). AAC outcomes can be determined by noting positive changes in the attitudes of teachers, classmates, co-workers and others toward the consumer (Calculator, 1998). However, the tools described here provide more objective data to represent the quality and quantity of communication performance. Clinicians using LAM tools are able to document daily use of targeted vocabulary and language representation methods thus facilitating the intervention process across environments. AAC teams have the instrumentation to develop and monitor Individual Education Program (I.E.P.) goals and objectives and to qualify the implementation strategies and techniques used to facilitate AAC system use.

ACKNOWLEDGEMENT

The development of LAM tools has been supported by a grant to Prentke Romich Company from the National Institute for Deafness and Other Communication Disorders of NIH.

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Consent and Privacy

> Individuals shall not reveal, without authorization, any professional or personal information about the person being served professionally, unless required by law to do so, or unless doing so is necessary to protect the welfare of the person or of the community.
>
> ASHA Code of Ethics
> Principle of Ethics I
> Rule of Ethics I

By the very nature of providing communication therapy, AAC professionals may hear, see, or otherwise receive information from the individual being served that could be sensitive. The ASHA Code of Ethics addresses the general issues, but specific reminders and procedures can be implemented to assure compliance.

Language activity monitoring (LAM) tools generally include reminders. For example PRC LAM systems transmit a header prior to the recorded data. Included in the header is a caution:

***** CAUTION! *****
The following data represents personal communication.
Respect privacy accordingly.

AAC professionals are advised to maintain a written consent form authorizing the collection of language data. The use of written documentation similar to that used for the more traditional methods of audio, video, and direct transcription recording is suggested. A sample consent form is included in the appendix.

Language Sample Collection Protocols

Language samples can be collected in either the clinical setting or in the natural environment. The clinical setting can be much more structured and thus more can be known about how the data was generated. However, communication in the natural environment is the ultimate goal of AAC therapy. Both offer particular values.

Language sample collection can be based on a number of approaches, including picture description, interview, conversation, or clinician choice. The goal of language sampling is to obtain the largest sample of continuous spontaneous interaction from the individual as possible. The communication partners should feel free to provide appropriate prompts and cues to elicit the most representative spontaneous sample from the individual. Here are brief descriptions of scenarios that were used in recent research. These scenarios are based on input from people who rely on AAC.

Picture Description Scenario: The picture description scenario is based on standard language sampling procedures. The Cookie Theft picture* (see appendix) is being used with both children and adults who rely on AAC. The individual is asked to describe the picture given the following instructions, "Tell everything you see going on in this picture." Terminate the activity when the individual has no more to say about the picture.

Interview Scenarios: Two interview scenarios have been modeled after a study by Dollaghan, et. al. One contains questions to use with children 5 through 15 years of age. The other contains questions to use with individuals 16 years and older. Both are included in the appendix. The interviewer utilizes discourse strategies to maintain and expand the dyadic conversation. The interview scenario generally is terminated at 30 minutes in length.

Conversation Scenarios: Conversation in the natural environment should involve more than one communication partner. The language sample should be collected from the augmented communicator in natural settings during activities of daily-living. Consideration should be given as to activities that provide maximum opportunities for interactive communication. Use knowledge of the individual to select communication topics that will provide for the most representative sample possible. The language sample will be terminated at 1 hour.

Clinician Choice Scenarios: A language sample can be collected based on clinical experience with the augmented communicator. Use knowledge of the individual to select an activity or task that will provide for the most representative sample possible. This is enhanced if the conversational sample is collected using familiar situations, persons, tasks or topics. The sample time is terminated at 45 minutes. A description of clinician choice methods should be maintained for future reference.

Reminder: During the language sampling procedure, no one other than the individual should generate communication using the AAC system.

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* Goodglass, H. & Kaplan, E. (1983). The Assessment of Aphasia and Related Disorders, Second Edition. Lippincott Williams & Wilkins, Philadelphia. Source: Lippincott Williams & Wilkins, 530 Walnut Street Philadelphia, PA 19106-3621; Tel: 215-521-8300; Fax: 215-521-8902; http://www.lww.com

Quick Reference LAM Procedures

Procedures for language sampling:

1. Confirm that the LAM function is on and test to ensure proper functioning and connections.
2. Engineer the environment to facilitate communication.
3. Arrange any materials needed to collect language sample.
4. Record start time.
5. Collect language sample.
6. Record stop time.
7. Turn the LAM function off if it was off prior to the session.

Uploading and Saving Language Samples

If PC-LAM was used to collect the language sample, the sample is already in the computer at the end of the collection process. Otherwise, the sample must be uploaded into the computer from either the LAM device or the AAC device with the built-in LAM function. This process has four steps.

1. **Prepare the computer to accept the uploaded data.** PRC has an upload program (LAMterm) that can be downloaded from the PRC web site www.prentrom.com. This program also is provided on disk with the LAM device and with AAC devices that include the LAM function. Alternatives to using this program would include using HyperTerminal (included in Windows) or another terminal program. HyperTerminal can be found by selecting START, PROGRAMS, ACCESSORIES, COMMUNICATION. The LAM device transmits at 9600 baud. The program running in the computer must match the baud rate of the LAM device or AAC device with the built-in LAM function. Creating a desktop shortcut icon will facilitate the upload process in the future.

2. **Assign a file name and location.** The use of some method and order at this stage will pay big dividends in the future. It is recommended that a LANGUAGE SAMPLES folder be created. Inside the LANGUAGE SAMPLES folder, create a separate folder named for each individual for whom language samples will be collected. Each language sample should be given a file name that includes information useful in selecting which file to open later. The suggested format is

   YYMMDD_n_ls_name.txt

   where

   - "YYMMDD" is the year, month and date
   - "n" is the number of the language sample for this individual on this date
   - "ls" is the language sample context (2 characters)
     (pd = picture description, in = interview, co = conversation, etc.)
   - "name" is the first four letters of the individual's last name.

   For example, the first language sample for John Doe that was collected using the picture description scenario on 21 April 2000 would be labeled "000421_1_pd_doe.txt" and would be found in the John Doe folder in the LANGUAGE SAMPLES folder. Since the computer organizes the files numerically and then alphabetically, samples will be listed in chronological order in the folder and the folders will be listed in alphabetical order.

3. **Connect the LAM or AAC device to the computer serial port.** Generally, this will require a NULL MODEM cable with a D-9 plug on each end. However, the AAC device may have a different connector for the RS-232c serial port.

4. **Activate the upload process in the LAM or AAC device.** Refer to the device instructions.

Editing, Analyzing, and Reporting Language Sample Data

At this time (April 2000), analysis of language sample data can be implemented using a few methods. The data can be viewed manually using a basic word processor. Particular words can be found using search features.

If the word processor has macro capability (such as Microsoft Word), a macro can be built to facilitate stripping the time stamps (HH:MM:SS), quotation marks (“), spaces, and new lines so that the sample can be made into an utterance format. Here is a macro for Microsoft Word 2000 that accomplishes this function. It searches for a quotation mark (“) and deletes all text on the line up to that point, then it moves to the end of the line and deletes the last character. This would typically be the ending quotation mark (“) for that language event. The macro can be set up for access using a single key, such as a function key, or by clicking on a toolbar icon.

```
Sub LAMedit()
'
' LAMedit Macro
' Macro recorded 5/8/00 by Customer
'
    Selection.Find.ClearFormatting
    With Selection.Find
        .Text = """"
        .Replacement.Text = ""
        .Forward = True
        .Wrap = wdFindContinue
        .Format = False
        .MatchCase = False
        .MatchWholeWord = False
        .MatchWildcards = False
        .MatchSoundsLike = False
        .MatchAllWordForms = False
    End With
    Selection.Find.Execute
    Selection.HomeKey Unit:=wdLine, Extend:=wdExtend
    Selection.Delete Unit:=wdCharacter, Count:=1
    Selection.Delete Unit:=wdCharacter, Count:=1
    Selection.EndKey Unit:=wdLine
    Selection.TypeBackspace
    Selection.HomeKey Unit:=wdLine
    Selection.TypeBackspace
    Selection.MoveDown Unit:=wdLine, Count:=1
    Selection.HomeKey Unit:=wdLine
End Sub
```

Various language analysis programs are available. Two such programs are indicated here. Feedback from individuals using other programs to analyze LAM data is requested.

Once the sample is in utterance form, it can be annotated for preparation to be fed into SALT, Systematic Analysis of Language Transcripts. Adhering to transcription conventions of notation found in the SALT documentation is important in order to obtain the maximum benefit from this analysis. SALT is available from:

Language Analysis Lab
Waisman Research Center
University of Wisconsin – Madison
1500 Highland Ave.
Madison, WI 53705-2280
Tel: 608-263-6791; Fax: 608-263-7710
Email: salt@waisman.wisc.edu
Web site: www.waisman.wisc.edu/salt/

Wordsmith Tools is a program available from the English Language Teaching catalogue of Oxford University Press http://www1.oup.co.uk/elt/catalogu/multimed/4589846/4589846.html. The Wordlist tool, one of six included, generates word lists in alphabetical and frequency order, enabling you to compare texts lexically. It also provides statistics such as total number of words, length of words, number of sentences, etc.

Language representation method analysis is possible through analysis of original data and some knowledge of the nature of the AAC system. For example, when a language event is a word or phrase that is part of the Minspeak core vocabulary, it can be identified as such. Spelling and word prediction use, as well as pre-stored utterances, are obvious. Transcription codes can be developed using SALT procedures to provide for analysis of the frequency of language representation method use. The development of standardized transcription codes is in process. Dissemination will follow.

A sample LAM Report is included in the appendix. It was generated using standard word processing and spreadsheet programs.

Work is under way toward the development of additional computer software to facilitate the uploading, editing and analysis of language samples and the generation of reports. Various analyses are being explored.

➲PC LAM software which allows your computer to work as a LAM, and LAMterm software, which allows you to upload LAM data to a computer, are both available to download from the PRC web site, www.prentrom.com. To be kept apprised of new developments in this area, visit the PRC web site and sign up for *The Grapevine*.

➲If you own a PRC AXS1600™, Vanguard™ or Pathfinder™ AAC device, the LAM software is already installed in the device.

Use with AAC Devices with Serial Port

The Language Activity Monitor device and PC-LAM both can accept language sample data from any AAC device that offers a textual representation of language events on the AAC device RS-232c serial port. The AAC device serial port is connected to the LAM or computer using an appropriate null modem type cable. Different AAC devices have different features. The AAC device will need to be configured to provide the most useful language sample information. Some general considerations are provided here. Information specific to particular AAC devices can be found at the PRC web site www.prentrom.com.

The AAC device serial port may need to be selected and/or turned on.

The baud rate may need to be set. LAM and PC-LAM can be set to accept baud rates over a range from 300 baud up.

If possible, the device should be configured to send the language event out the serial port at the time that the language event occurs. (Immediate vs. delayed.)

Character pacing, if available, should be turned off. This is a feature of some systems that was included to facilitate computer access with older computers.

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Consent to Monitoring of Language Activity

The most effective provision of therapeutic services to individuals who rely on augmentative and alternative communication (AAC) depends on the monitoring of communication. Generally, this monitoring takes place in the clinical setting. However, modern methods of AAC therapy include provision for monitoring communication in the natural environment. Effective communication in the natural environment is, after all, the goal of AAC intervention. The American Speech-Language-Hearing Association (ASHA) acknowledges this issue and includes consideration in the ASHA Code of Ethics.

> Individuals shall not reveal, without authorization, any professional or personal information about the person being served professionally, unless required by law to do so, or unless doing so is necessary to protect the welfare of the person or of the community.
>
> ASHA Code of Ethics
> Principle of Ethics I
> Rule of Ethics I

The purpose of this consent is to maintain a record of communication on this issue. Further, it provides for the option of sharing logged language samples, modified if necessary to maintain confidentiality, with others for the purpose of advancing the general practice of AAC intervention.

Consent

I hereby consent to the collection of language samples from the communication of

_____ in **clinical settings** and/or in **the natural environment**.
(Print name of individual being served) (Circle (YES) or X (NO) each **bold** choice.)

Samples also may be used for **inclusion in a language sample library** and for **educational purposes**,
(Circle (YES) or X (NO) each **bold** choice.)

including the inclusion in materials for publication. I understand that samples will be modified if necessary to prevent identification of the source of the sample and/or the identification of any other person who has not provided consent. I understand that the language activity recording can be turned on and off at will and that I have received instruction on how to do that.

_____
Signature of individual or legal representative. (If not individual, print name also.) Date

Address _____

City, State, Zip_____

Telephone _____

Email _____

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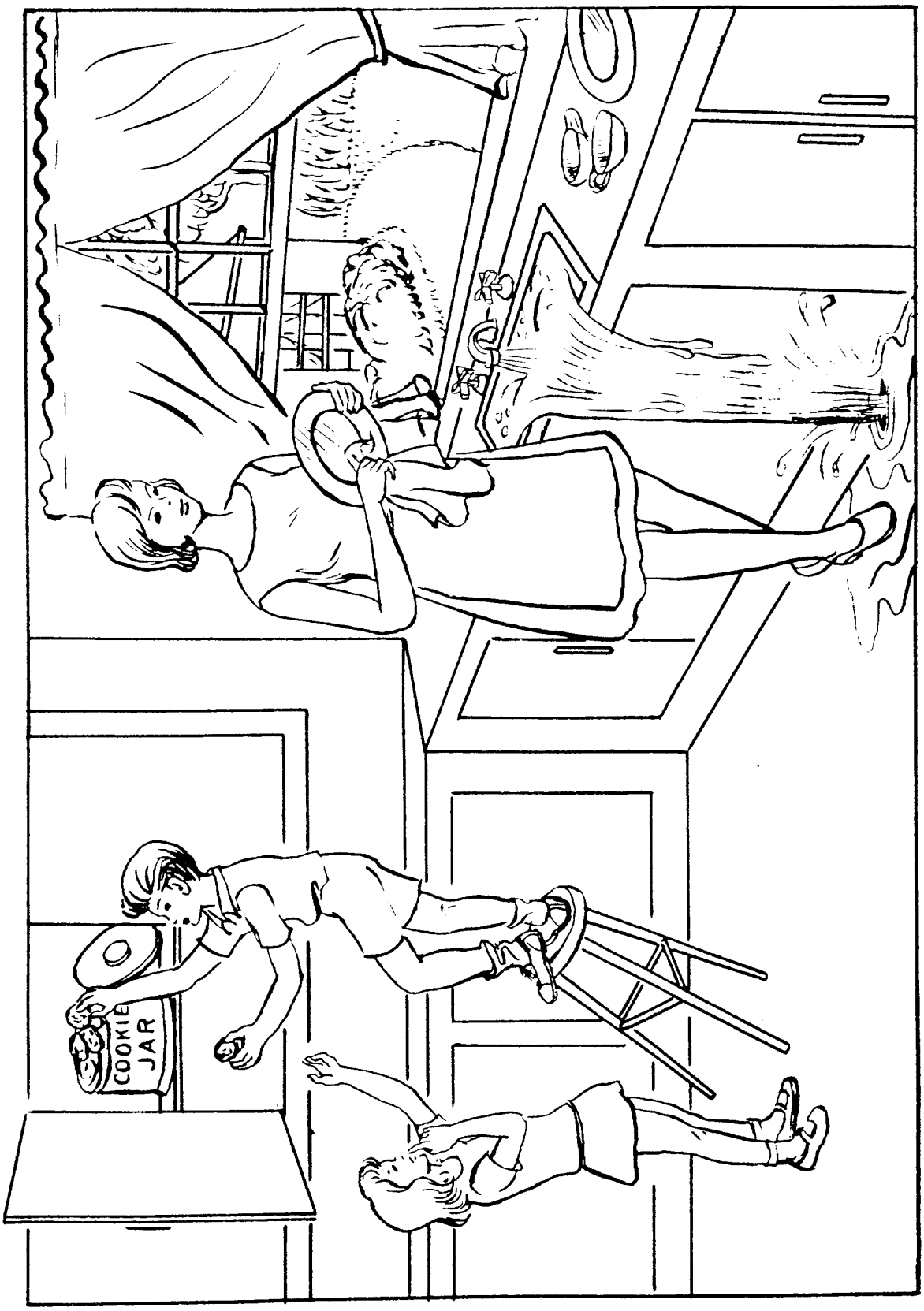


Child Interview

Interview Procedures*

1. Test the LAM function, engineer the environment to facilitate communication, arrange materials, etc.
2. Explain that you and the child will be talking for 30 minutes and you will be using a watch or clock to know when it's time to do something different.
3. Record the start time and begin the interview. These topics are meant to generate other subjects in which the child may be interested. Follow this sequence until he or she shows interest in a topic and follow up on this until the child seems ready to move on. If the child introduces a new topic, stay with it until it appears that he or she is ready to move on to another one. Our goal is to obtain the largest sample of continuous spontaneous interaction from each child as possible; the topic being discussed is of minor importance. Clinicians need to use their own discretion in modifying questions and determining appropriateness of the task based on the abilities of the child.
4. Record the stop time.
5. **At no time during the procedure should anyone else use the child's AAC device.**

*Instructions for obtaining an interview sample from a child have been adapted from the following article: Dollaghan, C.A., Campbell, T.F. & Tomlin, R. *Video narration as a language sampling context*. Journal of Speech and Hearing Disorders, 1990. **55**: pp. 582-590.

1. What is your name?
2. Tell me all about who you live with.
    a. If brothers or sisters are mentioned ask about them.
    b. What kinds of games do you play with them?
3. Where do you go to school?
    a. What is your teacher's name?
    b. What do you like to do most at school? Why?
    c. What don't you like about school? Why?
    d. How do you talk to the other kids in your class?
4. How long have you been using your (communication device)?

a. Do you like it?

b. What do you/don't you like about it?

c. What do other people say about it?

d. Tell me how it works. . .

e. What are some things you like to say?

5. What other devices have you used?

   a. Why did you switch to (current device)?

   b. What did/didn't you like about the others?

6. What kinds of things do you like to do for fun?

   a. If a television show/game: I've never seen/played that. What's it about?

   b. If an activity/task: How do you do that?

7. Tell me about your favorite television show/movie/book?

   a. When did you see/read it last?

   b. Who is in it?

   c. What did they do the last time you saw/read it?

   d. Why do you like that show/movie/book?

   e. What would you do/Who would you be if you were in it?

   f. Why would you pick that activity or person?

8. Have you ever gone on a vacation? Tell me about it.

Adult Interview

Interview Procedures*

1. Test the LAM function, engineer the environment to facilitate communication, arrange materials, etc
2. Explain that you and the individual will be talking for 30 minutes and you will be using a watch or clock to know when it's time to do something different.
3. Record the start time and begin the interview. These topics are meant to generate other subjects in which the individual may be interested. Follow this sequence until he or she shows interest in a topic and follow up on this until the individual seems ready to move on. If the individual introduces a new topic, stay with it until it appears that he or she is ready to move on to another one. Our goal is to obtain the largest sample of continuous spontaneous interaction from each person as possible; the topic being discussed is of minor importance. Clinicians need to use their own discretion in modifying questions and determining appropriateness of the task based on the abilities of the person.
4. Record the stop time.
5. **At no time during the procedure should anyone else use the person's AAC device.**

*Instructions for obtaining an interview sample from a child have been adapted from the following article: Dollaghan, C.A., Campbell, T.F. & Tomlin, R. *Video narration as a language sampling context.* Journal of Speech and Hearing Disorders, 1990. **55**: pp. 582-590.

1. What is your name?
2. How old are you?
3. What are your reasons for using an AAC system?
4. When and where were you first introduced to AAC? (Please explain in detail).
5. Tell me about your current equipment.
    a. How long have you had it?
    b. What have you used in the past?
    c. Why did you change?
6. What features do you like/dislike most about your current system?
7. How do you manage the vocabulary and messages stored in your AAC system?

8. Explain the ‘social rules’ you would like your communication partners to honor when you are carrying on a conversation. (An example of this may be that others don’t complete/anticipate your sentences for you).
9. How has your current system changed your life?
10. Do you have any specific suggestions for how to adapt or change your current system to increase its efficiency?
11. If you work or attend school, tell me about it.
    a. Where do you work/go to school? Describe the setting in detail please.
    b. What types of things do you do?
    c. How do you use your AAC system to assist you there?
    d. How do others react to you and your AAC device?
    e. Why do you think they react in that manner?
12. What advice would you give new users of the same equipment?
13. How do you feel the LAM will benefit AAC?
14. Why should/shouldn’t LAM devices be integrated (internal function) in equipment?
15. What would you like others to know about you?
16. What are your goals for the future?
17. What types of activities do you do for fun or in your leisure time?
18. Tell me all about the activity you enjoyed most in the past 6 months.

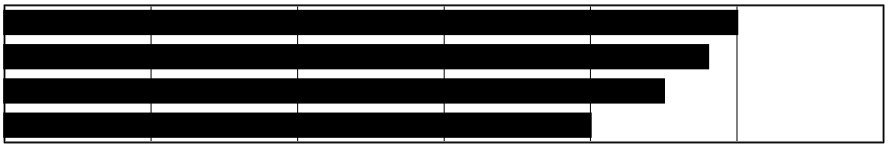
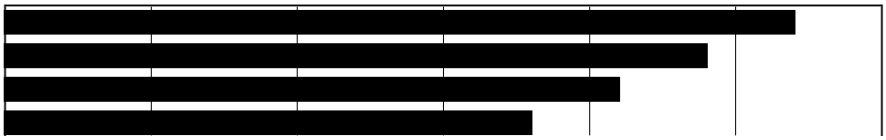
LAM Report

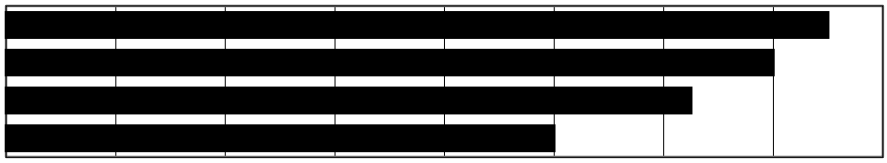
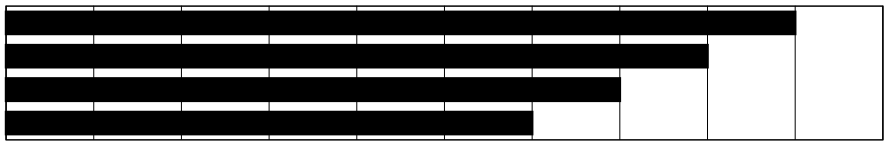
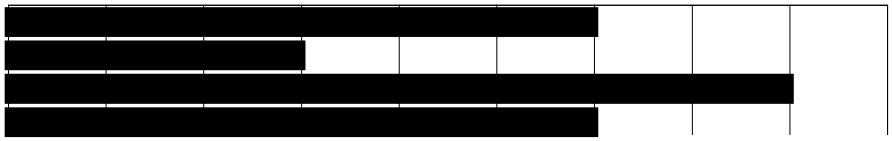
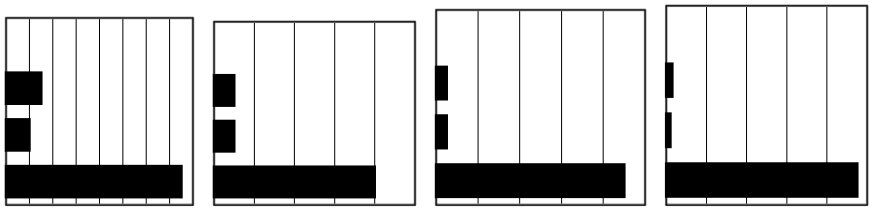
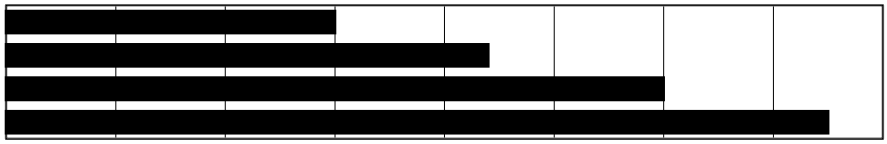
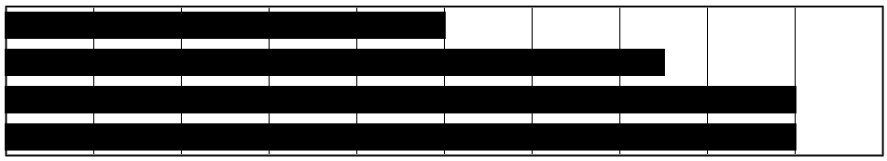
Name: John Smith
DOB: 25 May 1982 (Age: 18)
Language Representation Methods: *(check all available)*
__X__ Sem; __X__ Spe; __X__ Wpr; __X__ Ppr; __X__ Smp
Selection Technique: Keyboard
AAC System: Pathfinder

LAM data file: 001120_1_in_smit.txt
Date of Report: 20 November 2000
Location: CATER, Edinboro, PA
Examiner: K. Hill
Transcriber: K. Hill
Sample time: 30 minutes

Language Sample Context: *Please check*
_____ Conversation (# Partners ___)
__X__ Interview
_____ Narrative
_____ Picture Description
_____ Natural Environment
_____ Other: _____
(Briefly describe)

Dates of historical reference (Maximum of three). 000107 000405 000708

Summary Measure	*Data*	**Bar Chart History (Current data is top (right for item K))**
A. Total utterances	**27** 26 26 26	
B. Complete utterances (%)	**50** 48 45 40	
C. Spontaneous utterances (%)	**95** 93 90 85	
D. Mean length of utterance in words (MLUw)	**10.0** 9.0 8.0 7.0	
E. Mean length of utterance in morphemes (MLUm)	**12.0** 10.0 9.0 8.0	
F. Total words	**270** 240 210 180	

G. Different word roots	**150** 140 125 100	
H. Average communication rate (Words / Min.)	**9.0** 8.0 7.0 6.0	
I. Peak communication rate (Words / Min.)	**12.0** 10.0 9.0 8.0	
J. Selection rate (Bits / Sec.)	**7.5** 7.3 7.7 7.5	
K. Language representation method (LRM) usage for spontaneous utterances (%)	**Pic: 0** **Spe: 3** **Wpr: 2** **Sem: 95**	
L. Word selection errors per utterance	**.3** .44 .6 .75	
M. Spelling errors per word spelled (%)	**10** 15 18 18	

Appended reports:

- X 1. Raw LAM data
- X 2. Edited utterances
- X 3. Coded utterances
- ____ 4. Word list in alphabetical order
- ____ 5. Word list in frequency order
- X 6. Word list by LRM
- ____ 7. Word list comparison to reference lists