A COMPARISON OF RESPONSE MODES IN A TEST OF MATHEMATICS IN LEARNERS WITH SEVERE PHYSICAL IMPAIRMENTS

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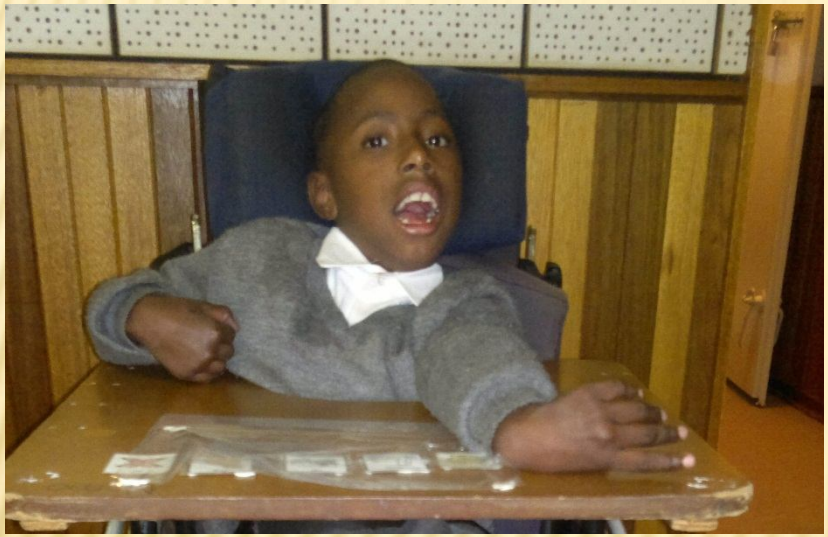
WHY?



THEORETICAL FRAMEWORK

- Every learner should be able to pursue his/her learning potential to the fullest.
- Assessing learners with severe physical impairments' knowledge or skills in the classroom can be difficult (Casey, Tonsing and Alant, 2007).
- One needs to be fair and equitable and inclusive in education but tests should also be valid and reliable (Elliott, Kratochwille and Schulte, 1998).

THEORETICAL FRAMEWORK (CONT):

- Education White Paper 6 Special Needs Education (2001) commits the State to accommodate every learner who experiences barriers to learning.
- Guidelines for Inclusive Learning Programmes of White Paper 6 (2005) state that assessment strategies cannot be separated from teaching and learning and assessment strategies should be continuously adapted according to the level of support that each learner needs.

THEORETICAL FRAMEWORK (CONT):

- There is a need for assessment procedures for learners with severe physical impairments. (Encouraged by Curriculum 2005 Assessment Guidelines for Inclusion).
- This is true for diagnostic and educational tests.
- Through the use of assessment concessions appropriate assessment procedures will ensure that *abilities* and not *disabilities* are assessed (Casey, 2004).
- Concessions should form an essential part of accountability in education strategies (Alant and Casey, 2005).

ASSESSMENT VALIDITY

- Need a balance between assessment validity and the needs of the learner.
- To reliably assess the abilities of learners with physical impairments, physical demands of the tests such as verbal responses, can be alleviated (Casey et al, 2007). Thus, we can address the barrier to learning and not compensate for it (Alant and Casey, 2005).
- Assessment concessions can be made for learners with LNFS but should not subvert the purpose of the assessment.

ASSESSMENT VALIDITY : CONCESSIONS

- i) **adaptations** (changes in content of the test e.g. simpler vocabulary),
  ii) **modifications** (changes in content of test e.g. for different levels of learners. Thus little assessment equivalence between original test and modified test) and
  iii) **accommodations** (changes in way that tasks are presented or how learners respond to tasks).
- Accommodations include: altering presentation format, altering response mode and altering timing and or setting of the test.

ASSESSMENT VALIDITY: CONCESSIONS (CONT.)

- More than one concession might be required – such as using eye-gaze as response mode (response format) and extra time to complete the assessment (Wasson, Arvidson and Lloyd, 1997, Thurlow, Elliott & Ysseldyke, 2003).
- Validity of assessment concession should focus on the **purpose** of the assessment, the **skills** measured and **inferences** that the test user wants from the measurement outcomes.
- Thus: can the scores with and without concessions be compared? (Alant & Casey, 2005).

EFFICACY

- Umbrella term for effectiveness, efficiency and effects (Schlosser, 2003).
- Effectiveness = is a direct result of intervention to change behaviour.
- Efficiency = the comparison of at least two effective treatments in terms of time, error, cost or error rate. (such as separating two response modes that are both effective in their own right).
- Effects = refers to the links of specific intervention components to specific changes and can be decisive in continuing/terminating intervention.

PREVIOUS STUDIES ON EFFICACY

- Few studies done on efficacy of response modes in tests.
- Wagner (1994) used yes/no responses with PPVT-R.
- Brown and McMullen (1982) used spoken mode and eye-gaze in IQ test on typically developing children.
- Casey (2004) used spoken mode and eye-gaze in test on phonological awareness on typically developing children.
- The use of eye-gaze as a response mode proved valid in these tests. Binary response modes were used.
- ?Different responses such as a mathematics test

EYE-GAZE

- Eye-gaze is a primary motor task also used in aided communication (Treviranus & Roberts, 2003).
- Communication through eye-gaze → using one's eyes to intentionally communicate one's thoughts and intentions to others via gaze interaction (Majaranta & Bates, 2009).
- Gaze control is comfortable for the user and requires relatively little effort (Donegan et al, 2009).
- May therefore be meaningful as response mode to learners with severe physical impairments.

EYE-GAZE IN COMMUNICATION

- The use of an E-tran (eye-gaze board) is suitable for use by persons who can understand spoken language but have LNFS (Bhatnagar & Silverman, 2010).
- It involves the use of a clear transparent board or frame that enable eye-contact between user and partner.
- Symbols are attached to both sides (back-to-back) for use by the user and the partner. It can be arranged in different groupings according to skills and needs of the user.
- Start with four symbols and progress to eight groups of symbols (Sigafoos & Couzens, 1995).

METHOD: DESIGN

- A crossover within-group design was used as it enabled a within-group comparison (Schlosser, 2003).
- Participants were divided into two equivalent groups according to selection criteria and performance on pretest.
- The order of response modes was randomly determined. Each participant used one of two modes of response (spoken mode or eye-gaze mode) in a mathematics test.
- The mathematics test was repeated after a week using the response mode which wasn't used during the first test.
- Aim of design was to ascertain whether learner's responses were equivalent for both types of responses.

METHOD: DESIGN (CONT.)

First test: Spoken Mode
Second test: Eye-Gaze

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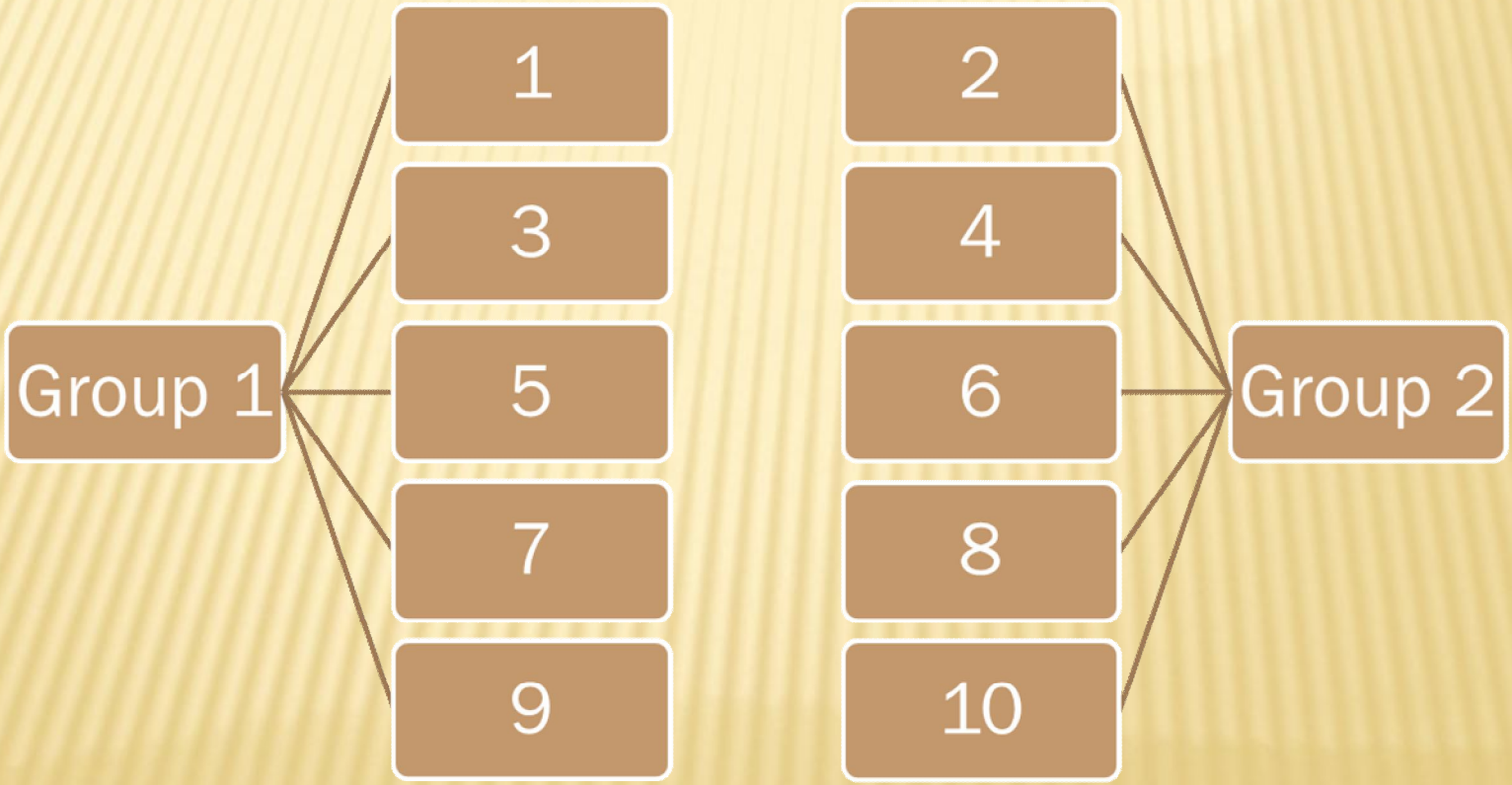
Second test: Spoken Mode



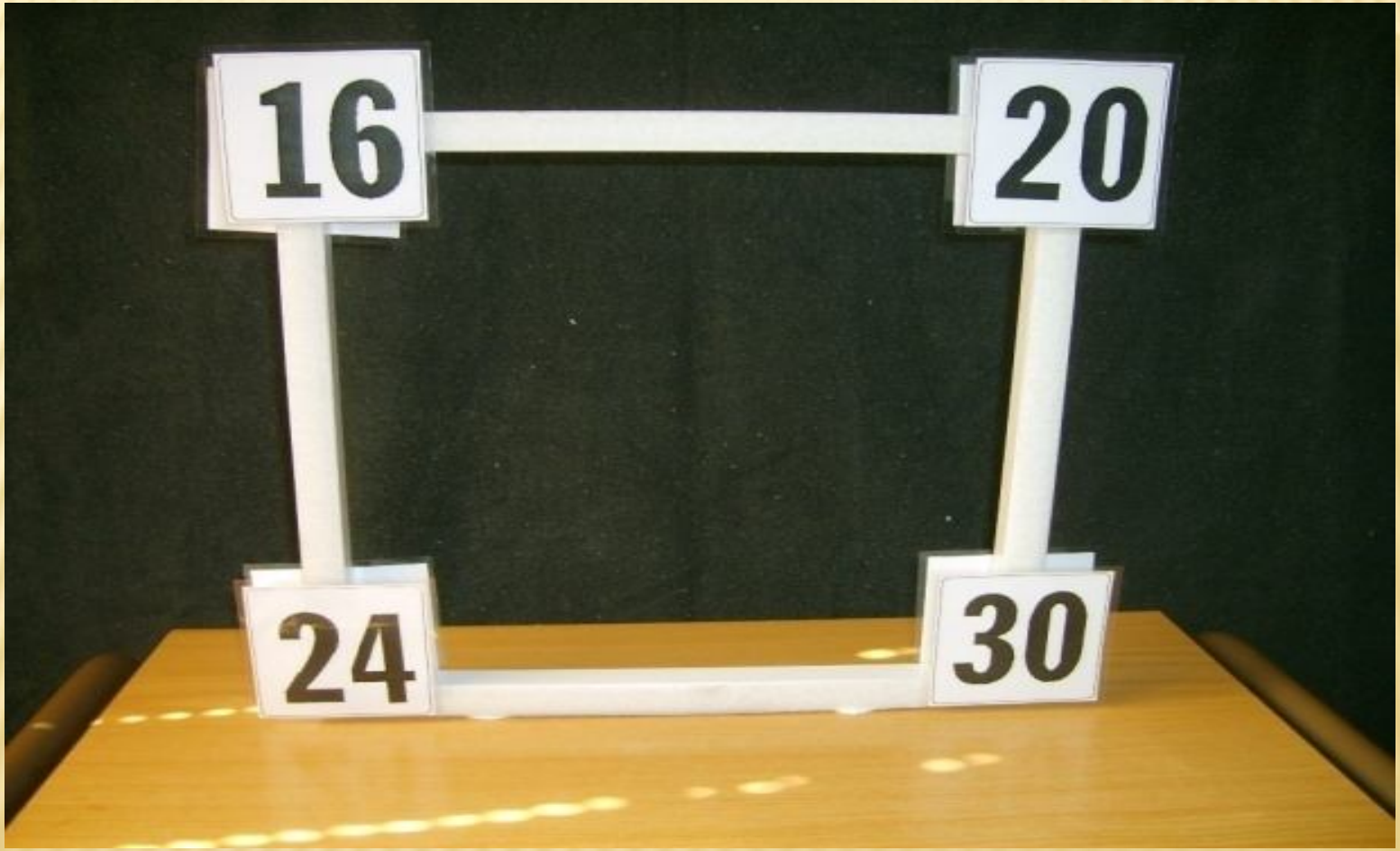
METHOD: PARTICIPANT SELECTION

SELECTION CRITERIA	METHOD
Severity of physical disability	GMFCS E+R (Palisano et al,2007)
Language competency	Teacher/Speech Therapist
Able to respond verbally to test	Teacher
Ability to visually identify numbers on E-tran	Pretest
Basic mathematical ability – grade 2 level (minimum) (+ / x)	Class test. Class teacher
Enrolled in grade 3 (8-11 y.)	Teacher/School register
Must attend a LSEN school	School register

METHOD: MATERIALS AND EQUIPMENT

- Mathematical test on adding and multiplication (grade two standard as appropriate level for first half of the grade 3 year).
- Recording sheets and pencil.
- Table, chair for researcher and chair for participant when wheelchair wasn't used.
- E-tran with four numbers (all possible answers) attached.
- Videocamera.

E-TRAN USED IN THE STUDY



PROCEDURES (PILOT STUDY)

- Permission from all the bodies involved were obtained.
- Dates and times for data collection were arranged.
- Individual assessment in a quiet room at school.
- Three practice trials were given with feedback if necessary.
- Test proceeded:

GROUP	TEST 1	TEST 2
1	Spoken mode	Eye-gaze mode
2	Eye-gaze mode	Spoken mode

PROCEDURES (CONT.)

- With test 2 the order of numbers was reversed, e.g. 12 + 4 = __, was changed to 4 + 12 = __ (order effects not a threat to internal validity).
- Sessions were videotaped by an assistant.
- Participants' score for each test was the total number of correct responses with maximum score = 15.
- Responses were recorded on data response sheets (coded to protect identity of participant).
- Total score per learner and per test were obtained.
- Scores for both tests were compared.
- Scores for response modes were compared. Total score per response mode was calculated.

PROCEDURES: PARTICIPANTS SCORES

SCORES PER PARTICIPANT			
PARTICIPANT NR	TEST 1	TEST 2	TOTAL SCORE
1	12	14	26
2	15	11	26
3	9	11	20
4*	8	5	13
5	11	14	25
6	12	8	20
7	9	7	16
8	8	6	14
9	6	7	13
10*	11	7	18

PROCEDURES: SCORES PER RESPONSE MODE

PARTICIPANT NR.	SPOKEN RESPONSE	NON-SPOKEN RESPONSE
1	12	14
2	11	15
3	9	11
4*	5	8
5	11	14
6	8	12
7	9	7 ♪
8	6	8
9	6	7
10	7	11

PROCEDURES FOR SCORING

- Functional equivalence of the two groups was determined by *s*, comparing the means of the two groups on both tests (Wilcoxin Two-Sample Test) (Cohen, Manion & Morrisen, 2001).
- Both Wilcoxin *p*-values of response modes were larger than 0.05. Thus no statistically significant difference between the orders of response modes used in the study.

RESPONSE MODE	P-VALUE
Spoken	0.2377
Eye-gaze	0.7583

PROCEDURES FOR SCORING (CONT.)

- As the *p*-value of the difference in error rate between the response modes is smaller than 0.05, there is a statistically significant difference between the scores on the two tests.

VARIABLE	MEAN	P-VALUE
Spoken mode	8.4000000	
Eye-gaze	10.7000000	
Difference	-2.3000000	0.0135

IMPLICATIONS (PILOT STUDY)

- To determine the efficacy by measuring the error rate of response modes in the test, functional equivalence of the two groups were determined.
- Groups were statistically equivalent.
- In pilot study, both *p*-values of the response modes were larger than 0.05. – Thus no statistically significant difference.
- Error rate in eye-gaze was less than that of spoken responses.
- Why?

IMPLICATIONS (CONT.)

- There might be different reasons:

- Goosens (1989) states that eye-gaze is a natural response mode and precedes the verbal response mode.
- Donegan et al (2009) state eye-gaze is easier, quicker and more effective than other methods, especially for persons who have limited options available.

IMPLICATIONS (CONT.)

- Casey (2004) states that under cognitively more demanding conditions learners revert to a previous and more immature level of response mode for accurate answers. (Participants were all second language learners and the test was presented in an oral rather than written mode which can be more demanding).
- Participants were all eager to comply and *help* their friends with LNFS.
- Added concentration due to novelty aspect of eye-gaze might also contributed to better scores (Casey, 2004).

DISCUSSION /CRITICAL EVALUATION OF METHODOLOGY AND PROCEDURES

- **Strenghts:**
- Issues of affordability and accessibility in a developing country are necessary in planning implementation of specialised services.
- Thus a study where a low cost method of assessment mode is explored, becomes important.
- But: the equivalence or non-equivalence of this assessment accommodation needs to be further explored before implementation.

DISCUSSION (CONT.)

- The cross-over design counterbalanced the threats to the internal validity of the study (Schlosser, 2003). - As the degree of equivalence between the two groups is necessary to validate the error rate of the two response modes.
- **Limitations:**
- The heterogeneous world of learners with severe physical impairments - ideally either physically impaired or having cerebral palsy.
- Learners with LNFS were excluded from study due to spoken response mode required by participants.

DISCUSSION (CONT.)

- Thus learners were selected according to the particular research problem (Higginbotham & Bedrosian, 1995).
- Further investigation would clarify the effect (if any) of impairment on response modes.
- These findings differ from findings of Casey's study (2004) on typically developing children. Further investigation is needed to verify findings and to find possible solutions for use as a response mode in assessment accommodations.
- Mathematics test was not a standardised test. See Education White Paper 6 Special Needs Education (2001) – tests and curriculum.

DISCUSSION (CONT.)

- **Recommendations:**
- Completion of the main study in order to verify the performance of severely impaired learners would explore the trend in performance in the eye-gaze response mode.
- All the participants in the pilot study came from one school. It can be of value to extend the study to learners from other schools as well.
- It might be of value to include different age groups to explore different responses, if any.
- It would be of value to extend the number of symbols used in the test from four to six and to eight symbols.

CONCLUSION

- This study sought to investigate the possibilities of using eye-gaze as a response mode when more conventional methods are not accessible to the learner.
- Should eye-gaze as response mode be found to advantage learners, it would not be a reliable method of response mode in assessment accommodations.
- To complete this study, the main study needs to be done to explore the preliminary findings of the pilot study.

REFERENCES

- Alant, E., & Casey, M. (2005). Assessment concessions for learners with impairments. *South African Journal of Education, 25*(3), 185-189.
- Bhatnagar, S.C., & Silverman, F. Communicating with non-verbal patients in India: Inexpensive augmentative communication devices. http://www.dinf.ne.jp/doc/english/asia/resource/apdrj/zl13jo0400/z13jo0405.html. Accessed 2010-02-14.
- Brown, R. J., & McMullen, P. (1982). An unbiased response mode for assessing intellectual ability in normal and physical disabled children. *Clinical neuropsychology, 4*(2), 51-56.
- Casey, M. (2004). A comparison of a non-spoken response mode and a spoken response mode in a test of phonological awareness. Unpublished MA dissertation in AAC. Pretoria: University of Pretoria.
- Casey, M., Tonsing, K. M., & Alant, E. (2007). Comparison of a non-spoken response mode and a spoken response mode in a test of phonological awareness. *South African Journal of Occupational Therapy,* Nov., 25-28.

REFERENCES (CONT.)

- Cohen, L., Manion, L., & Morrison, K. (2001). Research methods in education. London: Routledge Falmer.
- Donegan, M., Morris, J. D., Corno, F., Signorile, I., Chió, A., Pasian, V., Vignola, A., Buchholz, M., & Holmqvist, E. (2009). Understanding users and their needs. *Univ Access Inf Soc.* 8, 259-275.
- Elliott, S. N., Kratochwill, T. R., & Schulte, A. G. (1998). The assessment accommodation checklist: who, what, where, why and how? *Teaching Exceptional Children.* 31, 10-14.
- Goossens', C. A. (1989). Aided communication intervention before assessment: A case study of a child with cerebral palsy. *Augmentative and Alternative Communication, 5*(1), 14-26.
- Higginbotham, D. J., & Bedrosian, J.L. (1995). Subject selection in AAC research: decision points. *Augmentative and Alternative Communication, 11*(1), 11-13.

REFERENCES (CONT.)

- Majaranta, P., & Bates, R. (2009). Communication by gaze interaction. *Univ Access Inf Soc.* 8. 239-240.
- National Department of Education. (2005). *Curriculum 2005 Assessment Guidelines for Inclusion*. Pretoria: Department of Education.
- National Department of Education. (2001). *Education White Paper 6: Special Needs Education. Building an Inclusive Education and Training System.* Pretoria: Department of Education.
- National Department of Education. (2002). *Revised National Curriculum Statement Grades R-9.* Pretoria: Department of Education.
- Palisano, R., Rosenbaum, P., Bartlett, D., & Livingston, M. (2007). CanChild Centre for Childhood Disability Research. Hamilton: McMaster University.
- Schlosser, R. W. (2003). The efficacy of augmentative and alternative communication. Toward evidence-based practice. California: Academic Press.

REFERENCES (CONT.)

- Sigafoos, J. & Couzens, D. (1995). Teaching functional use of an eye gaze communication board to a child with multiple disabilities. *The British Journal of Developmental Disabilities.* XLI Part 2(82), 114-125.
- Thurlow, M.L., Elliott, J.L., & Ysseldyke, J.E. (2003). Testing students with disabilities: Practical strategies for complying with district and state requirements. California: Corwin Press.
- Treviranus, J., & Roberts, V. (2003). Supporting competent motor control of AAC systems. In J. C. Light, D. R. Beukelman, & J. Reichle (Eds.), *Communicative competence for individuals who use AAC. From research to effective practice (pp. 199-240).* Baltimore: Paul H. Brookes Publishing Co., Inc.
- Wagner, P. A. (1994). Adaptations for administering the Peabody to individuals with severe communication and motor dysfunctions. *Mental Retardation.* 32. 107-112.
- Wasson, C.A., Arvidson, H.H., & Lloyd, L.L. (1997). AAC assessment process. In L.L. Lloyd, D.R. Fuller, & H.H. Arvidson, (Eds.), *Augmentative and Alternative Communication: A handbook of principles and practices (pp. 169-198)*. Boston: Allyn & Bacon.