Réseau canadien de recherche sur le langage et l'alphabétisation

CANADIAN LANGUAGE & LITERACY RESEARCH NETWORK

Rapid naming and its component subprocesses in young adults and children

Raymond Klein, Marc Joanisse, Karen Arnell, Rosemary Tannock & Cathy Barr

Dalhousie University · U. of Western Ontario · Brock University · The Hospital for Sick Children

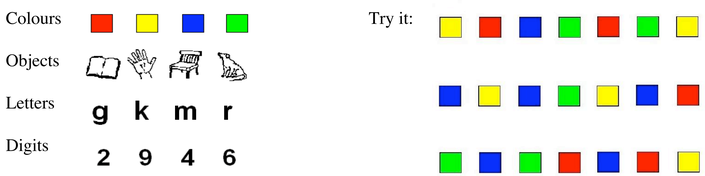
Presented at the Annual Network Conference
June 16-19 2004,
Montreal, QC

Abstract:

Children with dyslexia and other learning difficulties have difficulty with Rapid Automatized Naming (RAN) of colours, shapes, letters and digits. Recent studies have also found poor RAN performance not only predicts literacy, but may also be linked to specific genes. The utility of such findings is limited by the factors that might cause poor RAN performance. Our interdisciplinary, collaborative project uses carefully designed tasks to determine what elements of the RAN task are linked to reading and learning problems. Earlier results from an under-graduate sample that we presented last year suggest that neither vocal production nor stimulus retrieval time underlie the RAN's utility as a predictor of reading ability. Instead, rapid attentional selection of the correct stimulus from amongst distractors appears to be a (if not the) primary contributor to the RAN's predictive ability. In the study presented here we administered a subset of the tasks to children. This year's presentation builds on the data from young adults while emphasizing the new findings from the younger sample. We are also conducting a large scale (community) study in Summer 2004 that will lay the foundation for a behaviour-genetic study to begin in Fall 2004. The resulting data will be incorporated in a cognitive model of how RAN test and the associated tasks we identify as measuring its component mental processes. Our ultimate objective is to link those component mental processes important in reading and learning to specific genes.

Background:

The Rapid Automatized Naming (RAN, Denckla & Rudel, 1974) test has, until recently, primarily been used clinically. RAN involves rapidly naming 50 items displayed simultaneously. It is administered using one of the following sets of items in each of four tests.



We think RAN is an exciting measure (Klein, 2002; Manis, et al., 1999) because:

- RAN predicts reading ability above and beyond that of phonological awareness (Bowers & Newby-Clarke, 2002; Tannock, et al., 2000; Wolf, et al, 2002)
- Specific brain structures are different in individuals who perform poorly on the RAN (Semrud-Clikeman, et al., 2000)
- Significant bivariate heritability estimates for reading measures exist with number-letter RAN, but are less marked with object/colour RAN (Davis, et al., 2001)
- Specific gene loci (1p and 6p) have been linked to RAN performance, (Grigorenko et al., 2000; 2001).

Rationale:

Yet the RAN provides a "blunt" performance measure because speed and accuracy of rapid naming can be influenced by so many different processing stages (sensory processing, encoding, retrieval, response selection, sequential response organization, switching, self-monitoring, executive control, vigilance, etc.). Our first objective was to decompose the RAN into its sub-component mental operations. In 2003, we computerized the RAN and developed a battery of computer-administered tasks aimed at this objective. Data was then collected in two studies; the first involved college students and the second involved school children.

DALHOUSIE UNIVERSITY
Inspiring Minds

Study 1:

Methods

Participants: 64 adults (ages 19-26) tested at Brock U. and at UWO.

Tasks:

- Reading was tested using the Nelson-Denny Test of Reading Comprehension and Speed.
- Computer Measures: each measure was obtained for each of the 4 stimulus types: colours, objects, letters and numbers.

RAN	Mean time to name all 50 items in an array.
Vocal RT	Mean time to name items presented individually
Manual RT	Manual button press (4AFC) to an item presented individually.
Delayed RT	Same as Manual RT, except response is not made until a "go" signal is presented 1.5-2 sec after the stimulus.
Modified QST	Following a brief (125 ms) display of four randomly ordered stimuli) a cue (^) appearing below the array indicates which item to report. DV= accuracy
RSVP	Rapid serial visual presentation (cf Klein & Dick, 2002): items are presented individually in rapid succession. Set items served as the targets with participants making a present/absent decision. DV= accuracy
Attentional Blink	Two targets are embedded in an RSVP stream. Dependent variable was accuracy in detecting the second target (cf, Raymond, Shapiro & Arnell, 1992).

Results

Statistical analyses revealed no differences between data collected at Brock U. and UWO. Each performance measure was individually correlated with our reading measures. Our results are encouraging: As expected, reading rate and reading comprehension correlated quite highly (r=.53); reading comprehension was significantly related to RSVP (r=.34), AB (r=.33), RAN (r=-.31), and manual RT (r=-.28, p<.05), but not to QST (r=.003), vocal RT (r=-.12), or delayed RT (r=.008); and, despite the correlation between reading comprehension and reading rate, the only variable to correlate with reading rate was the RAN (r=-.41). Multiple regression, factor analysis and other techniques were used to explore the relative contributions of our measures to reading and their relations to one another.

	Correlations with Reading Comprehension					Correlations with Reading Speed				
	All	Colour	Digit	Letter	Object	All	Colour	Digit	Letter	Object
RAN	**-0.313**	**-0.322**	-0.139	-0.205	**-0.310**	**-0.412**	**-0.321**	**-0.286**	**-0.338**	**-0.434**
Manual RT	-0.276	-0.199	-0.161	**-0.365**	-0.170	-0.113	-0.180	-0.087	-0.178	0.043
Delayed RT	0.008	-0.048	0.055	-0.037	0.060	-0.027	-0.035	0.062	-0.075	-0.052
Vocal RT	-0.116	-0.145	-0.088	-0.111	-0.075	-0.109	-0.141	-0.009	-0.093	-0.139
QST	0.003	0.106	0.101	-0.114	-0.091	-0.010	-0.018	0.134	0.025	-0.153
RSVP	**0.342**	0.110	**0.337**	**0.405**	0.177	0.019	-0.128	0.258	0.096	-0.114
AB	**0.334**	**0.291**	0.187	**0.345**	0.193	0.196	0.157	0.183	0.221	0.040

Bold: p<0.025

References:

Barr, CL, Humphries, TW, Lovett, MW, Tannock, R. (2002) Genetics of reading disabilities (5 year CIHR operating grant)
Bowers, P.G. & Newby-Clark, E. (2002). The role of naming speed within a model of reading acquisition, *Reading and Writing: An Interdisciplinary Journal 15:*, 109-129.
Davis CJ, Gayan J, Knopik VS, Smith SD, Cardon LR, Pennington BF, Olson RK, DeFries JC. (2001) Etiology of reading difficulties and rapid naming: the Colorado Twin Study of Reading Disability. *Behav Genet. 31*, 625-35.
Denckla MB, Rudel R. (1974) Rapid "automatized" naming of pictured objects, colors, letters and numbers by normal children. *Cortex, 10*, 186-202.
Grigorenko, E. L., F. B. Wood, et al. (2000). Chromosome 6p influences on different dyslexia-related cognitive processes: further confirmation. *Am J Hum Genet 66*, 715-723
Grigorenko EL, Wood FB, Meyer MS, Pauls JE, Hart LA, Pauls DL. (2001) Linkage studies suggest a possible locus for developmental dyslexia on chromosome 1p. *Am J Med Genet.* 8;105(1):120-9. Apr;39(4):477-84.
Jared, D. (CLLRNet) Understanding Reading Development in Second Language Learners. Theme IV Project.
Joanisse, M.F. and Seidenberg, M.S. (2003) Phonology and Syntax in Specific Language Impairment: Evidence from Connectionist Model. *Brain and Language, 86*, 40-56.
Klein, R. M. (2002) The temporal correlates of reading failure. *Reading and Writing: An Interdisciplinary Journal, 15*, pp 207-232.
Klein, R. M. & Dick, B. (2002) Temporal Dynamics of Reflexive Attention Shifts: A Dual-Stream Rapid Serial Visual Presentation Exploration. *Psychological Science, 13*, 176-179.
Manis, F., Seidenberg, M.S., & Doi, L. (1999). See Dick RAN: Rapid naming and the longitudinal prediction of reading subskills in first and second graders. *Journal of the Society for the Scientific Study of Reading*, 3, 129-157.
Raymond, J.E., Shapiro, K.L., & Arnell, K.M. (1992). Temporary suppression of visual processing in an RSVP task: An attentional blink? *Journal of Experimental Psychology: Human Perception and Performance, 18*, 849-860.
Semrud-Clikeman M, Steingard RJ, Filipek P, Biederman J, Bekken K, Renshaw PF. (2000) Using MRI to examine brain-behavior relationships in males with attention deficit disorder with hyperactivity. *J Am Acad Child Adolesc Psychiatry*.
Tannock, R, Martimsson, R. & Frijters, J. (2000) Naming speed performance and stimulant effects indicate effortful, semantic processing deficits in attention-deficit hyperactivity disorder. *J. Abnormal Child Psychology, 28*).
Wolf, M., Goldberg O'Rourke, A., Gidney, C., Lovett, M., Cirino, P. & Morris, R. (2002,). The second deficit: An investigation of the independence of phonological and naming-speed deficits in developmental dyslexia, *Reading and Writing: An Interdisciplinary Journal* 15: 43–72.

Study 2:

Methods

Participants: 13 London area children whose parents responded to a newspaper advertisement were tested. We asked for children 9-11 years old but included siblings who were a bit younger.

Tasks:

From the original test battery we used the following measures:

RAN	Rapid naming of colour, digits, letters, objects. Each run separately.
Manual RT	Speeded button press response for colours digits, letters, objects.
Vocal RT	Speeded naming of individual colours, digits, letters, objects.
RSVP	Digits (100 ms SOA), letters (100 ms SOA), objects (83 ms SOA)* (*n=8 for RSVP since we changed SOAs after the first 6 children)

Literacy/language measures:

TOWRE	Test of word reading efficiency. Speeded word and nonword naming. Measures speed and accuracy of sight word reading and decoding.
CTOPP	Phoneme elision and non-word repetition subtasks of the Comprehensive test of phonological processing. These are classic measures of phonological memory and phonological awareness.

Results

Performance on the alpha-numeric and colour RAN tests was more strongly correlated with reading efficiency scores than object RAN. Speed of manual response and speed of input processing as measured by RSVP accuracy were also strongly correlated with RAN performance. As with the adults in Study 1, object naming speed showed no relationship to RAN scores; rapid encoding of identities as measured by speed (manual RT) and accuracy (RSVP) was highly correlated with reading ability. The results with these tests are sufficiently similar to those obtained with our larger sample of young adults to warrant their use with much larger community sample.

Correlations Bold<=0.05	**Reading Measures**		
Performance Measures	TOWRE words	TOWRE nonwords	NonWord repetition
RAN digits	**-0.877**	**-0.692**	**-0.552**
RAN letters	**-0.721**	**-0.566**	**-0.607**
RAN colours	**-0.815**	**-0.616**	-0.512
RAN objects	-0.408	-0.215	-0.039
ManRT digits	**-0.546**	-0.439	-0.194
ManRT letters	**-0.556**	-0.375	-0.306
ManRT colours	**-0.661**	-0.451	-0.480
ManRT objects	**-0.568**	-0.310	-0.319
RSVP digits	0.625	0.555	0.583
RSVP letters	**0.831**	**0.786**	0.591
RSVP objects	0.538	0.483	0.439

What's next:

- Using our data together with data collected by Debra Jared (CLLRNet) in her Theme IV project we have designed a large scale community-based study will be conducted at the Ontario Science Centre this summer. This will serve as the foundation for:
- A **behavior-genetics study** aimed at linking specific genes (Barr et al., 2002) to reading, RAN and the efficacy of the mental processes identified via our performance measures will commence in the Fall.
- **Neuroimaging studies** to provide precise temporal (ERPs) and spatial (fMRI) information about the stages of processing that contribute to rapid naming and
- **A computationally explicit model** (cf Joanisse & Seidenberg, 2003) of how these contributions might operate.

Partager la science. Éveiller les esprits. _ sharing the science. opening minds.