Contemporary issues of brain, communication and education in psychology:
The science of mind

Edited by Kazuhito Yoshizaki and Hisao Ohnishi

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We would like to appreciate everything that Professor Emeritus Takeshi Hatta taught us ..... how a researcher should be, attractiveness of science, research findings that he published in more than 200 papers and so forth. We are sure to pass his lessons on to the next generation.

Contents

Part IV: Family and education

Foreword

This book is a tribute to Takeshi Hatta who reached his 60th birthday in the summer of 2005. The book also deals with several important themes in contemporary psychology that are becoming more prominent and more important. At the end of 2005, Hisao Ohnishi and I called on Japanese researchers who have studied under Takeshi Hatta, as well as on his friends who are working around the world, to submit papers to this book, and to our delight, more than fifteen researchers offered to submit papers.

The book is organized into four parts. The first part assembles three invited papers. I am grateful to four influential researchers in their respective fields who contributed these papers. Takeshi Hatta and his colleagues contributed the first paper on the development of the Digit Cancellation Test (D-CAT), which assesses attention. The second paper, by Israel Nachson and Anat Zelig, is a theoretical review about the memory for traumatic events in relation to a very famous assassination in Israel. The paper also includes experimental studies undertaken by the authors. The third invited paper, written by Che Kan Leong and Jun Yamada, investigates the phonological structure of English words used in the National Adult Reading Test (NART) that provides a good estimate of premorbid intelligence of adult patients with dementia.

The second part of this collection includes four studies on the issue of “Brain and Cognition.” Terumasa Kogure has investigated whether reference frame cueing can influence laterality (visual-field difference) in spatial relation judgments. Kazuhito Yoshizaki and Kimiko Kato have extended their previous study (Yoshizaki, Weissman, & Banich, 2007) that explored how the two hemispheres cooperate to improve mental rotation. Mari Higashikawa and Kazuo Hadano have reported three cases of semantic jargon aphasia, and have described how semantic systems become disorganized at various levels in this condition. The fourth paper, written by Emi Ito and her colleagues, has described the development of norms for the Verbal Fluency Tests (VFT) for the Japanese population. This test was originally used to assess cognitive deficits in clinical and research settings in the West.

The third part of the book includes four studies on "Language and Communication." The first paper, written by Peter John Wanner, presents evidence that in Bilingual First Language Acquisition (BFLA) by infants, there is no delay in acquiring the syntactic structures of the language compared to Native Speaker Language Acquisition (NSLA). Ayako Kawakami has investigated the relationship among motives, attitudes and behaviors related to English language learning in Japanese university students and, as a result, she has identified the essential conditions for effective learning of English. The third paper, written by Akihiko Iwahara, examines the effects of using pictographs, script types, and font types by a sender on the addressee's understanding. His study is motivated by recent changes in communication tools, and the increasing popularity of email communication. Naohiro Minagawa has investigated the cognitive processes of understanding Haiku, a form of Japanese poetry.

The last part of this collection consists of five studies on issues related to the "Family and Education." Kazuo Ikeda has investigated recent changes in the Japanese family structure as perceived by university students, by using the Family System Test (FAST) developed by Gehring (1993). The next two papers deal with individual differences in autistic traits. Mayumi Yamamoto has investigated the relationship between egocentrism measured by the Japanese version of Adolescent Egocentrism-Sociocentrism (AES) and autistic trend measured by the Autism-spectrum Quotient Japanese version (AQ-J). Hisao Ohnishi and Zenjiro Nakatsuka have investigated the validity of the Nakatsuka Screening Scales of Autistic Tendencies (NSSAT) which was developed to measure the early symptoms of autistic individuals who are within 30 months old (Ohnishi et al., 2006). Yumiko Yamada and Asako Yamada have reviewed recent problems in schools, such as bullying. They have classified bullying into three types and have identified the features and cause of each type of bullying. The last paper, written by Masahiko Okamoto, has focused on the relationship between the acquisition of number representation and the calculation skills of six to eight years old Japanese children.

I express my appreciation to the many individuals who helped in the preparation of this book. I am grateful to the contributors of this book for the prompt response to editorial requests. This book would not be possible without the generous support and encouragement of Hiroshi Ikeda, Manager of Union Press and especially of Hajimu Ikeda, Managing Director of Union Press.

I hope that the reader will find the research and discoveries described in these pages to be useful and interesting. We will be more than contented if this book succeeds in stimulating the research interests of the reader.

Kazuhito Yoshizaki

Aichi Shukutoku University

October 1, 2008

Contributors

Takeshi Hatta, Dr. Lit. is a professor of Department of Health Sciences, Kansai University of Welfare Sciences and Professor of Emeritus of Nagoya University. He has a research career of more than 35 years and his interests include laterality, higher brain function of the middle and upper-middle aged people, cognitive processing of Japanese language, development of psychological assessment tests for human relation, and others. He has published more than 200 articles (both in English and Japanese) and 40 books (both in English and Japanese, single author, book edition and chapter contributions). Among them, more than 130 articles have been adopted by the PsycINFO, APA database. He received a research award from the Japan Society for Artificial Intelligence in 2003 and the excellent thesis prize from JHES at 2007. He founded the *Journal of Human Environmental Studies* and is now working as the editor-in-chief of the journal. He is now director of Neuropsychological Association of Japan and editing manager of the *Japanese Journal of Neuropsychology*.

Israel Nachson is professor emeritus at the Department of Criminology, Bar Ilan University, Ramat Gan, Israel. Currently he heads the Department of Criminology, Ashkelon Academic College, Ashkelon, Israel. He began his research activities in the field of neuropsychology, studying a variety of phenomena associated with laterality in normal, brain-damaged and psychopathological populations. Subsequently, he moved to more cognitive areas, such as detection of deception and face perception. In all fields of research, cross-cultural aspects of the phenomena under study have always been of particular interest. Thus, collaboration with Professor Takeshi Hatta yielded publications on cross-cultural comparisons of performance by Japanese and Israeli participants. Most recently, Professor Nachson's research interest has shifted toward issues of memory in the real world, especially of emotionally-arousing events; such as very long term memory of holocaust survivors, memory of distinctive and non-distinctive terrorist attacks in Israel, effects of beliefs and attitudes on memory of traumatic events, and cross-cultural comparisons of attitudes toward issues of recovered memories.

Anat Zelig is a lecturer at the Department of Criminology, Ashkelon Academic College, Ashkelon, Israel. In the past, she co-authored a study on memories of the assassination of the Israeli Prime Minister, Itzhak Rabin. Her Ph. D. dissertation, completed in 2005, focused on cognitive functions of literary detectives - an issue she intends to pursue further in the future.

Che Kan Leong is Professor Emeritus, Department of Educational Psychology and Special Education, University of Saskatchewan, Canada and also Hon. Professor, Department of Educational Psychology, the Chinese University of Hong Kong, Hong Kong. He earned his Ph. D. at the University of Alberta and his DLitt at the University of Saskatchewan. His research interest is in morphological and phonological processing in learning to read English and Chinese and developmental dyslexia. His publications include research papers in *Journal of Educational Psychology*, *Reading and Writing*, *Scientific Studies of Reading*, *Annals of Dyslexia* and others. He served as editor-in-chief of *Annals of Dyslexia* from 2001 to 2006. His books include: *Cognitive Processing of the Chinese and Japanese Languages* (edited by Leong & Tamaoka, 1998), *Cross-language Studies of Learning to Read and Spell* (edited by Leong & Joshi, 1997), and *Developmental and Acquired Dyslexia* (edited by Leong & Joshi, 1995), all published by Kluwer Academic Publishers and other works. The honors he has received include: Hon. Doctorate from the University of Umeå, Sweden and the Margaret Rawson LifeTime Achievement Award by the International Dyslexia Association. He is a Fellow of the American Psychological Association, the Canadian Psychological Association, and the Association of Psychological Science.

Jun Yamada, Ph. D., is a professor of Hiroshima University, Graduate School of Integrated Arts and Sciences. He is currently doing research on acoustic characteristics of the speech of people who stutter. He is also interested in developmental dyslexia and second language acquisition. He has published many articles in international journals including *Journal of Psycholinguistics*, *Brain and Language*, *Reading and Writing*, and *Medical Hypotheses*.

Terumasa Kogure is now an Associate Professor of Center for Regional Affairs, Fukushima University. His scientific research interest is visual cognition (e.g., visual laterality and visual attention) and memory error (e.g., cognitive bias of dating past events). Also, he is interested in applied research and social practice; for example, lifelong learning, e-Learning, and social collaboration. His articles include: "Extension lectures and community college: A discussion based upon questionnaire data," *Annual Report of Research Center for Life-Long Learning and Education, Fukushima University* Vol. 13 (2008): 15-27; "Individuated e-Learning environments: A preliminary investigation by questionnaire," *Annual Report of Research Center for Life-Long Learning and Education, Fukushima University* Vol. 8 (2003): 25-27"; "Characteristics of proper names and temporal memory of social news events," *Memory* Vol. 9 (2001): 103-116"; "Spatial relations and object processes in two cerebral hemispheres: A validation of a sequential matching paradigm for the study of laterality," *Laterality* Vol. 6 (2001): 57-68"; "Hemisphere specialisation and categorical spatial relations representations," *Laterality* Vol. 4 (1999): 321-331. He is now a vice-director of Center for Regional Affairs, Fukushima University, and part-time member of several committees of Fukushima Prefecture and Fukushima City.

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Emi Ito is a lecturer at the Department of Occupational Therapy, School of Health Sciences, Nagoya University. She is an authorized occupational therapist and her clinical experiences have been with patients who experience physical and cognitive dysfunction. Her research interest is the relation between cognitively healthy aging and life style, such as habits of leisure activity, exercise, and interaction. The content of her Ph. D. thesis "Neuropsychological study of verbal fluency tests" was published in *The Japanese Journal of Neuropsychology* Vol. 20 (2004): 254-263, "Performance of verbal fluency tasks in Japanese healthy adults" and in *The Japanese Journal of Neuropsychology* Vol. 22 (2006): 146-152, "Reliability and validity of verbal fluency tasks". Her articles include: "Effect of leisure activities on cognitive functions," *Journal of Human Environmental Studies* Vol. 1 (2003): 15-20; "Life style and verbal fluency performance in healthy aged people" *Journal of the International Neuopsychological Society* Vol. 9 (2003): 525; "Effect of cognitive activities for older adults" *Alzheimer's Diseases International* (2004): s. 184; "Influence of leisure activities on the cognitive maintenance in normal aging" International Neuropsychological Society (2005): s. 77. She is a member of the Neuropsychology Association of Japan, the Japanese Association of Occupational Therapists and a judge of the Long-term Care Insurance for the Elderly.

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Part I: Invited papers

1. Development of the screening test for attention by digit cancellation method

Takeshi Hatta, Kazuhito Yoshizaki, and Yasuhiro Ito

Abstract
A new neuropsychological test for attention by digit cancellation method was developed as a screening test. This test named D-CAT (digit cancellation test) aimed to evaluate information processing speed, attention focusing and sustained attention function with a high practical utility. In the D-CAT, participants were requested to delete given target numbers on a sheet of randomly arranged numbers. They were given three trials, the first with a single digit, the second with two digits and the third with three. The attention ability of participants was calculated from three indices; total performance score, omission rate, and reduction ratio of performance (one /two and three digits trials). In this study, 1338 normal adults aged from 18 to 91 years old were given the D-CAT. The results showed a relationship between age and performance.

Key words: digit cancellation test, neuropsychological assessment, screening test for attention

1. Introduction

It is well known that human higher cognitive function consists of several different facets such as attention, memory, language, problem solving, and each of the facets interrelate in a complex way. Therefore, the assessment of attention is usually regarded as one way of neuropsychological evaluation looks at a broad range of cognitive, psychological, and behavioral factors. Various kinds of evaluation techniques have been developed to precisely measure human attention ability. Evaluation of attention has been based on *freedom from distraction* subtests (e.g., *digit span, arithmetic, coding/digit symbol*) of Wechsler Adult Intelligence Scale (WAIS), on attention demanding tasks from Halstead-Reitan Neuropsychological Battery (e.g., Speech-Sounds Perception Test), or on specially developed measures derived from the experimental research (e.g., Paced Serial Addition Tests (PASAT), Stroop Test, Brief Test of Attention (BTA), Continuous Performance Test (CPT), Symbol Digit Modalities Test (SDMT), and Visual Search and Attention Test (VSAT)). Although many assessment techniques are sensitive to disorders of attention, models to guide such assessment of the attention system are rare. It is due to the fact that tests have almost never been developed based upon a particular theory of attention that there are few crossovers between the clinical and experimental attention studies as Mateer (2000) suggested.

The purpose of this study was to develop a new test with a theoretical background for the evaluation of attention. The motive for this attempt emerged as a result of a public health service center staff's requirements. The staffs were not neuropsychological specialists. They requested us to develop an assessment test with a high level of practical utility such as, no need of expensive equipment, quick administration without special training, quantitative expression of results, a high possibility of repeated administration for longitudinal examinations, without negative feeling on the part of the participants after the administration, and finally, a high possibility of group style administration. The importance of a short screening test has also been stressed among clinical neuropsychologists because a fixed test battery such as the Halstead-Reitan battery is overly time-consuming and sometimes the client fatigues easily or is likely to fail demanding tests (Spreen & Strauss, 1998).

The staff required a new, easy-to-administer test for attention with high practical utility. In previous studies, validity of attention tests were examined, but in most cases, on the basis of content validity, criterion validity, and construct validity (Milberg, 1996). A test for neuropsychological ability should emphasize user-oriented criteria of validity. The validity of a test should be examined from the standpoint of criteria such as clinical efficiency and practical utility. The former relates to the value of information, time and financial costs, while the latter refers to time cost, the testing environment (e.g., requirement for a sound proof room), and tester requirements (whether the test can be administered by a non-professional person). Most existing attention tests seem to not fulfill these requirements. We therefore set out to develop a new attention test satisfying the requirements of clinical efficiency and practical utility.

Each test for attention possesses not only advantages but also shortcomings (Spreen & Strauss, 1998). Actually, many researchers considered the PASAT as a good indicator of attention. Typically, the PASAT is presented via an audiotape on which sequences of digits are read at different speeds (e.g., one digit every 2.4, 2.0, 1.6, 1.2 s). Thus, the PASAT requires participants to hold one digit in their mind while performing an addition of two numbers (e.g., each number is added to the one that immediately precedes it). Clearly the PASAT is too difficult a cognitive task for aged people (Fisk & Archibald, 1998). Furthermore, participants generated negative feelings such as “I failed to do the final trial and then the examiner ended the testing”. Other tests for attention such as BTA and CPT involve similar shortcomings, that is, these tests require various equipments (e.g., tape recorder or computer) and are not good for group administration. The SDMT, Concentration Endurance Test (d2Test) and VSAT are basically paper and pencil tests but they are not necessarily the proper test in regards to cost, time and difficulty for middle to upper middle aged people (Ballard, 1997; Brickenkamp, 1981; Schretlen, Bobholz, & Brandt, 1996; Smith, 1991; Trenerry, Crosson, DeBoe, & Leber, 1990).

The D-CAT satisfies the above requirements. First, the D-CAT is a pencil and paper test and it does not need special and expensive equipment; second, it requires only three minutes for administration (including instruction and practice time, it needs five minutes at the most). Third, the performance of the participants can be analyzed quantitatively. Fourth, it is possible to administer it repeatedly. Fifth, participants can finish the task without negative feelings, such as that of having failed the last and most difficult trial (participants are unaware of missed digits). Sixth and finally, group or individual administration test style is possible.

The idea of digit cancellation is not particularly new or innovative. Actually, Weintraub and Mesulam (1988) and Egelko, Riley, Simon, and Diller (1988) used digit cancellation test for hemi-neglect patients. Geldmacher and his colleagues used a letter cancellation for elderly and Alzheimer's disease patients (Geldmacher, 1998; Geldmacher, Doty, & Heilman, 1995; Geldmacher, Fritsch, & Riedel, 2000; Geldmacher & Hills, 1997). Ruff also developed two and seven selective attention tests (Ruff, 1994). However, the concern of these previous attention tests relates mainly to the patients in a clinical situation instead of ordinary people in a public health examination situation.

Various models have been proposed for attention. For example, Mirsky (1987) and Mirsky, Fantie, and Tatman (1995) proposed a model where attention comprises four components; *sustain, focus/execute, shift,* and *encode*. Shum, McFarland, and Bain (1990) proposed three components; *sustained selective attention, visual-auditory span,* and *visuomotor scanning* model. Sohlberg and Mateer (1987, 1989) described five components, *focused attention, sustained attention, selective attention, alternating attention,* and *divided attention,* model. Recently, Mateer and Mapou (1996) proposed a new assessment model that classified attention into two major components, deployment and encoding. Across of these models, there is substantial agreement that there are at least three types of attention, which the D-CAT examines, i.e., simple attention focusing and speed of response, selective or divided attention that requires managing two sets of stimuli simultaneously, and endurance or sustained attention.

In other words, the D-CAT basically follows the attention model proposed by Sohlberg and Mateer (1989) where they proposed five hierarchical classifications; each component of the hierarchy requires the effective functioning of the one below it. Once again, the D-CAT aimed to evaluate three levels of attention, *focused attention, sustained attention concentration* and *selective attention.*

The purpose of this study was to develop a new screening test for attention that possesses highly practical, and has clinical efficiency. We administered the

D-CAT to 1338 healthy normal adults to develop normative data for the D-CAT and examine possible factors that affect the D-CAT results.

2. Method

2.1 Participants

Thirteen hundred and thirty-eight (868 females and 470 males) community dwellers participated in this study. The D-CAT was administered as a part of an ongoing community study (Nagoya University Y-town Project which started from 1982) set in Y-town, a rural farming community of Hokkaido district. Samples from I-city, a satellite city of Nagoya were also included to control sampling bias. The background and methods are reported in greater detail elsewhere (Aoki & Ito, 1999; Hatta, Ito, Nagahara, Masui, & Hasegawa, in preparation). The study analyzed only the D-CAT data given from April 2000 to August 2002. All the data in this analysis was obtained from volunteers who had no neurological or psychological anamneses. Table 1 shows the participants' demographic data. All of the participants were ordinary healthy citizens. The participants showed no sing of physical disorders, internal disease, or dementia at the time of examination in August 2001 and 2002. For signs of the internal diseases, the participants were examined by physicians in accordance with the

Table 1: Participants' demographics in the present study

Age (Years old)	Male			Female		
	Education level			Education level		
	Low	Middle	High	Low	Middle	High
18-29	0	0	147	0	3	223
30-49	2	18	23	11	58	53
50-59	22	24	31	45	95	29
60-69	57	43	9	127	95	14
70-91	61	26	7	83	29	3
Total	142	111	217	266	280	322

Education level; Low (less than 9 years), Middle (10-12 years), and High (13 years and greater) health examination program, and for signs of mild dementia or other neurological defects, by the neuropsychologists using tests such as the Clock Drawing test, the D-CAT (attention), memory tests (immediate, delayed and prospective memories), Stroop test, Money road test, the QOL (quality of life) questionnaire. The selection criteria for including data analysis were as follow; in the Clock Drawing Test (Rouleau, Salmon, Butters, Kennedy & McGuire, 1992), any respondents with mild dementia or dementia (more than 4 points according to the Japanese criteria by Nagahama Okina, Nabatame, Matsuda & Murakami, 2001) was excluded. As Clock Drawing test is not regarded as a sensitive measure of mild dementia, participants whose performance was less than 2 *SD* from the mean in the memory test, Stroop test, and Money road test were also excluded because they were given the suggestion by the Y-town community project administration office to attend precise examination in the hospital (0.051 % of participants in 2001; 0.06 % in 2002 of participants).

All participants were given an informed consent sheet and only those who agreed to participation were included. Well-trained examiners administered the D-CAT individually.

2.2 Materials

The test sheet of the D-CAT consisted of 12 rows of 50 digits. Each row contained 5 sets of the numbers 0 to 9 arranged in random order. Thus, any one digit would appear 5 times in each row with randomly determined neighbors. The D-CAT as a whole consisted of three such sheets as described by Hatta, Ito, and Yoshizaki (2001).

2.3 Procedure

Participants were instructed to search for the target number(s) which had been specified to them and to delete each one with a slash mark as fast and as accurately as possible until the experimenter sent a stop signal. The experimenter emphasized that the participants must start their searching from the left end digit in the uppermost row, and, as they finished a row, that they should delete the last number in the row (i.e., the number located in right hand end) whether it was a specified target number or not. They then should move on to the next row. There were 3 trials, first with a single target number (6), second with two target numbers (9 and 4), and third with three (8, 3, 7). Each trial was allowed 1 minute; hence the total time required for the D-CAT was 3 minutes. In the second and third trials, it stressed that all of the target numbers instructed should be cancelled without omission.

In this study, three measures of the D-CAT, *Total Performance, Omission* ratio, and *Reduction* ratio were used according to the test manual. *Total Performance* is one of the indices of the D-CAT and it refers to the total number of digits the participant inspected (not the digit numbers of the deleted) items. This relates mainly to the components such as the information processing speed, focused attention, and sustained attention mentioned earlier. *Omission* ratio is also one of the indices of the D-CAT and it reflects components mainly such as sustained attention and selective attention. It calculated by the formula that (number of missed target) ÷ (number of digits inspected) × 100. *Reduction* ratio is calculated by the formula that (number of digits inspected in Trial 2 or 3) ÷ (number of digits inspected in Trial 1). It relates to the fragility of focused attention, sustained attention and selective attention or the tolerance of mental fatigue. As one of the measures of the D-CAT, the false alarm (commission error) has been prepared. However, the occurrence of false alarm is less than 0.1 % in the case of normal participants (even in TBI patients), this measure is substantially not efficient in our experiences and did not analyze in this study.

2.4 Results

Table 2 shows the results of *Total Performance* as a function of age levels. As apparent from Table 1, education levels are generally higher in the younger age groups. This cohort effect suggests that the levels of education in younger age groups indicated in the analysis of the effect of education on the D-CAT are quite different from that of the older age groups and thus do not correspond well among different age groups. It is therefore not proper to conduct statistical analysis for the data, which involve a wide age range. A low education level in the 60’s and 70’s does not mean a low level of intelligence in youth.

Table 2: Mean Total Performance and *SD* (in the parentheses) of the participants in Trial 1, 2 and 3 as a function of age

Age (years)		Trial 1	Trial 2	Trial 3
18-29	*N* = 373	375.3 (89.6)	293.7 (58.1)	224.0 (42.2)
30-49	*N* = 165	346.6 (72.8)	280.9 (58.4)	211.9 (53.3)
50-59	*N* = 246	293.9 (60.8)	242.6 (45.2)	181.0 (39.5)
60-69	*N* = 345	255.7 (58.4)	209.7 (44.0)	157.9 (36.5)
70-91	*N* = 209	212.5 (50.8)	180.2 (39.0)	135.2 (30.2)

Recently in Japan, more than 40 % of the young population go to a university or junior college whereas less than 10 % in their 60's had higher education. As such, education was confounded with age and therefore was not analyzed separately. However, to control this cohort effect in educational experience, we collected the data from the population with various backgrounds. For example, data of the young age population were collected from high school graduates, training colleges' graduates, and low, middle, and high prestigious universities. The people who participated over 30-years-olds were community dwellers in Y-town (rural area in Hokkaido Island) and I-city (satellite city of Nagoya). Therefore, we can regard that the participants used in this population can be regarded as a typical representatives of recent Japanese. In the following analyses, we focused mostly on the effect of age (5 groups) and trial (Trials 1, 2 and 3) in the data analyses.

In this paper, an ANOVA was conducted to examine the effect of age on trials. The results showed that both main factors, age and trial, were significant (F (4, 1333) = 292.3 and F (2, 2666) = 4018.2, p < .001). The interaction between the two factors was also significant (F (8, 2666) = 61.8, p < .001). These results indicated first that *Total Performance* decreased as a function of age, second that as the number of target digits increased, *Total Performance* decreased, and finally that the decrease of *Total Performance* was more prominent in Trial 1 than in Trial 3. These results suggest that *Total Performance* strongly reflects age effects.

The results of the *Total Performance* for males in Trial 1, Trial 2 and Trial 3 were 300.3, 235.0 and 177.9, and for females were 300.8, 247.8, and 186.8, respectively. The authors of this paper conducted an ANOVA to examine the effect of sex and trial on *Total Performance*. The results showed first that the main factors of sex and trial were significant (F (1, 1335) = 3.9 and F (2, 2670) = 3645.2, ps < .048 and .001). Furthermore, the interaction between the two factors was significant (F (2, 2670) = 10.3, p < .001). These results indicated first that the *Total Performance* of females was better than that of the males, second that as the number of target digit increased, *Total Performance* decreased, and third that a sex difference appeared in Trial 2 and 3 while there was no difference on Trial 1. The statistical analyses showed significance, however, the results should be carefully interpreted as for whether there is a sex difference in the digit cancellation task performance. The statistical significance of the main factor sex and the interaction must be negligible because it was generated by an unusually large number of degrees of freedom.

Table 3 shows the result of *Omission* ratio as a function of age levels. An ANOVA for age effects showed that the main factors of age and trial were significant (F (4, 1333) = 106.8, and F (2, 2666) = 363.8, p < .001). Furthermore, the interaction between the two factors was significant (F (8, 2666) = 22.6, p < .001). These results indicated first that the *Omission* ratio increases as a function of age, second that as the number of target digits increases, *Omission* ratio increases, and finally that the increase in Omission ratio is more prominent in Trial 1 than in Trial 3. These results suggest that Omission ratio strongly reflects the age effect.

The results of the *Omission* ratio for males in Trial 1, Trial 2 and Trial 3 were 3.78, 6.25, and 9.22 for males and 3.91, 6.89, and 9.25 for females, respectively. This paper examined the sex difference on *Omission* ratio. First, an

Table 3: Mean Omission ratio and *SD* (in the parentheses) of the participants in Trial 1, 2 and 3 as a function of age

Age (years)		Trial 1	Trial 2	Trial 3
18-29	*N* = 373	1.96 (3.56)	2.56 (3.55)	3.59 (3.97)
30-49	*N* = 165	1.89 (3.89)	5.35 (5.40)	8.04 (7.09)
50-59	*N* = 246	2.93 (4.37)	6.53 (6.02)	8.79 (7.68)
60-69	*N* = 345	6.07 (8.49)	9.92 (8.60)	12.13 (9.26)
70-91	*N* = 209	6.37 (7.77)	9.83 (8.74)	16.08 (11.20)

ANOVA showed that the main factor of the sex was not significant (F (1, 1335) = 0.57) while main factor of the trial was significant (F (2, 2670) = 286.9, $p < .001$). The interaction between both factors was not significant (F (2, 2670) = 1.05). The results indicate that the *Omission* ratio increases as the number of target digits increases and there is no sex difference in *Omission* ratio.

Table 4 shows the result of the *Reduction* ratio as a function of age levels. The authors conducted an ANOVA on *Reduction* ratio to examine the effect of age. First, the results showed significance for the main factors of age and trial (F (4, 1333) = 23.72 and F (1, 1333) = 4311.8, $p < .001$). Furthermore, the interaction between both factors was also significant (F (4, 1333) = 26.7, $p < .001$). These results indicate that *Reduction* ratio increases as a function of age. *Reduction* ratio in Trial 3 was smaller than in Trial 2. These results suggest that fatigue effect became prominent as a function of age and it is also more prominent when the number of target numbers increased.

The results of the *Reduction* ratio in Trial 2 and Trial 3 were 0.85 and 0.61 for males and 0.87 and 0.64 for females, respectively. This paper examined the sex difference in *Reduction* ratio. Results show significance for the main

Table 4: Mean Reduction ratio of performance and *SD* (in the parentheses) of the participants in Trial 2 and 3 as a function of age

Age (years)		Trial 2	Trial 3
18-29	N = 373	0.80 (0.16)	0.61 (0.12)
30-49	N = 165	0.83 (0.10)	0.62 (0.11)
50-59	N = 246	0.86 (0.11)	0.62 (0.10)
60-69	N = 345	0.90 (0.16)	0.63 (0.13)
70-91	N = 209	0.94 (0.15)	0.66 (0.15)

factors of sex and trial (F (1, 1335) = 11.9 and F (1, 1335) = 3984.3, p < .001) while they show no significance for the interaction (F (1, 1335) = 1.4). These results indicate first that *Reduction* ratio is higher in females than in males and second that *Reduction* ratio in Trial 3 is smaller than in Trial 2 irrespective of sex difference. As described earlier, when we consider the large number of degree of freedom, we should carefully interpret if these results suggest that a fatigue effect becomes more prominent in females than in males and it also becomes more prominent when the number of target digits increases.

2.5 Discussion

First of all, it should be stressed that all participants could quite easily do this screening test, the D-CAT, without any stopover participation. In spite of their wide age range, all participants, without exception, could understand the instructions and finished three trials within 5 minutes, though sometimes it became necessary to allow a little practice before the test. None of the participants expressed a negative view or seemed to find the test difficult. The participants of this study have never expressed a feeling of failure. These facts suggest that the D-CAT fulfills one of the primary criteria of practical utility.

The analyses of the three indices for the D-CAT results revealed several things. First, a very clear age effect appeared as we expected. As seen in Table 2, 3 and 4, all indices, *Total Performance*, *Omission* ratio, and *Reduction* ratio, decreased with the increase of participants age. It is well known that information processing speed is one of the most sensitive and prominent factors of human cognitive function in relation to age effects (Li, Lindenberger, & Sikstrom, 2001; Park, 2002; Reuter-Lorentz, 2002). As described earlier, we regard the index of *Total Performance* as being strongly influenced by the information processing speed that relates strongly to focused attention, sustained attention and selective attention components of the five components model by Sohlberg and Mateer (1989). The clear decline with age is consistent with our expectation and previous studies (Reuter-Lorentz, 2002). In this study, we analyzed the data with 5 categories of age and *Total Performance* that decreased linearly with increasing age. The difference between under and over 50's was 8.5 % in Trial 1, 7.3 % in Trial 2, and 7.9 % in Trial 3.

Second, the index of *Total Performance* did show a very small sex difference (though statistically marginally significant at $p = .048$, it is mainly due to the large size of data set). The results suggest that compared to the age factor, the effect of sex difference on information processing speed is minimal, especially in the case of a brief cognitive test. Generally, we tend to assume a sex difference in information processing speed in a manual task (Coppola et al., 2002; Hershey, 1991; Plude, 1987; Spirduso & MacRae, 1990). A weak sex difference in this index might be due to the fact that the *Total Performance* relates not only to a focused attention but also to sustained attention, concentration and selective attention.

The index of the *Omission* ratio also showed a prominent effect on aging. The *Omission* ratio increased linearly but there was a steep increase between the 50's and 60's age groups. This result suggests that components of selective attention and sustained attention in the Sohlberg and Mateer model deteriorate prominently at the age of around 60-years old. Furthermore, the results suggest that there is no sex difference in the components of selective attention and sustained attention.

The index of *Reduction* ratio showed a clear age effect and sex difference. This index seems to correspond with either a sustained attention component or a fatigue effect. Many previous studies have demonstrated that the scores of older people tend to show a fatigue effect. However, the present results showed that this is not necessarily true. There was a linear increment of reduction rate and no age difference. These results suggest that when a given cognitive task finishes within 3 minutes, the fatigue rates of older people seem not so different from those of younger groups.

These results suggest first that if we prepare norms and distribution pattern for each of three indices in terms of age and sex, we can evaluate the participant's level of attention ability and his/her deviation from the average as a screening for further examination of cognitive deficit. Although statistical differences were apparent, differences in performance on *Total Performance* and *Reduction* ratio might not be of clinical significance. Nonetheless, separate norms for men and women may be appropriate to account for any differences.

Needless to say the evaluated attention ability includes only three of the five components of the model by Sohlberg and Mateer (1989); those, which relate to focused attention, sustained attention, and selective attention. We realize that many studies suggest an effect of educational level on cognitive function, especially on attention but we did not conduct any analyses on this variable. As mentioned earlier, the extent of education is strongly related to the age group. For the last 15 years, more than 95 % of the Japanese population graduated from high school and nearly 40 % of high school graduates entered various levels of university in Japan. However, only 15 % of the population over 50 had a university level of education. Therefore, we regarded it as useless to conduct this type of analysis for the rural community dwellers and it is meaningless to prepare the norms as a function of education level for the screening test at present. When we have collected much more data, we may be able to prepare norms for educational level.

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2. Memory of a public traumatic event: The assassination of Israel's Prime Minister, Itzhak Rabin

Israel Nachson and Anat Zelig

Abstract
A series of four experimental studies on theoretical issues regarding memory of traumatic events is reviewed. The studies focused on memory of the assassination of Israel's Prime Minister, Itzhak Rabin on November 4, 1995. The issues discussed pertain to the quantitative and qualitative properties of factual and flashbulb memories and of collaborative and individual memories, as well as to the effect of post-event misinformation on memory. Together, these discussions may enhance our understanding of some cognitive aspects of memory in general, and of the nature of traumatic memory in particular.

Key words: assassination, memory, Rabin

1. Introduction

The present chapter constitutes an integrative analysis of four studies (Benjaminova & Nachson, 2007; Nachson & Zelig, 2003; Yaron-Antar & Nachson, 2006; Zelig & Nachson, 2007) on the memory of the assassination of Israel's Prime Minister, Itzhak Rabin. The assassination and its aftermath have been preoccupying the Israeli society ever since it took place about 11 years ago. Collective memory of the assassination has been studied from a sociological point of view (Vinitzky-Serroussi, 1998, 2001, 2002), but the studies reported here are the first to look into individual memories of the tragic event from a psychological perspective. The four studies constitute empirical investigations of theoretical issues which have been discussed by memory researchers in recent years; each study dealing with a different issue. The purpose of the present review is to provide a comprehensive, integrated analysis of the findings that will contribute to the understanding of traumatic memory in general, and of the specific tragic episode under investigation in particular.

The assassination took place on November 4, 1995, at the conclusion of an open air rally that was held in Tel Aviv, Israel, in support of Rabin's peace policy toward Israel's Palestinian neighbors. A major element in his policy was the trading off most Palestinian territories held by Israel since the conclusion of the Six Day War in 1967 for peace. Right wing radicals objected to this trade-off, and one of them, a young man by the name of Yigal Amir, assassinated the Prime Minister by shooting him at the back as he was heading toward his car. The event has been repeatedly broadcast by the local television stations for a long period of time, and it had aroused strong emotional reactions (particularly fright and surprise; see Nachson & Zelig, 2003) that have not fully subsided until this very day. The intense emotional reactions have turned the assassination into a national trauma whose impact on personal memories is at the core of the present discussion.

The discussion begins with an evaluation of the memories of the assassination itself (factual memories, FTM) and of the circumstances in which people first learned about it (flashbulb memories, FBM). It has been argued (Brown & Kulik, 1977) that the two kinds of memory are functionally and phenomenologically distinguishable. Quantitative as well as qualitative analyses (Nachson & Zelig, 2003; Zelig & Nachson, 2007) have been employed in order to find out if this distinction is empirically valid.

Usually, people who witness a traumatic event reminisce about it both individually and in collaboration with others. What does collaboration do to memory? A literature search reveals that collaborative memory which has so far been studied in the laboratory using neutral, non-emotional stimuli is impaired relative to individual memories pooled together (Basden, Basden, & Henry, 2000; Finlay, Hitch, & Meudall, 2000; Weldon & Bellinger, 1997). A pioneering study (Yaron-Antar & Nachson, 2006) examined the ecological validity of this finding on a real-life emotion-arousing event of the assassination of a Prime Minister.

Finally, media reports of traumatic events, such the one under consideration, produce veridical information as well as misinformation (see Lewandowsky, Stritzke, Oberauer, & Morales, 2004). One may wonder whether subsequent exposure to misinformation can distort memory. In an attempt to answer this question, a pioneering study (Benjaminova & Nachson, 2007) on the differential effects of misinformation on individual and collaborative memories of a traumatic event was conducted.

The review of the four studies is designed to illuminate various aspects of the memory of a traumatic public event which differs in many respects from both, memories of everyday events and privately experienced traumata.

2. Factual and flashbulb memories

Research on memories of public traumatic events focuses on FTM that refer to memories of the central and peripheral details regarding the public event, and FBM that refer to the personal circumstances in which a person first learned about an unexpected, emotionally-arousing and important public event. According to Brown and Kulik (1977) who coined the term FBM, these memories are processed by a special mechanism that makes them accurate, “live”, rich with visual representations, consistent over time, retrieved with confidence in its accuracy, and thematically characterized by seven “canonical categories” (place, ongoing event, informant, affect in others, own affect, aftermath, and idiosyncratic information). Furthermore, these memories are better and longer remembered than FTM. Brown and Kulik’s hypothesis of flashbulb memory has gained some support (Bohannon & Symons, 1992; Conway et al., 1994; Finkenauer, Luminet, Gisle, El-Ahmadi, & Filipopot, 1998; Larsen, 1992; Pillmer, 1984; Rubin & Kozin, 1984; Talarico & Rubin, 2007; Winograd & Killinger, 1983), but it has been challenged by studies (Christianson, 1989; McCloskey, Wible, & Cohen, 1988; Neisser, 1982; Neisser & Harsch, 1992; Schmolck, Buffalo, & Squire, 2000; Wright, 1993) showing that FBM suffer from inaccuracies and inconsistencies, and that even when they are more accurate than FTM, their superiority may be accounted for in terms of enhanced rehearsal rather than in terms of a putative special mechanism.

Nachson and Zelig (2003) and Zelig and Nachson (2007) have further elucidate the differential nature of the two kinds of memory by analyzing memories of the assassination of Itzhak Rabin (FTM) and the circumstances in which they had been first learned (FBM). About two weeks after the assassination 61 Israeli participants filled out a memory questionnaire, and about 11 months later they filled it out again and self-assessed their emotional and cognitive reactions to the assassination, as well as specific properties of their memory; such as confidence in its accuracy, and the amounts of rehearsals and visual representations. Quantitative and qualitative data analyses provided a clue as to what happens to memory of such a traumatic event over a period of almost a year.

3. Quantitative analysis

Data analysis uncovered a decrement of about 25 percent in FTM accuracy, and about 36 percent in FBM consistency (Figure 1). The similarity between

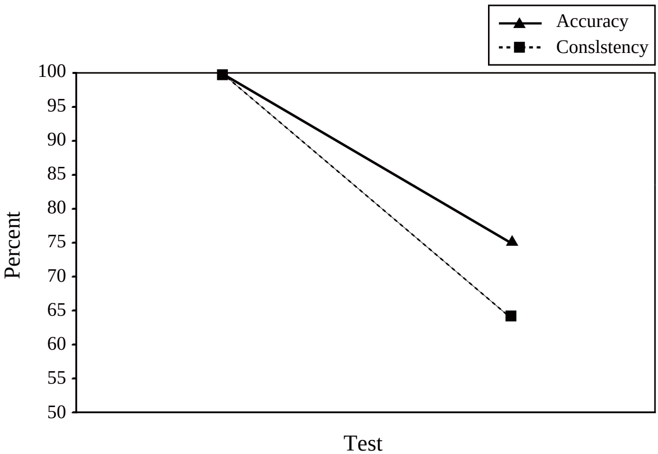

Figure 1: Factual memory accuracy and flashbulb memory consistency over a period of about 11 months

the two tendencies might indicate similar decrements in resistance to interference over time (see Er, 2003). FTM-FBM similarity is also evident in the amount of visual representations and in the (high) level of confidence that the participants had in memory accuracy. Taken together, these findings seem to imply that the distinction between FTM and FBM is not empirically valid, and that they are both stored together in episodic memory, presumably by the same memory mechanism (see Brown, 1990; Gold, 1992; Neisser et al., 1996).

The 9.11.2001 disaster of the World Trade Center in New York provided ample opportunities to examine the relative efficacy of FTM and FBM in terms of memory consistency over time. The results of these examinations are conflicting. Talarico and Rubin (2003) found similar decrements in memory consistency for both FTM and FBM. Some authors (Coluccia, Bianco, & Brandimonte, 2006; Curci & Luminet, 2006; Smith, Bibi, & Sheard, 2003; Tekcan, Ece, Gülgöz, & Er, 2003) found a greater decrement in consistency of FTM than of FBM, but Shapiro (2006) found the opposite. Employing a different methodology, Pezdek (2003) also concluded that FTM and FBM are in fact separate memories. An easy way out of the conundrum of the conflicting data is to point to methodological differences among the various studies (in terms of questions asked, length of event-test interval, data coding, etc.). However, in the final analysis it seems that the issue of the nature of FBM vis-à-vis FTM is not settled yet.

FTM-FBM similarity also led Nachson and Zelig (2003) to the conclusion that in the modern world where exposure to live television broadcasts is common, there is a tendency to respond to broadcasts of traumatic public events as if they are episodic experiences. As evident by the participants' responses and their memory characteristics, they had seemingly reacted to the broadcasts of the assassination on television as if they had been actually present at the scene of the crime. Indeed, like any eyewitness to a crime, they remembered not only the details of the event itself (FTM), but also the personal circumstances in which they had first learned about the news (FBM).

4. Qualitative analysis

As a traumatic event, assassination of a Prime Minister is expected to produce memories with special characteristics. After years of controversy between laboratory- (Clifford & Scott, 1978; Deffenbacher, Bornstein, Penrod, & McGorty, 2004; Loftus & Burns, 1982) and field-researchers (Christianson & Hubinette, 1993; Yuille & Cutshall, 1986) showing negative and positive correlations between emotionality and memory, respectively, it is now accepted that the memory of each detail of an emotion-arousing event depends on its levels of emotionality (Chrisitanson, 1992), visual saliency (Chistianson & Loftus, 1991), and importance for the narrative (Heuer & Reisberg, 1990). Thus, Heuer and Reisberg found that in recalling emotional experiences, central details (whose omission impairs the basic narrative) are more accurately remembered than peripheral details (whose omission does not adversely affect the narrative). However, the peripheral details which are forgotten are only those that are not directly related to the course of event or the major character in the story. Burke, Heuer and Reisberg (1992) further observed that peripheral details associated with the main characters are better recalled (along with the central details) than those associated with neutral events, whereas the details which are not directly related to the emotional event, and those preceding or succeeding it, are remembered less well than peripheral details of neutral events.

Studying eyewitnesses' reports of an armed robbery, Yuille and Cutshall (1986) found that most inaccurate details referred to the appearance of others (the robber, the store owner and the eyewitnesses); particularly with respect to numerical details such as height and weight. Fewer errors appeared in descriptions of the sequence of events, and least appeared in those of objects; particularly the car (model, color). Similarly, Christianson and Hubinette (1993) found a high rate of accurate reports of a robbery (activity at the scene of the crime, the weapon used and the robber's cloths), including contextual information (such as day and date).

In Zelig and Nachson's (2007) study the most frequent accurate and inaccurate details, as well as the omitted items (that were recalled in the first but not in the second memory test) were recorded. Corroborating previous findings

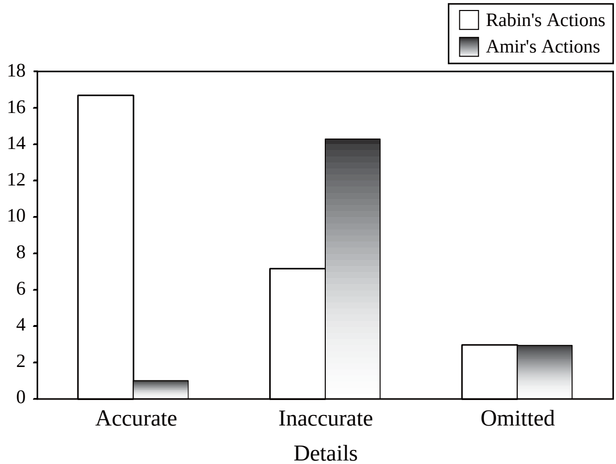

Figure 2: Accurate, inaccurate and omitted memory details of Rabin’s and Amir’s actions

(Christianson & Hubinette, 1993; Clifford & Scott, 1978; Tickner & Pulton, 1975; Yuille & Cutshall, 1986), in the case of Rabin’s assassination there were more accurate memories for actions performed by or on Rabin than for descriptions and contextual information. This finding is perhaps due to the fact that attention focusing is impossible during a rapidly unfolding emotion-arousing event (Tickner & Pulton, 1975). By contrast, the omitted details referred to actions carried out by persons who were unrelated to Rabin (organizers of the rally, performers, speakers). Rabin was both familiar and visible - two properties that are associated with memory accuracy (Christianson & Loftus, 1991; Davies, 1993). Comparison of the memories of Rabin’s and Amir’s (the assassin) actions (Figure 2) shows that the rate of accurate memories was about twice as high for Rabin’s as for Amir’s actions, whereas the opposite was true for the inaccurate memories (there was virtually no difference in the rate of omitted actions performed by the two). Clearly, Rabin who was a familiar, highly visible celebrity drew more attention than Amir who prior to the assassination was totally unknown to the public.

In line with Heuer and Reisberg’s (1990) finding, about a third of the most frequent accurately recalled details were considered central to the narrative of Rabin's assassination. Most inaccurate (94 %) and omitted (88 %) details were peripheral.

Numerical details were generally inaccurate (see Christianson & Hubinette, 1993; Loftus, 1996; Yuille & Cutshall, 1986). Usually, these are very difficult to remember (Christianson & Hubinette, 1993; Loftus, 1996; Yuille & Cutshall, 1986); especially when assessments of time (hours, minutes), distance (meters, centimeters) and weight (kilograms, grams) are not directly linked to physical sensations (in daily life these assessments are aided by instruments such as watches, rulers and weights). Regarding the last explanation, it was found that general details (date, city, part of the day) were accurately remembered, whereas specific details (exact times of the assassination, of the death and of its official announcement) were inaccurately reported.

It is noteworthy that memory characteristics of Rabin's assassination which has been repeatedly broadcast, are similar to those found in memories of emotional events to which the participants were exposed only once (Burke et al., 1992; Christianson & Hubinette, 1993; Christianson & Loftus, 1991; Heuer & Reisberg, 1990; Yuille & Cutshall, 1986). Previous research on the effect of repeated exposures to negative emotional events on memory has yielded inconsistent data (Conway et al., 1994; Finkenauer et al., 1998; Guy & Cahill, 1999; Neisser et al., 1996). If the finding of Zelig and Nachson's (2007) study is replicated, it will support Gold's (1992) suggestion that only the first encoding has a lasting effect on memory. Indeed, all accurate details of Rabin's assassination were made public at the first hours after the event when the emotions were at their peak.

The decrement in memory accuracy over about 11 months was accompanied by a decrease in emotionality which is usually involved with memories (see Davies, 1993). Moreover, the participants' high emotionality about two weeks after the assassination might have served as a contextual cue for the associated memories (see Bower, 1992). This cue was apparently absent about a year later when emotionality was considerably reduced.

In sum, it appears that multiple exposures to emotion-arousing events do not always significantly enhance memory accuracy beyond the effect of the initial exposure; and that the fate of the encoded details of these events (accurately or inaccurately remembered, or altogether omitted) depends not only on the rememberer's meta-cognitive judgments (of emotionality and narrative importance), but also on specific stimulus properties (levels of activity, visibility and familiarity).

Memories of traumatic events tend to be repeatedly rehearsed and memorized, either individually or collaboratively with others. The question is: Are the two different; and if they are - in what way?

5. Collaborative memory

Collaborative memory is the joint product of two or more individuals who collaborate in creating a common report of a given stimulus (Weldon, Blair, & Huebsch, 2000). Effect of collaboration on memory has been tested by comparing memories of collaborative and nominal groups. A nominal group is created by pooling together nonredundant details that are individually recalled by participants whose number equals that of the collaborative group (Basden et al., 2000). Performance of the collaborative group is thus compared with its expected performance were the recollection task performed individually. It has been found that collaborative memories often contain less accurate details than nominal memories (Basden, Basden, Bryner, & Thomas, 1997; Basden et al., 2000; Finlay et al., 2000; Weldon & Bellinger, 1997). This finding has been accounted for in terms of "collaborative inhibition" (Weldon & Bellinger, 1997) which is apparently due to interference in the individual organizational and retrieval processes by information provided by other members of the group (Anderson & Nealy, 1996; Roediger & Neely, 1982; Slamecka, 1969); to the tendency to exert less effort in performance of collaborative than individual tasks (Karau & Williams, 1993; Latane, Williams, & Harkins, 1979; Taylor, Peplau, & Sears, 1994); and to the apprehension of a negative feedback on the part of other group members (Collaros & Anderson, 1969; Dihel & Stroebe, 1987).

Effects of collaboration on memory which has so far been tested under experimental, emotionally-neutral conditions, was for the first time tested by Yaron-Antar and Nachson (2006) on the emotional, well rehearsed memories of a real-life event. About six years after Rabin's assassination, 146 participants responded to questions regarding the rally, the assassination, the evacuation and hospitalization, the funeral and the assassin. About half of the participants were tested individually, and the other half - collaboratively (in groups of three). In the collaborative groups all decisions were unanimous. The individual responses given by the three group members were pooled together so as to form nominal groups. Nominal remembering could potentially produce multiple responses; e.g., two accurate and one inaccurate responses which were scored accordingly.

As Figure 3 shows, overall, the nominal memory produced more details than the collaborative and the individual memories, but the accuracy rate was higher for the collaborative than for the other two memories. It therefore appears that the collaborative inhibition affected the incidence, but not the accuracy rate of the collaborative memory. The nominal memory was the most productive but the least accurate of all memories, whereas the individual memory was the least productive but almost as accurate as the collaborative memory.

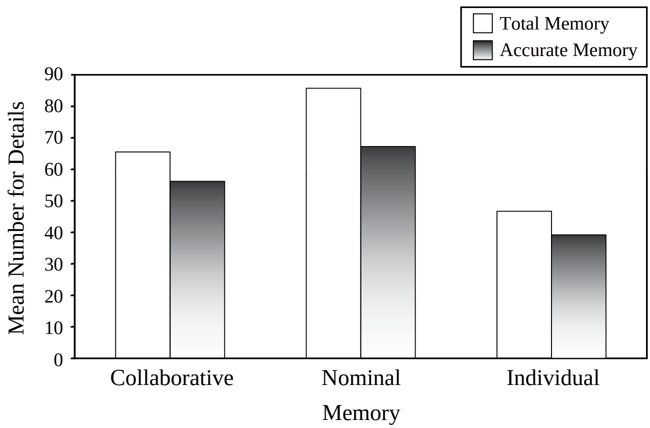

Figure 3: Total and accurate number of collaborative, nominal and individual memory details

This finding is inconsistent with the laboratory findings (Basden et al., 1997; Basden et al., 2000; Finlay et al., 2000; Weldon & Bellinger, 1997) that demonstrate the superiority of nominal over collaborative memory (for further details, see Yaron-Antar & Nachson, 2006).

Nachson and Zelig (2003) tested the individual memory of the assassination twice; about two weeks and about 11 months after the event. Yaron-Antar and Nachson's (2006) study was conducted about six and a half years after the assassination. Effects of the event-test intervals on memory could therefore be compared for the individual responses. As the comparison shows, on both tests the participants in the former study remembered more accurate details than those in the latter study. Presumably, crucial contextual cues that originally helped reconstruct the event have been eliminated over time (see Nachson & Zelig, 2003).

In conclusion, in line with earlier findings on memories of word lists, the collaborative memory of the assassination of Prime Minister Itzhak Rabin produced more accurate memories than individual memories. In extending the laboratory findings regarding memory of neutral stimuli to memory of real-life, emotion-arousing events, these data provide ecological validity to the phenomenon of collaborative remembering.

These findings refer to veridical information that has been delivered to the participants via the news broadcasts by the mass media. However, in the aftermath of traumatic events veridical information is often mixed with misinformation. It makes sense to assume that both kinds of information affect memory; collaborative as well as individual. This hypothesis was systematically investigated in Benjaminova and Nachson's (2007) study.

6. Misinformation effect

Numerous examples of effects of post-event misinformation on memory have been reported (see Loftus, 2006). For example, misinformation led participants to "memorize" that they saw a silo in a rural area when in fact they had not seen buildings at all; that a white (rather than blue) vehicle was involved in a car accident; that they had been lost in a shopping mall; and that they were hospitalized or had an unusual birthday party (Hyman, Husband, & Billings, 1995; Hyman & Loftus, 1998; Hyman & Pentland, 1996; Loftus, 1993, 1996, 1997; Loftus & Hoffman, 1989; Loftus & Ketcham, 1994; Loftus & Pickrell, 1995; Toland, Hoffman, & Loftus, 1991).

The standard experimental procedure for testing the misinformation effect is as follows: All participants are first exposed to a given event which is displayed by either slides or a videotape. Following the exposure the experimental group receives written misinformation about some critical details of the event which the control group does not receive. Finally, all participants are asked to remember the original event. Usually, memory accuracy of the experimental group is reduced relative to that of the control group (see Ayers & Reder, 1998; Loftus, 1979a). Misinformation may also be conveyed by the wording of the questions asked (Loftus, 1975; Loftus & Palmer, 1974; Loftus & Zanni, 1975; Shechori, Nachson, & Glicksohn, 2007; Toland et al., 1991). For example, Ayers and Reder (1998) exposed their participants to a short movie on a car accident. Half of them were subsequently questioned about the two cars that smashed into each other, while the others were questioned about the two cars that hit each other. The former group reported seeing broken glass which in fact did not appear in the movie at all.

According to the "storage-based impairment hypothesis", the misinformation actually replaces the original memory (Ayers & Reder, 1998; Loftus, 1975, 1979a, 1979b, 1993, 1996, 1997; Loftus & Hoffman, 1989) which is consequently lost. However, according to the "coexistence hypothesis" the two memories, the original and the false, coexist (Toland et al., 1991), and consequently the original memory might be temporarily inaccessible, but it is not lost.

Benjaminova and Nachson (2007) examined the effects of misinformation on collaborative and individual memories of Rabin's assassination. It was assumed that since the former memory is better than the latter (Yaron-Antar & Nachson, 2006), it would be less amenable to the influence of misinformation. One hundred and eighty participants filled out a questionnaire that entailed 22 questions; half referring to veridical information (for example, on what day

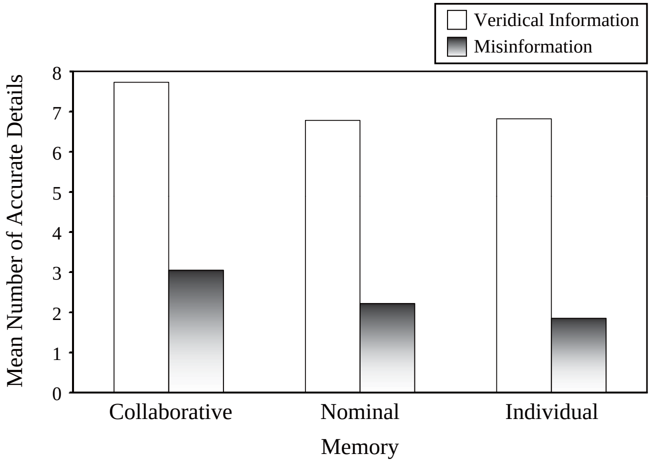

Figure 4: Accurate collaborative, nominal and individual memories following exposure to veridical information and misinformationd

of the week was Rabin assassinated?), and the other half - to misinformation (for example, next to whom was the Prime Minister buried in Har Hamenuchot cemetery? [in fact, he was buried elsewhere]). One hundred and thirty five participants filled out the questionnaire collaboratively and 45 filled them out individually. Since Wright and Stroud (1998) and a preliminary study showed that the misinformation referring to central details is readily detected, all false questions referred to peripheral details (as defined by Nachson & Zelig, 2003). As Figure 4 shows, both the veridical and the false details were better recalled under the collaborative than under the nominal and the individual conditions.

In the past, misinformation effects on memory have been demonstrated solely on neutral stimuli, such as a word list, a story, or a simulation of a road accident which does not evoke emotions as much as a real accident does (e.g., Ayres & Reder, 1998; Dalton & Daneman, 2006; Hyman & Loftus, 1998; Loftus, 1975, 1979a, 1979b; 1993, 1996, 1997; Schooler & Loftus, 1993; Toland et al., 1991). Benjaminova and Nachson (2007) were able to show, for the first time, that misinformation may also affect memory of real-life emotional events to which the participants have been repeatedly exposed. However, because the questionnaire focused exclusively on peripheral details, it is possible that this effect is limited only to this particular category. This conclusion is consistent with the "weapon-focus effect" (Christianson, 1992; Christianson & Loftus, 1990; Kramer, Buckhout, & Eugenio, 1990; Loftus, Loftus, & Messo, 1987; Yuille & Cutshall, 1986) which postulates that during a traumatic event (such as an armed robbery) the observer's attention is exclusively drawn to the central, emotion-arousing details of the event (such as the weapon in the robber's hand) while disregarding its peripheral details. Consequently, the memory of the weapon is accurate, whereas that of the robber's face and other details is impaired. Under such circumstances memory might be distorted by misinformation.

In Benjaminova and Nachson's (2007) study misinformation clearly adversely affected more the individual than the collaborative memory. This finding is consistent with earlier data (e.g., Ayers & Reder, 1998; Barnier & McConkey, 1992; Loftus, 1975, 1979a, 1979b, 1996, 1997; Toland et al., 1991) showing that exposure to misinformation brings about more reports of misinformation by individual than by collaborative participants. Most recently, Dalton and Daneman (2006) further found that misinformation affects mostly peripheral individual memories. It appears that the participants were worried about reporting inaccurate details of the event, perhaps because of evaluation apprehension on the part of the group members (see Collaros & Anderson, 1969), and in case of doubt they preferred a non-response to an erroneous response. Corroborating previous studies on the memory of Rabin's assassination (Nachson & Zelig, 2003; Yaron-Antar & Nachson, 2006; Zelig & Nachson, 2007), Benjaminova and Nachson (2007) indeed found that recall of the assassination was characterized by many errors of omission, but only by a few errors of commission.

Analysis of the individual reports showed that following exposure to misinformation the participants' original memories did not get lost. The participants' answers were inaccurate only in response to questions that contained misinformation. Answers to questions that contained veridical information were accurate. Corroborating Paterson and Kemp's (2006) finding, this result is clearly inconsistent with the "storage-based impairment hypothesis" which postulates that misinformation causes the original memory to get lost, but it is consistent with the "coexistence hypothesis" which postulates that the two versions of an event may coexist in memory.

However, as McCloskey and Zaragoza (1985) showed, post-event misinformation neither changes the original memory of a given event, nor makes it inaccessible. In-fact, it does not affect the original memory at all, and the effects that had been previously reported (e.g., Loftus, 1975, 1979a, 1979b, 1993, 1996, 1997; Morton, Hammersley, & Bekerian, 1985; Toland et al., 1991) are a methodological artifact of the standard testing procedure which creates a bias to accept the misinformation without ever storing the original information. Moreover, under the standard procedure the participants are influenced by experimental demand characteristics. Thus, when the participants remember equally well both the original information and the misinformation, they tend to report the latter because it is usually being delivered by a trustworthy experimenter whom the participants wish to please (for a compromise among the various hypotheses, see Loftus, 2006). However, since in Benjaminova and Nachson's (2007) study the participants filled out the questionnaire anonymously, it is more likely that their memories were affected by impaired access to the original memory than by demand characteristics.

Assuming that the two kinds of memory, the veridical and the false, are encoded in memory, it seems plausible to account for the tendency to retrieve the misinformation rather than the veridical information in terms of Morton et al.'s (Abeles & Morton, 1999; Morton et al., 1985) "headed records theory". According to this theory, information is represented by individual memory records each of which is accessible by a specific heading that entails coded information on its content. Memory search begins by a description of the relevant accessible information, and it is accomplished by matching the heading with the description. Misinformation affects memory when the record of the original memory is inaccessible relative to that of the misinformation that follows (Morton et al., 1985). Accordingly, when the question in Benjaminova and Nachson's (2007) study was veridical it was matched with the description of the assassination, and once matched the record was accessible. However, when the question was false, the record was inaccessible, and consequently a misinformation effect appeared.

Finally, it is noteworthy that the rate of accurate memories of Rabin's assassination as found in Benjaminova and Nachson's (2007) study that was conducted about eight years after the event (26.95 %) is reduced relative its rate (39.59 %) about a year after the assassination (Nachson & Zelig, 2003), but is similar (28.72 %) to that obtained about six years after the event (Yaron-Antar & Nachson, 2006). That means that over the years memory accuracy stabilizes.

7. Conclusion

Taken together, the four studies on the memory of Rabin's assassination not only highlight some pertinent psychological aspects of this specific traumatic event, but also shed light on memories of emotion-arousing events in general, as well as on theoretical issues currently debated by students of memory. In particular, the nature of flashbulb and collaborative memories, and the effects of post-event misinformation on memory of Rabin's assassination have been systematically investigated, and the data obtained were compared to those reported in experimental studies on memory of neutral stimuli. The findings of this series of studies may therefore contribute also to the ongoing discussion of the nature of laboratory versus field studies on memory.

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3. Pronunciation of low-frequency irregular words in estimating premorbid intelligence

Che Kan Leong and Jun Yamada

Abstract

Recently, McGurn et al. (2004) confirmed that the pronunciation of the low frequency and irregular words in the National Adult Reading Test (NART) is preserved in adult patients with dementia and NART provides a good estimate of premorbid intelligence of these patients. We attempted to answer these intriguing questions by examining the phonological structure of NART words, particularly the optimality of the demisyllables constituting these words. Following Clement (1990), we found the initial and final demisyllables of NART words are near optimal in sonority dispersion as compared with some regularly spelled counterparts. The near optimality of NART words may facilitate their retrieval and become part of "crystallized intelligence". We further invoked the concept of word reading as paired-associate learning to explain the unique visual-verbal contribution to irregular word reading. We speculated that the pronunciation of NART-like low frequency Japanese kanji words or Chinese characters with optimal speech forms may also be preserved in Japanese or Chinese dementia patients and may correlate with premorbid intelligence.

Key words: National Adult Reading Test (NART), optimality of demisyllables, phonological structure of NART words, premorbid intelligence in dementia, word reading as paired-associate learning,

1. Introduction

It is no exaggeration to say that Professor Takeshi Hatta has played an important leadership role in the development of psychology as an academic discipline in Japan these thirty years. We have no doubt that he will continue to do so. It is a privilege and an honor for both authors to be asked to contribute a paper to help celebrate Professor Hatta's Sixtieth Birthday. Rather than writing just a congratulatory message, we thought it more meaningful to append a small note on our reactions to a paper on estimating premorbid intelligence in adult patients from low-frequency irregular words in English from the well-known National Adult Reading Test (Nelson, 1991). The phenomenon puzzles us and other researchers (e.g., Detterman, 2004). We feel the topic in an area of neuropsychology reflects part of the many interests and contributions of Professor Hatta and hope our note will promote further debate and research among colleagues.

Many complimentary remarks can be made about the important achievements of Takeshi Hatta. Suffice it to state his research interests are many and varied: The processing of Japanese kanji and kana, functional cerebral laterality and more recently organizational psychology of which he is the founder and Editor-in-Chief of the *Journal of Human Environmental Studies*.

One of the authors (CKL) first met Takeshi at a Chinese/Asian Language conference in Hong Kong in the early 1980s or late 1970s. Takeshi and CK subsequently met a number of times on similar occasions and also during CK's visit to his neuropsychology lab at Osaka University of Education. It was where he conducted many of his visual-half field studies and CK at that time was interested in the auditory counterpart of dichotic listening experiments, both techniques being used to infer functional cerebral laterality. These behavioral studies using visual-half fields and dichotic listening paradigms were long before the days of fMRI, ERP and other neurobiological studies of the brain. CK was amazed that the number of papers that Takeshi published in prestigious journals such as Cortex relied on just one tachistoscope! This goes to show that research is the product of hard work, good ideas, asking the right questions and of course sophisticated instrumentation helps and often is essential these days.

Takeshi simply goes ahead and does what he considers to be right, to help promote the field of psychology and to mentor young scholars. The founding of the *Journal of Human Environmental Studies* is a case in point when he saw the need several years ago and had the courage and tenacity to start the Journal from scratch. Now it is going into the sixth year of publication and by all accounts is thriving. May we wish Takeshi many years of equally productive research and writing for the benefit of psychology and the younger generation of scholars and researchers. On a personal note we also wish Takeshi and Setsuko Hatta many years of longevity and happiness.

2. Estimating pre-morbid intelligence from NART

We now wish to append this small note on clinical neuropsychology by way of sharing our puzzlement. It was the second author (JY) who first raised the issue on reading the paper by McGurn, Starr, Topfer, Pattie, Whiteman, Lemmon et al. (2004) on estimating intelligence in patients with dementia from the National Adult Reading Test (NART) and it was JY who did much of the cooperative work. NART is “specifically designed to provide a means of estimating the premorbid intelligence levels of adult patients suspected of suffering from intellectual deterioration” (Nelson, 1991, p.1; Ryan & Paolo, 1992). The NART has also been adapted for North American population as North American Adult Reading Test (NAART or NART-R) (Blair & Spreen, 1989; see also Spreen & Strauss, 1998).

Since its early version (Nelson & O’Connell, 1978) NART has been shown to be a reasonably good indicator of premorbid intellectual ability. It has also been shown that in moderate to severe levels of dementia there is a deterioration in NART performance (Patterson, Graham, & Hodges, 1994), and NART performance is influenced by severity of dementia (Taylor, 1999). The reading test also tends to underestimate the intelligence levels of patients with mild dementia with some accompanying linguistic deficits (Stebbins, Gilley, Wilson, Bernard, & Fox, 1990). Recently, McGurn et al. (2004) demonstrated that the correlation between NART scores at about age 80 and IQ at age 11 was similar in people with and without dementia, thereby further confirming that the NART (composed of low-frequency irregular words such as *aisle*, *psalm*, *campanile*) can be used to estimate premorbid intellectual ability in dementia. When controlling for age 11 IQ scores, mean NART scores did not differ in healthy and demented people, thus demonstrating the utility of NART as an instrument in the assessment of cognitive impairment in adult patients.

This finding by McGurn et al. (2004) is intriguing because all of the NART test words are irregular words and most are low-frequency words. Puzzling questions as posed by Detterman (2004) thus remain as to: (1) Why pronunciation of irregular words is preserved in dementia and (2) Why it is highly correlated with premorbid intelligence. We attempt to answer these vexing questions by examining some psycholinguistic characteristics of the NART words.

3. Method

The NART words appear to have at least three important psycholinguistic characteristics: (1) All the words are relatively short, mostly one to three syllables in length, (2) Most are low-frequency words, and (3) Most appear to be relatively easier to learn due to their phonological quality. The first is a characteristic feature of this test which was specifically designed "to avoid the possible adverse effects of stimulus complexity on the reading of dementing subjects" (Nelson, 1991, p. 2). The second can easily be verified by utilizing the Carroll, Davis, and Richman (1971) corpus, which has some 87,000 word types from about 5,000,000 graphic words of running text, and the Francis and Kučera (1982) corpus, which is based on about 1,000,000 graphic words of running text.

The third question involves word learning and processing, and needs some psycholinguistic explanation. Learning to read words, especially irregular (or exception) words, can be taken as a special case of paired-associate learning (Hulme, Goetz, Gooch, Adams, & Snowling, 2007; Treiman & Baron, 1983). In the case of irregular words used in the NART, one may well pay attention to the orthographic complexity of the stimulus items, e.g., *ache* and *thyme*, but the paired-associate learning theory suggests that the familiarity, meaningfulness, and pronounceability of the response items, i.e., /eik/ and /taim/, are far more important (Underwood & Schulz, 1960). Given this hypothesis, the question to ask is if most of the 50 NART words consist of easier words then one may imagine if the phonological cues of these words are generally optimal in terms of phonological structure. We thus attempted to measure the quality of the phonology of the NART words.

One way to measure such quality is to examine the degree of optimality of syllables, demisyllables in particular, which compose the NART words. Given a syllable CCCVCCC, where C designates a consonant and V a vowel, a demisyllable is defined as CCCV or VCCC, i.e., a maximal sequence of tautosyllabic segments of the form containing a vowel V. Clement (1990) formulated the Sonority Dispersion Principle to show the degree of distance from the optimal syllable based on the Core Syllabification Principle. The Core Syllabification Principle states, “Given P (an unsyllabified segment) adjacent to Q (a syllabified segment), if P is lower in sonority rank than Q, adjoin it to the syllable containing Q (iterative)” (Clement, 1990, p. 317). A measure of dispersion D of the distances in sonority rank d between the pairs of segments in a demisyllable is defined as:

$$D = \sum_{i=1}^{m} \frac{1}{d_i^2},$$

where d_i is the distance in sonority rank between each ith pair of segments in the demisyllable, and m is the number of pairs in the demisyllable. The well-formedness of a syllable is indicated by D values such that for the initial demisyllable, the smaller the D value is, the more optimal it is, and for the final demisyllable, the larger the value is, the more optimal it is.

All the D values of basic demisyllables are available in Clement. We used these values to show how optimal the demisyllables of the NART words are. For example, the word *thyme* /taym/ is composed of the initial demisyllable /ta/ OV and the final demisyllable /aym/ VGN, where O designates an obstruent, G a glide, and N a nasal, and the D for the initial demisyllable is 0.06 and that for the final is 1.36. These values indicate that both the initial and final demisyllable are near optimal. Our working hypothesis is that the demisyllables of the NART words may be better than those of their regularly spelled counterparts.

Since word frequency is considered a critical variable which affects lexical learning and processing, we could use words whose frequencies are comparable to the frequencies of the NART words as control words. Specifically, controlling for number of syllables and parts of speech, we chose two words per one NART word, which are ranked around the NART word in the Carroll et al. (1971) word frequency rank list. (The rank list of the Francis & Kučera corpus is too short to be useful; so is that of the British National Corpus (Leech, Rayson, & Wilson, 2001). As an example, the NART word *psalm* with a frequency of 6 has a D value for the initial demisyllable of .06 and a D value for the final demisyllable of .11. The two control words with comparable frequency are: *pep* with a frequency of 8 and a D value for the initial demisyllable of .06 and a D value for the final demisyllable of .06; and *throb* with a frequency of 6 and a D value for the initial demisyllable of .56 and a D value of the final demisyllable of .06.

4. Results

The first finding was that the NART words by and large consisted of low-frequency or very rare words. Of the 50 NART words, only 20 words (27 words if derived forms included) were found in the Carroll et al. (1971) corpus. The mean printed frequency of these 20 words were 29.1 but if the "outlier" first word "chord" with a frequency of 303 was excluded the frequency of the remaining 19 words dropped to 14.68. Similarly, 30 words were found in the Francis and Kučera (1982) corpus, and there were 19 words whose frequency counts were more than one.

With regard to the quality of phonological structure of the NART words, results were not straightforward because of the rarity of many of the words. We had 18 words out of the 50 for which we could adequately select control words from the Carroll et al. corpus and then compared their mean D values. Table 1 shows the main results.

The mean D value of the initial demisyllables of the first syllables tended to be smaller for the NART words ($M = 0.22$) than for the controls ($M = 0.38$), $t\,(17) = 1.67$, $p < .06$ (one-tailed), and the mean D value of the final demisyllables

Table 1: Mean D values (*SD*s) of the initial and final demisyllables for the NART and control words

	NART words	Controlled words
1st syllable (*n* = 18)		
Initial	0.22 (0.35)	0.38 (0.36)
Final	1.33 (0.71)	0.55 (0.61)
2nd syllable (*n* = 8)		
Initial	0.26 (0.37)	0.32 (0.35)
Final	0.89 (0.36)	0.62 (0.47)
3rd syllable (*n* = 1)		
Initial	0.25 (0)	1.00 (0.43)
Final	1.00 (0)	0.62 (0.44)

of the first syllables was significantly larger for the NART words ($M = 1.33$) than for the controls ($M = 0.55$), $t\ (17) = 4.62$, $p < .0001$ (one-tailed), thereby suggesting that the first syllables of the NART words are phonologically more optimal than those of the controls. (Note that 9 of the 18 words were monosyllabic words which also exhibited essentially the same tendency.)

For the remaining 32 rare words, the mean D values were 0.39 ($SD = 0.41$) and 0.80 ($SD = 0.48$) for the initial and final demisyllables of the first syllables ($n = 32$); 0.39 ($SD = 0.43$) and 0.59 ($SD = 0.45$) for the second syllables ($n = 29$); 0.39 ($SD = 0.41$) and 0.80 ($SD = 0.58$) for the third syllables ($n = 17$); and 0.49 ($SD = 0.44$) and 0.63 ($SD = 0.43$) for the fourth syllables ($n = 7$), respectively. These values were comparable to those of low-frequency control words (see Table 1).

5. Discussion

We have shown the following. (1) Most of the NART words are relatively short (29 of the 50 words with 6 letters or less) and of very low-frequency (20 words with available printed frequency from Carroll et al., 1971, average 29.1 or 14.68 after excluding the outlier word “chord”). (2) Although the orthographic forms of the NART words appear very complicated, their phonological structure is rather better-formed than that of their regularly spelled counterparts. These findings certainly allow for several interpretations. The interpretation we prefer is the following.

Learning to read these NART words should not be very difficult following the principle of paired-associate learning which states that the more pronounceable the response item is, the easier the paired-associate learning becomes (Underwood & Schulz, 1960). Consistent with this notion is the recent study by Hulme, Goetz, Gooch, Adams, and Snowling (2007) from two experiments examining three paired-associate tasks (visual-verbal, visual-visual, and verbal-verbal) in single word, nonword reading and phonemic awareness in seven- to eleven-old typical readers. Of particular relevance to our study is the finding that the cross-modal visual-verbal paired-associate learning, compared with the within-mode pair-associate learning, contributed unique variance to irregular word reading and single word reading. Together with phonemic awareness, visual-verbal associate learning was shown to play an important role in learning to read. The plausible explanation is that the cross-modal visual-verbal paired-associate learning requires memory representation of graphemic shapes and thus adds another component in learning to read in addition to phonemic awareness. This cross-modal learning goes beyond the learning of visual or phonological representation in relation to reading (Hulme et al., 2007).

Why is pronunciation of low-frequency irregular words preserved in dementia? It is plausible that once relatively easy written words have been acquired, they become part of “crystallized intelligence” which is difficult to lose (Horn & Cattell, 1967). These crystallized words are easily retrieved especially when the first syllables are phonologically optimal. We add here that the importance of word-initial speech-sound cues has been shown to help both aphasic patients (Goodglass, 1980) and normal people (Goodglass & Wingfield, 1997) in retrieving or naming words, and that crystallized words such as the NART words are less vulnerable not only to age changes but also to dementia, aphasia, and normal TOT (tip-of-the-tongue) phenomena. It is also possible that the semantic memory system which is critical to reading exception words is only partially impaired in patients with mild and moderate dementia, thus making the oral reading of NART words less vulnerable to impairment (Patterson, Graham, & Hodges, 1994).

Secondly, why does pronunciation of irregular words correlate highly with premorbid intelligence? We propose that it is not because the ability to read irregular words is inherently associated with intelligence. It is because reading ability, reading experience, and intelligence are highly correlated with one another and thus the ability to read irregular words is correlated with intelligence via reading experience which helps readers learn low-frequency or rare words such as the NART words. The learnt words are soon preserved in the readers' mental lexicon.

Although this second conclusion may strike us as less dramatic, it would not invalidate the NART as a tool to assess demented and possibly alexic patients' premorbid intelligence. We need to examine more rigorously the limitations and possibilities of the NART, however. For example, we did not examine imageability of the NART words where the orthography to phonology mapping is not strong. There is evidence of interaction between imageability and regularity where imageability facilitates the naming of low-frequency words (Strain & Herdman, 1999). However, our close observations suggest that many of the NART words have moderate imageability values. If such is the case, that would also be a contributing factor to the learning and processing of the words in childhood and adolescence. There are also doubts about the validity of the NART as a comparator of premorbid functioning in dementia even though its usefulness in estimating the lower limit of premorbid IQ is recognized (Beardsall & Huppert, 1997; Stebbins et al., 1990). To remedy this, there is the suggestion that NART should be used in conjunction with demographic information such as education, age, ethnicity and occupation to booster its effectiveness (Spreen & Strauss, 1998).

Also of interest is the generality of the NART. Specifically, we ask if the NART may be translated into or adapted for non-alphabetic writing systems such as the Japanese syllabary and the morphosyllabic Chinese, both of which use logographic characters, analogous to irregular words in English. As researchers in reading and psycholinguistics especially in the processing of Japanese kanji and kana and Chinese characters and words (e.g., Leong, Nitta, & Yamada, 2003; Yamada & Leong, 2005) we are keenly interested in this issue. It may turn out that pronunciation of low-frequency kanji words or Chinese characters with optimal speech forms in Japanese, for example, is also preserved in dementia and correlates with premorbid intelligence. This is a worthwhile question for further research.

With the above note and our observations of the estimation of intellectual functioning in patients with dementia from the pronunciation of low-frequency irregular English words, we invite our colleagues to make further observations. Again, we wish Takeshi Hatta many happy returns and many more years of productive academic endeavours.

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Part II: Brain and cognition

4. Visual field asymmetry in spatial relation judgments: Reference frame effect

Terumasa Kogure

Abstract

The present experiments examined whether reference frame cueing can influence visual field asymmetries in spatial relation judgments. In Experiment 1, a right visual field advantage was found for categorical spatial decisions (i.e., above/below judgment) when a reference cue was presented simultaneously with a target, but this advantage disappeared when the reference was viewed prior to the target. This lack of asymmetry can be attributed to the precomputation of a spatial reference frame (e.g., Logan, 1994, 1995), though there is also an alternative account proposing that attention is directed by the abrupt onset of the stimuli (e.g., Yantis & Jonides, 1984). In Experiment 2, this alternative *attention-based* explanation was tested, and it was found that attentional manipulation did not influence visual field asymmetries. Overall, the present results are not adequately explained by Kosslyn’s (1987, 1994) original hypothesis regarding spatial relation representations. An alternative interpretation, Logan's sequential computation of spatial relations, is discussed.

Key words: visual field asymmetry, spatial relation representations, reference frame

1. Introduction

Kosslyn (1987) proposed a division of labor between the two cerebral hemispheres for spatial information processing (see also Kosslyn, 1994). According to his theory, the left hemisphere is more effective at computing categorical or relative spatial relationships (e.g., above/below, left/right, etc.), whereas the right hemisphere is more effective at computing coordinate or metric spatial relationships (e.g., the distance between objects). The validity of this theory has subsequently been examined using spatial relation discrimination tasks (e.g., Hellige & Michimata, 1989) and sequential matching tasks (Kogure, 2001; Laeng & Peters, 1995).

In their classic study, Hellige and Michimata (1989) examined Kosslyn's (1987, 1994) hypothesis with a simple spatial relation discrimination task. A target dot was presented on a computer screen, either above or below a reference bar, and either nearer or farther than 2 cm from the bar. Observers were required to indicate the dot's location (categorical relation judgment: above/below) or the distance between the two stimuli (coordinate relation judgment: near/far). A tendency toward a right visual field (RVF)/left hemisphere (LH) advantage was found in the above/below judgments, and a left visual field (LVF)/right hemisphere (RH) advantage was found in the near/far judgments, thus supporting Kosslyn's hypothesis. Since this defining study, a large body of research has demonstrated supportive data using simple stimuli: i.e., a dot and bar (Anderson & Marsolek, 2005; Baciu et al., 1999; Banich & Federmeier, 1999; Cowin & Hellige, 1994; Kosslyn et al., 1989; Kosslyn, Thompson, Gitelman, & Alpert, 1998; Michimata, 1997; Niebauer & Christman, 1998; Parrot, Doyon, Démonet, & Cardebat, 1999; Roth & Hellige, 1998; Rybash & Hoyer, 1992). However, other researchers have criticized these results because they are not replicable (e.g., Sergent, 1991) or because the visual field asymmetries seen could instead be attributed to various methodological factors (e.g., Bruyer, Scailquin, & Coibion, 1997). Additional problems in the support data stem from difficulties in consistently detecting a RVF advantage in categorical judgments and from the finding that the LVF advantage in coordinate judgments tends to disappear with practice (see review, Jager & Postma, 2003; Kosslyn, Chabris, Marsolek, & Koenig, 1992; Laeng, Chabris, & Kosslyn, 2003).

In contrast to the relatively simple task described above, Laeng and Peters (1995) examined Kosslyn's (1987, 1994) hypothesis using a sequential matching task (see also Laeng, 1994). In this task, the observer was required to memorize a sample drawing of natural objects (e.g. animals) and subsequently to decide whether or not a second stimulus was identical to the sample. The sample was viewed in free vision, and the match was tachistoscopically presented to the LVF or the RVF. On half of the trials the same object as the sample was presented, whereas on another half either a categorical or a coordinate transformation was made. In the categorical transformation, the relative spatial location between the sample card and the match was changed, and in the coordinate transformation the metric properties were changed but the relative positions remained the same. A RVF/LH advantage was observed in the categorical transformation condition, whereas a LVF/RH advantage was observed in the coordinate condition, thus supporting Kosslyn's hypothesis. Although few experimental studies have used this paradigm, contrastive laterality effects by the two transformations seem to be strong (e.g., Kogure, 2001).

Although evidence supporting Kosslyn's (1987, 1994) hypothesis has been found with discrimination tasks (e.g., Hellige & Michimata, 1989) and with sequential matching tasks (e.g., Laeng & Peters, 1995), the size of visual field asymmetry differs between these two experimental paradigms. Possible reasons for this difference may be quantitative one (e.g., task difficulty) or qualitative (e.g., the computational processes underlying the tasks). Recently, van der Lubbe, Schölvinck, Kenemans, and Postma (2006) conducted an experiment incorporating both paradigms. They used a sequential matching task, but presented bar and dot stimuli. Unlike previous studies using the simple bar and dot stimuli, observers were required to memorize either the categorical or coordinate relations of the sample stimulus presented in central vision and to judge whether the spatial relation of the subsequent stimulus presented either in LVF or RVF was identical to or different from that of the sample. A LVF advantage was seen for the coordinate memory condition, but the categorical condition produced no visual field asymmetry. This evidence implies that the discrepancy in results seen between experimental procedures examining visual field asymmetries could be ascribed simply to task difficulty. That is, the categorical task is so easy that visual field asymmetries do not emerge. Kosslyn et al. (1998)

presents a similar interpretation. However, van der Lubbe et al. did not directly compare sequential matching with discrimination, so further research is necessary to draw a firm conclusion.

In contrast to the indirect evidence on task difficulty, there is clear-cut evidence on the difference in computational processes underlying the two tasks. Banich and Federmeier (1999) examined the importance of the spatial reference frame by comparing two conditions: *static* and *variable*. In the static condition, as in the Hellige and Michimata (1989) experiment, the reference bar was presented at the middle of the vertical extent of the computer screen. In contrast, in the variable condition, the bar was presented randomly at an upper, middle, or lower location along the vertical dimension of the screen. The static condition allowed observers to compute spatial relations either by means of the bar or the computer screen as a reference frame. However, in the variable condition observers were forced to use only the bar presented simultaneously with the target as a reference frame. No visual field asymmetries were found in the static condition, whereas a RVF advantage in categorical decision making and a weak LVF advantage (but nonsignificant) in coordinate decision making were found in the variable condition (however, the interaction between visual field and spatial relations was obtained only on the last half of trials). Thus, cerebral hemispheric asymmetry in spatial processing (especially in the categorical processing) may be related to the computational processing of the spatial reference frame. Of note, during sequential matching tasks, as in the variable condition described above, observers would not be able to compute the spatial relations in advance of the presentation of the potentially matching stimuli. This evidence suggests that differences in the potential computational processes for the spatial reference frame can account for the discrepancy in the size of visual field asymmetry produced by the different experimental procedures.

The main purpose of the present study was to replicate and extend the results of Banich and Federmeier (1999), with certain modifications. First, a slightly different cueing procedure was adopted. In all trials, a reference bar and a target were presented in random locations, similar to the variable condition of Banich and Federmeier. However, in one condition (the *previous* condition), the bar was presented prior to the target as a cue for computation of a spatial reference frame, similar to the static condition of Banich and Federmeier. In another condition (the *simultaneous* condition), the bar and target were always presented at the same time, so that the stimulus location could not be predicted in advance. This procedure resolves the problem in the Banich and Federmeier experiment that stimuli in the variable condition were presented at more peripheral locations than stimuli in the static condition.

A second modification was that stimuli used by Sergent (1991) were presented as well as the original stimuli used by Hellige and Michimata (1989) (see Figure 1). Sergent could not replicate Kosslyn's (1987, 1994) hypothesis using stimuli differing from a bar and dot, such as those shown in the central panel of Figure 1. Carlson-Radvansky and Logan (1997) reported that a spatial decision in a *goodness of fit* situation, such as deciding above or below in the original bar and dot task, is faster than a decision in an *acceptable* situation such as the above or below decision in the stimuli of the central panel of Figure 1. The present experiment directly compared decisions made with two different stimulus types to decisively determine whether or not the type of stimuli influences the visual field asymmetries produced by spatial relation decisions.

If the present experiment replicated the main results of Banich and Federmeier (1999), the interaction between visual field and categorical/coordinate decision (especially a RVF advantage in the categorical decision) should be observed in not the *previous* condition but the *simultaneous* condition. In addition, if the reason why Sergent (1991) could not replicate Kosslyn's hypothesis would be ascribed mainly to spatial properties of the stimulus, the interaction between visual field and spatial decision should be observed in not an *acceptable* but *goodness of fit* situation.

2. Experiment 1

2.1 Method

2.1.1 Participants

Thirty-two undergraduate and graduate students (22 male and 10 female) participated in this experiment. Their mean age was 22.6 years (*SD* = 1.58). All participants had normal or corrected-to-normal vision and were right-handed as assessed by the H. N. handedness inventory (Hatta & Nakatsuka, 1975). Half of the participants participated in the original stimulus version (i.e., a dot and bar, the *standard* version), and the other half participated in the Sergent (1991) stimulus version (the *modified* version).

2.1.2 Stimuli

In the *standard* version, stimuli were identical to those used by Banich and Federmeier (1999) and Hellige and Michimata (1989). A dot (as a target) and horizontal bar (as a reference) were presented on a computer screen and depicted in black on a white background (see the left panel of Figure 1). The size of the dot was 0.2° visual angle along its vertical and horizontal dimensions. The size of the bar was 0.6° along the horizontal dimension. The bar was presented either in the center of the screen along the vertical dimension, or 1.9° above or below the center. The dot was above or below the bar at 6 different distances (5, 10, 15, 25, 30, 35 mm in physical size, and 0.5, 1.0, 1.4, 2.4, 2.9, 3.3 degrees in visual angle), for a total of 12 possible positions. For presentation in the left or right visual fields, the stimulus was presented approximately 2.9° horizontally apart from the center of the screen.

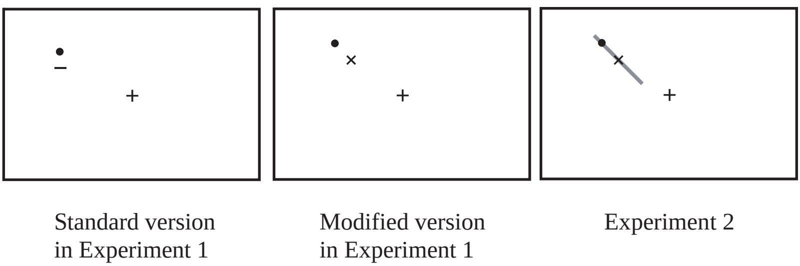

Figure 1: Examples of stimulus displays used in the present experiments

Note: The stimuli are not drawn to the actual scale.

In the *modified* version, the stimulus pattern was based on that used by Sergent (1991), as shown in the central panel of Figure 1. The dot was located diagonally with respect to a reference cross. The dot and cross were 0.2° along their vertical and horizontal dimensions. Like the bar in the standard version, the cross was presented either in the center of the screen along the vertical dimension, or 1.9° above or below the center. The dot was located in one of 16 positions with respect to the cross, consisting of 4 variants of distance (7, 14, 28, 35 mm in physical size, 0.7, 1.3, 2.7, 3.3 degrees in visual angle), presented within each quadrant. The cross was presented 4.8° to the left or right of the center of the screen, so that when the dot was located at the farthest diagonal distance from the cross (i.e., 3.3°) the distance in the horizontal plane between the center of the screen and the dot was approximately 2.4°.

2.1.3 Apparatus

Stimulus presentation and response recording were controlled by PsyScope software (Cohen, MacWhinney, Flatt, & Provost, 1993) on a Macintosh Performa 6310 with a color monitor. A chin rest was used to fix head position such that the distance between the screen and the observers' eyes was approximately 600 mm.

2.1.4 Design

The design consisted of 4 factors, each with two levels: stimulus type (standard version versus modified version), reference (*previous* condition versus *simultaneous* condition), task (categorical task versus coordinate task), visual field (LVF versus RVF). Stimulus type was a between-subjects factor, with half of participants presented with the standard version and the other half with the modified version. The remaining three factors were manipulated within-subjects.

2.1.5 Procedure

Each participant completed 4 separate sessions by task and reference condition: categorical-*previous*, categorical-*simultaneous*, coordinate-*previous*, and coordinate-*simultaneous*. In the categorical task, participants were instructed to indicate whether the dot was above or below the bar, and in the coordinate task they were to indicate whether the distance between the stimuli was greater or less than 1.9° (20 mm). The order of task and that of reference condition were counterbalanced across the participants.

2.1.5.1 The standard version

Participants were tested individually with the sequence of trials shown in Figure 2. At the start of each trial, a fixation point (a plus sign, 0.6° in visual angle) was presented in the center of the screen for 500 ms. Participants were instructed to maintain their fixation on this point during each trial. In the *previous* condition, two bars, one in each visual field, were then presented at the same height (i.e., above, even, or below the center) for 1000 ms. This ensured that participants were not cued to anticipate in which visual field the target would appear. Finally, a target was presented to either the LVF or the RVF for 150 ms, with the reference point in the same visual field remaining, and that in the opposite field extinguished. In the *simultaneous* condition, the fixation point appeared for 1500 ms followed by presentation of the target and reference.

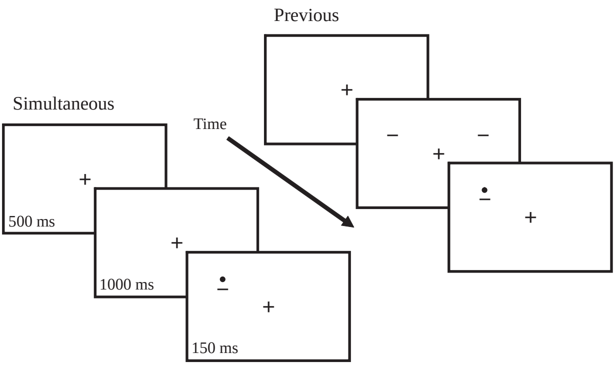

Figure 2: The trial sequence of experiment 1

Note: The stimuli are not drawn to the actual scale.

Participants responded by pressing the left or right button with their left thumb or right thumb, respectively, on a keybox (Bbox for PsyScope software). The key assignment for responses was counterbalanced across the participants; that is, in the categorical task half of the participants used the left key to indicate ‘above’ and the right key to indicate ‘below’ and the keys corresponding to each response were reversed for the other half of the participants. The similar assignment employed in the coordinate task. Participants were instructed to respond as quickly and accurately as possible. Until his or her response, the screen was blank. A short audible beep was presented at the end of each trial to provide feedback for incorrect responses. The intertrial interval was 500 ms.

In the standard version, each block consisted of 72 trials (i.e., 2 visual fields × 3 reference heights × 12 target locations), for a total of 288 trials. Trial order was pseudorandomized with the constraint that the target did not appear in the same visual field for more than 4 consecutive trials. Prior to each test session, a practice phase consisting of 16 trials was conducted in order to familiarize participants with the task. A short break was provided halfway through the experiment, between the second and the third trial sessions.

2.1.5.2 The modified version

The procedure in the modified version was identical to the standard version mentioned above except that the referent was a cross (0.2° in visual angle) and that each block consisted of 96 trials (i.e., 2 visual fields × 3 reference heights × 16 target locations), for a total of 384 trials.

2.2 Results

2.2.1 Reaction time

For data trimming, outliers in correct responses were discarded. When reaction time (RT) in correct response was two standard deviations greater or less than the mean computed on all correct responses for each participant, this trial was regarded as an outlier. Outlying scores comprised 3.8 % of the total data.

Figures 3 and 4 show mean RTs (in ms) for the standard and modified versions, respectively. A repeated-measures analysis of variance (ANOVA) was performed on RTs. There was a significant main effect of task, F (1, 30) = 13.01, MSE = 4575.96, p < .005. Two first-order interactions including task factor were also significant. Task interacted with version, F (1, 30) = 16.12, MSE = 4575.96, p < .001, because the task effect disappeared in the modi-

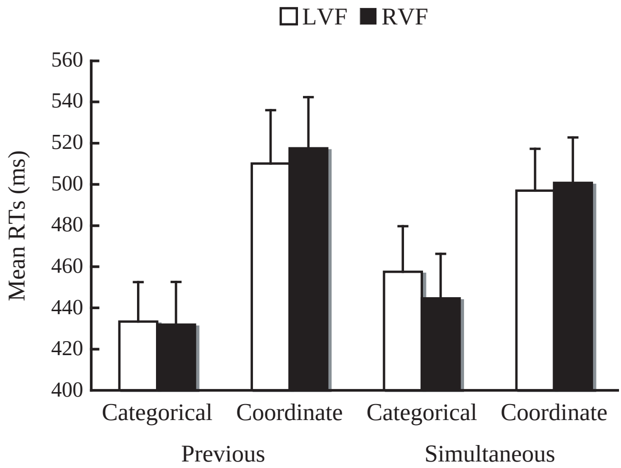

Figure 3: Mean reaction times in ms in the Standard version of experiment 1

Note: Error bars represent standard error.

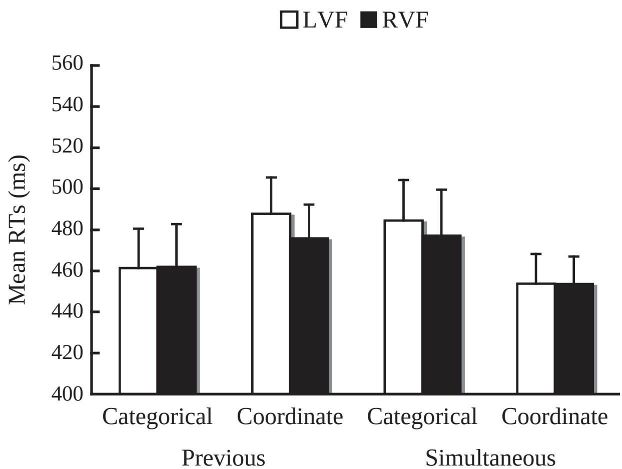

Figure 4: Mean reaction times in ms in the Modified version of experiment 1

Note: Error bars represent standard error.

fied version; standard: F (1, 30) = 29.10, p < .005; modified: F < 1. As well, an interaction was seen between task and reference, F (1, 30) = 10.28, MSE = 2529.15, p < .005, because the task effect disappeared in the *simultaneous* condition; *previous*: F (1, 60) = 23.16, MSE = 3552.55, p < .005; *simultaneous*: F < 1.

In addition, importantly to the visual laterality study, two significant second-order interactions were found that included the factors of task and visual field. First, a significant interaction was found between version, task, and visual field, F (1, 30) = 4.62, MSE = 207.98, p < .05. Second, an interaction was seen between reference, task, and visual field, F (1, 30) = 6.18, MSE = 125.68, p < .05. For further analyses of the former interaction (version × task × visual field), simple effects for each version were calculated. For the standard version, a significant simple interaction was found between task and visual field, F (1,30) = 6.29, MSE = 207.98, p < .05, because there was a RVF advantage for the categorical task; LVF M = 445 ms, RVF M = 438 ms, F (1, 60) = 4.08, MSE = 202.17, p < .05, and a nonsignificant tendency toward a LVF in the coordinate task; LVF M = 504 ms, RVF M = 509 ms, F (1, 60) = 2.49, *ns*. In contrast, for the modified version, the interaction between task and visual field was not found, F < 1.

For further analyses of the other second-order interaction (reference × task × visual field), simple effects for each type of reference condition were calculated. For the *simultaneous* condition, the interaction between task and visual field was significant, F (1, 60) = 6.87, MSE = 166.82, p < .05, showing a RVF advantage in the categorical task; LVF M = 471 ms, RVF M = 461 ms, F (1,120) = 9.01, MSE = 182.59, p < .005, and no visual field advantage in the coordinate task; LVF M = 475 ms, RVF M = 477 ms, F < 1. In contrast, no interaction was found for the *previous* condition, F < 1.

2.2.2 Error rates

As with the RTs, a repeated-measures ANOVA was performed on error rates. The main effect of task was significant, F (1, 30) = 11.17, MSE = .002, p < .005, and consistent with the RT data, indicating that the categorical task (M =

3.9 %, *SD* = 3.24) was easier than the coordinate task (*M* = 5.9 %, *SD* = 5.00). A significant main effect of visual field was seen, F (1, 30) = 5.49, *MSE* = .001, $p < .05$, showing a LVF advantage (LVF: *M* = 5.5 %, *SD* = 4.27; RVF: *M* = 6.1 %, *SD* = 4.37). An interaction between task and reference was significant, F (1, 30) = 6.81, *MSE* = .001, $p < .05$, indicating that, similar to RTs, the task effect appeared in the *previous* condition, categorical *M* = 3.7 %, *SD* = 2.92, coordinate *M* = 6.6 %, *SD* = 5.15, $F(1, 60) = 17.68$, *MSE* = 0.0016, $p < .005$, whereas it disappeared in the *simultaneous* condition, categorical *M* = 4.1 %, *SD* = 3.53, coordinate *M* = 5.2 %, *SD* = 4.79, F (1, 60) = 2.60, *ns*. Unlike the RT data, there were no higher-order interactions including a task by visual field interaction.

2.3 Discussion

For the error rate data, although a LVF advantage was found, no task by visual field interactions were observed. Thus, the data are not considered to reflect a speed-accuracy trade-off.

Importantly, for the RT data there are two second-order interactions including task and visual field. The interaction of version, task, and visual field demonstrated that reliable visual asymmetries consistent with Kosslyn’s (1987, 1994) hypothesis, i.e., a RVF/LH advantage in categorical processing and a weak LVF/RH advantage in coordinate processing, is obtained with the standard version of stimuli, that is, the bar and dot type of stimuli from the original Hellige and Michimata (1989) study. This can explain why Sergent (1991) was unable to replicate these results with alternate stimuli. As noted in the Introduction, Carlson-Radvansky and Logan (1997) reported that a categorical spatial decision in a *goodness of fit* situation such as the standard version was faster than a decision in an *acceptable* situation such as the modified version. As a result, visual field asymmetry in spatial decisions is readily obtained in a *goodness of fit* situation. However, in order to elucidate the precise mechanism underlying this effect, further research is necessary.

In addition, the interaction of reference by task by visual field is consistent with the findings of Banich and Federmeier (1999) and demonstrated that a

RVF advantage in categorical task can be seen with a simultaneous presentation if the stimuli do not allow the observer to compute spatial relations by any reference frame in advance. Because the original theory of Kosslyn (1987, 1994) assumed that the computation of categorical spatial relations is completed by a single subsystem, it is difficult to completely explain all of the present evidence with this account.

In contrast, Logan (1994, 1995) proposed sub-processes in the computation of spatial relations. His architecture consists of three main subcomponents, which work in a sequential manner. Consider the situation presented in Figure 5. If an observer's task is an above/below discrimination of the target (O) relative to the reference (X), three cognitive processes are engaged. First, in a *spatial indexing* (or visual attention) phase, the region that contains the target and reference is captured. In the next phase (*imposing a reference frame*), a reference frame is imposed, and the reference stimulus is marked (X in Figure 5). As well, the captured region is divided into several subregions (an *above* region

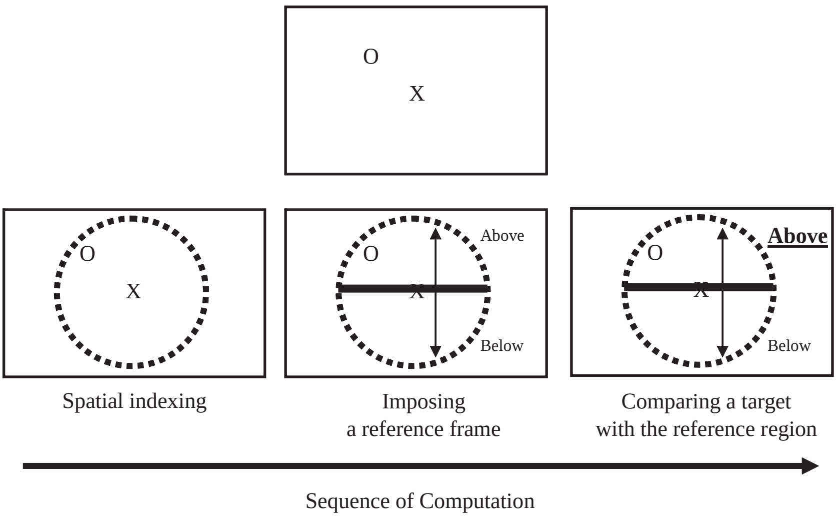

Figure 5: A schematic illustration of Logan's (1994, 1995) architecture of spatial relation computations

Note: See the main text for a detailed explanation of this proposal.

and a *below* region in the example). In the final phase (*comparing a target with the reference region*), the target is compared with the reference region and the judgment is accomplished (*above* in the example).

Logan's (1994, 1995) architecture of spatial computation can explain the present finding of a LH superiority in categorical computations for the simultaneous presentation of the stimulus and reference, but no lateralization in the *previous* condition of the present experiment where a spatial reference frame cue preceded the target presentation. Thus, the cue allowed an observer to complete the first two computational phases before presentation of the target, so no hemispheric asymmetry was found; that is, the final phase (comparing the target to the reference region) dose not lateralize. On the contrary, in the *simultaneous* condition, both the target and the reference were presented concurrently, and a LH processing superiority was seen. Therefore, the first or second phase, or perhaps both phases lateralize to the left cerebral hemisphere. The disappearance of visual field asymmetry is considered to due mainly to prior computation for a spatial reference frame because this is the most critical difference between the *previous* and *simultaneous* condition in the present experiment. Thus, LH may specialize in the phase of *imposing a reference frame*.

Of note, it is also possible that the LH is specialized for the spatial indexing phase. In the *simultaneous* condition of the present experiment, the target and reference pair were presented suddenly. Yantis and Jonides (1984) demonstrated that presenting a stimulus abruptly the stimulus captures attention quite efficiently (see also Gibson, 1996a, 1996b; Yantis & Jonides, 1996 for critical discussions of this). If spatial indexing is the lateralized sub-process, this attentional laterality may be strengthened by an abrupt stimulus onset, and this factor could account for the present results.

Egly, Driver, and Rafal (1994) conducted an experiment with a modified precueing methodology and suggested the cerebral lateralization of attention. They proposed that the LH is specialized for object-based attention whereas the RH is specialized for space-based attention (see also Egly, Rafal, Driver, & Starrveveld, 1994; for evidence supporting lateralization to the RH for object-based attention, see Valsangkar-Smyth, Donovan, Sinnett, Dawson, & Kingston, 2004). Also, Yantis and Hillstrom (1994) suggest that the abrupt onset of stimuli elicits the formation of new object representations, so that automatic (exogenous) attention is captured efficiently (for a critical discussion see Gellatly, Cole, & Blurton, 1999). On the basis of the above evidence, the abrupt simultaneous onset of the target and reference might elicit the formation of a new object representation, and then object-based automatic attention (which may show a LH superiority) could facilitate the subsequent processing phase of imposing a reference frame. This would be consistent with a RVF advantage in the simultaneous presentation condition of the categorical task. This *attention-based* account of visual field asymmetries was examined in Experiment 2.

3. Experiment 2

In Experiment 2, the effect of an object-based attentional manipulation on the visual field asymmetries produced by categorical spatial relation judgments was tested. Because there does not appear to be any previous research investigating object-based attentional effects in spatial relation judgments, the author administered a preliminary experiment, in which a gray diagonal bar was added to the modified stimulus (as illustrated in the right panel of Figure 1, see also Figure 6) so that the target dot was presented either on the bar (within-object condition) or off it (between-object condition). According to object-based attentional effects, performance in the within-object condition should be faster and more accurate than that in the between-object condition (e.g., Baylis & Driver, 1993). Contrary to this expectation, the results of this preliminary experiment did not confirm the presence of object-based attentional effects. Rather, performance of the between-object condition was superior.

Indeed, in this preliminary experiment the target was presented with equal frequency on the gray bar (within-object) and off it (between-object). It is possible that its procedure prevented the emergence of object-based attention. Egly and Driver et al. (1994) and Egly and Rafal et al. (1994) used a procedure in which a target was frequently presented on a cued object, thereby inducing the observer to devote sufficient attention to the cued object. In contrast, participants were not reinforced for attending to the object (gray bar) in the preliminary experiment. Therefore, in Experiment 2, to induce participants to preferentially attend to a gray bar as a beneficial object, the within-object trials were presented 2 times more frequently than the between-object trials.

In addition, two experimental factors were introduced in the present experiment: type of categorical judgment (above/below versus left/right) and distance (far versus near). Indeed, these factors were manipulated in the Sergent (1991) study for deliberately examining visual field asymmetries in spatial relations processing. In addition to the vertical judgment task adopted in Experiment 1, a horizontal judgment task (left versus right) was introduced to manipulate task difficulty. According to Logan (1995), vertical judgments are easier than horizontal judgments because the former are based on gravity whereas the latter are arbitrary. Thus, the present experiment examined whether task difficulty influenced visual field asymmetries in categorical spatial decisions. Also, distance was introduced as the independent factor for examining whether distance effects interacted visual field asymmetries in categorical spatial decisions.

3.1 Method

3.1.1 Participants

Sixteen undergraduate and graduate students (14 male and 2 female) participated in this experiment. None of them had participated in the previous experiments. Their mean age was 21.2 years (*SD* = 2.32). Consistent with Experiment 1, all participants had normal or corrected-to-normal vision, and were right-handed as assessed by H. N. handedness inventory (Hatta & Nakatsuka, 1975).

3.1.2 Stimuli and apparatus

The stimuli and apparatus in the present experiment were identical to the modified version of Experiment 1 with the following exception. In order to construct the within-object and between-object conditions, a gray diagonal bar was added to the modified stimulus, as illustrated in the right panel of Figure 1. The bar was 6.7° (70 mm) in length and it angled leftward or rightward at 45 degrees. The reference cross was located at the center of the gray bar, so that even a target dot at the furthest distance (3.3° in visual angle, 35 mm in physical length) was located on the bar. Instead of two crosses acting as the reference in Experiment 1, two gray bars were each paired with a reference cross and presented mirrored each other. If the bar in the LVF was angled leftward, the bar in the RVF was angled rightward, and vice versa (see Figure 6). Stimulus pattern with distance between a dot and cross was greater or less than 1.9° was regarded as the far or near condition, respectively.

3.1.3 Design and procedure

The design of Experiment 2 included four within-subjects factors, each of which had two levels: judgment (vertical versus horizontal), object (within versus between), distance (far versus near), and visual field (LVF versus RVF).

Participants were instructed to make categorical judgments (above versus below in the vertical judgment task whereas left versus right in the horizontal judgment task). Response style for the vertical judgment task was identical to the categorical task of Experiment 1, whereas for the horizontal judgment task, the response key box was rotated such that the response keys were aligned vertically in order to reduce the stimulus-response congruency. As in the preceding experiment, in order to remove the congruency between stimuli and response box orientations, the response assigned to each key was counterbalanced across participants.

The trial sequence was identical to the *previous* condition of Experiment 1 except that reference crosses were replaced by a pair of gray bars and crosses (Figure 6) and, that in addition, for inducing participants to preferentially attend to within-object region (on the gray bar), the within-object trials were presented 2 times more frequently than the between-object trials, which was instructed to the participants.

For each judgment task, two blocks were prepared. In one block, a leftward bar was presented in LVF and rightward bar in RVF (V-type reference), whereas the reverse presentation in the other block (inverted V-type reference). The order of judgment task and that of reference type were counterbalanced across the participants.

Although trial number of each block was identical to that in Experiment 1 (96

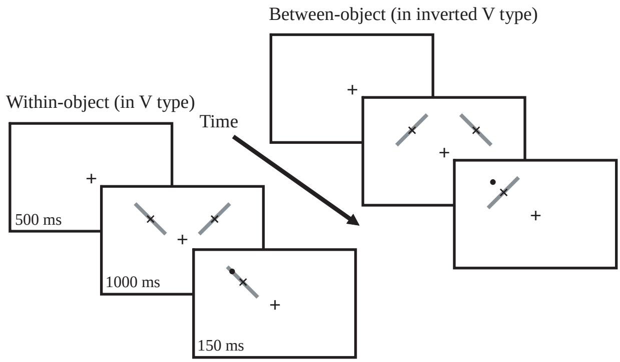

Figure 6: The trial sequence of experiment 2

Note: The stimuli are not drawn to the actual scale.

trials), however, for creating object-based benefit mentioned above, the number of the within-object condition was increased 2 times than that of the between-object condition (64 trials versus 32 trials). Trial number of visual field (LVF, RVF) and distance (far, near) was equal on each block. As in the modified condition of Experiment 1, stimuli prepared for each reference type (V-type and inverted V-type) consisted of 96 patterns (= 2 visual fields × 3 reference heights × 16 target locations). Because stimulus patterns for each object condition were half (48), 16 patterns were used twice for the within-object condition whereas 16 patterns were not used for the between-object condition. Stimuli used on each running experiment were randomly selected by PsyScope program. There were 384 trials across the 4 blocks, and 16 practice trials were conducted prior to each block.

3.2 Results

The same procedure for removing outliers was performed as in Experiment 1. Outliers represented only 3.0 % of the total data.

3.2.1 Reaction time

Figures 7 and 8 show the mean RTs (in ms) for the vertical and horizontal tasks

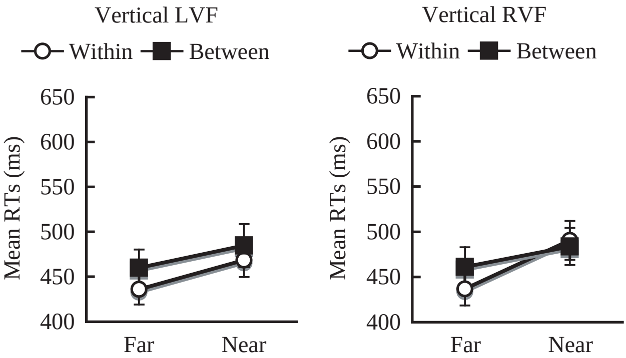

Figure 7: Mean reaction times in ms for the Vertical judgment task of experiment 2

Note: Error bars represent standard errors.

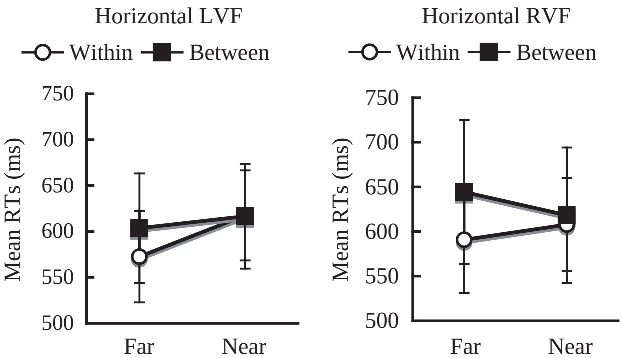

Figure 8: Mean reaction times in ms for the Horizontal judgment task of experiment 2.

Note: Error bars represent standard errors.

of Experiment 2, respectively. A repeated-measures ANOVA was performed on RTs. The main effect of judgment was significant, F (1, 15) = 7.73, MSE = 170998.01, $p < .05$, indicating that the vertical task (M = 465 ms) was easier that the horizontal task (M = 609 ms).

A significant effect of object was seen only in an interaction with distance, *F* (1, 15) = 7.26, *MSE* = 1771.94, $p < .05$, indicating that the object benefit was obtained in the far condition only; object benefit 33 mm, *F* (1, 30) = 5.81, *MSE* = 6035.05, $p < .05$. Although a simple main effect in the near condition was not statistically significant, $F < 1$, a difference was in the expected direction (+5 mm).

A main effect of distance was significant, *F* (1, 15) = 9.16, *MSE* = 3645.15, $p < .01$, indicating that RTs in the far condition were faster than those of the near condition. An interaction among judgment, distance and visual field was significant, *F* (1, 15) = 12.39, *MSE* = 597.68, $p < .005$. For further analysis, simple effects for each judgment task were calculated. For vertical judgments, no simple interaction between distance and visual field was found, $F < 1$. In contrast, this interaction was significant for horizontal judgments, *F* (1, 30) = 11.46, *MSE* = 784.06, $p < .005$, indicating that, only in the far condition, a LVF advantage was observed: that is, far: *F* (1, 60), = 9.56, *MSE* = 1451.93, $p < .005$; near: $F < 1$, respectively.

As shown in Figure 7, although the object benefit (between minus within) in the RVF (53.6 ms) was larger than in the LVF (30.9 ms) in the far condition of the horizontal task, this difference was not significant as determined by a one-tailed t-test, *t* (14) = –1.28, $p > .1$.

3.2.2 Error rates

As with the RTs, a repeated-measures ANOVA was performed on error rates. Significant main effects were seen for judgment, *F* (1, 15) = 11.68, *MSE* = .011, $p < .005$, and distance, *F* (1, 15) = 33.41, *MSE* = .002, $p < .001$. Similar to RT data, responses during the vertical task (*M* = 3.6 %, *SD* = 3.99) were more accurate than the horizontal task (*M* = 8.0 %, *SD* = 7.80), and responses in the far condition (*M* = 4.2 %, *SD* = 5.33) were more accurate than those in the near condition (*M* = 7.3 %, *SD* = 7.31).

3.3 Discussion

As demonstrated in RTs and error rates, the vertical decision making is faster and easier that the horizontal decision making. This finding is consistent with

Logan (1995).

Unlike the preliminary experiment, an object benefit effect was obtained (though only in the far condition). Thus, the task frequency manipulation in the present study is considered enough to induce an object benefit effect.

Nevertheless, there was not found visual field asymmetry suggesting LH advantage in spatial indexing. In the far condition of the horizontal task, visual field asymmetry was found, but a LVF/RH advantage. Although on the horizontal task object benefit value (between minus within) in RVF appears to be larger than that in LVF, this difference is not significant. On the basis on this result, it cannot be concluded that there is a LH advantage for the spatial indexing phase. This evidence suggests that the phase of imposing a reference frame is lateralized to the LH.

4. Conclusion

The main purpose of Experiment 1 was to replicate and extend the findings of Banich and Federmeier (1999) using different stimuli modeled after Sergent (1991) and procedures (reference cueing methodology). Our results suggest that visual field asymmetries consistent with Kosslyn's (1987, 1994) hypothesis can be obtained in certain situations; that is when using standard stimuli, such as those in a goodness of fit situation. In addition, a RVF advantage in categorical decision was obtained in the simultaneous situation when the observer could not compute spatial relations to any reference frame in advance.

Kosslyn (1987, 1994) assumed that a single subsystem underlies categorical spatial relation computation. However, our results support Logan's (1994, 1995) proposal of sub-processes in the computation of spatial relations. The disappearance of visual field asymmetry in the *previous* condition may result from prior computation of the spatial reference; therefore, it is possible that the phase of imposing a reference frame is specialized in the LH.

Experiment 1 did not allow for a conclusion as to the hemispheric advantage for spatial indexing (or visual attention). In Experiment 2, I demonstrated that there was no influence of object-based attention on visual field asymmetries in categorical spatial relation judgments. As a result, it cannot be concluded that there is a LH advantage for the spatial indexing phase. Instead, it may be the phase of imposing a reference frame that is lateralized to the LH.

Because the present experiment was a behavioral study, the neural circuits with respect to spatial computation could not be examined directly. Future research should investigate cerebral hemispheric activation with respect to the three components of Logan's (1994, 1995) spatial computation theory.

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5. Does an unequal hemispheric division of labor aid mental rotation?

Kazuhito Yoshizaki and Kimiko Kato

Abstract

The current experiment was designed to extend the view obtained in Yoshizaki, Weissman, and Banich (2007). "A hemispheric division of labor aids mental rotation", *Neuropsychology*, *21*, 326-336. Yoshizaki et al. (2007) demonstrated that an unequal hemispheric division of cognitive load helps to produce the across-field advantage for complex tasks using the mental rotation matching task. In their study, however, a pair of letters each needed to be rotated up to the position in the *same* direction was only used. Based upon the rationale and procedure of Yoshizaki et al. (2007), the present study investigated whether or not an unequal division of cognitive load (mental rotation) helped to produce the across-field advantage when each for a pair of the letters was rotated in the *different* direction. The results were inconsistent with Yoshizaki et al. (2007), suggesting that the across-hemispheric advantage was constant irrespective of the conditions where an inequality of cognitive load across the hemispheres was manipulated. We discuss this discrepancy in terms of parallel and serial processing in each hemisphere.

Key words: interhemispheric interaction, laterality, mental rotation

1. Introduction

Not only Professor Takeshi Hatta but also the researchers who involve laterality studies have accumulated a large amount of the findings as to cerebral hemispheric asymmetry (review for Bradshaw & Nettleton, 1983; Hatta, 1984; Hellige, 1993; Springer & Deutsch, 1998). However, little is known how the two cerebral hemispheres interact and how the interaction between the hemispheres has an influence upon information processing.

We provide the original findings in terms of the mechanism for interhemispheric interaction. The original experiment we report here is motivated in order to compliment the view of our recent study (Yoshizaki, Weissman, & Banich, 2007, *Neuropsychology, 21*, 326-336). In order to help readers to understand the present study, it is absolutely necessary to review our prior work. Therefore, firstly, we will refer some parts of the statements (mainly "Introduction" and "Result") in Yoshizaki et al. (2007). Although any figures were not presented in " Introduction" of the original article (Yoshizaki et al., 2007), we will show some figures to help the readers' understanding.

2. The background of our prior study (Yoshizaki et al., 2007)

"*…………Recently, Banich and colleagues (Banich, 1998; Banich & Belger, 1990) have proposed that a division of processing across the hemispheres increases the processing capacity of the brain. According to Banich (1998), a division of critical information across the hemispheres allows for a more efficient hemispheric division of labor than does directing critical information to a single hemisphere. In support of this view, Banich and colleagues have consistently demonstrated that as the resource demands for a task increase, across-field processing (i.e., a division of critical information across the left and right visual fields) becomes more advantageous to performance relative to within-field processing (e.g., Banich & Belger, 1990; Belger & Banich, 1992; Passarotti, Banich, Sood, & Wang, 2002; Weissman & Banich, 1999, 2000), a result that has also been reported by other groups (Compton, 2002; Coney, 1985; Koivisto, 2000; Norman, Jeeves, Milne, & Ludwig, 1992; Yoshizaki, 2000; Yoshizaki & Tsuji, 2000; Zhang & Feng, 1999). Converging evidence to support this model comes from neuroimaging studies, which demonstrate that bilateral activity (which could be taken to indicate a hemispheric division of labor) often increases as task demands become greater (e.g., Jonides et al.,* *1997; Klingberg, O'Sullivan, & Roland, 1997; Pollman, Zaidel, & von Cramon, 2003; Tsukiura et al., 2002).*

According to Banich (1998), the across-field advantage is determined jointly by (a) the resource demands imposed by a task and (b) the time costs associated with interhemispheric communication via the corpus callosum. When a task is relatively complex, the benefits afforded by additional processing resources outweigh the time costs associated with interhemispheric communication, leading to an across-field advantage. On the other hand, when a task is relatively simple, the need for additional processing resources does not outweigh the time costs associated with interhemispheric communication, leading to a within-field advantage."

………………………………..

"In the present study, we investigated whether the size of the across-field advantage also depends on the extent to which task inputs impose unequal cognitive demands on the two cerebral hemispheres. This hypothesis was motivated by Banich and Belger's (1990) claim that an unequal hemispheric division of inputs helps to produce the across-field advantage for complex tasks. Specifically, these authors suggested that when the processing load on the hemispheres is unequal, it creates conditions favorable to each cerebral hemisphere taking the lead for different cognitive operations underlying performance. For example, they argued that on across-field trials in 3-item letter-matching tasks, the hemisphere that receives two letters takes the lead for perceptual processing while the hemisphere that receives only one letter takes the lead for decision-making, a hypothesis that was supported in a subsequent study (Banich, Stolar, Heller, & Goldman, 1992). Thus, a key prediction of Banich and colleagues' model is that the across-field advantage for complex tasks should be greater when task inputs impose unequal cognitive demands on the cerebral hemispheres than when they impose equal demands.

In line with this view, Weissman, Banich, and Puente (2000) found that the size of the across-field advantage is greater when the inputs to each hemisphere are unequal (e.g., one item in the left visual field and two in the right visual field). In this study, they used the same letter-matching tasks as employed *by Banich and Belger (1990). In the physical identity task, participants decided whether a letter beneath fixation (e.g., A) was perceptually identical to either of two letters above fixation (e.g., A and B) while in the name identity task they decided whether a letter beneath fixation (e.g., a) had the same name as either of two letters above fixation (e.g., A and B). For both tasks, Weissman et al. (2000) manipulated whether the hemispheres received unequal processing loads or equal processing loads by varying whether there was just one letter beneath fixation (3-item trials)* [see Figure 1] *or two letters, one in each visual field (4-item trials)* [see Figure 2]. *In support of the view that an unequal hemispheric division of labor facilitates across-field processing, Weissman et al. (2000) found that the across-field advantage was significantly larger for 3-item than for 4-item displays in both the Physical Identity and the Name Identity tasks. Moreover, this effect occurred even though mean reaction time was sig-*

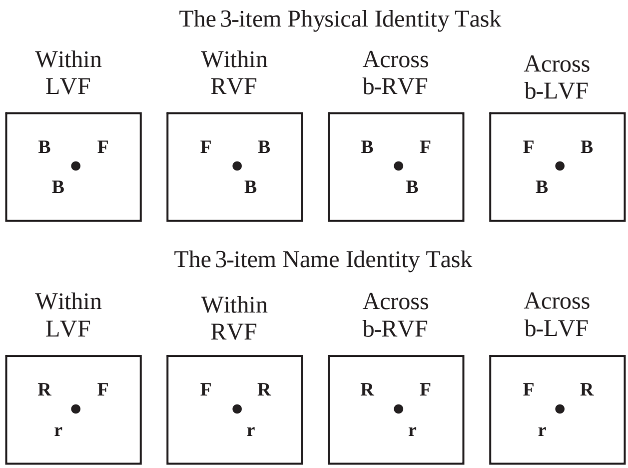

Figure 1: Examples of stimulus configurations used for the 3-item identification task in Weissman et al. (2000).

Note: The Physical Identity task required the participants to make a decision whether a target letter beneath fixation was perceptually identical to one of the two letters above fixation. The Name Identity task required them to make a decision whether a target letter beneath fixation was the same name as one of the letters above fixation.

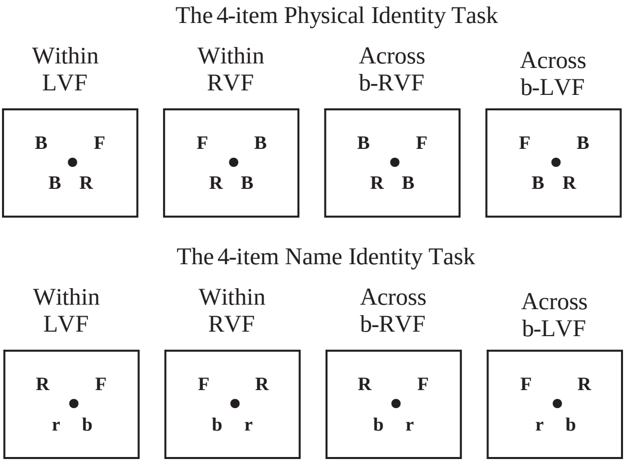

Figure 2: Examples of stimulus configurations used for the 4-item identification task in Weissman et al. (2000).

Note: The Physical Identity task required the participants to make a decision whether either bottom target letter was perceptually identical to one of the two letters above fixation. The Name Identity task required them to make a decision whether either bottom target was the same name as one of the letters above fixation.

nificantly longer for the 4-item than for the 3-item tasks, demonstrating that the manner in which information is divided between the hemispheres, and not task difficulty, is the primary determinant of the across-field advantage.

Although Weissman et al.'s (2000) findings support Banich and colleagues' model, they leave uncertain whether equating the number of inputs directed to each hemisphere dilutes the advantage of across-field processing by equating (1) the perceptual load directed to each hemisphere and/or (2) the cognitive load imposed on each hemisphere. In the present study, we directly investigated whether equating the cognitive load imposed on the left and right cerebral hemispheres reduces the size of the across-field advantage.

To investigate this hypothesis, we employed a mental rotation task, since prior data indicate that the cognitive load imposed by mental rotation is direct-

ly related to the number of degrees a stimulus must be rotated. For example, Cooper and Shepard (1973) found that the time needed to decide whether a letter is in the normal orientation or mirror-reversed is directly proportional to the number of degrees the letter has been rotated away from the upright position. This finding led these authors to argue that participants needed to rotate the letter to the upright position before they could decide whether it was normally oriented or mirror-reversed. Such effects have also been observed in mental rotation matching tasks, in which two rotated letters are presented and participants must decide whether both are in the normal orientation or whether one is normally oriented and the other is mirror-reversed (Fischer & Pellegrino, 1988; Francis & Irwin, 1997; Hishitani, 1983). Thus, we reasoned that a mental rotation matching task was ideally suited for testing our hypothesis.

Of importance, our mental rotation matching task allowed us to manipulate the cognitive load imposed on each hemisphere while holding constant the perceptual load that was directed to each hemisphere. In each trial of our task [see Figure 3]*, we presented a pair of rotated letters, either in the same visual-field (within-field trials) or in opposite visual fields (across-field trials). Participants were asked to decide whether both letters were normally oriented or whether one was normally oriented and the other was mirror-reversed. We also presented two task-irrelevant stimuli (i.e., two circles) on each trial, so that the perceptual load directed to each hemisphere (i.e., two stimuli) was equated in within-field and across-field trials. To manipulate the cognitive load imposed on each hemisphere, we varied whether the two letters needed to be rotated by similar or dissimilar numbers of degrees in order to reach the upright position. In two experiments, we predicted the across-field advantage would be maximal under conditions in which unequal mental rotation demands (i.e., cognitive loads) were imposed on the left and right cerebral hemispheres.*"

3. The hypotheses and findings of Experiment 1 in Yoshizaki et al. (2007)

"*In Experiment 1, we varied the number of degrees each letter needed be rotated in three pairings: 5 degrees and 85 degrees (5-85), 25 degrees and 65 degrees (25-65), and 45 degrees and 45 degrees (45-45), while holding constant*

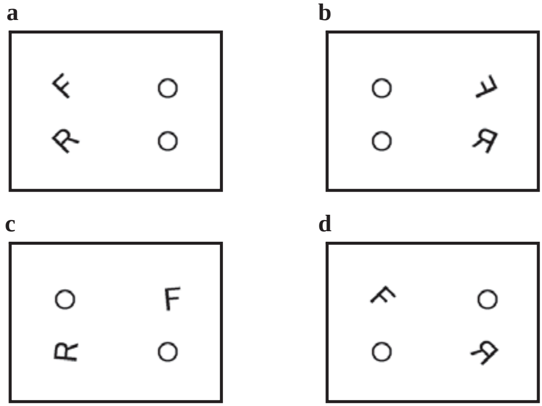

Figure 3: Examples of stimulus configurations used in Experiment 1of Yoshizaki et al. (2007).

Note: Shown are sample (a) within-LVF match trials (the 45-45 condition), (b) within-RVF mismatch trials (the 25-65 condition), (c) across-bottom LVF match trials (the 5-85 condition), and (d) across-bottom RVF mismatch trials (the 45-45 condition).

the total number of degrees the two letters needed to be rotated in order to reach the upright position (i.e., 90 degrees) [see Figure 3]. *This design allowed us to investigate how varying the cognitive load to each hemisphere affected the size of the across-field advantage while holding constant the total demands on mental rotation processes. We predicted that the across-field advantage would grow larger as the difference in cognitive load imposed on the two hemispheres increased*."

…………………………

"*……………… As predicted, the across-field advantage increased as the number of degrees each letter needed to be rotated became more and more unequal. This result appears to support our hypothesis that the across-field advantage derives, at least in part, from the ability to direct unequal cognitive loads to the left and right cerebral hemispheres*." [see Figure 4]

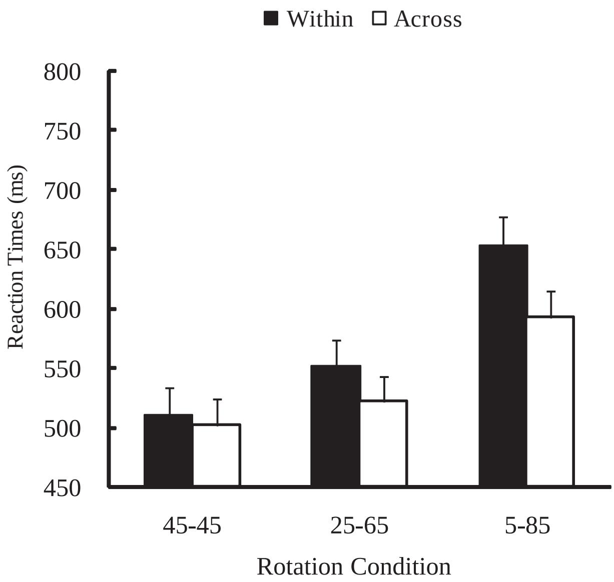

Figure 4: Mean reaction times for correct match decisions as a function of the Presentation Mode and Rotation Condition in Experiment 1 of Yoshizaki et al. (2007). Bars indicate standard errors.

4. The aim of the present study

Although Yoshizaki et al. (2007) demonstrated that an unequal hemispheric division of cognitive load helps to produce the across-field advantage for complex tasks using the mental rotation matching task, it is noteworthy that each for a pair of letters used in their study was rotated from the upright position in the *same* direction (i.e., clockwise OR counterclockwise rotation). In the current study, we investigated whether the findings of Yoshizaki et al. (2007) were supported when a pair of letters was rotated from the upright position in the *different* direction (clockwise AND counterclockwise rotation).

This research question is motivated by Burton, Wagner, Lim, and Levy (1992)'s findings. They demonstrated that clockwise rotation is more readily performed in the right hemisphere and counterclockwise rotation in the left hemisphere. These findings suggested that clockwise rotation would be different from counterclockwise rotation in terms of the property of information processing. Yoshizaki et al. (2007) argued that the obtained results for the relationship between the size of across-field advantage and varying the number of degrees each letter needed be rotated would be reasonable if the authors assume that two letters may be rotated in parallel. Certainly, it is more likely that rotating the letters in the *same* direction leads the parallel rotation. On the contrary, when the letters are rotated from the upright position in the *different* (opposite) direction, it is difficult to rotate them in parallel.

In the experimental setting of the present study where a pair of letters needed to be rotated to the upright position in the opposite direction, we assumed that both letters would be rotated in serial, not in parallel. Our recent findings supported this view as to parallel or serial processing in each hemisphere. Yoshizaki (2000) demonstrated that when the heterogeneous processes are divided across the hemispheres, parallel processing in each hemisphere is hampered, so that the across-hemisphere advantage is attenuated, which was supported by our previous research (Yoshizaki & Hatta, 2005; Yoshizaki, Sasaki, & Kato, 2008).

Following the above assumption, we predicted the different pattern in the relationship between the benefits of across-hemisphere processing and the unequal division of labor across the hemispheres, compared with Yoshizaki et al. (2007).

We designed the present experiment to test this hypothesis. In order to compare the previous findings (Yoshizaki et al., 2007) with the present results, we applied the procedure of Experiment 1 in Yoshizaki et al. (2007) to the present experiment, which used a pair of letters each needed to be rotated to the upright position in the *different* direction (clockwise and counterclockwise rotation), instead of the letters each needed to be rotated in the *same* direction. As with Experiment 1 of Yoshizaki et al. (2007), a pair of the distorted letters was presented at the within-field and the across-field and two task-irrelevant stimuli (i.e., circles) were presented in order to control perceptual load to each hemisphere (two inputs in each hemisphere). Importantly, we varied the number of degrees each letter needed be rotated in three pairings: 5 degrees and 85 degrees (5-85), 25 degrees and 65 degrees (25-65), and 45 degrees and 45 degrees (45-45), while holding constant the total number of degrees the two letters needed to be rotated in order to reach the upright position (i.e., 90 degrees). Right-handed participants were asked to make a judgment whether the two letters were normally oriented or whether one was normally oriented and the other was mirror-reversed.

Following the Banich and colleagues model (Banich, 1998; Banich & Belger, 1990) as well as the assumption that the two letters distorted in the opposite direction are serially rotated, the size of across-field advantage would be invariant among the three paring conditions, as the total number of degrees the two letters needed to be rotated was constant (i.e., 90 degrees). This expected pattern of the results contrasts with that in Experiment 1 of Yoshizaki et al. (2007), in which the across-field advantage increased as the number of degrees each letter needed to be rotated became more and more unequal.

5. Method

5.1 Participants

Thirty-two right-handed undergraduate students (16 women and 16 men: mean age = 20.9 years) participated in this experiment. They had normal or corrected-to-normal vision. Their handedness was evaluated by the H.N. Handedness Inventory (Hatta & Nakatsuka, 1975). Participants received course credit for their participation. Any participants did not take part in the experiments of Yoshizaki et al. (2007).

5.2 Stimuli

Target letter stimuli were the letters “F” and “R”, presented in MS UI Gothic font. Each letter was displayed in four different angular orientations, ranging from 5° to 85° clockwise and counterclockwise from the normal upright in 20° steps. Each letter target was displayed in each orientation condition in both a normal and backward (mirror-image) version. Letters subtended 1.4° by 1.0° of visual angle. The distracter stimulus was a circle “O”, which subtended 0.9°

by 0.9° of visual angle. All stimuli were displayed in black on a white background.

On every trial, two letters and two distracters were simultaneously presented on the screen. Each target and distracter was located either 3.0° to the left or to the right of the central fixation point, and at a visual angle of 3.0° above or below the level of the central fixation point. As Figure 5 shows, there were four types of match trials: within left visual-field (within LVF), within right visual-field (within RVF), across bottom LVF (across b-LVF) and across bottom RVF (across b-RVF). In addition, there were an equal number of mismatch trials. In half of these, the bottom item was presented in the LVF and in half it was presented in the RVF.

Each target letter pair consisted of the letter "F", which was displayed in the upper visual-field, and the letter "R", which was displayed in the lower visual-field. Each letter was rotated in the different direction (clockwise and counterclockwise) from the upright position. The two letters were rotated by

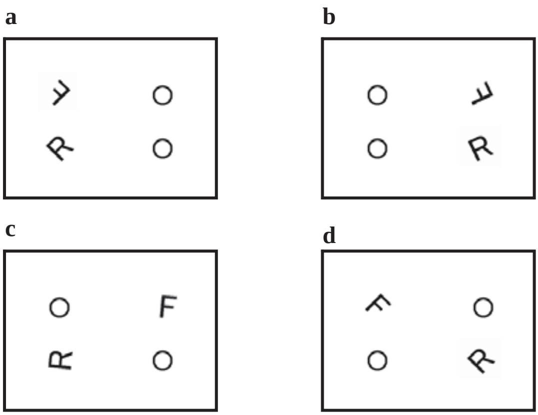

Figure 5: Examples of stimulus configurations in the present experiment.

Note: Shown are sample (a) within-LVF mismatch trials (the 45-45 condition), (b) within-RVF mismatch trials (the 25-65 condition), (c) across-bottom LVF match trials (the 5-85 condition), and (d) across-bottom RVF match trials (the 45-45 condition).

a total of 90 degrees, but the number of degrees each letter was rotated varied systematically across three rotation conditions. The degrees of rotation for the three conditions were 5° and 85°, 25° and 65°, and 45° and 45°.

In match trials, both letters were oriented normally. In mismatch trials, one letter was oriented normally while the other was mirror-reversed.

5.3 Apparatus

An IBM compatible personal computer equipped with a 17-inch XGA color monitor (Sony, Model CPD-E230) was used to present the stimuli. Trial presentation and the recording of response choices and latencies were controlled by 'SuperLab Pro for Windows Ver. 2.04' software (Cedrus Company). Participants' responses were recorded by a Microsoft compatible serial mouse.

5.4 Experimental design

There were three within-subjects factors: Type of Judgment (match, mismatch), Rotation Condition (5-85, 25-65, 45-45), and Presentation Mode (within-field, across-field).

5.5 Procedure

The participants were tested individually. They were strongly encouraged to maintain central fixation at all times during the task. The viewing distance from participants' eyes to the monitor was 37 cm and maintained with a chin-rest.

The sequence of events in each trial was as follows. First, there was a warning tone and a 1,000 ms central fixation point. Second, the two letters and two distracters were simultaneously presented for 180 ms. The participants were required to judge, as quickly and as accurately as possible, whether both target letters were in the normal orientation (match trials) or whether one was in the normal orientation while the other was mirror-reversed (mismatch trials) via a button press made with the index or middle finger. All reaction times in the present study were measured from stimulus onset to response. Half of the participants responded with the right hand and the other half responded with the left. The inter-trial interval was 2,000 ms. Nine blocks of 48 trials were presented. The first block was discarded from the analysis because it served as a practice run.

6. Results

For each participant, the mean of the individual reaction times in each experimental condition was calculated for correct responses. Trials with response times less than 200 ms, or exceeding 1,500 ms, were treated as errors. Such outliers were 0.72 % of all trials. Reaction time analyses in the present study were carried out only for correct responses in match trials. Mismatch trials were omitted from the analyses because, in these trials, participants might simply rotate one of the two letters to the upright position and, if it happened to be the letter in mirror-reverse orientation, immediately reach a mismatch decision. Thus, while correct performance in match trials required that both letters be rotated to the upright position, correct performance in mismatch trials did not.

6.1 Reaction time

An analysis of variance (ANOVA) with two within-subjects factors - Rotation Condition (5-85, 25-65, 45-45) and Presentation Mode (within-field, across-field) - was carried out using mean response times for correct match judgments. Table 1 shows mean reaction times and their standard deviations (*SD*s) for correct responses in each experimental condition. Table 2 shows mean error rates and their *SD*s in each experimental condition.

Table 1: Mean reaction times (ms) and standard deviations (*SD*) for correct responses in each experimental condition.

		45-45 condition		25-65 condition		5-85 condition	
		Within	Across	Within	Across	Within	Across
Match	Mean	707	654	710	652	770	700
	SD	88	78	88	71	94	74
Mismatch	Mean	694	709	699	695	725	723
	SD	87	82	87	63	91	85

Table 2: Mean error rates and standard deviations (*SD*) in each experimental condition.

		45-45 condition		25-65 condition		5-85 condition	
		Within	Across	Within	Across	Within	Across
Match	Mean	0.068	0.019	0.063	0.028	0.094	0.059
	SD	0.054	0.031	0.058	0.043	0.065	0.060
Mismatch	Mean	0.089	0.077	0.092	0.102	0.117	0.114
	SD	0.072	0.049	0.072	0.056	0.083	0.071

There was a significant main effect of Rotation Condition, F (2, 62) = 57.10, p < .01, partial eta squared (η_p^2) = .65. Tukey honestly significant difference (HSD) tests (α = .05) showed that mean response time in the 5-85 condition (735 ms) was significantly slower than in the 25-65 (681 ms) and in the 45-45 condition (681 ms). Furthermore, there was no difference in mean response time between the 25-65 and the 45-45 conditions. There was also a significant main effect of Presentation Mode, F (1, 31) = 98.58, p < .01, η_p^2 = .76, indicating that across-field processing (669 ms) was significantly faster than within-field processing (729 ms).

As illustrated in Figure 6, the interaction between Rotation Condition and Presentation Mode did not reach conventional levels of significance, F (2, 62) = 2.74, p = .07, η_p^2 = .08, indicating that the size of across-field advantage was invariant among the three Rotation Conditions (53 ms in the 45-45 condition, 58 ms in the 25-65 condition and 70 ms in the 5-85 condition). In order to test the hypothesis, analyses of simple effects for Presentation Mode were carried out in each Rotation Condition, indicating that an across-field advantage appeared in all the Rotation Conditions, the 45-45 condition F (1, 93) = 50.67, p < .01, the 25-65 condition F (1, 93) = 60.23, p < .01, and the 5-85 condition, F (1, 93) = 88.31, p < .01.

6.2 Error rates

An analogous ANOVA carried out with mean error rates yielded results that

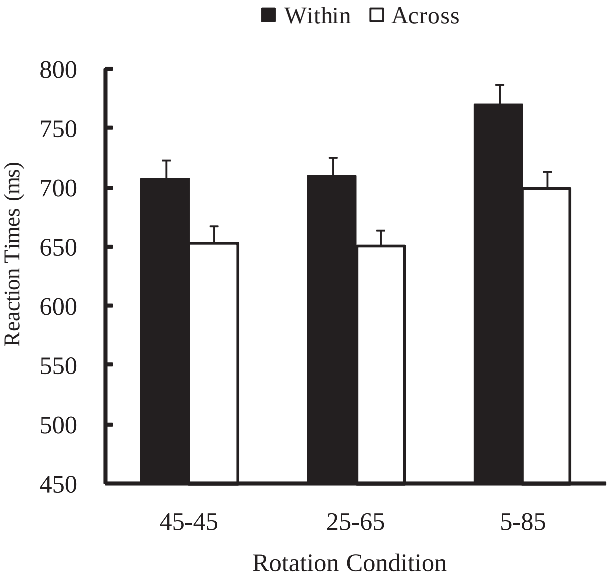

Figure 6: Mean reaction times for correct match decisions as a function of the Presentation Mode and Rotation Condition in the present experiment. Bars indicate standard errors.

were consistent with the ANOVA on mean reaction times above, suggesting that the size of across-field advantage was constant irrespective of the Rotation Conditions. First, there was a significant main effect of Rotation Condition, F (2, 62) = 13.05, $p < .01$, $\eta_p^2 = .30$. Tukey HSD tests ($\alpha = .05$) showed that while there was no difference in mean error rates between the 45-45 (.043) and the 25-65 conditions (.045), the mean error rate for the 5-85 condition (.076) was significantly higher than in the other two conditions. Second, there was a significant main effect of Presentation Mode, F (1, 31) = 33.78, $p < .01$, $\eta_p^2 = .52$. Error rates in the across-field condition (.035) were significantly lower than in the within-field condition (.075). The interaction between Rotation Condition and Presentation Mode did not reach significance, F (2, 62) = .80, $p = .46$, but, similar to the analyses of RT presented earlier, tests of simple effects revealed a significant across-field advantage in the 45-45, F (1, 93) = 22.34, $p < .01$, the

25-65, F (1, 93) = 10.54, $p < .01$, and the 5-85 conditions, F (1, 93) = 11.15, $p < .01$.

6.3 Comparison the present data with the data in experiment 1 of Yoshizaki et al. (2007)

In order to compare the present results with those obtained in Experiment 1 of Yoshizaki et al. (2007), we conducted a mixed three-way ANOVA with a between-factor (Experiment) by two within-factors (Rotation Condition and Presentation Mode), using reaction time and error rates. Note that important focus was on the second order interaction.

As expectations, the second order interactions were significant for using reaction times, F (2, 108) = 3.39, $p < .05$, $\eta_p^2 = .06$, and error rates, F (2, 108) = 3.12, $p < .05$, $\eta_p^2 = .05$. These interactions suggested that while the size of across field advantage was invariant across the Rotation Conditions when each for a pair of letters was needed to be rotated in the *different* direction, the across-field advantage increased as the number of degrees each letter needed to be rotated became more and more unequal when each for a pair of letters was needed to be rotated in the *same* direction.

7. Discussion

Yoshizaki et al. (2007) varied the number of degrees that each letter needed to be rotated in order to reach the upright position while holding constant the total number of degrees of rotation that were required in each trial. They demonstrated that the across-field advantage increased as the number of degrees each letter needed to be rotated became more and more unequal. These findings supported the hypothesis that the across-field advantage derives from the ability to direct unequal cognitive loads to the left and right cerebral hemispheres.

More interestingly, they argued the possibility for the parallel rotation in each hemisphere. Their arguments are as follows.

"*In Experiment 1, our finding that reaction time increased going from the 45-45 to the 25-65 to the 5-85 condition (on both within-field and across-field* *trials) is clearly inconsistent with the view that the two letters in each trial were serially rotated to the upright position. Indeed, the total number of degrees the two letters needed to be rotated remained constant across these three conditions. However, the gradual increase in reaction time across these three conditions is consistent with parallel rotation of the two letters in each trial because the number of degrees the more severely rotated letter needs to be rotated is increasing across these conditions (i.e., from 45 to 65 to 85). Assuming both letters are being rotated at the same rate, the time needed to complete a parallel rotation should be determined by the letter that needs to be rotated by the largest number of degrees.*"

Although their arguments explain their results well, it is noteworthy that they used the letters needed to be rotated to the upright in the *same* direction (clockwise or counterclockwise rotations). As Burton et al. (2002) argued, it is plausible that the mental rotation to the right direction is basically different from that to the left. Therefore, it is possible that each hemisphere does not work in parallel, i.e., serially, when the two letters which needed to be rotated to the upright position in the *different* (opposite) direction are projected in the hemispheres. We predicted that requiring the participants to perform two distinctive processes (clockwise and counterclockwise rotation) would lead to the serial mental rotation, so that produce the different pattern of results compared with our previous study (Yoshizaki et al., 2007).

As expected, the present study demonstrated that the across-hemisphere advantage was constant irrespective of the three pairing conditions, which was much different from the results of Experiment 1 in Yoshizaki et al. (2007). Assuming that a letter of the pairs was rotated after the counterpart was rotated to the upright position makes the present findings understand reasonably, because of holding the total numbers of degrees the two letters needed to be rotated to the upright position constant (i.e., 90 degrees) among the three pairing conditions. Taking into consideration that the total cognitive load (mental rotation) across the conditions was invariant, the present results supported the Banich and colleagues model (Banich & Belger, 1990), in which the benefits of bihemispheric processing increase as the task is more complex.

When we focus on the difference in total performance between the present results and the previous one (Yoshizaki et al., 2007, Experiment 1), we provide further evidence to support the Banich and colleagues model, in which as the cognitive load increase, the benefits of across-hemisphere processing increase. According to the mixed three-way ANOVA (Experiment by Rotation Condition by Presentation Mode), the total mean reaction times for the match trials of the present experiment(699 ms) were longer than those of the previous experiment (556 ms), F (1, 54) = 33.96, $p < .01$, $\eta_p^2 = .39$. These differences may be due to that the some additional processes are involved in the present experiment, relative to the previous experiment. The possible additional process is the burden of working memory. Taking into consideration that the two letters are rotated serially in the present task, the result (parity) obtained by rotating one of a pair of letter to the upright position has to keep until the counterpart is rotated to the upright position. On the contrary, in the previous task, the burden of keeping the result in working memory is conserved, as it is assumed that the two letters are rotated to the upright position in a parallel fashion. In this sense, the present task was more complex than the previous task, in which parallel rotation in each hemisphere is assumed to be carried out.

Furthermore, the present task was more complex than the previous one in terms of the time for mental rotation. In the present task, the time to be rotated at 90 degrees in total was constant among the three paring conditions, as the letters are rotated serially. On the contrary, the previous task would be time-saving, because each letter is rotated to the upright position in parallel, so, the time for at most 85 degrees of rotation is needed.

Based on the above consideration, the argument in which the present task involved more additional processes compared with the previous task would be reasonable. Interestingly, the size of the across-hemisphere advantage in the present experiment (60 ms) was larger than that in the Experiment 1 of Yoshizaki et al. (2007) (33 ms), interaction between Experiment and Presentation Mode, F(1, 54) = 9.63, $p < .01$, $\eta_p^2 = .15$; suggesting that the benefits of across-hemisphere processing increase, as the cognitive load is higher.

The present study provides the possible limit for our previous view (Yoshizaki et al., 2007) that an unequal division of cognitive load between the cerebral hemispheres facilitates the performance of a complex mental rotation task. That is, when it is demanded that the letters needed to be rotated in the *same* direction, not the *different* direction, are matched, our previous view is approved.

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6. Three cases of semantic jargon aphasia

Mari Higashikawa and Kazuo Hadano

Abstract

In this paper three cases of semantic jargon aphasia are reported. Their speech characteristics are summarized and the disabilities in the selection of items in the lexicon are analyzed. Each speech is characterized by abundant iterative patterns of semantic variations in many semantic categories (Case 1), an iterative pattern of semantic variations in only a particular category (Case 2) and stereotypic repetitions of a particular lexical item ("nimotsu") without variations (Case 3). These three cases may indicate that the range of scanning in the lexicon may shrink in this order (Case 1 → Case 2 → Case 3). These cases suggest that the semantic system can be disorganized on some various levels in semantic jargon.

Key words: aphasia, semantic jargon, iterative pattern of semantic variations, semantic system, semantic field

1. Introduction

Alajouanine (1956) defined a jargon as a disintegration of the semantic values of language and classified three different types of jargon aphasia: undifferentiated, asemantic and paraphasic jargon. Alajouanine stated that these three types appear in the order as listed above. Kertesz and Benson (1970) called the asemantic jargon a neologistic jargon and the paraphasic jargon a semantic jargon. These names are now used widely (Brown 1972, 1977; Buckingham & Kertesz

1976). A neologistic jargon is composed of many neologisms, and a semantic jargon is made of verbal paraphasia or misused words. According to Brown (1981), a semantic jargon usually consisted of irrelevant words, or wild verbal paraphasias.

We define a semantic jargon as incomprehensible fluent speech where neologisms do not appear and irrelevant words recur. Three cases have been analyzed.

2. Case studies

The three cases of semantic jargon below are all from patients in the department of speech-language hearing therapy at Eisei Hospital (Hachiooji, Tokyo) who received an assessment of language.

2.1 Case 1 (Right-handed female. Age 61 at the onset of disease. High school graduate.)

She was sent to an emergency hospital after a headache and disturbance of consciousness appeared. Subarachnoid hemorrhage due to the rupture of an aneurysm in the left middle cerebral artery was identified. The excision of the left cerebral arteriovenous malformation and the amputation of the left temporal lobe were performed. She was hospitalized to the department of psychiatry at Eisai Hospital 11.2 months after the onset of disease. Fifteen years before this operation, another aneurysm in the right basilar artery had been excised.

Below are clinical findings at the time of hospitalization to Eisai Hospital.

She had a right hemianopsia. A right hemiparesis had been observed soon after the onset of disease, but disappeared at the time of hospitalization to Eisai Hospital.

In addition to fluent aphasia, bucco-facial apraxia, ideomotor apraxia and memory disorder were observed. The score of Mini-Mental State (Folstein, Folstein, & McHugh, 1975) was 6/30.

The head CT 11.2 months after the onset of disease is shown in Figure 1. We found in the CT that craniotomies were performed to the left and right side and at least 3 clippings were done in the cerebral basal region. There was a

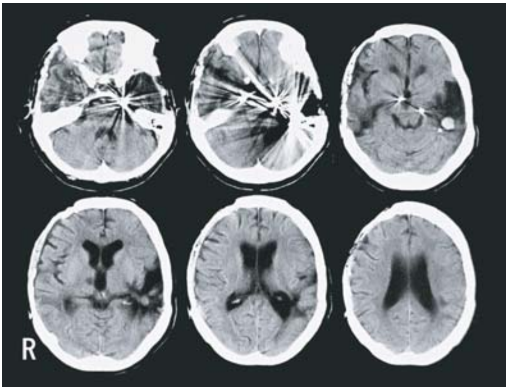

Figure 1: CT of Case 1

high density area in the left temporal region which was identified as an aneurysm that had not ruptured. There was also a finding of the left temporal lobe excision and an ischemic lesion with a low density in the right thalamus.

Speech was fluent and no dysarthria was identified. The amount of speech was large. Simple greetings and conversations were possible. Her speech included many empty phrases with little actual information. Word finding difficulty was serious and the naming of simple everyday objects was also difficult. Irrelevant words to the target words (e.g. saying “kangaroo” instead of pencil) were observed, with also a tendency to repeat the same word. Even after hearing the correct answer, she often could not understand it as correct. Furthermore, she often could not show the use of real objects presented (e.g. when a nail cutter was presented, the patient said that she had never seen or used one before) and her semantic memory could not function. She could repeat sentences with 3 phrases fluently.

Regarding listening, there was a disability in the auditory phonological analysis and in word meaning comprehension.

Regarding oral reading, most Kanji and Kana letters could not be read. Writing was practically impossible.

The Standard Language Test of Aphasia (SLTA, Japanese Society of

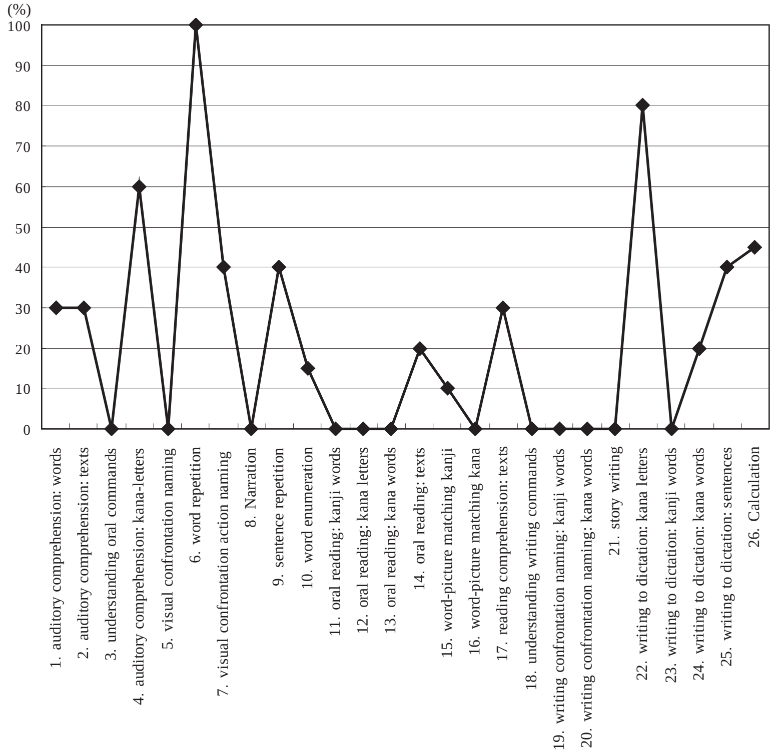

Figure 2: SLTA profile of Case 1

Aphasiology, 1977 ; Higashikawa, Hadano, & Hatta, 2006) profile of Case 1 is shown in Figure 2.

The examples of speech in naming tasks of objects presented on pictures are shown in Table 1. This naming task was examined 12 months after the onset of disease.

Characteristic of the speech which is shown in Table 1 is that, several words with semantic relations are spoken repeatedly. These words belong to the same category (or to the same semantic field), and tend to lead further to words in another category. In contrast to the neologistic jargon, where neologism repeats itself while slightly altering the word sound (Green, 1969; Higashikawa, Iida, & Hadano, 2001), Hadano, Matsuda, Toyoshima, and Hamanaka (1986) called

Table 1: Examples of case 1's speech in naming tasks (in visual confrontation naming)

Table:	**Kore-sharin, sharin-desyo?** (Wheel, isn't this a wheel)
Coffee:	**Kore-wa-tokei, eeto, ude, ano-udedokei-zya-nakute, kodomo-no-are, nan-te-yuunoka, sharin, sharin-zya-nai-wa, udedokei, udedokai-no-dokka-to, tori-ni-yuku-tokoro, ubaguruma, ubaguruma-zya-naku, nan-te-itte-iinoka-na** (This is a clock, uum, arm, not that watch, but that of children, what do you call it, wheel, wheel, not that, but watch, somewhere on the watch and about to go get it, baby carriage, not baby carriage, but what can I call it)
Stone:	**Kore-hari-zya-nai-kana, hari, sanrinsha-no-nani-ka, mitsuba-no-hari-to-omou-no-dakedo** (Isn't this a needle, needle, something of the tricycle, I think it's a clover's needle)
Ball:	**Kore-wa-shamisen-no-kono-hari-no-are, kono-are-ga-chakuchaku-ga-tui-te-iru-kara-mitsuba-no-hari** (This is that of shamisen's [a three-stringed Japanese banjo-like musical instrument] needle, because this that is stuck, it's a clover's needle)
Pencil:	**Kore-wa-futsuu, zya-nai-ka, iro, iro-tsuki-no-are-kana, kuro-zya-naku-te, aa, demo, sode-dake-ga-kuro-ka, kou-iu-tokoro-ga-aka-de-syou, dakara, iro-tsuki-no-hari-to-ie-ba-are-kana, kore-demo-futsuu-no-hari-kana, kore-desu-yo-watashi-ichiban-machigae-no…** (This is normal, right, color, that colored one, not black, uum but only the sleeve is black, around this place is red, so the colored needle would be that, would this still be a normal needle, this is it, the one I most mistaken…)

Note: This naming task was examined 12 months after the onset of disease. Rough English translations are given in parentheses.

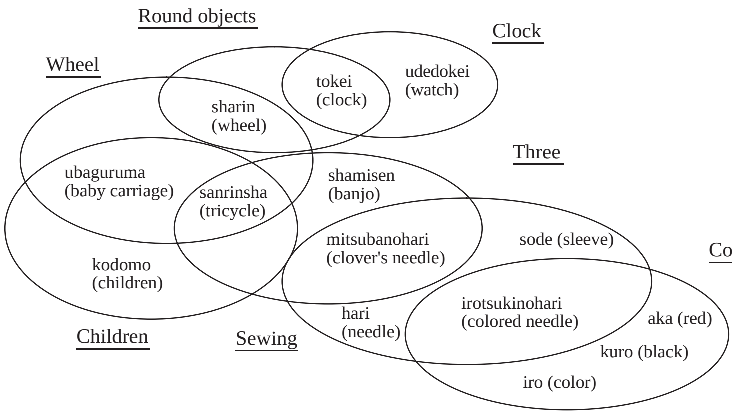

Figure 3: Iterative patterns of semantic variations observed in speech example in Case 1

in the semantic jargon the case where one word leads to words with semantic relations the “iterative pattern of semantic variations”. Hadano el al. (1986) suggest this pattern is one of the characteristics of semantic jargon. We believe the speech in Table 1 is characteristic of an “iterative pattern of semantic variations”. Shown in Figure 3 is how the irrelevant words appeared in speech example of Case1.

An analysis of speech has been performed by the method of Hadano (1991) in the above case by taking the speech in the naming task, separating it into phrases and categorizing the content word in each phrase into 7 groups. The 7 categories are 1) neologism, 2) the fragmental syllable, 3) semantic or phonemic paraphasia, 4) word included in the circumlocution, 5) correct word, 6) word belonging to empty phrases having no actual information and 7) irrelevant word which has no correlation to the target word.

Figure 4.1 Case 1

Figure 4.2 Case 2

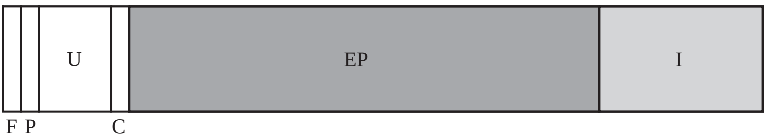

Figure 4.3 Case 3

N: neologism F: fragmental syllables P: paraphasia U: circumlocution
C: correct word EP: empty phrase I: irrelevant word

Figure 4: Analysis of speech in a naming task. The analysis method follows Hadano’s method. (Hadano, 1991)

Results of the analysis of speech by this method are shown in Figure 4.1. Figure 4.1 shows that the speech in Case 1 consists of mostly empty phrases (63.8 %) and irrelevant words (25.9 %) and can be interpreted in the framework of semantic jargon as an incomprehensible fluent speech that consists of mostly empty phrases and irrelevant words but has almost no neologism.

2.2 Case 2 (Right-handed male. Age 49 at the onset of disease. High school graduate.)

He was hospitalized to an emergency hospital since a paralysis suddenly appeared in the right hand. With a diagnosis of intracerebral hemorrhage the hematoma was removed surgically on the day of hospitalization. A serious aphasia appeared beside a right hemiplegia. He was hospitalized to Eisai Hospital 12.6 months after the onset of disease.

Below are clinical findings at the time of hospitalization to Eisai Hospital.

He had a right hemiplegia and a fluent aphasia. The result of the Raven's Coloured Progressive Matrices (Raven, Raven, & Court, 2003) was 22/36.

The head MRI, 13 months after the onset of disease, is shown in Figure 5. It shows a lesion with high signal intensity mostly in the cortical and subcortical region of the left temporo-parietal lobe.

No dysarthria was identified. Speech was fluent with paragrammatism. Simple conversations such as greetings were possible only. Very little actual information came from the patient, because there were many empty phrases and

Figure 5: MRI of Case 2

irrelevant words. The amount of information was small relative to the amount of speech. Many of the irrelevant words were words related to “nomiya” (Japanese word for drinking bar). This characteristic was observed constantly until the patient was discharged from Eisai Hospital no matter what the situation the patient was in, during conversation or during therapy. The difficulty of word finding was serious and naming of even simple daily objects was not possible. During naming, at times some verbal paraphasia were observed along with irrelevant words. Repetition of speech was done relatively well, possible up to 4 phrases.

Regarding auditory comprehension, there was a serious difficulty in understanding meanings of words; understanding everyday objects was difficult.

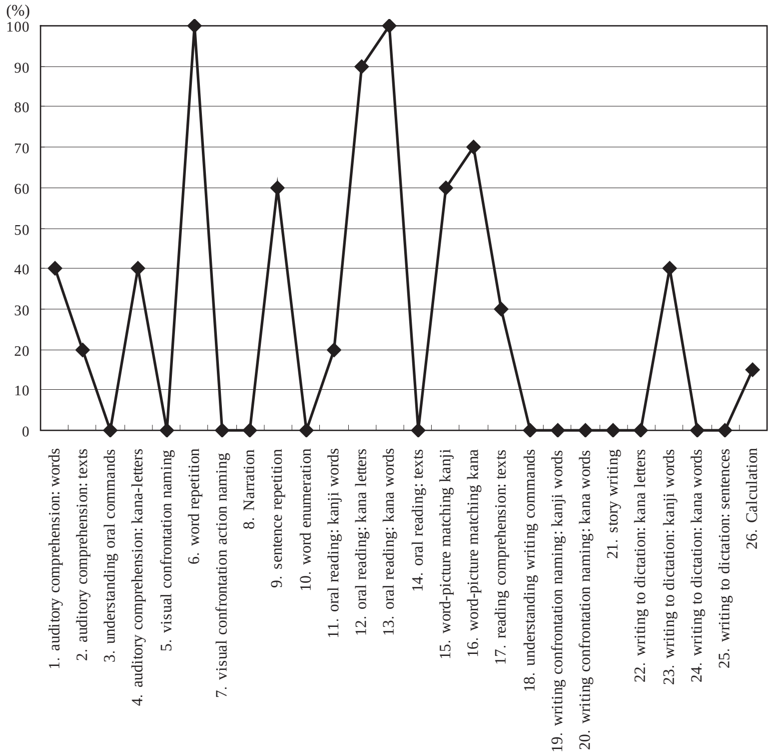

Figure 6: SLTA profile of Case 2

In oral reading, Kana words were better than Kanji. However the oral reading of sentences was difficult. He could only write his name.

The SLTA profile of Case 2 is shown in Figure 6. The examples of speech in Case 2 are shown in Table 2. This speech was recorded in naming tasks 13.6 months after the onset of disease.

As shown in Table 2, the speech in this case includes words such as "nomidai" (drinking fee), "sakaya-nomiya" (liquor store and drinking bar), "mizusyoobai" (night club), "sake-nonda" (I drank), "meshi" (rice) that are irrelevant to the target word and are related to "nomiya" (drinking bar) semantically. These words were repeatedly observed. This could be understood as an iterative pattern of semantic variations. These semantic variations were limited only to a semantic field of the word "nomiya", and in his speech we did not observe any iterative pattern of semantic variations where words related to a concept

Table 2: Examples of case 2's speech in naming tasks (in visual confrontation naming)

Newspaper:	**Kore-wa-nomidai-no-asobutokoro-dabe, nan-toka, wasurechatta-na…** (This is the place where the drinking fee plays, it's called that…I forgot)
Medicine:	**Kore-mo-nomidai-dabe** (This is also the drinking fee)
Drum:	**Kore-mo-kore-non-den-dabe, nan-toka-ttutta-na** (This also, this is drinking, it's called that)
Alligator:	**Kore-mo-nan-toka-no, sakaya-nomiya-tsutta-na, nan-toka-tsutta** (This also is of something, it's called liquor store drinking bar, it's called that)
Lantern:	**Kore-mo-nan-toka-tsutta-na, kocchi-mo-kore-omoidashita-na, hotondo-na, kore, nan-toka-tsutta-na, mizusyoubai-yaru-nantoka-tsuu, nonnderu-yatsu, wasurechatta-na** (This is also called that, this also I recalled this, almost all, this, it's called that, it's the one you drink with the liquor you work in a night club with)
Torii (a gateway to a Shinto shrine):	**Kore-nomidai-da, mizusyoubai-yaru-nan-toka-tsuu, nonderu-yatsu, wasure-chatta-na** (This is a drinking fee, the one you work in a night club with, the one you drink, I forgot)
Kadomatsu (New Year decorations made with pine branches, bamboo sticks and plum tree sprigs):	**Kore, sake-nonda, nonde, nondeta-yatsu-dana, un, ue-ni-meshi, meshi-ga-tuite-te-yo, nan-toka-tsutta-na, wasurechatta-yo** (This, I drank, the one I drank and drank, yeah, on top of it was rice, rice was on it, it was called something, I forgot)

Note: This naming task was examined 13.6 months after the onset of disease. Rough English translations are given in parentheses.

other than "nomiya" (drinking bar). Results of the analysis of speech in this case are shown in Figure 4.2. This figure shows that empty phrases and irrelevant words were abundant; they amount to over 99 % of the entire speech. In particular, 78 % of the irrelevant words were related to "nomiya." Neologism was not observed. We interpreted the speech of this case as a semantic jargon.

2.3 Case 3 (Right-handed male with familial sinistrality. Age 59 at the onset of disease. College graduate.)

He suffered from a cerebral infarction during hospitalization at a hospital with a bronchial asthma. At the onset of the infarction he had a right hemiparesis that later disappeared. Aphasia remained. He went to Eisai Hospital 6.8 months after the onset of the cerebral infarction and received speech therapy. The chief complaint of his family was that he would express everything as "nimotsu" (Japanese word for baggage). Below are the findings at Eisai Hospital.

The result of the Raven coloured progressive matrices was 34/36.

The head CT 6.9 months after the onset of the cerebral infarction is shown in Figure 7. A large ischemic lesion with a low density is seen over a large region, mainly in the left temporal and partially into the parietal lobe.

He spoke sentences fluently, but the amount of speech was not large. No dysarthria was present. The difficulty of word finding was heavy and only approximately 5-10 % of everyday objects could be named. During naming, there were many empty phrases and the irrelevant word "nimotsu". Verbal paraphasia and phonemic paraphasia were observed at times. Other than empty phrases, his speech consisted mostly of irrelevant words and paraphasias and did not

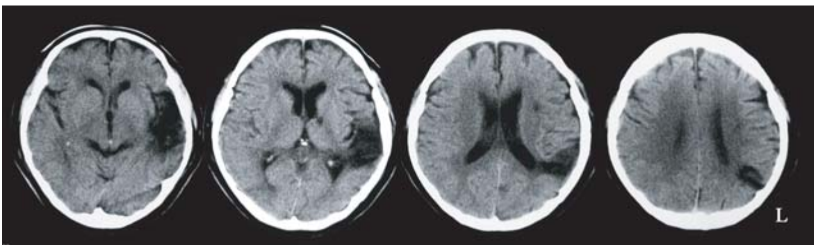

Figure 7: CT of Case 3

offer actual information. Paragrammatism was also observed. The repetition of speech was possible up to 2 phrases.

There was a disability in auditory phonological analysis. Finding word form was difficult and lexical decision was hardly possible. The disability in word meaning comprehension was also serious.

Regarding words, Kanji was seriously disabled; he could not write even the simplest Kanji letters that seven-year-old normal children can read and write. He wrote Kana letters mostly, and he wrote also sentences mostly identical to his speech. The word "nimotsu" was frequently written in his sentences as observed in speech.

In oral reading, Kana words were better than Kanji. Part of the mistakes

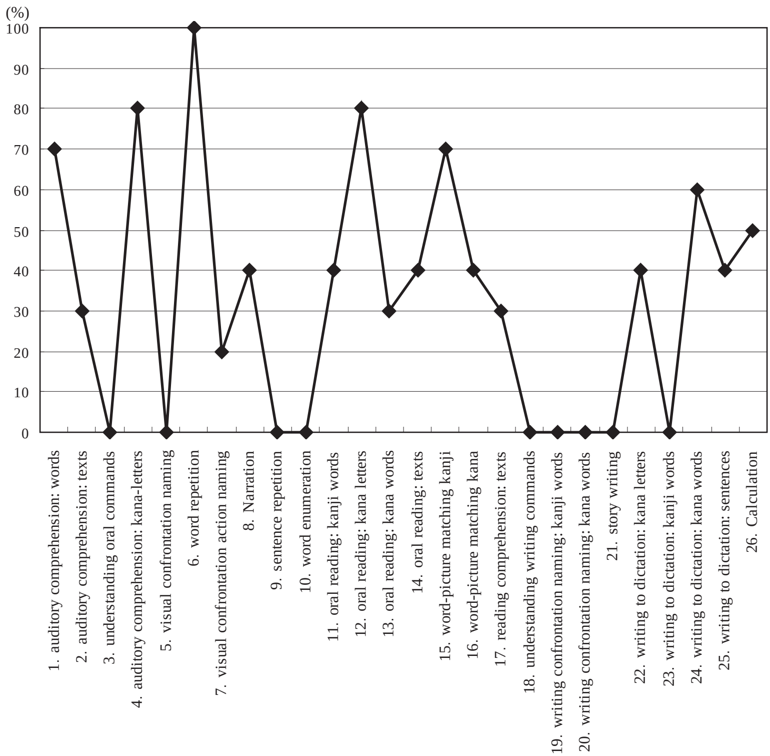

Figure 8: SLTA profile of Case 3

made in the oral reading of Kanji words was similar to that of Gogi-aphasia (word semantic aphasia, Imura, 1943) — e.g. Kimono: “Chakumono”, Tenjyo: “Teni”, Dansei: “Otokosei”.

We diagnosed his language disturbance as Wernicke’s aphasia.

The SLTA profile of Case 3 is shown in Figure 8. Table 3 shows the examples of speech in naming tasks 18.1 months after the onset of the cerebral infarction.

Figure 4.3 shows results of an analysis performed on the speech in Table 3. It shows that a large part of the speech (87 %) consists of empty phrases and irrelevant words. Many of the irrelevant words (39 %) were “nimotsu.” Neologism was not observed. His incomprehensive speech was due to many empty phrases and irrelevant words that recurred carelessly. We interpreted this speech as a semantic jargon.

Table 3: Examples of case 3’s speech in naming tasks (in visual confrontation naming)

Bread:	**Kore? Kore-wa-nimotsu-de, tyotto-muzukasii-ne. Kore, kokoni-iruno-ne, tyotto-wakaranai** (This? This is a nimotsu and it’s a bit difficult. This, here it is, I don’t know.)
Teacher:	**…Kore, kore, n, nn, konohito, nimotsude-kore, ya, zutto-yaruno-ne** (…This, this, um, uum, this person, with nimotsu, do, does it all the time)
Camera:	**Kore-wa-kuruma, kuruma-de-mite-iru** (This is a car, is looking at it in the car)
Letter:	**Kore-wa-nimotsu-de, nimotsu-ni-atte-iru. Yoku-mite-iru-kedo-wakaranai-ne** (This is a nimotsu, it fits with nimotsu, look, I’m looking at it carefully, but I don’t know)
Sun:	**Kore-wa, kore-nimotsu-de, attakai. Kore-yoru-de-mite-iru-kedo-tyotto-muzukasii-na** (This, this is a nimotsu, and it’s warm. This, I see at night, but it’s a bit difficult)

Note: This naming task was examined 18.1months after the onset of infarction. Rough English translations are given in parentheses.

3. Discussion

The characteristics of speech in the three cases of semantic jargon are summarized below.

In all cases, the repetition of speech and oral reading are done fairly well and no (or few) phonemic paraphasia is apparent. We consider that aphasia-type of Case 1 and 2 transcortical sensory aphasia, as repetition is relatively well preserved. Case 3 is interpreted as Wernicke's aphasia, since phonemic mistakes were observed.

In all 3 cases, empty phrases are particularly abundant, and irrelevant words appear stereotypically, while neologisms and phonemic paraphasias are hardly observed.

In the speech of Case 1, several words belonging to a semantic category appeared successively, which is considered as an iterative pattern of semantic variations which Hadano (1991) defined. Also, on a following occasion, several other words belonging to another category appear successively. This pattern does not limit itself to one category, but rather develops to different categories. For example, the lexicon varies from "hasami" (scissor) to "kamisori" (razor) to "haburashi" (toothbrush) to "hamigakiko" (toothpaste), so that initially the lexicon is in the category of cutlery, but later develops to words in the category of washroom, as if playing with words.

In Case 2, an iterative pattern of semantic variations is observed only in a particular category: spoken words are almost lexically related to "nomiya" (drinking bar). The lexical items in this category are not abundant and limited to some words, such as "mizusyoobai" (night club), "nomidai" (drinking fee), and "meshi" (rice).

Finally in Case 3, all words have a tendency to be expressed as "nimotsu" (baggage). An iterative pattern of semantic variations is not observed, while the nouns recall all have a tendency to lead to "nimotsu." This speech pattern may be similar to recurrent utterance observed in some cases of global aphasia, but we can not understand so because there is no element of non-fluency in the speech of Case 3.

The observations of our three cases of semantic jargon aphasia are as follows. In Case 1, lexical items are automatically scanned within categories that are activated successively — that is, several categories are activated. In Case 2, lexical items which belong to only one category are always scanned — that is, an activated category is always one and the same. In Case 3, only one lexical item is selected and activated stereotypically. All cases have a disability in the automatic scanning in semantic jargon. We interpret that these three cases show steps in which the range of scanning in the lexicon becomes narrower and narrower.

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7. The verbal fluency tasks in the Japanese population

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Abstract

Verbal fluency tests (VFT) have been used to assess cognitive deficits at clinical and research fields in the West. It is difficult for Japanese to use the normative VFT data of other language-speaking people because of linguistic factors. The objective of the present study was to develop the norms of VFT for Japanese population and examine the effect of age, education and gender on the performance. We assessed 1433 healthy community adults on letter fluency (LF) tasks and 934 healthy community subjects on category fluency (CF) tasks with their informed consent and their age range was from 19 to 91. Our tasks comprised three LF ("A", "Ka", Shi") and three CF ("Animal", "Sport", "Occupation"). Examiners asked each participant to generate as many nouns as possible orally, except for proper nouns and repetitive words, for 1 minute on every task. The present study indicated the norm using percentile scores stratified by age, education and gender. Consistent with early studies of other language-speaking samples, age and years of education were strongly related to the number of words generated on both letter and category fluency tasks.

Key words: verbal fluency, normative data, Japanese-speaking subjects

1. Introduction

Verbal fluency tasks (VFT) involve the production of as many words as possible beginning with a given letter (letter fluency) or belong to a certain category

(category fluency) within certain time. In Western countries, Controlled Verbal Fluency Task (CVFT; FAS test) has been used. In this test, examinees orally generate words beginning with a letter (“F”, “A” and “S”) within 60 seconds for each letter (Bechtoldt, Benton & Fogel, 1962). Later Controlled Oral Word Association test (COWAT) consisted of two sets of letters (“C”, “F”, “L” and “P”, “R”, “W”) chosen by analysis of the word difficulty based on the number of words which begin with the particular letter (Benton & Hamsher, 1989). For CF tasks some designate semantic categories have been used, such as, animals, items in supermarket, first names, US states, things-to-ride and professions (Kozora & Cullum, 1995; McCarthy, 1972; Van Der Elst, Van Boxtel, Van Breukelen, & Jolles, 2006).

From 1970s to 1990s, performances on verbal fluency tasks of healthy people were investigated to develop the norm and indicated effect of age and education in early studies (Mitrushima, Boone, Razani, & D’Elia, 1999). Some studies documented the effect of gender on VFT (Bolla, Lindgren, Bonaccorsy, & Bleecker, 1990; Chan & Poon, 1999; Crossly, D’Arcy, Rawson, 1997; Ruff, Light, Parker, & Levin, 1996). They reported female superiority in performance to male. However, others mentioned no gender differences (Boone et al., 1995; Ripich, Petrill, Whitehouse, & Ziol, 1995; Yeudall, Reddon, Gill, 1987). The effect of education on verbal fluency performance was found in some literatures (Benton, 1983; Crossly et al., 1997; Kempler, Teng, Dick, Taussig, & Davis, 1998; Kosmidis, Vlahou, Panagiotaki, & Kiosseoglou, 2004). However, it was not found in others (Axelrod & Henry, 1992; Bolla et al., 1990). While some previous research suggested that the performance on CF is poorer in elderly than in younger adults (Bolla et al., 1990; Bolla, Gray, Resnick, Galante, & Kawas, 1998; Crossly et al., 1997; Kozora & Cullum, 1995; Kosmidis et al., 2004; Ostrosky-Solis, Gutierrez, Flores, & Ardila, 2007; Tomer & Levin, 1993; Van Der Elst et al., 2006), several reports showed that age did not affect the performance on category fluency (Bord, Goodglass, & Kaplan, 1980). According to a meta-analysis of FAS test in healthy adults (Loonstra, Tarlow, & Sellers, 2001), the performance declines with age. By contrast, other researchers showed that LF performance tends to be comparatively resistant to effect of age (Harrison, Buxton, Husain, & Wise, 2000; Ivnik, Malec, & Smith, 1996; Mathuranath, George, Cherian, Alexander, Sarma, & Sarma, 2003; Tomer & Levin, 1993).

In addition, VFT were applied to clinical subjects, and performances of people with dementia, traumatic brain injury, depression and schizophrenia were examined (Baldo, Shimamura, Delis, Kramer, & Kaplan, 2001; Bokat & Goldberg, 2003; Gourovitch, Goldberg, & Weinberger, 1996; Cerhan et al., 2002; Tucha, Smely, & Lange, 1999). According to Tucha et al. (1999), patients with frontal lobe deficit especially in left dorso-lateral area resulted in worse performance on verbal fluency tests compared with that of other cortical regions. Differential performance between letter and category fluency tasks has been demonstrated as diagnostic utility in age-associated pathology such as Alzheimer's disease. Patients with Alzheimer's disease showed impairment on CF tests compared to LF tests (Barr & Brandt, 1996; Cerhan et al., 2002; Henry, Crawford, & Philips, 2005; Hodges, Salmon, & Butters, 1992; Monsch, et al., 1994). Some studies indicated schizophrenia patients were impaired in both LF and CF tasks (Gourovich et al., 1996; Kremem, Seidman, Faraone, & Tsuang, 2003)

Since 1990s, imaging studies have been used to analyze functional regions in human brains relative to VFT. Imaging studies revealed that performance of VFT is associated with increased left prefrontal activity (Elfgren & Risberg, 1998) and medial temporal lobe is required for the process of retrieval by category (Pihlajamaki et al., 2000). Hubrich-Ungureanu, Kaemmere, Henn, & Braus (2002) studied brain activity of a right-handed healthy woman during silent letter fluency tasks with functional neuron-imaging techniques. They found that letter fluency tasks are associated with the left fronto-parietal cortex and the right cerebellar hemisphere.

From a neuropsychological viewpoint, VFT are used to gauge executive function, such as keeping rules in mind as well as following rules, self-monitoring, the speed and ease of verbal production and to assess the readiness with which participants can initiate behavior in response to novel requests (Lezak, 1995; Parker & Crawford, 1992). It is also remarked that VFT measures a variety of cognitive process, such as word knowledge, access to semantic memory, long-term verbal memory, attention (Crowe, 1998; Ruff et al., 1996), speed of information processing, vocabulary size, working memory and inhibition of irrelevant words (Sergent, Geurts, & Osdterlaan, 2002). Therefore verbal fluency tests have been widely used to measure cognitive functions in clinical settings and research institutes.

In spite of the use of VFT widely in western countries, there are few norms available in Japanese society. Our early studies with Japanese community dwellers demonstrated that age and education considerably influence the performance on both letter and category fluency tasks (Ito, Hatta, Ito, Kogure, & Watanabe, 2004). In addition, we examined the validity and reliability on a Japanese version of verbal fluency tasks, and verified the test-retest reliability and criterion-related validity as a measurement for anterior and temporal lobules functions (Ito & Hatta, 2006).

In order to extensively apply the Japanese version of verbal fluency tasks to Japanese, we newly give them a large sample of Japanese people (more than 2,000) and provide the norms of the LF and the CF tasks.

2. Method

Participants were recruited at annual health examination in four communes in Japan between June, 2001 and August, 2004. The total number of 2,392 community-dwelling individuals aged from 19 to 91 participated in the study with their informed consent. Five hundred and sixty nine subjects participated in both letter and category fluency tasks and others participated in either of LF or CF tasks. The first data were adopted if the case tried these tasks twice and more, with the result that data from 1,499 participants in letter fluency tasks and 1,002 participants in category fluency tasks were obtained. According to screening tests, participants were classified into 2 groups: healthy and excluded samples. The healthy sample for LF tasks consisted of 1,433 individuals living independently, and ranged in age from 19 to 91years (M = 58.4, SD = 12.3), education from 1 to 31 years (M = 11.1, SD = 2.6). The male to female ratio was 442 to 991 ($\chi^2 = 210.3$, $p < .01$). The other healthy sample for CF tasks consisted of 934 individuals and age range was 19-91 (M = 57.7, SD = 13.5), educational range was 1 to 16 years (M = 11.4, SD = 2.7). The gender ratio (male to female) was 295 to 639(χ^2 = 126.7, p <.01). The healthy participants were divided into 5 groups by age (under 40, 40's, 50's, 60's, over 70) and 4 groups by years of education (to 9 years, 10-12, 13-15, over 16 years) for analyses. All participants were Japanese-speaking people and their characteristics were indicated in Table 1.

Table 1: Characteristics of the participants

	Letter Fluency task		Category Fluency task	
	Healthy	Excluded	**Healthy**	Excluded
Mean age	58.4(12.3)	69.6(8.5)	57.7(13.5)	71.7(6.4)
19－39	97	0	87	0
40－49	203	4	135	0
50－59	406	6	258	2
60－69	477	22	270	23
70－91	249	34	184	43
Unknown	1	0	0	0
Mean education	11.1(2.6)	9.2(2.1)	11.4(2.7)	8.8(2.0)
Under 10	566	45	312	50
10－12	566	10	381	8
13 – 15	173	1	143	0
Over 16	89	1	76	2
Unknown	39	9	22	8
Male	442	34	295	34
Female	991	32	639	34
	1433	66	934	68
	1499		1002	

Three letters (“A”, “Ka”, “Shi”) for LF tasks were selected from 51 Japanese letters based on the number of general nouns begin with each letter and their familiarity. Three categories (“Animal”, “Occupation”, “Sport”) for CF tasks were selected which contained a large number of items and indicated normal distribution in our preliminary study.

Prior to VFT, screening tests were conducted in order to distinguish participants with cognitive impairment from healthy ones. They consisted of brief interviews concerning orientation (time, place and person), medical history, Mini-Mental State Examination (MMSE: Folstein, Folstein & McHugh, 1975) and an immediate sentence recall task of Wechsler Memory Scale-Revised Japanese version (WMS-R: Sugishita, 2001). Participants who marked under 24 points at MMSE or under 4 points of an immediate sentence recall task of WMS-R and had some neurological medial history such as stroke, Parkinson’s disease and traumatic brain injury were excluded from healthy samples.

LF tasks were examined by asking participants to generate as many words as possible orally beginning with 3 letters “ A”, “ Ka” and “Shi” for 60 seconds each.

CF tasks were examined by asking participants to retrieve the name of items from 3 categories “Animal”, “Occupation” and “Sport” within 60 seconds each. The task-operating order was randomized among the participants.

Examiners instructed participants not to name proper nouns and repeat same words previous to the tests. Examiners recorded all the words participants had reported on the sheet. The number of correct words and repetitive words produced constituted the raw scores for each task.

3. Result

We explored the total number of words produced on the three LF tasks (“A”, “KA”, “Shi”), and the three CF tasks (“Animal”, “Occupation”, “Sport”). The mean number of LF tasks was 22.3 (SD = 8.98) and mean number of repetitive words was 0.8 (SD = 1.2). The mean number of CF tasks was 37.4 (SD = 11.72) and repetitive words was 1.2 (SD = 1.5). Table 2 and 3 showed the mean number and percentile scores of VFT for 3 variables (age, education and gen-

Table 2: Norms of letter fluency test (3 tasks) stratified for age, years of education and gender

Age	Educa -tion	G	n	5	10	25	50	75	90	95	*M*	*SD*
				Percentile Score								
	≦9	F	1									
	10-12	M	1									
19		F	22	13.3	16.2	20.0	28.0	29.3	34.7	38.4	25.9	6.5
|	13-15	M	10	16.0	16.6	22.8	28.0	39.3	49.3		30.4	10.5
39		F	36	24.0	24.7	31.5	37.0	43.0	53.6	59.3	38.2	9.6
	16≦	M	6	21.0	21.0	24.0	28.5	41.3			31.0	8.9
		F	21	15.0	24.2	28.5	34.0	40.0	48.2	49.9	34.1	8.7
	total		97	18.7	21.0	25.0	32.0	39.0	45.6	53.0	33.1	9.9
	≦9	M	5	18.0	18.0	18.0	18.0	21.5			19.4	2.2
		F	22	6.8	11.6	18.8	23.5	28.5	33.0	33.0	22.9	7.5
	10-12	M	25	2.1	8.2	14.5	23.0	27.5	30.8	36.4	21.3	8.8
40's		F	73	12.0	16.4	19.0	24.0	28.5	38.2	40.3	24.5	7.6
	13-15	M	10	7.0	8.2	19.0	20.5	33.5	40.4		24.1	9.9
		F	37	15.9	17.6	24.0	26.0	39.0	44.2	47.1	29.4	10.0
	16≦	M	11	25.0	25.2	26.0	33.0	43.0	66.6		36.2	13.9
		F	12	19.0	20.8	33.8	37.5	41.8	48.9		36.9	8.5
	total		203	11.0	14.4	19.0	25.0	31.0	39.6	43.8	25.6	10.0
	≦9	M	38	5.8	69.8	11.5	17.0	24.0	29.1	33.5	17.5	9.0
		F	83	10.2	12.0	15.0	20.0	23.0	27.6	30.0	19.7	5.7
	10-12	M	45	13.0	14.6	16.0	20.0	23.5	29.8	33.7	20.9	5.8
50's		F	162	13.0	14.0	18.0	25.0	30.0	35.0	38.0	24.6	7.9
	13-15	M	15	9.0	11.4	17.0	22.0	27.0	33.4		21.5	7.2
		F	30	12.6	14.5	20.0	23.5	32.3	34.8	39.9	25.6	7.4
	16≦	M	8	12.0	12.0	19.3	26.5	32.8			26.4	9.9
		F	15	16.0	20.2	25.0	35.0	38.0	47.8		32.9	9.3
	total		406	11.0	13.0	17.0	22.0	28.0	33.0	37.0	22.7	8.1
	≦9	M	75	6.0	9.6	12.0	15.0	20.0	24.8	28.8	16.3	6.5
		F	174	10.0	12.0	15.0	19.0	24.0	27.0	30.5	19.5	6.4
	10-12	M	61	11.0	11.0	14.0	18.0	24.5	30.8	33.9	19.6	7.3
60's		F	117	10.9	14.0	18.0	22.0	27.0	31.2	39.2	22.6	7.7
	13-15	M	6	10.0	10.0	12.3	22.5	30.3			21.5	8.7
		F	17	7.0	8.6	19.0	26.0	29.0	40.2		23.8	9.2
	16≦	M	8	9.0	9.0	15.5	19.5	25.5			19.5	6.2
		F	6	13.0	13.0	16.0	21.0	33.5			24.3	11.2
	total		477	9.0	11.0	15.0	19.0	24.5	29.0	33.0	20.0	7.5
	≦9	M	67	6.0	7.8	12.0	16.0	23.0	29.4	35.8	17.5	8.3
		F	101	10.0	11.0	13.5	17.0	22.5	26.0	29.0	17.9	5.9
70	10-12	M	30	7.1	8.2	15.0	19.0	25.0	29.0	32.9	19.5	7.3
|		F	30	9.1	16.0	19.8	23.0	29.3	33.8	38.3	23.9	7.2
91	13-15	M	6	14.0	14.0	14.0	18.5	36.8			24.7	12.7
		F	6	17.0	17.0	17.8	21.5	25.3			21.8	14.5
	16≦	M	2	15.0	15.0	15.0	24.5				24.5	13.4
	total		249	8.0	10.0	14.0	18.0	24.0	29.0	32.5	19.0	7.5
Total			1432	10.0	12.0	16.0	21.0	27.0	34.0	39.0	22.3	9.0

Table 3: Norms of category fluency test (3 tasks) stratified for age, years of education and gender

Age	Educa-tion	G	n	Percentile score 5	10	25	50	75	90	95	*M*	*SD*
	10-12	F	17	33.0	34.6	36.0	39.0	45.0	53.2		41.1	6.4
19	13-15	M	10	40.0	40.0	46.8	53.0	55.8	69.7		52.5	8.9
|		F	34	34.8	36.5	43.8	50.5	58.0	62.0	68.8	50.4	10.3
39	16≦	M	5	41.0	41.0	42.0	45.0	50.0			45.8	4.3
		F	21	35.5	40.0	44.5	51.0	54.5	60.8	65.5	50.5	7.9
	total		87	35.0	36.0	41.0	48.0	54.0	60.0	63.6	48.6	9.3
	≦9	M	4	44.0	44.0	44.0	44.5	45.0			44.5	0.6
		F	6	30.0	30.0	30.8	39.5	43.3			38.2	6.6
40’s	10-12	M	15	34.0	34.6	41.0	45.0	58.0	59.8		47.0	9.1
		F	47	24.0	30.0	35.0	38.0	44.0	51.4	56.0	39.5	8.2
	13-15	M	9	27.0	27.0	32.0	42.0	51.0			43.0	13.0
		F	33	30.4	35.2	40.0	44.0	52.5	56.2	75.2	46.4	10.9
	16≦	M	9	39.0	39.0	46.5	53.0	68.0			57.1	15.2
		F	11	43.0	43.0	44.0	49.0	55.0	60.8		49.9	6.6
	total		135	29.8	31.0	37.0	43.0	51.0	57.0	62.0	44.3	10.7
	≦9	M	23	20.0	20.8	26.0	33.0	37.0	44.2	45.8	31.7	7.2
		F	45	21.3	25.2	30.5	35.0	40.0	46.0	49.0	35.4	7.6
50’s	10-12	M	24	21.0	31.0	34.3	38.5	41.8	46.0	50.0	37.9	6.5
		F	105	25.0	29.6	35.0	40.0	46.0	51.0	54.0	40.6	9.0
	13-15	M	10	32.0	32.0	35.0	40.5	50.0	52.7		41.9	7.9
		F	27	31.8	33.8	37.0	42.0	48.0	52.4	56.4	42.6	7.0
	16≦	M	10	24.0	25.1	38.0	46.0	54.5	57.8		44.8	10.4
		F	8	39.0	39.0	41.5	51.0	61.8			51.4	10.3
	total		258	24.0	28.0	34.0	39.0	45.0	51.0	56.1	39.5	9.3
	≦9	M	40	16.2	20.1	25.5	30.0	36.8	42.8	47.9	31.3	8.9
		F	72	20.3	24.0	26.3	31.0	38.0	42.4	47.0	31.8	8.3
60’s	10-12	M	46	24.7	27.7	30.8	37.5	44.3	47.9	52.0	37.5	7.8
		F	81	23.2	26.0	30.0	36.0	42.5	52.6	55.8	36.9	9.5
	13-15	M	2	36.0	36.0	36.0	40.5				40.5	6.4
		F	9	35.0	35.0	36.0	43.0	47.0			42.0	5.6
	16≦	M	5	27.0	27.0	27.0	38.0	40.0			34.4	6.8
		F	6	32.0	32.0	37.3	44.5	52.8			44.8	9.1
	total		270	21.0	25.0	29.0	34.0	41.0	46.0	51.5	34.9	9.2
	≦9	M	51	11.6	16.2	21.0	28.0	32.0	39.8	43.2	27.2	9.2
70		F	71	14.6	16.0	20.0	26.0	31.0	35.8	39.0	25.6	7.3
|	10-12	M	18		11.7	21.3	29.0	35.3	42.5		27.6	11.3
91		F	28	16.5	21.5	25.3	32.0	38.3	46.2	48.6	32.1	8.5
	13-15	M	6	25.0	25.0	27.3	30.5	48.3			35.2	10.6
		F	3	26.0	26.0	26.0	32.0				35.3	11.4
	16≦	M	1									
	total		184	14.3	17.0	22.0	28.0	34.0	39.0	44.3	27.9	9.0
Total			934	20.0	24.0	30.0	37.0	44.0	52.0	56.0	37.4	11.3

der) in healthy sample. Moreover, appendix 1 to 6 indicated the norms (percentile score) of each task stratified by age, education and gender.

An analysis of variance (ANOVA) was conducted to examine the effects of age, education and gender on both fluency scores. On letter fluency score, an ANOVA of gender (2) by age (5) by education (4) showed a significant interaction between age and education as well as significant main effects of three variables (Gender: F (1,1354) = 8.87, $p < .01$; Age: F (4,1354) = 11.02, $p < .001$; Education: F (3,1354) = 11.43, $p < .001$; Age × Education: F (12,1354) = 2.78, $p < .01$). On category fluency score, an ANOVA of gender (2) by age (5) by education (4) demonstrated a significant interaction between age and gender as well as significant main effects of age and education (Age: F (4,876) = 14.37, $p < .01$; Education: F (3,876) = 15.54, $p < .01$; Age × Gender: F (4,876) = 2.62, $p < .05$).

Furthermore, the performance was analyzed by multiple regression analyses with samples who participated in both fluency tasks to obtain the contribution of gender, age and education. The equations of both fluency tasks were presented as follows.

(1) Letter fluency score = 21.44 – 0.23 (age) + 0.87 (education) + 3.42 (gender)
(2) Category fluency score = 39.12 – 0.30 (age) + 1.39 (education) – 0.10 (gender)

On letter fluency tasks, age, education and gender were selected for equation (R^2 = .316, F (3, 566) = 86.78, $p < .001$). On category fluency tasks, age and education were selected for equation (R^2 = .425, F (3, 566) = 140.66, $p <$ .001). Education had a positive effect and age had a negative effect on both fluency score, in addition, these factors had a more influence on CF tasks than on LF tasks (Table 4).

4. Discussion

The present study provides normative data stratified by age, education and gender from a large number of Japanese speaking subjects without cognitive impairment. It is very helpful for Japanese speaking people to use these norms in a meaningful way because there are some different linguistic factors among

Table 4: Estimates of multiple linear regression analyses of VFT

VFT	Estimate B	Standardized β	R	R^2	p
A (invariable 5.02)			.447	.195	<.001
Age	-.045	-.183			<.001
Education	.348	.273			<.001
Gender	1.074	.128			<.001
Ka(invariable 9.05)			.521	.268	<.001
Age	-.088	-.325			<.001
Education	.310	.220			<.001
Gender	1.011	.108			<.001
Shi(invariable 5.26)			.548	.296	<.001
Age	-.076	-.300			<.001
Education	.352	.267			<.001
Gender	1.188	.136			<.001
Total LF(invariable 21.44)			.562	.313	>.001
Age	-.225	-.331			<.001
Education	.872	.246			<.001
Gender	3.417	.146			<.001
Occupation(invariable 8.40)			.556	.306	<.001
Age	-.077	-.273			<.001
Education	.490	.333			<.001
Gender	.351	.036			.313
Sport(invariable 15.27)			.644	.412	<.001
Age	-.122	-.426			<.001
Education	.429	.287			<.001
Gender	-.833	-.084			<.05
Animal(invariable 15.95)			.542	.290	<.001
Age	-.110	-.329			<.001
Education	.461	.264			<.001
Gender	.260	.023			.533
Total CF(invariable 39.12)			.655	.425	<.001
Age	-.304	-.384			<.001
Education	1.392	.337			<.001
Gender	-.095	-.003			.915

languages, such as length of words, frequency and familiarity of words (Ardila, 1995; Lopez & Taussig, 1991; Lowenstein, Arguelles, Arguelles, & Linn-Fuentes, 1994).

Age and years of education were strongly related to the number of words generated on both letter and category fluency tasks. These findings are consistent with some previous studies (Age: Bolla et al.,1998; Crossly et al.,1997; Harrison et al., 2000; Kosmidis et al., 2004; Kozora & Cullum, 1995; Ostrosky-Solis, Gutierrez, Flores, & Ardila, 2007; Tomer & Levin, 1993; Van Der Elst et al., 2006; Education: Benton, 1983; Chan & Poon, 1999; Crossly et al., 1997; Kempler et al., 1998; Kosmidis et al., 2004; Ratcliff et al., 1998). When we use VFT as a functional assessment, age and education of clients should be considered. Gender had an influence only on the performance of the letter fluency task, suggesting that women are superior to men in the letter fluency task. This was also consistent with the reports of Bolla et al. (1990), Crossely et al. (1997) and Kosmidis et al. (2004), while there have been some reports of no gender differences on both fluency tasks (Harrison et al., 2000; Kozora & Cullum, 1995; Lee et al., 2004). These inconsistencies for gender difference may be due to the ratio of participants and/or the difference of mean age in gender.

The present study provides the normative VFT data of Japanese with comprehensive age and educational range, although there is some limitation on gender ratio. Further research is needed to investigate detectable ability of the CF and the LF tasks to identify cognitive impairment.

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Appendix 1: Norms of “A” task stratified for age, years of education and gender

Age	Educa-tion		n	5	10	25	50	75	90	95	*M*	*SD*
				Percentile Score								
	≦9	F	1								8.0	
	10-12	M	1								13.0	
19		F	22	4.0	4.0	5.0	8.0	10.0	13.0	14.8	8.2	3.3
|	13-15	M	10	2.0	2.4	6.9	10.0	12.0	14.7		9.3	3.6
39		F	36	7.9	8.0	9.0	11.5	14.0	16.9	21.0	12.0	3.7
	16≦	M	6	8.0	8.0	8.0	11.5	14.3			11.3	3.3
		F	21	6.0	6.2	8.5	11.0	13.5	15.8	18.7	11.0	3.4
	total		97	4.9	6.0	8.0	10.0	13.0	15.0	16.5	10.6	3.7
	≦9	M	5	6.0	6.0	7.0	8.0	9.0			8.0	1.2
		F	22	3.0	3.0	6.0	8.5	9.3	11.0	12.7	7.9	2.7
	10-12	M	25	0.9	3.0	3.5	7.0	9.0	11.8	13.7	6.8	3.4
40’s		F	73	4.0	5.0	6.0	9.0	10.0	12.0	13.0	8.3	2.6
	13-15	M	10	3.0	3.1	5.5	7.0	12.5	16.6		8.5	4.4
		F	37	3.0	4.6	7.0	9.0	11.0	14.4	15.6	9.4	3.6
	16≦	M	11	8.0	8.0	8.0	11.0	14.0	24.8		12.6	5.7
		F	12	6.0	6.0	9.5	11.5	13.8	15.4		11.3	3.1
	total		203	3.0	4.0	6.0	9.0	10.5	13.0	14.0	8.7	3.5
	≦9	M	38	1.0	2.0	3.3	5.5	7.0	10.3	11.2	5.6	2.8
		F	83	3.0	3.0	5.0	7.0	8.0	10.0	10.8	6.5	2.3
	10-12	M	45	3.0	3.6	5.0	7.0	8.0	10.4	12.0	6.9	2.6
50’s		F	162	3.0	4.1	6.0	8.0	10.0	12.9	14.0	8.4	3.2
	13-15	M	15	2.0	2.0	4.0	7.0	10.0	11.0		6.9	3.2
		F	30	3.0	3.2	6.0	9.0	11.0	12.9	14.5	5.6	3.2
	16≦	M	8	6.0	6.0	6.3	7.5	9.8			8.4	2.7
		F	15	4.0	5.2	8.0	12.0	13.0	18.0		11.2	4.1
	total		406	3.0	4.0	6.0	7.0	10.0	12.0	13.0	7.6	3.2
	≦9	M	75	1.0	2.0	4.0	5.5	7.0	9.0	10.0	5.5	2.6
		F	174	3.0	4.0	5.0	7.0	9.0	10.6	11.0	6.9	2. 5
	10-12	M	61	2.1	3.2	5.0	6.0	8.5	11.8	13.0	6.7	3.2
60’s		F	117	3.0	4.0	6.0	7.5	9.0	12.0	14.0	7.9	3.1
	13-15	M	6	3.0	3.0	3.8	8.5	10.5			7.7	3.5
		F	17	1.0	1.0	6.0	8.0	11.0	12.2		7.7	3.6
	16≦	M	8	4.0	4.0	4.3	7.0	8.0			6.8	2.4
		F	6	4.0	4.0	5.5	6.0	11.0			7.7	3.7
	total		477	3.0	3.0	5.0	7.0	9.0	11.0	12.0	6.9	2.9
	≦9	M	67	2.4	3.0	4.0	6.0	8.0	10.0	12.2	6.3	2.9
		F	101	3.0	3.0	5.0	6.0	8.0	10.0	10.0	6.4	2.5
70	10-12	M	30	1.6	2.0	4.8	6.0	10.0	11.0	12.0	6.7	3.2
|		F	30	3.6	4.0	5.8	8.0	10.0	11.8	12.5	7.8	2.6
91	13-15	M	6	4.0	4.0	4.8	6.0	11.5			7.8	4.5
		F	6	7.0	7.0	7.0	8.0	9.3			8.2	1.2
	16≦	M	2	6.0	6.0	6.0	10.0				10.0	5.7
	total		249	2.6	3.0	5.0	6.0	9.0	10.0	12.0	6.7	2.8
Total			1432	3.0	4.0	5.0	7.0	9.0	12.0	14.0	7.6	3.3

Appendix 2: Norms of "Ka" task stratified for age, years of education and gender

Age	Educa-tion		n	Percentile Score 5	10	25	50	75	90	95	*M*	*SD*
19–39	≦9	F	1									
	10-12	M	1									
		F	22	3.2	5.0	6.5	8.0	11.5	13.8	14.0	9.0	3.1
	13-15	M	10	5.0	5.3	8.8	11.0	14.3	17.7		11.3	3.8
		F	36	8.9	9.7	11.3	14.0	17.0	20.0	21.2	14.5	3.7
	16≦	M	6	7.0	7.0	9.3	11.5	13.3			11.2	2.6
		F	21	8.1	9.4	11.5	14.0	14.5	16.6	18.8	13.2	2.5
	total		97	5.9	7.7	10.0	13.0	14.8	18.0	19.2	12.4	3.9
40's	≦9	M	5	4.0	4.0	4.5	5.0	5.5			5.0	0.7
		F	22	3.0	3.3	6.0	8.5	11.3	13.0	14.7	8.6	3.4
	10-12	M	25	0.0	1.8	5.5	8.0	11.0	14.0	14.7	8.0	4.1
		F	73	5.0	5.4	7.0	9.0	11.5	15.0	16.3	9.5	3.7
	13-15	M	10	3.0	3.0	6.0	9.5	11.3	12.9		8.6	3.4
		F	37	3.8	6.2	9.0	10.0	14.0	17.4	21.2	11.3	4.4
	16≦	M	11	9.0	9.2	12.0	14.0	15.0	23.4		14.1	4.3
		F	12	10.0	10.3	12.5	14.5	16.0	22.2		14.8	3.7
	total		203	3.0	5.0	7.0	9.0	12.0	15.8	17.0	9.9	4.3
50's	≦9	M	38	0.0	2.4	4.0	7.0	9.0	12.3	14.3	6.8	3.9
		F	83	3.0	4.0	6.0	8.0	9.0	12.0	12.0	7.7	2.7
	10-12	M	45	5.0	5.0	6.0	8.0	9.5	12.0	13.7	8.2	2.6
		F	162	4.0	5.0	7.0	9.0	12.0	14.0	15.0	9.5	3.3
	13-15	M	15	2.0	3.8	6.0	7.0	10.0	13.2		7.9	3.3
		F	30	5.0	6.1	7.8	9.0	11.0	13.9	16.9	9.6	2.9
	16≦	M	8	2.0	2.0	8.5	10.0	11.0			9.5	3.5
		F	15	5.0	6.2	10.0	12.0	14.0	16.2		11.8	3.3
	total		406	4.0	5.0	7.0	9.0	11.0	13.0	14.8	8.8	3.3
60's	≦9	M	75	3.0	3.0	5.0	7.0	8.0	11.0	12.5	6.8	2.9
		F	174	4.0	4.0	6.0	7.0	10.0	11.0	12.0	7.6	2.7
	10-12	M	61	3.0	5.0	5.5	7.0	10.0	13.0	14.0	7.8	3.2
		F	117	4.0	4.0	6.0	8.0	10.0	13.0	14.0	8.6	3.2
	13-15	M	6	4.0	4.0	5.5	9.0	12.0			8.7	3.3
		F	17	3.0	3.8	6.5	8.0	12.0	14.0		8.8	3.3
	16≦	M	8	4.0	4.0	6.3	7.0	8.8			7.3	1.8
		F	6	5.0	5.0	5.8	7.5	13.8			9.2	4.4
	total		477	3.0	4.0	6.0	8.0	10.0	12.0	13.0	7.8	3.0
70–91	≦9	M	67	1.4	3.0	4.0	6.0	9.0	12.2	14.6	6.9	3.6
		F	101	3.0	4.0	5.0	7.0	9.0	10.0	11.9	6.9	2.5
	10-12	M	30	1.6	3.0	6.0	8.0	10.0	12.0	12.9	7.8	3.1
		F	30	3.6	5.0	6.0	9.0	11.3	13.0	13.9	8.9	3.1
	13-15	M	6	4.0	4.0	5.5	9.0	16.8			10.5	5.9
		F	6	5.0	5.0	7.3	9.0	12.0			9.2	2.6
	16≦	M	2	6.0	6.0	6.0	8.5				8.5	3.5
	total		249	3.0	4.0	5.0	7.0	9.0	12.0	13.0	7.4	3.2
Total			1432	3.0	4.0	6.0	8.0	11.0	13.0	15.0	8.6	3.6

Appendix 3: Norms of “Shi” task stratified for age, years of education and gender

Age	Educa -tion		n	5	10	25	50	75	90	95	*M*	*SD*
				Percentile Score								
	≦9	F	1									
	10-12	M	1									
19		F	22	2.1	3.4	5.5	7.0	10.0	11.8	13.8	7.7	2.9
|	13-15	M	10	5.0	5.0	5.8	8.5	13.3	19.4		9.7	4.7
39		F	36	5.0	6.0	9.0	12.0	14.0	18.3	20.2	12.1	4.1
	16≦	M	6	4.0	4.0	5.5	8.5	13.3			9.0	4.2
		F	21	6.1	7.0	7.0	11.0	13.0	14.0	14.0	10.3	2.9
	total		97	5.0	5.0	7.0	10.0	13.0	14.3	18.2	10.2	4.0
	≦9	M	5	4.0	4.0	5.0	6.0	8.0			6.4	1.8
		F	22	0.3	2.3	3.0	7.5	8.3			6.4	3.1
	10-12	M	25		1.2	3.5	7.0	9.0	11.0	11.7	6.5	3.4
40’s		F	73	2.0	3.0	4.5	7.0	9.0	11.0	12.3	6.9	3.2
	13-15	M	10	1.0	1.0	2.5	8.5	10.3	11.0		7.0	4.0
		F	37	3.8	4.0	6.0	8.0	12.0	14.0	16.2	8.5	3.6
	16≦	M	11	6.0	6.0	7.0	10.0	14.0	19.0		10.5	4.3
		F	12	3.0	4.2	8.3	10.5	13.0	15.4		10.6	3.6
	total		203	2.0	3.0	5.0	7.0	10.0	12.0	14.0	7.5	3.6
	≦9	M	38	1.0	1.0	3.0	4.0	7.0	10.0	13.1	5.4	3.8
		F	83	2.0	3.0	5.0	6.0	7.0	9.0	9.0	5.4	2.6
	10-12	M	45	3.0	3.0	4.0	6.0	8.0	9.0	10.0	6.1	2.3
50’s		F	162	2.1	3.0	5.0	7.0	9.0	11.0	12.0	7.0	2.9
	13-15	M	15	2.0	2.0	4.0	6.0	10.0	11.8		6.7	3.3
		F	30	1.6	2.0	4.0	7.0	10.0	11.0	13.5	6.8	3.4
	16≦	M	8	2.0	2.0	4.3	7.5	12.8			8.5	5.6
		F	15	4.0	4.6	7.0	10.0	12.0	14.4		9.8	3.2
	total		406	2.0	3.0	4.0	6.0	8.0	11.0	12.0	6.5	3.2
	≦9	M	75	1.0	1.5	2.0	3.0	5.0	8.0	9.0	3.9	2.4
		F	174	1.0	2.0	3.0	4.0	7.0	8.0	10.0	5.0	2.5
	10-12	M	61	1.0	2.0	3.0	5.0	6.0	9.8	11.0	5.3	2.8
60’s		F	117	2.0	3.0	4.0	6.0	8.0	10.0	11.3	6.3	2.9
	13-15	M	6	2.0	2.0	2.8	4.5	7.3			5.2	3.2
		F	17	2.0	2.8	4.0	7.0	9.0	14.4		7.3	3.8
	16≦	M	8	1.0	1.0	3.5	5.5	7.8			5.5	2.6
		F	6	3.0	3.0	5.3	7.5	11.0			8.0	3.8
	total		477	1.0	2.0	3.0	5.0	7.0	9.0	11.0	5.3	2.9
	≦9	M	67	0.0	1.0	2.0	4.0	6.0	8.0	9.6	4.3	2.9
		F	101	1.0	2.0	3.0	4.5	6.0	8.0	9.9	4.7	2.6
70	10-12	M	30	0.6	2.0	3.0	5.0	7.0	8.0	8.9	5.0	2.4
|		F	30	1.6	5.0	5.0	7.5	8.0	10.9	13.5	7.1	2.7
91	13-15	M	6	3.0	3.0	3.0	5.0	8.5			6.3	4.9
		F	6	2.0	2.0	2.8	6.5				6.2	3.2
	16≦	M	2	3.0	3.0	3.0					6.0	4.2
	total		249	1.0	2.0	3.0	5.0	7.0	8.0	10.0	5.0	2.9
Total			1432	2.0	2.0	4.0	6.0	8.0	11.0	13.0	6.2	3.4

Appendix 4: Norms of "Occupation" fluency task stratified for age, years of education and gender

Age	Educa-tion		n	5	10	25	50	75	90	95	*M*	*SD*
				Percentile score								
	10-12	F	17	6.0	7.8	9.0	11.0	12.3	14.2		10.8	2.4
19	13-15	M	10	8.0	8.2	12.0	16.0	17.8	20.0		15.2	3.9
|		F	34	5.8	8.0	11.8	14.0	18.0	20.0	21.0	14.0	4.2
39	16≦	M	5	11.0	11.0	11.0	12.0	13.0			12.0	1.2
		F	21	10.2	12.0	12.5	15.0	17.0	18.8	19.9	15.1	2.7
	total		87	8.0	8.9	11.0	14.0	16.0	19.0	20.0	13.6	3.7
	≦9	M	4	12.0	12.0	12.3	13.0	13.8			13.0	0.8
		F	6	6.0	6.0	7.5	10.0	13.5			10.3	3.3
40's	10-12	M	15	7.0	7.6	10.0	12.0	15.0	19.8		12.7	4.0
		F	47	4.4	5.0	8.0	11.0	13.0	15.0	15.6	10.5	3.3
	13-15	M	9	7.0	7.0	8.5	9.0	15.5			11.4	4.0
		F	33	6.7	8.4	10.0	13.0	15.0	18.0	20.3	12.6	3.6
	16≦	M	9	8.0	8.0	11.0	16.0	20.0			16.1	6.5
		F	11	9.0	6.0	7.5	14.0	15.0	20.6		14.1	3.4
	total		135	6.0	7.0	9.0	12.0	14.0	18.0	19.2	12.1	4.0
	≦9	M	23	3.2	4.4	6.0	8.0	11.0	11.0	13.4	8.2	2.8
		F	45	3.0	5.0	7.3	9.5	11.0	13.0	14.0	9.3	3.1
50's	10-12	M	24	7.0	7.0	8.0	11.0	12.8	14.0	14.0	10.4	2.4
		F	105	6.0	7.0	9.0	11.5	14.0	16.3	17.7	11.8	3.8
	13-15	M	10	7.0	7.1	8.0	10.5	15.0	15.9		11.5	3.4
		F	27	5.0	7.4	9.0	12.0	13.0	14.2	16.2	11.1	2.8
	16≦	M	10	4.0	4.2	6.0	11.5	16.0	20.5		11.5	5.3
		F	8	8.0	8.0	9.3	14.0	18.5			14.0	4.9
	total		258	5.0	6.0	8.0	11.0	13.0	16.0	17.0	10.9	3.7
	≦9	M	40	3.0	4.0	6.0	8.0	10.0	12.0	15.0	8.1	3.6
		F	72	3.0	4.4	6.0	8.0	10.5	12.0	13.0	8.1	3.0
60's	10-12	M	46	5.0	6.7	8.0	10.0	13.0	15.0	15.7	10.3	3.0
		F	81	6.0	6.0	8.0	10.0	12.0	17.0	18.0	10.5	3.9
	13-15	M	2	12.0	12.0	12.0	13.5				13.5	2.1
		F	9	9.0	9.0	10.0	12.0	15.0			12.6	2.6
	16≦	M	5	4.0	4.0	5.5	8.0	10.5			8.0	2.7
		F	6	9.0	9.0	9.8	12.0	17.3			13.0	3.7
	total		270	4.0	5.0	7.0	9.0	12.0	15.0	16.0	9.5	3.6
	≦9	M	51	1.6	3.0	5.0	6.0	9.0	11.0	13.4	6.7	3.0
70		F	71	2.0	3.0	4.0	7.0	9.0	11.0	12.0	6.8	3.0
|	10-12	M	18		1.8	5.8	7.0	12.0	13.2		8.1	4.0
91		F	28	2.4	4.9	8.3	9.5	11.0	14.1	16.1	9.4	3.4
	13-15	M	6	7.0	7.0	7.8	9.0	13.0			9.8	2.6
		F	3	9.0	9.0	9.0	10.0				11.3	3.2
	16≦	M	1									
	total		184	2.0	3.0	5.0	8.0	10.0	12.0	14.0	7.5	3.4
Total			934	4.0	5.0	7.0	10.0	13.0	15.0	17.0	10.3	4.1

Appendix 5: Norms of "Sports" fluency task stratified for age, years of education and gender

Age	Education		n	5	10	25	50	75	90	95	*M*	*SD*
	10-12	F	17	6.0	9.6	12.0	13.0	15.3	16.1		13.0	2.6
19	13-15	M	10	14.0	14.1	15.0	18.0	21.3	25.6		18.5	3.8
|		F	34	10.0	10.5	13.5	15.5	17.0	20.0	23.5	15.5	4.0
39	16≦	M	5	12.0	12.0	14.0	16.0	17.0			15.6	2.1
		F	21	11.0	11.2	13.0	15.0	17.0	22.4	23.9	15.7	3.5
	total		87	10.0	11.0	13.0	15.0	17.0	20.0	22.6	15.4	3.8
	≦9	M	4	12.0	12.0	12.0	12.0	12.8			12.3	0.5
		F	6	6.0	6.0	6.8	13.0	15.8			12.0	4.8
40's	10-12	M	15	9.0	9.0	13.0	14.0	17.0	21.0		14.8	3.9
		F	47	9.0	9.0	11.0	12.0	14.0	17.2	19.0	12.6	3.2
	13-15	M	9	9.0	9.0	11.0	14.0	18.0			14.8	5.0
		F	33	9.7	10.4	12.0	15.0	16.0	18.6	21.4	14.7	3.4
	16≦	M	9	12.0	12.0	15.5	20.0	22.5			19.1	4.2
		F	11	12.0	12.0	13.0	16.0	17.0	19.8		15.6	2.6
	total		135	9.0	9.0	12.0	13.0	16.0	19.0	22.2	14.2	3.9
	≦9	M	23	6.0	6.4	8.0	10.0	12.0	14.0	14.8	10.3	2.4
		F	45	6.0	7.0	9.0	11.0	13.0	15.0	15.0	10.9	2.8
50's	10-12	M	24	6.0	9.0	11.0	13.0	14.0	16.0	16.8	12.4	2.7
		F	105	8.0	8.0	10.0	12.0	14.0	17.0	19.0	12.4	3.3
	13-15	M	10	8.0	8.3	11.8	14.0	15.8	18.9		13.9	3.2
		F	27	9.0	9.0	12.0	14.0	16.0	19.0	20.2	14.2	3.2
	16≦	M	10	11.0	11.1	12.0	16.0	17.3	21.6		15.6	3.3
		F	8	13.0	13.0	15.3	17.0	19.8			17.1	2.5
	total		258	7.0	8.0	10.0	12.0	15.0	17.0	19.0	12.5	3.4
	≦9	M	40	5.1	7.0	8.0	10.0	12.0	14.0	15.0	10.1	3.1
		F	72	6.0	7.0	8.5	10.0	12.0	14.0	15.0	10.1	2.8
60's	10-12	M	46	8.0	8.0	10.0	12.0	14.0	17.3	18.0	12.2	3.1
		F	81	5.0	6.2	9.0	10.0	13.5	16.0	16.0	10.9	3.5
	13-15	M	2	11.0	11.0	11.0	12.0				12.0	1.4
		F	9	9.0	9.0	10.0	12.0	15.5			13.0	3.3
	16≦	M	5	11.0	11.0	11.5	12.0	15.5			13.2	2.8
		F	6	7.0	7.0	10.0	13.5	16.0			12.8	3.4
	total		270	6.0	7.0	9.0	11.0	13.0	15.0	16.4	11.0	3.2
	≦9	M	51	3.0	4.0	6.0	9.0	10.0	13.8	14.4	8.4	3.4
70		F	71	3.0	4.0	5.0	7.0	10.0	11.9	12.0	7.5	2.9
|	10-12	M	18			4.8	7.0	10.3	14.1		7.3	4.2
91		F	28	1.8	4.9	7.0	9.0	11.0	13.1	14.6	8.9	3.3
	13-15	M	6	5.0	5.0	8.0	9.5	12.3			9.7	2.8
		F	3	8.0	8.0	8.0	8.0				9.7	2.9
	16≦	M	1									
	total		184	3.0	4.0	6.0	8.0	10.0	12.0	14.0	8.1	3.3
Total			934	5.0	7.0	9.0	12.0	14.0	17.0	19.0	11.7	4.1

Appendix 6: Norms of “Animal” fluency task stratified for age, years of education and gender

Age	Educa-tion		n	5	10	25	50	75	90	95	*M*	*SD*
				Percentile score								
	10-12	F	17	12.0	12.0	13.8	16.5	18.3	21.4		16.5	3.4
19	13-15	M	10	15.0	15.1	16.8	17.5	21.3	24.7		18.8	3.1
|		F	34	13.0	15.5	17.0	21.0	24.0	25.5	28.0	20.9	4.2
39	16≦	M	5	15.0	15.0	16.0	17.0	21.0			18.2	3.4
		F	21	12.2	14.0	15.5	19.0	23.0	26.0	26.9	19.7	4.4
	total		87	13.0	14.0	16.3	19.0	22.8	25.0	26.0	19.3	4.2
	≦9	M	4	19.0	19.0	19.0	19.0	19.8			19.3	0.5
		F	6	13.0	13.0	14.5	15.5	17.5			15.8	2.0
40’s	10-12	M	15	15.0	15.6	17.0	20.0	21.0	24.0		19.3	2.7
		F	47	9.8	11.8	13.0	17.0	19.0	21.0	22.6	16.5	3.7
	13-15	M	9	5.0	5.0	10.0	17.0	23.5	23.5		16.8	7.2
		F	33	12.7	13.4	16.0	18.0	20.5	24.2	34.5	18.9	5.3
	16≦	M	9	15.0	15.0	18.0	19.0	26.0			21.9	6.4
		F	11	18.0	18.0	19.0	20.0	22.0	23.6		20.2	1.9
	total		135	11.0	13.0	15.0	18.0	20.0	23.0	25.0	18.2	4.6
	≦9	M	23	6.4	8.4	10.0	12.0	17.0	20.6	23.4	13.4	4.7
		F	45	9.3	10.0	12.3	15.0	16.0	19.5	20.0	14.7	3.2
50’s	10-12	M	24	2.5	10.5	14.0	15.0	17.8	20.5	21.0	15.1	4.2
		F	105	9.4	11.0	13.0	15.5	19.0	22.0	23.7	16.1	4.4
	13-15	M	10	13.0	13.0	13.0	15.0	21.3	23.8		16.5	4.2
		F	27	12.0	12.0	15.0	17.0	20.0	21.4	25.4	17.3	3.6
	16≦	M	10	7.0	7.2	15.0	19.0	20.8	23.9		17.5	5.5
		F	8	14.0	14.0	15.0	19.5	23.3			20.3	5.9
	total		258	9.0	11.0	13.0	15.0	19.0	22.0	23.0	15.9	4.4
	≦9	M	40	7.1	8.0	10.0	12.5	16.0	18.0	24.8	13.1	4.8
		F	72	9.0	10.0	11.0	13.0	16.0	19.6	22.0	13.4	4.1
60’s	10-12	M	46	9.4	10.0	13.0	15.0	17.0	20.0	21.7	15.0	3.7
		F	81	8.1	10.0	12.0	15.0	18.0	22.0	23.0	15.3	4.4
	13-15	M	2	10.0	10.0	10.0	15.0				15.0	7.1
		F	9	9.0	9.0	15.0	17.0	19.0			16.4	3.5
	16≦	M	5	7.0	7.0	9.5	12.0	17.5			13.2	4.8
		F	6	15.0	15.0	15.8	19.5	21.0			19.0	3.2
	total		270	8.0	10.0	11.0	14.0	17.0	20.0	22.0	14.5	4.3
	≦9	M	51	3.0	6.0	9.0	13.0	15.0	18.0	20.0	12.1	4.6
70		F	71	6.0	7.0	8.8	11.0	14.0	15.0	17.0	11.2	3.2
|	10-12	M	18	0.0	5.4	8.0	13.5	16.0	18.2		12.2	5.2
91		F	28	7.0	7.0	10.3	13.0	16.0	20.0	21.7	13.5	4.2
	13-15	M	6	8.0	8.0	9.5	15.0	22.5			15.7	6.5
		F	3	8.0	8.0	8.0	15.0				14.3	6.0
	16≦	M	1									
	total		184	6.0	7.0	9.0	12.0	15.0	18.0	20.0	12.2	4.3
Total			934	8.0	10.0	12.0	15.0	19.0	22.0	23.2	15.4	4.9

Part III: Language and communication

8. Consequences for bilingual first language acquisition (BFLA) and native speaker language acquisition (NSLA) infants

Peter John Wanner

Abstract
This paper provides evidence that a Bilingual First Language Acquisition (BFLA) infant has no specific delay in acquiring syntactic structures of a language compared to Native Speaker Language Acquisition (NSLA) infants. In this study, a Japanese and English BFLA infant's acquisition of English sentences with the verb 'go' show similar times of production to NSLA infants for simple present and simple past tense as well as progressive aspect for constituents with the verb 'go' as the head of a verb phrase (VP) followed by the preposition 'to' as the head of a prepositional phrase (PP).

Key words: bilingual acquisition, syntax, nativism, universal grammar

1. Introduction

This paper looks at the consequences of bilingual first language acquisition (BFLA) and monolingual native speaker language acquisition (NSLA) of sentences with the simple present and simple past tense as well as progressive aspect for constituents with the verb 'go' as the head of a verb phrase (VP) followed by the preposition 'to' as the head of a prepositional phrase (PP). This paper determines if development of these phrase structures provide evidence of any cognitive deficit or enhancement in BFLA infants. Cook (1997) identifies two views of Bilingualism in terms of cognitive deficit and enhancement, the 'subtractive view' and the 'additive view,' respectfully. The subtractive view suggests that BFLA infants would acquire sentence patterns later than NSLA infants while the additive view suggests that BFLA infants will acquire these patterns similar to NSLA infants or better.

Chomsky (1981), a generativist, maintains that Universal Grammar (UG) consists of principles and rules that are common to all human languages. If these principles are innate, the development of them should be similar in both BFLA infants and NSLA infants. The verb 'go' is one of the first high frequency verbs in an infant's vocabulary for NSLA infants (MacWhinney, 2006). Hence, this paper looks at simple sentences with the verb 'go' in simple present and simple past tense form as well as the progressive aspect of it as a head of a verb phrase (VP) followed by 'to' as the head of a prepositional phrase (PP). The PP 'to' can take on a noun phrase (NP) location or VP action within the constituent. This paper presents novel evidence of a similar language acquisition process for a BFLA infant and NSLA infants. Thus, this paper provides evidence supporting cognitive enhancement in a BFLA infant.

2. Method

2.1 Participants

2.1.1 BFLA participant

The main participant of this study is a Japanese and English BFLA child, Theresa, between the ages of 23- to 41-months-old (Wanner, 2002). She was born to a Japanese mother (bilingual in Japanese [her native language] and English), and an American father, the researcher, (bilingual in English [his native language] and Japanese). The participant lived with her parents primarily in Japan, however she went to America once for two months from 23 to 25 months. The participant had been exposed to English and Japanese predominantly through interaction with her parents. From her birth, the parents established, in their interactions with the child, "language boundaries." Such language boundaries were determined by maintaining a one person – one language model (native parents speaking only their native language to the children.)

2.1.2 NSLA participants

The data of the native English speaking monolingual children comes from Bloom (1970, 1973, 1974, 1975), Sachs (1983), and MacWhinney (2006). The Bloom corpus (1970) is a boy, Eric (1;07.01-1;11.02) as well as a female, Gia (1;07.01-1;11.03). His other corpus (1974, 1975) looks at one boy, Peter (1;09.08-3;01.20). His final corpus (1973) is of a girl, Allison (1;08.21-2;10). The Sachs corpus (1983) is of a female child, Naomi (1;01-5;01). The MacWhinney corpus participant is one boy, Ross (0;07-3;05).

2.2 Analysis

This study analyzes a number of recorded tapes that fall within the acquisition period of 1;08.00 and 3;5.17 that were transcribed by the BFLA researcher (Wanner, 2002) and the NSLA researchers (Bloom 1970, 1973, 1974, 1975; Sachs 1983; MacWhinney 2004). The Wanner corpus (2002) is a collection of 14 audio transcripts for Theresa. The Bloom Corpus (1970) is a collection of audio transcripts for two participants: three tape transcripts for Eric, and five tape transcripts for Gia. His other corpus (1973) is a collection of six audio transcripts of Allison. His other corpus (1974, 1975) is 20 tape transcripts for Peter. The Sachs corpus (1983) is a collection of 91 audio transcripts for Naomi. Furthermore, the MacWhinney corpus (2006) is a collection of 40 video and audio transcripts.

This study analyzes the time of acquisition for the verb ‘go’ in simple present, simple past tense as well as the progressive aspect of the head of a verb phrase (VP) followed by ‘to’ as the head of a prepositional phrase (PP) in all the participants. Likewise, it analyzes the frequency in which they occur in relation to the type of clause combinations performed. The author employed the use of the CHILDES CLAN analysis program. This program analyzes combinations of specific clause searches. All tables with examples of context for the utterances follow guidelines specified by CHAT. All utterances of the individual speakers are identified by an asterisk followed by the three letters before the identity of the target individual followed by a colon (i.e. *CHI:). Furthermore, actions are described using the symbol of a percent sign followed by the abbreviation 'act,' followed by a colon (i.e. %act:). Likewise, comments are described using the symbol of a percent sign followed by the abbreviation 'com,' followed by a colon (i.e. %com:).

3. Results

3.1 Initial acquisition of the word 'go'

3.1.1 BFLA infant-theresa

To establish an understanding of the relationship between the verb 'go' with a constituent PP identifying a location or action, first it is necessary to understand when the verb 'go' is initially acquired with or without a PP. Table 1 shows that Theresa produced her first utterance of the word 'go' at 2;03.05. She said, 'Ready to go.' as an elliptical clause with an implied subject following a question produced by her father 'Are you ready to go?' Following this the father corrected her saying 'I'm ready to go.' Likewise, she repeated after him saying 'I'm

Table 1: BFLA initial utterance of word 'go' at 2;03.05

@Situation:	Peter (PET) and Theresa (TER) went downstairs to get some cough medicine to give to Theresa and were going to return to go to bed after getting the medicine.
*TER:	plastic spoons, yah.
%act:	picks up another spoon and shows PET and jumps up and down excitedly
*PET:	are you ready to go?
%com:	asking if TER is ready to go upstairs for bed
*TER:	ready to go.
%act:	coming to PET to go to upstairs
*PET:	I'm ready to go.
%com:	correcting TER
*PET:	say, +"/.
*PET:	I'm ready to go.
*TER:	I'm ready to go.

ready to go.' This was the first time Theresa used the verb 'go.' However, the active verb was repeated almost directly after the adult spoke in both instances, so the utterance cannot necessarily be considered as a comprehensive production initiated by her on her own will.

Table 2 shows that six days later at 2;03.11, Theresa, produced the verb 'go' simultaneously with her father while they were singing. Again, the clause, 'the lamb was sure to go.' can only be considered as a repetition of phrases produced by the father just previously. Hence, it cannot be classified as her comprehensive initiation only.

Table 2: BFLA infant producing 'go' at 2;03.11

@Situation:	TER is singing with PET from a rhyme book in the room upstairs
*PET:	and everywhere <that <Mary went> [/] Mary went, Mary went, everywhere that Mary went the lamb was sure to go> [>1].
*TER:	<that <Mary went> [/] Mary went, Mary went, everywhere that Mary went the lamb was sure to go> [>1].

At 2;04.00 Theresa produced her first full sentence with a subject and predicate using the word 'go.' She produced a NP followed by a VP 'did' followed by 'go' as the head of an embedded VP followed by a PP with 'to' as its head. In this instance, she replies to a question from the interlocutor that does not include the word 'go' or the preposition 'to.' In the prior two examples (Table 1 and Table 2), it is unclear if Theresa is producing the word 'go' as a repetition of the interlocutor (Table 1) or an interesting utterance as in a song 'Mary Had a Little Lamb' (Table 2). Hence, this study maintains that her utterance here at 2;04.00 is clearly her initial comprehensive production of the verb 'go' as the head of a VP in the present tense form. Likewise, it is the first time she provides a location using a PP with 'to' as its header. This will be referred to later when we look at the complete sentence analysis.

3.1.2 English participants

Table 4 shows initial acquisition of the word 'go' for the English participants

Table 3: BFLA infant VP with 'go' as the head and a PP with 'to' as its head

@Situation:	Eating breakfast in Grandpa's room next to the kitchen
*PET:	What did jj do?
*TER:	jj did go to mommy.
*PET:	very good.
*PET:	what is that?
%act:	watching TER eat something in her mouth

Table 4: Initial acquisition of NSLA infants for the action verb 'go'

Researcher	Participant	Date of Acquisition	Utterance
Bloom (1970)	Eric	*	*
Bloom (1970)	Gia	1;10.01	Go on
Bloom (1974, 1975)	Peter	1;09.08	Go
Bloom (1973)	Allison	2;04.00	I go dump them out.
Sachs (1983)	Naomi	1;06.16	Go (a)way
MacWhinney (2006)	Ross	1;04.11	Can I go down there?

* No evidence of acquisition in data.

from the data that was analyzed. All participants except Eric produced the word 'go' comprehensively. Eric only has data up till 1;11.00, so this might be the reason for no occurrences on his part. He probably acquired the word afterwards similar to Allison.

3.2 Acquisition of the simple present verb 'go' followed by 'to' as the head of a PP

3.2.1 BFLA infant-theresa

Table 3 shows that at 2;04.00, Theresa first produced the verb 'go' with a PP

Table 5: BFLA production of VP with go as a head and a PP with 'to' as the head

@Situation:	PET is hanging clothes on the clothes line outside has his pants on the floor in the kitchen because he placed them there temporarily
*TER:	daddy, too big that.
%act:	pointing to PET's pants on the floor and picking it up
*PET:	That's because that's daddy's pants.
*TER:	why?
*PET:	because I wear them for Judo.
*PET:	I have to wear them for Judo.
*TER:	daddy, you go to Judo.
*PET:	no, I'm not going to Judo, tonight.
*PET:	I'm going to Judo tomorrow night.

Table 6: Context for complete complex double preposition 'to' construction

*PET:	dada has to change his clothes quickly because he has to go to work now.
*TER:	Theresa, too.
*TER:	I want to go to work, too.

with 'to' as its head on her own initiative. This occurs at the same time she fist acquires the word 'go' in the present tense form. At 2;10.13 Theresa produced the sentence 'you go to Judo,' following an explanation from the father about why his pants are on the floor in the kitchen area. Here, Theresa refers to the location 'Judo' referring to 'Judo class.' Table 5 shows the context of this phrase. Likewise, at 2;10.13, Theresa produced the complete sentence, 'Theresa wants to go to mass.' without any prior reference. Six days later, at 2;10.18, she creates a similar construction implying her wish to go somewhere else

Table 7: BFLA VP with 'go' as head followed by PP with 'to' as the head

%com:	the family is going to look at an apartment complex they might move into in Katsura
*FUM:	watch out for John.
*TER:	sacyan(Theresa) no(POS) hou(way) ni(pm).
%act:	talking to FUM
*FUM:	sacyan(Theresa) tabete(eat) shimai(no+use) no(pm) ka(QUEST) ii(good).
*TER:	Theresa want to go ofuro(bath+tub).
*PET:	ofuro(bath+tub)?
*PET:	you don't want to go to ofuro(bath+tub)?
*TER:	Theresa want to go ofuro(bath+tub).
*TER:	Theresa want to go ofuro(bath+tub)no(POS) ouchi(house).
*PET:	no, we are not going to go to an ofuro(bath+tub) house.
*TER:	why?
*PET:	because.
*PET:	we only go there when the boiler is broken.
*JES:	you want to go there once more, right Theresa?
*TER:	yah.

when she says, 'I want to go to work, too.' as described in Table 6. At 3;03.30 Theresa omitted a determiner in front of the word 'ofuro' trying to refer to the 'ofuro,' or bath house as described in Table 7.

Theresa was expressing a desire to go to a bath house referred to as 'sento' in Japanese. She had gone to a sento for the first time shortly beforehand, a couple of days prior, when the boiler for the bath tub was not fixed, yet.

Table 8 shows that at 3;05.09 another example appears for this phrase construction, however this time Theresa used a semantically complex sentence with an inanimate object and the verb 'go.' First, she asked the question 'Where

Table 8: BFLA semantically complex sentence with an inanimate object

@Situation:	TER is in the living room with PET helping put together puzzle.
*TER:	where's money?
*PET:	mommy went to the potty.
*TER:	money!
*PET:	mommy went outside.
*TER:	money, money!
*TER:	money, where money go?
*TER:	where money go to?
*PET:	money, do you want money?
*PET:	the money is down there.
*PET:	you dropped it.
*PET:	do you want me to go down under the chair and get it.
*TER:	yah.

the money go?' but when the father tried to interpret what she was saying, she expanded it hoping he would understand better by saying, 'Where money go to?' Thus, we see various forms of VP with 'go' as the head followed by a PP with 'to' as the head between 2;04.00 and 3;05.09.

3.2.2 NSLA infants

Table 9 shows that Allison (Bloom, 1973), one of the NSLA infants, also acquired the verb 'go' followed by the preposition 'to' at 2;04.00. Peter (Bloom, 1974, 1975), Eric (Bloom, 1970), and Gia (Bloom, 1970) did not produce the sentence pattern formation of 'go to' at all. Eric and Gia only had data collected till 1;11.03 and possibly acquired this pattern later similar to some of the other NSLA infants. However, Peter, on the other hand, had data collected until 3;01.20, and he still did not provide evidence of this sentence pattern for-

Table 9: NLSA Initial acquisition infants for the verb ‘go’ followed by preposition ‘to’

Researcher	**Participant**	**Date of Acquisition**	**Utterance**
Bloom (1970)	Eric	*	*
Bloom (1970)	Gia	*	*
Bloom (1974, 1975)	Peter	*	*
Bloom (1973)	Allison	2;04.00	Go to the airport.
Sachs (1983)	Naomi	1;11.10	Go to bed.
MacWhinney (2006)	Ross	1;04.11	When we go to where those girls to where they are.

* No evidence of acquisition in data.

mation at all. Naomi (Sachs, 1983) produced this specific sentence pattern the earliest of the NSLA participants at 1;11.10 when she said ‘go to bed.’ Ross (MacWhinney, 2006) initiated this sentence pattern the latest at 3;00.17 saying the same sentence as Naomi, ‘go to bed.’

3.3 Progressive VP ‘going’ + PP ‘to’

3.3.1 BFLA infant

Table 10 shows the context for Theresa’s initial use of the progressive verb, ‘going,’ followed by a PP with ‘to’ as it’s head at 2;01.29 (Wanner, 2002). She said ‘We are going to pray,’ trying to get her brother to fold his hands in prayer. This is acquired earlier than the present tense form ‘go,’ but the meaning that is assigned is related to an action of praying instead of a location of a place where an arrival will take place.

Table 11 shows all of the transcribed utterances as well as time of initiation during the study. Out of the twelve utterances using ‘going,’ only three incorporate use of for the PP with ‘to’ as a head. Only two of the utterances ‘going to pray,’ and ‘going to look,’ refer to an action. All the other utterances with the

Table 10: BFLA progressive VP with 'going' as a head and PP with 'to' as a head

@Situation:	sitting at the dinner table to eat dinner
*TER:	JJ(Jessie)@c pray at the dinner table.
%act:	looking at JES
%com:	JES didn't like to fold his hands at the table, so TER reminded him
*TER:	we are going to pray.
%act:	looking at JES

Table 11: BFLA infant's acquisition of the progressive verb 'going'

2;01.29	we are going to pray.
2;02.02	ball going.
2;04.27	where is jj@wp(Jessie) going?
2;06.02	keep going.
2; 06.04	Theresa going to look at it. (2 times in a row)
2;08.23	Theresa going this way.
2;08.23	we're going to another mass.
2;11.12	going to bed soon.
3;01.30	Jessie no stop going, daddy.
3;02.00	I know, <daddy's going> [/].
3;02.30	is John going, too?
3;02.30	why (is John) going with daddy.

progressive verb ‘going’ followed by the PP with ‘to’ as a head refer to a location, specified or implied.

3.3.2 NSLA infants

The data from the NSLA infants indicates that five of the six participants used the progressive verb ‘going.’ Gia did not produce this utterance in any of the transcription data. Furthermore, it is clear that only four of the six participants initiated the progressive VP ‘going’ followed up by the PP ‘to’ after 1;11.00. Table 12 provides a summary of the initial productions and the corresponding initial utterances using ‘going.’ The two participants who did not provide evidence of any progressive VP with ‘going’ as the head followed by a PP with ‘to’ as the head were Eric and Gia for whom only data was collected and tran-

Table 12: NSLA Infant progressive VP with ‘going’ followed by PP with ‘to’

Researcher	Participant	Date of Acquisition	Utterance
Bloom (1970)	Eric	1;08.07	Where are you going?
Bloom (1970)	Gia	*	*
Bloom (1974, 1975)	Peter	1;11.17 2;02.13	Going go round (I) going to nana’s house to see nana.
Bloom (1973)	Allison	2;04.00 2;04.00	Going to march It (i)s going to school xxx.
Sachs (1983)	Naomi	1;09.26 1;11.00	Going shopping Daddy going to work.
MacWhinney (2006)	Ross	2;06.17 2;06.17	I’m going to pull Marky’s hair I’m going to conference

* No evidence of acquisition in data.

scribed up till 1;11.00. However, Eric did produce a transitive sentence with the progressive verb ‘going’ as early as 1;08.07. He said, ‘Where are you going?’

There are two patterns of development regarding the use of a PP with a NP location name or a VP action word following it. Peter (Bloom, 1974, 1975) and Naomi (Sachs, 1983) provide evidence of earlier acquisition for the use of a PP headed by ‘to’ with a VP action word following it one month (Naomi) and three months (Peter) [i.e. ‘go round,‘ and ‘go shopping,’ respectively] prior to acquisition of it being followed by a NP location name (i.e. ‘to work,’ and ‘to Nana’s house,’ respectively).

The second pattern of development shows that Allison (Bloom, 1973) and Ross (MacWhinney, 2006) both produced sentences with a PP headed by ‘to’ with a VP action word or a NP location name during exactly the same time period. This would seem to suggest that there is no clear evidence that the use of a VP action word is acquired earlier than with the NP location name following a VP with ‘going’ as its head for NSLA infants. However, the evidence makes it clear that none of the participants used a NP location name earlier than the VP action word in the PP headed by ‘to.’ Hence, this paper maintains that the NSLA infants either attain a VP action word accompanying the PP headed by ‘to’ either before or around the same time in the acquisition process as for that followed by a NP location.

3.4 Past Tense VP ‘went’ followed by a PP ‘to’

3.4.1 BFLA infant

Table 13 shows at 2;05.03, Theresa (Wanner, 2002) produced the utterance, ‘this is the park we went to.’ It is evident that Theresa initially acquired this form when seeing a picture of the same park that her cousins took her to in Tokyo a few weeks prior.

Table 14 shows another example at 2;06.09 where Theresa used a past tense verb, ‘went,’ followed by a PP with ‘to’ as the head in reply to a prior question, ‘Are you in America?’ She employed the use of an implied subject, ‘I,’ for the elliptical VP, ‘went,’ followed by the PP, ‘to church.’

Table 13: BFLA past tense 'went' followed by a PP with 'to' as the head

@Date:	27-NOV-1998
@Age:	2;05.03
@Situation:	TER looking at a brochure of a park where her cousins took her to in Tokyo
*TER:	this is the park we went to.

Table 14: BFLA embedded phrase in elliptical sentence production

@Date:	2-JAN-1999
@Age:	2;06.09
@Situation:	PET, TER, and JES are in the living room
*PET:	are you in America?
*TER:	no!
*TER:	went to church.
*PET:	oh, you went to church in America.
*TER:	yah!

The following day, January 3, 1999, Theresa used the PP 'to' in many different ways while trying to describe where her brother Jessie and she went. Table 15 provides a description of Theresa saying, 'J+J (Jessie) went to school.' referring to Jessie having gone to school. She follows this with an incomplete sentence leaving out the proposition 'to' that should head the PP '(to) hoikuen [day+care+center].' However, she corrects her next response to a clarification from her father including the preposition 'to' when she says, 'Daddy went to hoikuen (day+care+center).' The correction might be because of her father indirectly providing the correct form in the prior utterance, 'Yah, you went to hoikuen, too.'

Table 15: BFLA past tense VP ‘went’ followed by an implied preposition ‘to’

@Date:	3-JAN-1999
@Age:	2;06.10
*TER:	J+J (Jessie) went to school.
%act:	talking about JES going to school the week before
*TER:	daddy came back hoikuen (day +care+center)
*TER:	mommy sleep.
%act:	speaking to PET
%com:	coming into the kitchen and holding PET’s leg
*TER:	Theresa went hoikuen (day+care+center)
*PET:	yah, you went to hoikuen, too.
*TER:	daddy went to hoikuen?
*PET:	daddy went to pick you up at the hoikuen.
*PET:	drink your juice.

3.4.2 NSLA infants

Table 16 provides a summary of the initial acquisition dates of all the NSLA infants for the past tense verb ‘went,’ followed by a PP with ‘to,’ as the head. Eric (Bloom, 1970), Gia (Bloom, 1970), and Allison (Bloom, 1973) did not acquire the past tense verb ‘went’ during their data collection. Since Eric and Gia provided transcripts for between 1:7 through 1;11 only, this might reflect why this pattern did not occur for them, but Allison provided data between 1;8 through 2;10 with no production of this form. However, Peter (Bloom, 1974, 1975), Naomi (Sachs, 1983) and Ross (MacWhinney, 2006) acquired the past tense form between 2;04.15 and 2;06.17.

Table 16: NSLA initial acquisition of verb 'went'

Infant	Date	Utterance
Eric	*	*
Gia	*	*
Peter	2;04.15 2:05.03	right, fire engine went by. (I) went to the store.
Allison	*	*
Naomi	2:05.08	I went to Michelle's.
Ross	2:06.17 2:06.17	Kitty went bye bye I just xxx went to preschool.

* No evidence of acquisition in data.

4. Discussion

The data above indicates that the NSLA infants acquired the action present tense verb 'go' over a fairly large time span between 1;04.11 and 2;04.00. Most of the children except for Peter followed the verb 'go' with a preposition. Given the large variance between the NSLA infants this study maintains that the BFLA infant could be anywhere within the range of the fairly large time span suggested above and it would be normal. The BFLA infant acquired the word 'go' at 2;04.00 similar to one of the NSLA children, Allison. Hence, we maintain that the BFLA infant acquires the action verb 'go' similar to a NSLA infant. Thus, this supports the theory that there is no deficiency in one language for BFLA infants.

It does not seem coincidental that the NSLA infant, Naomi, acquires the sentence pattern formation of the VP with 'go' as a head followed by 'to' as a head of a PP similar to the BFLA infant, Theresa. Naomi is the only participant that had a similar age of acquisition for the verb 'go' as the BFLA infant, Theresa. Hence, this study maintains that this sentence pattern consistency for both participants also provides further evidence for no deficiency in language in terms of acquisition for this phrase structure in BFLA infants.

Furthermore, It is evident that the BFLA infant, Theresa, initiated the progressive verb ‘going’ with a PP ‘to’ followed by an action at least three months earlier at 2;01.29 saying ‘We are going to pray,’ than her initial acquisition of the word ‘go’ at 2;04.00. The first time she uses the progressive form with a NP with a location mentioned following it is when she said ‘We going to another mass,’ at 2;08.23. Furthermore, it is evident that Theresa’s initial production of the progressive VP with ‘going’ as the head followed by ‘to’ as the head of a PP followed by the VP with an action word falls within the period of production for the five NSLA infants between 1;08.07 and 2;06.17. Theresa’s initial production of the progressive VP with going as the head followed by ‘to’ as the head of a PP followed by a NP location name at 2;08.23 comes about two months later than the latest acquisition of the NSLA infants at 2;06.17. The production for the five NSLA infants occurs somewhere between 2;02.02 and 2;06.17. Finally, it is also clear that Alison and Theresa’s production of both the PP ‘to’ with a NP have a variance of about two months.

Acquisition of the past tense verb ‘went’ for the BFLA infant at 2;05.03 occurs within the same time period, within a month variance, as that for the NSLA infants. The NSLA speakers, Peter and Naomi, both used the VP with ‘went’ as the head followed by the preposition ‘to’ at 2;05.03 and 2;05.08, respectively, while Ross produced this utterance at 2;06.17, hence he has a one month variance. This provides further evidence that BFLA infants do not have any deficiencies evident from acquiring two languages at the same time.

Table 17 provides an overview for the development of the present tense verb, ‘go,’ as well as it’s productions with the PP that has ‘to’ as the head for the BFLA infant and the NSLA infants.

The BFLA infant’s initial development series of acquisition for the verb ‘go’ and the addition of a PP to follow it occur at the same time as Allison. Thus, we might expect development to be similar to Allison in terms of time and order. However, the BFLA infant acquired the phrase structure with the present progressive VP with the head ‘going’ followed by a PP with the head ‘to,’ about three months earlier than Allison. Furthermore the BFLA infant acquired the past tense VP with the head ‘went’ followed by a PP with the head ‘to’ at 2:05.03 while Allison never acquired this VP pattern for ‘went’ followed by PP

Table 17: Tense and Aspectual VP with 'go' as head followed or not followed by a PP

Child	go	go + to	going + to	went + to
Theresa	2;04.00	2;04.00	2;01.29	2;05.03
Eric	*	*	1;08.07	*
Gia	1;10.01	*	*	*
Peter	1;09.08	*	2;02.13	2:05.03
Allison	2;04.00	2;04.00	2;04.00	*
Naomi	1;06.16	1;11.10	1;11.00	2:05.08
Ross	1;04.11	1;04.11	2;06.17	2:06.17

* No evidence of acquisition in data.

'to,' even though she provided data leading up till 2;10.00. However, Peter and Naomi acquire the past tense VP with 'went' as a head followed by a PP with 'to' as a head around the same time period (2;05.03 and 2;05.08 respectively) as Theresa (2;05.03). Furthermore, Ross acquires the past tense pattern about 40 days later (2;06.17). Further analysis of other variables might provide an explanation for why the BFLA infant acquired the progressive tense 'going' before the present tense verb 'go.'

It is clear that the BFLA infant follows the same general pattern of development for the present verb 'go' and past tense verb 'went' when followed by a PP headed by 'to' as the NSLA infants in this study. In summary, acquisition of the present tense form of the verb 'go' always precedes acquisition of the past tense verb 'went.' The present tense form 'go' and present perfect progressive form 'going' can be acquired at the same time or the progressive form might be learned later. The incidence of one NSLA infant only using the present perfect progressive form and not acquiring the others can possibly be explained by other extenuating factors. Thus, this study maintains that the development of the BFLA infant for the present, and past tense as well as progressive forms of the verb 'go' followed by a PP with 'to' as its head are similar and there are no deficiencies evident.

5. Conclusion

This study provides evidence that there are no necessary deficiencies evident in the BFLA infant compared to NSLA infants in relation to the age of acquisition or the manner in which the different tense verbs ‘go,’ ‘going,’ and ‘went,’ were followed by a PP with ‘to’ as its head were acquired. The age of acquisition for the BFLA infant is almost the same as or within 30 days of the date of initial acquisition for acquisition of all tenses for the clauses that were analyzed of at least one of the NSLA infants. Furthermore, the order of acquisition of the tenses is also similar. Further analysis of the Japanese verb that is equivalent to ‘go,’ ‘iku,’ and the various tenses as well as sentence constructions will bear further evidence regarding the relationship between the BFLA infant and Japanese monolingual NSLA infants. Likewise, it will determine the relationship between the development of the BFLA infant relationship between both languages, Japanese and English, in regards to lexical development of the word ‘go’ and ‘iku,’ as well as the syntactic developmental relationship.

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9. Relation among attitudes, motives and behaviors in English learning of Japanese university students

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Abstract

This study aimed at examining the relation among motives, attitudes and behavior for English language learning of Japanese university students. As indices of learning behavior, learning styles according to Personal Learning Theory (Kajita, Ishida, & Uda, 1984) and strategies on vocabulary learning were examined. One hundred and five university students completed the questionnaire including items about attitudes, motives, styles and strategies of English learning in a class at the university. From the results, four factors were identified by a factor analysis of learning style scores. On the whole, university students did not study so steadily and were noncommittal about flexibility and earnestness in their learning. However, from the results of learner types, it was shown that the levels of flexibility and earnestness differed with attitudes and motive for English learning. Based on these results, the essential conditions for effective learning of English were discussed.

Key words: English learning, attitude, motive, learning style, learning strategy

1. Introduction

Academic achievement depends upon various factors that are divided task-related and learner-related factors. Task-related factors can also be expressed task-requirements. That is, both the quality and quantity of knowledge or cognitive processing required for the accomplishment of the learning task affect on the learning processes and results (Bruer, 1993). Learner-related factors are individual characteristics that will influence how successful different individuals will be at that learning. The learner's psychological factors such as motives, beliefs, attitudes, intelligence and cognitive styles relevant to the learning are typical learner-related factors and the learner's behavioral factors are such as learning methods including learning styles and strategies.

Regarding foreign language learning, there are a number of studies that examined mutual relationships of these factors (see, Kurahachi, 1994; Masgoret & Gardner, 2003). For instance, Ehrman and Oxford (1988) investigated the use of learning strategies in relation to sex differences, career choice, cognitive styles and aspects of personality on adult language learners. Carter (1988) tested the influence of field dependent/independent cognitive style and course orientation (grammar-oriented/proficiency-oriented) towards performance of the target language. Gardner, Tremblay and Masgoret (1997) examined individual difference measures that were identified a relation to achievement of a second language learning, and they proposed the causal model in which five factors were identified as self-confidence, learning strategies, motivation, aptitude and orientation.

In Japan, several researches on motives, cognitive appraisals, beliefs, learning strategies and styles, and their interactions at foreign language learning have been reported (e.g., Horino & Ichikawa, 1997; Kubo, 1999; Nakayama, 2005; Uda, 1988). For English learning of high school students, Horino and Ichikawa (1997) identified two types of motives: "content-attached" and "content-detached" motives, and three types of strategies for English vocabulary learning: organization, imaging, and repetition. They investigated the relationship among these motives, strategies, and performance of English achievement tests, and indicated that the content-attached motives correlate with the strategies but the content-detached motives do not, and only the organization strategy has a significant effect on test performance. Kubo (1999) showed that, in English learning of Japanese university students, a self-esteem-reward orientation type of learning motives and cognitive appraisals mutually affects learning strategies, and that learning strategies influence the performance. Cognitive appraisals were the estimation for learning skill acquisition and learning behavior's costs of each learner. Also, Nakayama (2005) investigated the mutual relationship among goal orientation, beliefs, and strategies in English learning of Japanese university students, and demonstrated that the difference of goal orientation leads to the difference of beliefs and used strategies. Namely, the students who rate high on scales of the "learning goal" and the beliefs about "self-competence" prefer to use metacognitive strategies, pronunciation strategies, and organization strategies, while the students who have high ratings on scales of the "performance goal" and the beliefs about "traditional English learning styles" tend not to use guessing strategies.

The present study aimed to investigate the relationship among motives, attitudes and behaviors for English language learning of Japanese university students. As learning behavior, this study dealt with learning styles and strategies. Uda (1988) examined the learning styles of English among Japanese high school students according to Personal Learning Theory (PLT) proposed by Kajita, Ishida and Uda (1984). PLT refers to the belief system which each learner has toward his/her own learning activities. On the data from a questionnaire about PLT, it was suggested that the tendencies of English learning styles among high school students are: (1) cramming, (2) running exercises quickly when facing a difficult problem, (3) keeping one's own pace, (4) flexibly changing one's plans and/or methods, and (5) seeing one's friends as rivals. This study, then, tested the tendencies of English learning styles in university students in order to compare with the results for high school students by Uda (1988) and to clarify the relation between learning styles and motives or attitudes for English learning.

As for learning strategies, this study especially focused on the strategies for vocabulary learning since it was pointed out that the vocabulary acquisition is disregarded in both of the practical side and the theoretical side though it is indispensable for studying a foreign language (e.g., Fan, 2003; Maiguashca, 1993; Singleton, 1997).

Regarding motives, two categories of motivation indicated by Gardner and Lambert (1959) are commonly known in the field of foreign language learning:

instrumental motivation and integrative motivation. Instrumental motivation focuses on an end goal and is associated with practical benefit such as personal achievement and economic advances, whereas integrative motivation drives the learner to study a foreign language for learning more about culture or meeting new people of the target language community and to have an openness to identification with that community. Much of the literatures have depicted integrative motivation as a key to acquire a foreign language. However, as a foreign language learner in Japan has the different socio-cultural backgrounds from one in Western countries, these categories seemed not to be entirely applicable (Kubo, 1999; Kurahachi, 1994). Thus, the present study adopted the idea of these categories partially and took it into consideration that participants are university students, and it was focused on whether a learner has autonomous or voluntary motives for learning a foreign language. Students at a junior high school or a high school are forced to study English for graduation requirement irrespective of their desires. However, in case of university students, more learners seem to study English from only autonomous motives and whether motive for learning English is autonomous or not could influence learning behavior of English.

The current study also took up attitudes toward learning a foreign language. Though Gardner (1988) examined the attitude toward the target language speakers, the attitude to the second language class and the general attitude toward the foreign language, it is not reasonable to examine an attitude to the target language speakers from the difference of the socio-cultural background as mentioned above in this study. It was also inappropriate to deal with an attitude to the second language class, because participants in this study were university students and some learners studied by themselves not in a classroom lesson. Therefore, the following three aspects were measured in this study as an attitude toward English learning: whether a learner enjoys studying English (Enjoyment), whether a learner think English learning to be important (Importance) and whether a learner is confident of English (Confidence). In addition, confidence for different activities of English learning, such as conversation, grammar and reading comprehension, was measured in order to investigate the relation with learning styles.

2. Method

2.1 Participants

The participants were 105 university students who learned English (52 males and 53 females). Their mean age was 21.1 with a range of 20-28 and the standard deviation of 1.6. They were not biased about their field in the university. No one had special ability and learning experience of English.

2.2 Measures

2.2.1 Attitudes to learning

Attitudes to all-round English learning were assessed on three aspects: *Enjoyment* (Do you enjoy studying English?), *Importance* (Do you think English learning to be important for you?) and *Confidence* (Are you good at English?). Each aspect was rated on 5-point scales (1: not at all to 5: extremely). Confidence in different activities of English learning was also measured on 5-point scales (the same as above). Given nine activities of English learning in the questionnaire were as follows: Conversation, Grammar, Memorizing words' meanings, Memorizing words' spellings, Memorizing words' pronunciations, Reading comprehension, Aural comprehension, Reading aloud, and Composition.

2.2.2 Learning motives

For learning motives, participants were asked to select the answer to the question "Why do you study English?" out of seven choices: Because I want to be a fluent speaker of English, Because I need it for the examination for service or a graduate school, Because it forms a part of my knowledge of some foreign countries' culture, Because I need to earn credits of English class for graduation, Because I am interested in English language, Because I need it for a job or a license in the future, and the others. Participants could choose the answers as many as he/she wanted.

2.2.3 Learning styles

Styles of English Learning were measured using 22 items selected from PLT scales for English learning of Japanese high school students (Uda, 1988). Each item consisted of a pair of contrast sentences. All of them were given in Table 1. Participants were asked to rate which sentence had a stronger correspondence to their English learning styles on 6-grade scales (1: perfectly correspond to A to 6: perfectly correspond to B).

2.2.4 Learning strategies

Strategies for English vocabulary learning were assessed with 16 items referred to questionnaires of Nezu (2004) and Horino and Ichikawa (1997). Table 2 shows all items. Each item was rated on 5-point scales (1: I do not use it at all, to 5: I very often use it.).

2.3 Procedure

Participants completed the questionnaire including above items about attitudes, motives, styles and strategies of English learning in a class at the university. They were given sufficient time to complete it and almost finished in 10-15 minutes.

3. Results

3.1 Relation between attitudes and behaviors

First of all, the differences of learning styles or strategies by the score in three aspects of attitudes –Enjoyment, Importance and Confidence– were tested. As for the aspect of Enjoyment, the total sample was split into three groups: Enjoying (Answer 5 and 4), Neutral (Answer 3) and Not-enjoying (Answer 2 and 1) samples. Data on Enjoying and Not-enjoying groups were used for the analysis. For each item of learning styles and strategies, *t*-test was conducted between the Enjoying and Not-enjoying group. Table 3 shows the mean scores of items where significant differences were found. Enjoying group students were inclined to study from day to day according to plan steadily (item No. 6, 13, 21) and aloud (8) as to English learning styles in comparison with Not-

Table 1: All items of a questionnaire for learning styles

No.	A	B
1	I study alone.	I study with my friends.
2	I repeat all parts.	I focus on my weak points.
3	I study in various ways.	I study in a consistent way.
4	I focus on the expected exam questions.	I focus on what I regarded as important.
5	I study with a sense of rivalry to my friends.	I study in cooperation with my friends.
6	I study a lot at once.	I study little by little everyday.
7	I study according to the contents of textbooks.	I arrange the contents of textbooks to myself.
8	I study aloud.	I study silently.
9	I work out various learning methods.	I am unconcerned about learning methods.
10	I stick to a difficult question for a long time.	I look up immediately given hints or answers to a difficult question.
11	I give me some exams for myself.	I do not give me any exams for myself.
12	I study at my own pace.	I study at the pace of my teacher.
13	I study at a stretch when the urge takes me.	I study step by step according to plan.
14	I study by the method of my choice.	I study by the method of my teacher's or friends' choice.
15	I focus on what I made mistakes in the exam.	I am worried about my exam result.
16	I study at my own pace.	I study at the pace of my friends.
17	I flexibly change the learning plan.	I keep the learning plan.
18	I solve a wide range of questions.	I solve mainly basic questions.
19	I look up what I can not understand every time it happens.	I first grasp an outline of what I am going to study.
20	I study at a language school or with a tutor.	I study alone.
21	I study only just before the exam.	I study steadily from day to day.
22	I study alone thoroughly.	I readily ask my teacher or friends what I can not understand.

Table 2: All items of a questionnaire for learning strategies

No.	Strategies of vocabulary learning
1	I write down the spelling of a new word over and over.
2	I put together various forms (noun, verb, etc.) of a new word.
3	I put together similar spelling words.
4	I put together words which can be used in the same situation.
5	I put together synonyms and antonyms of a new word.
6	I stare a new word over and over to memorize that spelling.
7	For verbs, I put together all conjugations.
8	For verbs, I classify those as transitive or intransitive.
9	I memorize an example sentence or an idiom in which a new word is used.
10	I associate a new word with semantically related words.
11	I pun on a new word by a Japanese word which has a similar sound.
12	I write down the spelling of a new word, pronouncing its word.
13	I repeat to recall its Japanese equivalent from an English word.
14	I repeat to recall its English equivalent from a Japanese word.
15	I listen to the sound of a new word by means of a compact disc prayer etc.
16	I make an image or a picture which shows the meaning of a new word, in my mind.

enjoying students. They also seemed to have a persevering style for English learning (10, 18). Regarding to vocabulary learning strategies, the Enjoying students used the organization and elaboration strategies (2, 3, 4, 5, 8, 9, 10) for vocabulary learning more often than the Not-enjoying ones. They also tended to learn the meaning of each English word with its pronunciation (15).

Similar analyses were conducted to the aspect of Importance and Confidence. The results of these two aspects are shown in Table 4 and 5, respectively.

As for learning styles, it was common to both aspects that there was a significant difference on each item of No. 6, 8, 13, and 21, and significant differences on these items were also found in the case of Enjoyment. These results

Table 3: Mean (*SD*) of the scores of each item on learning styles and strategies for each group of enjoyment

	Enjoying (N = 49)	Not-enjoying (N = 24)	t
Style No.			
6	3.12 (1.39)	2.04 (1.00)	3.39**
8	2.59 (1.41)	3.50 (1.76)	2.39*
10	3.78 (1.50)	4.83 (1.17)	3.02**
13	2.86 (1.26)	1.96 (1.08)	3.00**
18	3.37 (1.42)	4.29 (1.27)	2.70**
21	2.96 (1.12)	1.50 (0.78)	5.74**
Strategy No.			
2	3.20 (1.04)	2.50 (1.06)	2.70**
3	2.51 (1.02)	2.00 (0.89)	2.09*
4	3.10 (1.01)	2.21 (1.02)	3.55**
5	3.10 (0.94)	2.25 (1.03)	3.52**
8	2.25 (1.05)	1.67 (0.64)	2.91**
9	3.43 (0.96)	2.50 (1.18)	3.60**
10	3.29 (1.06)	2.46 (1.06)	3.13**
15	2.75 (1.13)	1.96 (1.12)	2.84**

Note: Style No./each item number of Table 1; Strategy No./each item number of Table 2. * $p < .05$, ** $p < .01$

suggested that, just as Enjoying students did, the students of Important and Confident (Answer 5 and 4) group studied more steadily and aloud than Not-important and Not-confident (Answer 2 and 1) group students. Significant differences on No. 10 and 18 were common between the aspect of Enjoyment and Confidence. The students of a confident group tended to be more tenacious for English learning compared to Not-confident group students. Significant differences on No. 15 and 16 were found only for the aspect of Confidence, and only the Importance aspect had a significant effect for the item of No. 2.

Regarding vocabulary learning strategies, a significant difference on No.4 was common among the aspects of Importance, Confidence and Enjoyment. Whether it was common between the aspects of Importance and Enjoyment

Table 4: Mean (*SD*) of the scores of each item on learning styles and strategies for each group of importance

	Important (N = 75)	Not-important (N = 13)	t
Style No.			
2	3.15 (1.45)	4.00 (1.67)	2.33*
6	2.88 (1.65)	2.08 (1.58)	2.09*
8	2.77 (2.20)	3.77 (1.53)	2.28*
13	2.73 (1.63)	1.85 (0.64)	2.42*
21	2.64 (1.31)	1.38 (0.26)	6.50**
Strategy No.			
4	3.03 (0.89)	2.31 (1.06)	2.50*
7	3.67 (0.71)	3.00 (1.00)	2.56*
9	3.29 (1.10)	2.38 (0.92)	2.91*
15	2.60 (1.14)	1.69 (1.40)	2.79**

Note: Style No./each item number of Table 1; Strategy No./each item number of Table 2. * $p < .05$, ** $p < .01$

that there was a significant effect on each item of No. 9 and 15, significant differences on No. 2, 3, 8, and 10 were common between the Confident and Enjoyment aspects. Only the Importance aspect had a significant effect for the item of No. 7 and significant difference on No. 5 was found only for the aspect of Enjoyment.

The correlation between the aspects of Enjoyment and Importance, Enjoyment and Confidence, and Importance and Confidence was 0.560, 0.603, and 0.564, respectively.

3.2 Relation between motives and behaviors

Second, for an analysis of the aspect of motives, participants were split into two groups according to whether he/she had autonomous or voluntary motive for English learning. It could be regarded that students who studied English only to fulfill graduation requirement of university had not autonomous motive for English learning. Therefore, twenty-nine participants who chose just only

Table 5: Mean (*SD*) of the scores of each item on learning styles and strategies for each group of confidence

	Confident (N = 28)	Not-confident (N = 53)	t
Style No.			
6	3.29 (1.92)	2.40 (1.32)	3.08**
8	2.46 (1.22)	3.30 (3.06)	2.63**
10	3.43 (1.66)	4.53 (1.64)	3.67**
13	3.04 (1.59)	2.28 (1.28)	2.73**
15	2.43 (1.44)	3.45 (2.33)	3.08**
16	1.71 (0.58)	2.45 (1.52)	3.32**
18	2.79 (1.36)	4.34 (1.77)	5.21**
21	3.18 (1.12)	1.98 (1.10)	4.88**
Strategy No.			
2	3.36 (0.90)	2.62 (1.12)	3.07**
3	2.54 (1.15)	2.04 (0.73)	2.28*
4	3.21 (1.00)	2.47 (1.02)	3.16**
8	2.38 (1.35)	1.82 (0.78)	2.20*
10	3.36 (0.83)	2.60 (1.05)	3.26**

Note: Style No./each item number of Table 1; Strategy No./each item number of Table 2. * $p < .05$, ** $p < .01$

the answer of "Because I need to earn credits of English class for graduation" were categorized in Heteronomous group and 39 students having not chosen that answer became Autonomous group members. The *t*-test was conducted between these two groups for each item of learning styles and strategies similar to the case of three aspects of attitudes. Table 6 shows the mean scores of items where significant differences were found.

It is characteristic of the case of learning motives to show significant differences between two groups on item No. 1, 4 and 12 for learning style, as these differences were not found on the results of attitudes. These suggested that Autonomous group students were inclined to study English with his/her own style compared to Heteronomous group students. It also seemed that students in Autonomous group tended to study English more steadily than Heteronomous

Table 6: Mean (*SD*) of the scores of each item on learning styles and strategies for each group of motive

	Autonomous (N = 39)	Heteronomous (N = 29)	t
Style No.			
1	1.69 (0.80)	2.31 (1.79)	2.15*
4	4.00 (2.11)	3.22 (1.67)	2.28*
6	3.33 (1.86)	2.10 (1.17)	4.01**
12	2.18 (0.99)	2.69 (1.22)	1.99*
21	2.95 (1.52)	2.03 (1.03)	3.25**
Strategy No.			
3	2.28 (0.94)	1.83 (0.50)	2.13*
4	3.13 (1.17)	2.41 (0.82)	2.88**
8	2.41 (1.25)	1.69 (0.51)	3.24**
10	3.23 (1.02)	2.66 (1.01)	2.32*
12	4.00 (1.53)	3.38 (1.53)	2.05*
15	2.69 (1.32)	2.10 (1.17)	2.14*

Note: Style No./each item number of Table 1; Strategy No./each item number of Table 2. * $p < .05$, ** $p < .01$

group students, on the basis of significant differences on No. 6 and 21. About learning strategies, a significant difference was newly found on No. 12.

3.3 Factor analysis of learning style scores

In order to grasp a factorial structure of English learning styles of participants, a factor analysis was employed for learning style scores, using the principal component method with the promax rotation. In consideration of explainability, four factors with eigenvalues over 1.00 and item loadings over 0.30 were identified. The obtained factor loadings of each item are given in Table 7.

The first factor (F1) was named “initiative”. Because factor loadings at No. 12, 16, 14, 1 and 4 were higher, this factor could be interpreted as showing whether a learner him/herself, not a teacher, a friend or an exam, took the initiative for English learning. The higher scores one gets for these items, the

Table 7: Factor loadings of learning style items

No.	Factors			
	F1	F2	F3	F4
12	*0.795*	-0.109	-0.141	-0.046
16	*0.630*	0.074	0.226	0.020
14	*0.519*	0.302	0.235	0.180
1	*0.453*	-0.016	-0.110	0.170
4	*-0.369*	0.288	0.061	0.364
21	-0.062	*0.852*	-0.072	-0.059
6	-0.200	*0.652*	0.023	0.025
13	0.091	*0.560*	-0.062	-0.316
8	-0.094	*-0.329*	0.154	-0.038
3	-0.200	-0.024	*0.717*	-0.096
9	0.038	-0.048	*0.617*	-0.064
17	0.204	-0.087	*0.599*	-0.079
15	0.206	-0.039	*0.322*	0.155
5	0.164	0.148	-0.207	*0.525*
10	-0.023	-0.209	-0.033	*0.525*
18	-0.092	-0.086	0.195	*0.479*
11	0.086	-0.133	-0.161	*0.430*
22	0.021	0.075	-0.047	*0.407*
2	-0.090	-0.093	0.139	*0.384*
7	-0.163	0.042	-0.053	0.038
19	0.160	0.242	0.080	0.068
20	-0.051	0.017	-0.087	-0.066

Note: No./each item number of Table 1

weaker his/her own initiative for English learning is.

Factor 2 (F2) had higher values of factor loadings at No. 21, 6, 13 and 8. These items referred to whether a student studied English steadily as planned, and then this factor was labeled “steadiness”. If one studies English everyday according to plan, his/her score for these items relatively becomes high.

Factor 3 (F3) was named “flexibility”, because factor loadings at No. 3, 9, 17 and 15 in which asked if one was flexible for methods or plans of English learning were higher. The lower scores for above four items are regarded as more flexible for learning methods or plans.

In Factor 4 (F4), factor loadings at No. 5, 10, 18, 11, 22 and 2 became higher. What these items asked in common could be whether or not one studies English in earnest. Therefore, this factor was called "earnestness". When a learner shows lower scores for these items, it is considered that he/she studies English more seriously.

Table 8 shows the mean of synthetic scores on each factor. As there are differences in the number of contained items among factors, the values obtained by dividing the mean by the number of items are also given in Table 8. General tendencies of all participants about each factor were (1) relatively taking the initiative for learning, (2) not studying so steadily, (3) being noncommittal about flexibility and earnestness in their learning.

Table 8: Mean, *SD* and Mean/items of the synthetic scores on each factor

	F1	F2	F3	F4
Mean	12.79	11.79	13.43	22.08
SD	3.86	3.79	3.78	4.82
Mean/items	2.56	2.95	3.36	3.63

Note: Mean/items; the value obtained by dividing the mean by the number of items on each factor

3.4 Attitudes and motives by learner types on learning styles

The correlation between the synthetic scores on each factor and the three aspects of attitudes is shown in Table 9. All correlations were significant, except for two values at F1. Particularly, the three positive correlations at F2 and the negative correlation between F4 and Confidence were stronger than others.

In order to investigate these results minutely, the synthetic scores on each factor were split into two parts on just the middle of a possible score range: A) the scores less than the middle, and B) the score of the middle and over (Kajita

Table 9: Correlation between each factor and attitudes to English learning

	F1	F2	F3	F4
Enjoyment	-0.189	0.460**	-0.270**	-0.203*
Importance	-0.074	0.363**	-0.271**	-0.242*
Confidence	-0.198*	0.489**	-0.321**	-0.408**

* $p < .05$, ** $p < .01$

et al., 1984). There were sixteen (2^4) ways of combination of A and B on four factors and each participant necessarily corresponded to one of these combinations. As a result, only 10 types were found in participants of this study and 76.2 % of all students were included in five types of ten. These five learner types were as follows: Type 1: AABB ($n = 23$), Type 2: AAAB ($n = 16$), Type 3: AABA ($n = 16$), Type 4: AAAA ($n = 13$), and Type 5: ABAA ($n = 12$). (These sequences of A and B correspond to F1, F2, F3 and F4, in due order.)

The difference of each aspect of three attitudes among these five types was examined using a one-way ANOVA. Table 10 gives the mean scores of three aspects of attitude by learner types.

As for the aspect of Enjoyment, there was a significant main effect, F (4, 75) = 4.59, $p < .01$, and a Tukey's HSD test as a post-hoc test showed that the score of Type 5 was significantly higher than the score of Type 1, 2 and 3. An ANOVA for the aspect of Importance also revealed a significant main effect,

Table 10: Mean (*SD*) scores of each aspect of attitudes by learner types

	Type 1 AABB	Type 2 AAAB	Type 3 AABA	Type 4 AAAA	Type 5 ABAA
Enjoyment	2.74	3.06	3.06	3.38	4.08
	(0.96)	(1.00)	(0.68)	(1.12)	(0.67)
Importance	3.48	3.75	3.63	4.08	4.58
	(1.04)	(1.00)	(0.89)	(1.32)	(0.51)
Confidence	1.96	1.94	2.25	3.31	3.25
	(1.19)	(0.93)	(1.06)	(1.32)	(1.36)

F (4, 75) = 2.83, $p < .05$, suggesting that the score of Type 5 was higher than the score of Type 1 as a result of a post-hoc test. Again, a main effect was significant for the aspect of Confidence, F (4, 75) = 5.09, $p < .01$. A post-hoc test showed that the score of Type 5 was higher than the score of Type 1 and 2, and the score of Type 4 was also higher than the score of Type 1 and 2.

Moreover, for each aspect of nine learning activities, a one-way ANOVA was employed to test the differences among five learner types. Table 11 shows the mean scores and results of ANOVAs for nine aspects of learning activities by learner types. There was a significant main effect in all aspects, except for Conversation and Reading aloud. At the aspect of Grammar, a Tukey's HSD test revealed that the score of Type 4 was higher than the score of Type 1 and 2. At three aspects of Memorizing words' meanings, Memorizing words' spell-

Table 11: Mean (*SD*) scores of each aspect of English learning activities by learner types

	Type 1 AABB	Type 2 AAAB	Type 3 AABA	Type 4 AAAA	Type 5 ABAA	F
Conversation	2.13 (0.76)	2.25 (0.93)	1.69 (0.70)	2.46 (1.39)	2.75 (1.06)	2.42
Grammar	1.96 (0.98)	1.88 (0.89)	2.69 (1.08)	3.15 (1.52)	3.00 (1.13)	4.46^{**}
Memorizing words' meanings	2.00 (1.00)	1.63 (0.72)	2.50 (1.15)	3.31 (1.03)	3.17 (1.19)	7.48^{**}
Memorizing words' spellings	2.26 (1.14)	2.00 (1.03)	2.56 (1.15)	3.31 (1.03)	3.33 (0.89)	4.67^{**}
Memorizing words' pronunciations	2.35 (1.23)	2.50 (1.21)	2.38 (1.20)	2.85 (1.07)	3.67 (1.15)	2.95^{*}
Reading comprehension	2.09 (1.04)	1.94 (1.12)	2.81 (1.28)	3.62 (1.04)	3.42 (0.79)	7.53^{**}
Aural comprehension	2.00 (1.24)	2.31 (1.25)	1.69 (0.79)	2.77 (1.36)	3.00 (1.28)	2.93^{*}
Reading aloud	2.61 (1.11)	2.75 (1.29)	2.63 (0.96)	3.00 (1.15)	3.25 (0.75)	0.92
Composition	1.96 (0.98)	1.69 (0.87)	2.06 (0.77)	2.85 (1.14)	2.67 (1.15)	3.63^{**}

* $p < .05$, ** $p < .01$

ings and Reading comprehension, Type 4 and 5 had higher scores than Type 1 and 2. The score of Type 5 was significantly higher than the scores of Type 1 and 3 at Memorizing words' pronunciations. As for Aural comprehension, a post-hoc test showed that Type 5 had a significant higher score than Type 3. At Composition, the score of Type 4 was higher than that of Type 2.

About learning motive, the number of participants of each learner type for Autonomous and Heteronomous group is shown in Table 12. While the number of students in Autonomous group was smaller than the one of Heteronomous group students at Type 1, Heteronomous group students were outnumbered by Autonomous group students at Type 4 and 5.

Table 12: The number of participants of each learner type in two groups of learning motives

	Type 1 AABB	Type 2 AAAB	Type 3 AABA	Type 4 AAAA	Type 5 ABAA
Autonomous	5	4	5	6	9
Heteronomous	10	5	4	2	2

4. Discussion

This study investigated the relation among motives, attitudes and behavior for English language learning of Japanese university students by means of the questionnaire.

Many items of learning style which showed the differences between two groups for each aspect of attitudes –Enjoyment, Importance and Confidence– were included in F2 and F4 found on the result of factor analysis. Enjoying, Important or Confident group students were inclined to study English from day to day according to plan steadily and to have a serious and tenacious style for English learning in comparison with the students of each opponent group.

About vocabulary learning strategies, the Enjoying and Confident students generally used the organization and elaboration strategies for vocabulary learning more often than each opponent group of students. In particular, there were more strategy items which had the significant difference between two groups at the aspect of Enjoyment compared with other two aspects. Enjoying English learning seemed to be associated with strategic vocabulary learning. On the other hand, for learning style, the aspect which had most items showing the difference between two groups was the ‘Confidence’. It is likely that learning styles had relatively strong relations with learner’s confidence for English performance.

Three items (No. 1, 4 and 12) of learning styles which had the significant difference only between Autonomous and Heteronomous group students were included in F1. It stands to reason that autonomy of learning motives is associated with the initiative for learning concerned. Students having autonomous motive intended to take the initiative by themselves for learning pace or focus parts of English. This was a different tendency as results of three aspects of attitude. As for vocabulary strategies, the results similar to those of three attitudes were found, that is, Autonomous students frequently used the organization and elaboration strategies compared with Heteronomous students.

Based on four factors identified by a factor analysis of learning style scores, general tendencies of university students in this study were as follows: (1) they relatively took the initiative for learning, (2) they did not study so steadily, (3) they were noncommittal about flexibility and earnestness in their learning. Uda (1988) suggested that the tendencies of English learning styles among high school students are: (1) cramming, (2) running exercises quickly when facing a difficult problem, (3) keeping one’s own pace, (4) flexibly changing one’s plans and/or methods, and (5) seeing one’s friends as rivals. Uda (1988) and this study share the similarities in that students do not study so steadily (that is, they were cramming) and they tend to take the initiative for learning pace (that is, they kept his/her own pace). However, there seems to be a slight difference on “flexibility” between Uda (1988) and this study. High school students in Uda (1988) had a tendency of flexibly changing one’s plans and/or methods, whereas university students in this study admittedly showed the medium level and were noncommittal about flexibility. Then, in order to investigate learning styles of university students in detail, relations between each factor and attitudes or motives were analyzed.

The correlations between the synthetic scores on each factor and the three aspects of attitudes demonstrated that the higher score a student got for Enjoyment, Importance or Confidence, the more steadily (F2), flexibly (F3), and earnestly (F4) the one studied English. Although each of flexibility and earnestness was a middle level as a mean of all students' scores, both seemed to vary with the level of attitudes.

On the relation between each attitude and learner types by combination of four factors, Type 5 (ABAA) showed higher scores at all attitudes. Because Type 5 was different from other four types in that F2 was B, it could say that studying steadily was associated with enjoying English learning, thinking English learning to be important, and having confidence in English. At the aspect of Confidence, the score of Type 4 (AAAA) was also higher than Type 1 (AABB) and Type 2 (AAAB), but not than Type 3 (AABA). This suggests that an earnest English-learner has confidence in English.

As for confidence in nine learning activities, the scores of Type 4 and/or 5 were generally high compared with the scores of Type 1, 2 or 3, just as the results of three attitudes. That is, students who had the learning style of Type 4 or 5 possess the tendency of being confident in English. It is reasonable to regard that students having confidence in English show actually good performance in English. Therefore, on a learning style for good achievement of English learning, it seems to need the conditions of (1) studying steadily and (2) being flexible for learning methods or plans with studying earnestly. The present study demonstrated that the university students who learn English steadily had probably good achievement. These results supported the finding of Uda (1988) in which *high school* students learning English steadily have good achievement.

The point in common between Type 4 and 5 was also found on the relation between learning motive and learner types. At these two types, the number of students in Autonomous group was larger than the one of Heteronomous group students. Autonomous group students, however, were outnumbered by Heteronomous students at Type 1. These results suggest that characteristics of learning style at Type 4 and 5, that is, studying steadily and/or flexibly with earnestness are associated with autonomous learning motive, whereas the characteristic of Type 1's style, studying not so steadily, so flexibly, nor so earnestly, has a relative strong relation with heteronomous motives.

Thus, it was clearly shown that the level of flexibility for English learning method or plan differed with attitudes and motive for learning in the case of university students, while high school students in Uda (1988) generally had a flexible learning style. Probably, the majority of high school students study English for examination in their school or for entrance of university, and it can be said that their purpose of English learning is heteronomous. However, that purpose is very clear and influential for students in various meanings. They necessarily work out various learning methods and change the learning plan in order to have good performance of English, and may become to take flexible learning style as a result. On the other hand, in the case of university students, their purpose for English learning is generally not clear and their English records are not influential compared with high school students. Therefore, only when a student has autonomous motive, that is, one studies English of his/her own accord, the learner has a tendency of flexible learning style. Whether a learner could recognize English learning as being influential and meaningful for his/her future or self-efficacy would seem to be important factor for effective learning.

From the standpoint of educational practice in schools, it is necessary for teachers to guide students to regard English learning as meaningful for them according to learners' age and other properties. How teachers can encourage students effectively to have autonomous motive should be investigated in future research.

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10. A computer-mediated communication mechanism of Japanese script: The effects of the usage of pictographs, script types, and fonts on the reduction of miscommunication

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Abstract

In order to develop a new computer-mediated communication system in which miscommunication can be deteriorated, the present study investigated the effects of using pictographs, script types and fonts by a sender on addressee's understanding. A new system should be conveyed not only semantic verbal information but also emotional semantic information of the senders. In this context, a series of experiments were conducted to examine the way to encode sender's emotional state in written language communication to avoid miscommunication. Two hundreds and eighty-five undergraduate students participated in a series of experiments. In Experiment 1, it was demonstrated that the addressee in the spoken language communication effectively decoded prosody. In Experiment 2, the effect of using a pictograph on the decoding of emotional semantic information and the effect of selecting a script type was examined in Experiment 3. The effects of selective use of a font on the decoding of emotional semantic information were evaluated in Experiment 4. The results showed that in written language, a pictograph was more effective than the selection of a script type or a font. It is evident that emotional semantic information can be conveyed by the selection of a script type or a font in written language communication. However, the selection of a script type or a font was not necessarily effective on avoiding miscommunication.

Key words: Japanese writing, decoding of the written message, computer-

mediated communication, miscommunication, script/font choice mechanism

1. Introduction

It is well known that consultations or arguments using e-mail sometimes invite misinterpretation and give rise to a quarrel between a sender and an addressee. One of the proper reasons for this type of miscommunication relates to the unique characteristics of e-mail communication. E-mail communication usually consisted of short written sentences by a sender to an addressee without any decorations such as a picture and a color. More concretely, e-mail communication is the communication based upon the written language.

Human communication consists of two facets, verbal and non-verbal. Verbal facet, in other words, language consists of two facets, written language and spoken language. When we compare the written language with the spoken language, we can realize the possible reasons why we sometimes fail in proper communication by e-mail. Spoken language can be divided into three components: verbal information (or neutral semantic information), para-linguistic information (or emotional semantic information), and non-verbal information in face-to-face communication situation such as a discussion and a consultation. When we communicate by telephone, the first two components are mostly engaged. Non-verbal information refers to attribution of speaker such as age or sex, which is not directly related to spoken contents.

Verbal information relates to the information, which includes words, syntax and meaning in discourse situation. Verbal information can be processed in both written language and spoken language communication. However, para-linguistic information can be easily processed in spoken language communication, whereas it is usually not processed in written language communication. Para-linguistic information can be expressed by prosodic elements (e.g., tone, speed or rhythm of speech) in spoken language. There is no disagreement on this point that para-linguistic information communicates intention and emotional state of speaker in spoken language communication. It is difficult for us to communicate full and smoothly with the opponents by means of written language. Therefore, people tries to meet the opponents to inform information properly when the matter is important, even if it needs expensive travel fares and significant time, not to fail in miscommunication.

There are sufficient evidences to support the above-mentioned proposal in some neuropsychological researches. Studies with aphasic patients have demonstrated that spoken language involves two different facets of human communication: neutral or symbolic semantic information conveyed by words and syntax, and emotional or biological semantic information conveyed by prosody (Yamadori, 1998). Both the prosody and syntax deficits of aphasic patients can yield inappropriate communication in spoken language (Ross & Mesulam, 1979; Yamadori et al., 1990; Yamadori, 1998). Hatta, Hasegawa and Wanner (2004) demonstrated that brain damaged patients tend to make errors in implicature understanding during communication because they have deficits in paralinguistic information processing.

How can emotional or biological semantic information be conveyed in written language? Is only neutral semantic information involved in the processing of written language? Is emotional semantic information not processed? As mentioned earlier, communication by face-to-face contact or telephone depends mostly on spoken language. On the other hand, communication by e-mail or letter is based on the written language. Therefore, it is hypothesized that spoken language can rely on not only neutral semantic information by words and syntax, but also on emotional semantic information by prosody to a listener. On the other hand, written language can transfer only neutral semantic information, but it cannot convey emotional semantic information. These aspects lead to more frequent miscommunication in written language situation than in spoken language situation, and this is typical in e-mail situation.

In order to solve this problem, a new system should be developed, so people can efficiently convey their emotional semantic information in written language situation. As several electric devices for communication have spread nowadays and e-mail has been a popular means of communication, a new method should be developed to avoid miscommunication in e-mail situation. Several attempts have already done though it might be implicit. For example, people use a pictograph or a smiley to express their emotional condition in e-mail situation. However, the use of these symbols is limited in private communication. Then, one of future aims is to develop a new hard/soft-ware system in e-mail communication, which is able to convey not only neutral semantic information but also emotional semantic information properly. To develop such systems, more empirical evidences should be accumulated, which suggest possible ways to transfer emotional semantic information in written language situation.

One of possible ways to convey emotional semantic information in written language to an addressee is the choice of a script type. The Japanese writing system has certain unique characteristics. The most remarkable one is the variety of script types. In Japanese writing, five different kinds of script - Kanji, Hiragana, Katakana, Roman alphabet and Arabic numerals - are employed. All these types of script originated elsewhere and have been adopted and adapted by the Japanese over hundreds of years (Hatta, 2001; Taylor & Taylor, 1995). The first three types of script are the most frequently employed in Japanese text. The origin and history of how and when various types of scripts were adopted by Japanese is not the concern of this study, and are dealt with elsewhere (e.g., Taylor & Taylor, 1995).

The Chinese and Japanese languages differ in syntax and in the use of grammatical morphemes. Kanji is well suited to writing content words with meaning but not to writing Japanese grammatical morphemes. Kana developed gradually out of Chinese characters in the following way; Kanji, Kanji as phonetic signs, simplified Kanji shapes and Kana. During this development, Hiragana was used mainly by female authors (who might not have been taught Kanji) to write letters, poems, diaries and stories. Hiragana has the graceful cursive form of the original Kanji. These early female writers might believe that a script type could convey semantic emotional information, that is, that associated with femininity. It has generally been the practice that the simplified Hiragana was used for grammatical morphemes while the simplified Katakana was used for European loan words and onomatopoeia. In any event, the employment of many kinds of scripts would seem to be one of the most unique characteristics of Japanese writing.

In written Japanese texts, the following three rules seem to influence the choice of script. Firstly, the word origin; words of Chinese origin are generally represented by Kanji, foreign loan words are written in Katakana, and Hiragana is usually employed in writing words of Japanese origin. However, this word-origin rule does not seem to be crucial to the choice of script. A conventional rule relating to type of script and word, which has been existence for many years, seems to have a strong influence. For example, “yakyu (baseball)” is customarily written in Kanji, “isu (chair)” in Hiragana, and “bara (rose)” in Katakana. Laboratory experiments have demonstrated that familiarity with these customs affects the speed of recognition and accuracy of memory (Hirose, 1984; Kawakami, 1993; Yokoyama, 1997). As far as familiarity is concerned, Ukita, Sugishima, Minagawa, Inoue and Kasyu (1996) proposed four types. These are (1) unique relationships; certain words are written mostly in Kanji (such as “ 愛 ”), others in Hiragana (such as “ あご ”), or in Katakana (such as “ アブラムシ ”), (2) dominant relationships; certain words are written frequently in Kanji (such as “ 青 ”), or in Hiragana (such as “ あじさい ”), or in Katakana (such as “ アヒル ”), (3) double relationships; certain words are written in either one of two types of script (such as “ 赤 ”-“ あか ”, “ 稲 ”-“ イネ ”, “ あさり ”-“ アサリ ”,), and (4) triple type: words are written with almost equal frequency in either of the three script types (such as “ 朝顔 ”-“ あさがお ”-“ アサガオ ”). Through several experiments as for reading processes, Ukita, et al. suggested that Japanese people subjectively associate word with script type. Recent studies also demonstrated that these association influence word reading processes and memory (Sugishima & Kasyu, 1992; Sugishima, Ukita, Minagawa, & Kasyu, 1993; Yokoyama & Imai, 1989).

Secondly, we use a particular script type to stress a particular word by violating the association of scripts with word. Advertisements sometimes use this kind of tactic. It is somewhat similar to the employment of italics in English orthography. Thirdly, we use Hiragana or Katakana instead of Kanji to avoid making spelling errors because Kanji writing is sometimes quite complex. Even well-educated adults do not know the entire official Kanji (1945 Kanji), or even all the Kanji taught in primary schools (881 Kanji).

A number of studies of reading processes in relation to Japanese texts have been conducted over the past two decades and have produced several findings which suggest that Japanese is unique in some ways (Goryo, 1987; Hatta 1985, Saito, 1997). These studies have been based on cognitive models developed after reading studies of English orthography (McClelland & Rumelhart, 1981; Morton & Patterson, 1980; Seidenberg & McClelland, 1989). These studies have revealed that there is a script familiarity effect; that is, some words are usually printed only in Kanji, Katakana, or Hiragana, whereas other words are printed in all these scripts and with almost the same frequency. Do Japanese people show a similar preference in writing? Do they choose a particular script type to convey emotional semantic information? To address this issue, we have conducted a series of experiments.

The author and colleagues have demonstrated the possibility that emotional semantic information is conveyed even in written language using a chosen script type. We have showed that a sender tried to communicate emotional semantic information to an addressee by the selection of script type or print (Iwahara, Hatta, & Maehara, 2003; Iwahara & Hatta, 2004). They showed firstly that modern Japanese people have strong emotional semantic associations with each type of script (Kanji, Hiragana, Katakana); for instance, the word printed in Kanji had the meaning of higher intelligence, likewise, Hiragana had the meaning of higher feminine, and Katakana had the meaning of higher modern, secondly that Japanese people chose a particular type of script if the compatibility between semantic image associated with the script type and the target word is realized. Iwahara and Hatta (2004) also identified the same kind of effects in the task that participants were asked to choose an appropriate font to correspond with the context. The diploma is printed in ornamental writing in every kind of different writing systems, so that we recognize from it a dignity or status. If a diploma is written in the pica-type font, we recognize from it feeble dignity, formality and status.

The purpose of this study was, firstly, to clarify the interaction between a content of correspondence and script or a font that should be used in written language communication, and secondly, to examine how to express emotional semantic information to avoid miscommunication in written language. That is, the aim of this study was to investigate that how a sender express his/her feelings in writing message, e.g., e-mail when he/she wants to communicate properly, e.g., to tell his/her intentions that he/she was not angry.

The present series of experiments addressed the question how addressees should encode sender's emotional semantic information in e-mail communication in order to avoid miscommunication. As mentioned earlier, we confirmed that senders encoded their emotional semantic information by their implicit attempts such as a selection of a script type or a font in written language communication (Iwahara, et al., 2003; Iwahara & Hatta, 2004). Then, in the present study, whether a selection of a script type or a font was valid for the decoding or not was examined; whether an addressee could decode sender's emotional intention properly from their expression when some attempts have been done. Four experiments were conducted to compare the efficiency among four kinds of encoding attempts (control: prosody, pictograph, font and script type) in decoding. Manipulations were conducted by the preparation of the communication situation where a sender wishes to convey his/her positive state such as delight to an addressee. In Experiment 1, vocal message with and without a delightful tone was manipulated. Likewise, in Experiment 2, messages with and without a delightful mark as "(^_^)" were prepared, and in Experiment 3, messages with or without the use of the Katakana script were prepared. In Experiment 4, messages with or without the use of Kraft font were prepared. These manipulations were based upon our previous findings (Iwahara et al., 2003; Iwahara & Hatta, 2004), in which Katakana script used at the end of the sentence made an addressee feel casual or modern, and Kraft print made an addressee feel as feminine or tender, etc.

The general method in the four experiments is introduced as a beginning, because the method of the experiments was quite similar, except for the manipulation to encode emotional semantic information.

2. General method

2.1 Participants

Two hundreds and eighty-five undergraduate students (232 male and 53 female) participated in the four experiments for course credits. Their aged ranged from 18 to 23 years and all were native Japanese. These participants were assigned to the four experiments: 59 for Experiment 1, 80 for Experiment 2, 80 for Experiment 3, and 66 for Experiment 4.

2.2 Experimental design

All the four experiments were conducted with a three-way repeated design (2 × 3 × 3). The first factor related to the encoding of emotional semantic information (encoded or not encoded). The second one related to emotional states of a sender (pleasant, unpleasant and neutral). The last one related to sender's characteristics (i.e., from whom the message was sent: sweetheart /family member, friend, and acquaintance). As to the first factor, encoding strategies were differently manipulated in the series of experiments. That is, prosody, pictograph, script type, and font type were manipulated in Experiment 1, 2, 3 and 4, respectively.

2.3 Material

Fifteen situations were selected. They gave rise to miscommunication from the results of our pilot study. In the pilot study, 525 undergraduate students were asked to remember their experience of miscommunication in the written language communication, and to write down their cases in the answer sheet of the questionnaire. The questionnaire consisted of 4 questions: contents of miscommunication, relationship between a sender / an addressee and subject, emotional state of a sender / an addressee, and the way to avoid miscommunication. Based on the pilot study, 90 stimulus materials (15 situations × 2 encoding conditions × 3 senders) were made. These materials were printed in two kinds of booklets in which the order of 90 materials were randomized. The sample materials are presented in Figure 1.

あなたが送信した内容 (an addressee: a content you sent)	あなたに送信した相手と内容 (a sendr: a content you received)	感情判断 (Judgment on emotional state of a sender: Task A)			確信度評定 (Judgment on confidence: Task B)	
		嬉しい (delight)	怒り (anger)	嫌悪 (disgust)	0- 1- 2- 3- 4- 5- 6	
自分　「まだ帰れそうにない」 ⇒ you　"I can't return soon."	親友　「今どこにいるの」 a friend　"Where're you?"	幸せ (happiness)	不安（心配） (anxiety)	無関心 (apathy)	確信をもてない (not confident)	確信がある (confident)
		楽しい (joy)	悲しみ (sadness)	中立 (neutral)		

Figure 1: The sample of materials used in the experiments

2.4 Task

The participants were given two kinds of tasks: evaluation of the emotional state of a sender (task A) and judgment's confidence (task B).

2.4.1 Judgment on emotional state of a sender (Task A)

The participants were asked to evaluate the content of intention of a sender and to choose an appropriate emotion type among 9 alternatives of emotions (delight, happiness, joy, anger, anxiety, sadness, disgust, apathy, neutral). For instance, as to the sample presented in Figure 1, assuming that a participant sent a message such as 'I can't return soon' to his/her friend and then received such a message as 'Where're you?' from his/her friend, the participant was asked to guess friend's intention in sending the message (e.g., whether he was angry or not) and to choose friend's emotional type among the 9 alternatives mentioned above. Three levels in a sender were established: sweetheart/family, friend, and acquaintance. It was hypothesized that the difference of encoding strategy influenced the accuracy of decoding of sender's emotional semantic information.

2.4.2 Judgment on confidence (Task B)

The participants were asked to evaluate the confidence of their choice. A seven-point scale was used in rating confidence.

2.5 Procedure

The experiments were conducted as a group experiment in the classroom. The experimenters distributed the booklet and gave instruction to participants. The participants made both tasks, the evaluation of the emotional state of a sender (task A) and the evaluation of the confidence (task B), basically at their own pace. It took about twenty-five minutes to complete both tasks.

3. Experiment 1 (control experiment: spoken language communication)

The purpose of this experiment was to examine whether prosodic information could facilitate decoding of sender's emotional semantic information.

3.1 Method

3.1.1 Task and procedure

In this experiment, prosody (encoded or not encoded) was manipulated, so the stimulus sentence was given by a female voice recorded on a tape.

3.2 Results and discussion

For the analyses, nine kinds of emotions were divided into three categories such as pleasant, unpleasant, and neutral. The "delight", "happiness", and "joy", belonged to the category of pleasantness. The "anger", "anxiety", "sadness", and "disgust", were classified to the category of unpleasantness. The "apathy" and "neutral" belonged to the category of neutral. Frequency of responses to each category was calculated. Table 1 shows the frequency of response to each category as a function of the encoding conditions. The frequencies were analyzed by a three-way logarithm linear analysis (2 (prosody encoded or not-encoded), × 2 (emotional state of sender: pleasant, unpleasant, and neutral) × 3 (type of sender: sweetheart / family, friend and acquaintance)). Only the interaction between encoding of prosody and emotional state of a sender was significant (χ^2 (2) = 1689.03, p < .001). However, an analysis of variance of three factors with confidence did not provide any main effects and interactions.

These results showed that the frequency of pleasant category was higher in the prosody (encoded) condition than the control (not encoded) condition, and the frequency of unpleasant category was higher in the control condition than the prosody condition. These results indicated that an addressee could correctly decode sender's emotional state that a sender had encoded by prosody. That is, vocal speech can easily convey emotional semantic information.

It is also evident that, in comparison with the frequency of each category in the prosody condition, the frequency of pleasantness was higher than that of unpleasantness and neutral. Likewise, it is evident that, in comparison with the frequency of each category in the control condition, the frequency of unpleasantness was higher than that of neutral and pleasantness, and the frequency of neutral was higher than that of pleasantness. These results suggest that an addressee could decode sender's emotional semantic information as not unpleas-

Table 1: Frequency (proportion) of response to each category as a function of encoding condition in Experiment 1

	prosody encoded		not encoded	
pleasant	1104	(.21)	29	(.00)
unpleasant	800	(.15)	1794	(.35)
neutral	739	(.13)	825	(.16)

ant but pleasant when sender's emotional state was encoded by prosody.

These results make it clear again that emotional semantic information of a sender could be correctly conveyed to an addressee in spoken language.

4. Experiment 2 (the usage of pictograph)

The purpose of this experiment was to examine whether or not pictograph could facilitate decoding of sender's emotional semantic information in written language communication situation.

4.1 Method

4.1.1 Task and procedure

In this experiment, a pictograph (encoded or not encoded) was manipulated, so the stimulus sentence was given as a message with or without a smiley (^_^).

4.2 Results and discussion

Table 2 shows the frequency of response to each category as a function of the encoding conditions. A three-way logarithm linear analysis was conducted with the frequency of encoding of emotional semantic information (pictograph encoded and not encoded), emotional state of a sender (pleasant, unpleasant, and neutral), and type of sender (sweetheart / family, friend and acquaintance). Only an interaction between the encoding of emotional semantic information and the emotional state of a sender was significant (χ^2 (2) = 296.62, p < .001). However, an analysis of variance of three factors to confidence did not provide

Table 2: Frequency (proportion) of response to each category as a function of encoding condition in Experiment 2

	pictograph encoded		not encoded	
pleasant	1145	(.16)	570	(.08)
unpleasant	970	(.13)	1455	(.20)
neutral	1522	(.21)	1617	(.22)

any main effects and interactions.

It is apparent that the frequency of pleasant category was higher in the pictograph condition than the control condition, and the frequency of unpleasant category was higher in the control condition than the pictograph condition. These results show that an addressee could correctly decode sender's emotional state that a sender had encoded by using a pictograph.

It is also evident that, in comparison with the frequency of each category in the pictograph condition, the frequency of neutral was higher than that of pleasantness and unpleasantness. Likewise, it is evident that, in comparison with the frequency of each category in the control condition, the frequency of unpleasantness and neutral was higher than that of pleasantness. These results suggest that an addressee could decode sender's emotional semantic information as not unpleasant but pleasant when sender's emotional state was encoded by a pictograph.

All these things make it clear that emotional semantic information of a sender could be correctly conveyed to an addressee in written language, if a sender encoded his/her emotional state by using a pictograph.

5. Experiment 3 (the usage of script type)

The purpose of this experiment was to examine whether or not the selection of script type could facilitate decoding of sender's emotional semantic information.

5.1 Method

5.1.1 Task and procedure

In this experiment, a script type (encoded or not encoded) was manipulated, so the stimulus sentence was given as a message with or without the use of Katanaka script at the end of the sentence.

5.2 Results and discussion

Table 3 shows the frequency of response to each category as a function of the encoding conditions. A three-way logarithm linear analysis (2 × 2 × 3) was conducted with the frequency of the encoding of emotional semantic information (script type encoded and not encoded), emotional state of a sender (pleasant, unpleasant, and neutral), and sender (sweetheart / family, friend and acquaintance). Only the interaction between the encoding of emotional semantic information and emotional state of a sender was significant (χ^2 (2) = 23.63, $p <$ .001). However, an analysis of variance of three factors with confidence did not show any main effects and interactionsr.

It is evident that, in comparison with the frequency of each category in the script condition, the frequency of neutral was higher than that of unpleasantness and pleasantness, and the frequency of unpleasantness was higher than that of pleasantness. Likewise, it is clear that, in comparison with the frequency of each category in the control condition, the frequency of unpleasantness and neutral was higher than that of pleasantness. These results suggest that an addressee had a tendency to decode sender's emotional semantic information as not unpleasant but neutral when sender's emotional state was encoded by the

Table 3: Frequency (proportion) of response to each category as a function of encoding condition in Experiment 3

	script encoded		not encoded	
pleasant	523	(.07)	538	(.07)
unpleasant	1262	(.18)	1441	(.20)
neutral	1812	(.25)	1618	(.22)

selection of script type.

In the written language communication, the selection of script type did not absolutely have an effect on decoding emotional semantic information, because of the slightly less probability that sender's delightful state was decoded as unpleasant. However, the selection of script type could not convey the pleasant emotion of a sender more correctly than prosody or pictograph.

6. Experiment 4 (the usage of font type)

The purpose of this experiment was to examine whether or not the selection of font could facilitate decoding of sender's emotional semantic information.

6.1 Task and procedure

In this experiment, a font type (encoded or not encoded) was manipulated, so the stimulus sentence was given as a message with or without the use of Kraft font.

6.2 Results and discussion

Table 4 shows the frequency of response to each category as a function of encoding condition. A three-way logarithm linear analysis (2 × 2 × 3) was conducted with the frequency: the encoding of emotional semantic information (font type encoded and not encoded), emotional state of a sender (pleasant, unpleasant, and neutral), and sender (sweetheart / family, friend and acquaintance) . Only the interaction between the encoding of emotional semantic information and emotional state of a sender was significant (χ^2 (2) = 23.63, $p < .001$). However, an analysis of variance of three factors with confidence did not show any main effects and interactions.

These results showed that, in comparison with the frequency of each category in the font condition, frequency of neutral was higher than that of unpleasantness and pleasantness, and the frequency of unpleasantness was higher than that of pleasantness. Likewise, it is clear that, in comparison with the frequency of each category in the control condition, the frequency of unpleasantness and neutral was higher than that of pleasantness. These results suggest that

Table 4: Frequency (proportion) of response to each category as a function of encoding condition in Experiment 4

	font encoded		not encoded	
pleasant	436	(.07)	488	(.07)
unpleasant	1057	(.18)	1173	(.20)
neutral	1469	(.25)	1295	(.22)

an addressee had a tendency to decode sender's emotional semantic information as not unpleasant but neutral when sender's emotional state was encoded by the selection of script type.

In the written language communication, the selection of font did not influence on the decoding emotional semantic information, because of the slightly less probability that sender's delightful state was decoded as unpleasant. However, the selection of font could not convey the pleasant emotion of a sender more correctly than prosody or a pictograph.

7. General discussion

In the present series of experiments, the aim was to examine whether or not a sender encodes his/her emotional semantic information without miscommunication in written language communication. The results of Experiment 2 show that encoding a pictograph in written language communication can correctly convey sender's emotional state to an addressee. In fact, many people try to use a pictograph or a smiley in their message and transmit their emotional state today. Moreover, all cellular phone companies have developed several kinds of tools for e-mail communication for a few years, and it suggests that people recognize the value in encoding emotional semantic information by a pictograph as the effective means to avoid miscommunication. However, using pictographs make people have a childish feeling, so the use of them is limited in the private communication situation at least in Japan.

On the other hand, people possess the feeling that the selective use of a script or a font type must be effective to decode emotional semantic information. Then, people do select a script or a font in written language communication situation to convey their emotional state (Iwahara et al., 2003; Iwahara & Hatta, 2004). In spite of these people's awareness, the results of Experiment 3 and 4 did not support the people's awareness in writing situation. The results showed firstly that the selection of a script or a font type can not convey sender's emotional semantic information more than prosody or pictograph, and secondly that an addressee cannot decode sender's delightful emotion encode by the selection of a script or a font type as pleasant.

However, the possibility that the selection of a script or a font type influences on decoding sender's emotional state should not be entirely ruled out, because an addressee can decode as not unpleasant, emotional semantic information which a sender encoded by selecting an appropriate script or font type. It is plausible that there are two proper reasons not to obtain the expected results in Experiment 3 and 4.

One is an inconsistency or an incompatibility of the rules of "encoding-decoding" between a sender and an addressee. That is, an addressee cannot decode sender's emotional state that he/she encoded by means of the selection of a script or a font type, because sender's encoding rules are different from addressee's ones.

The other lies in the use of an inappropriate measure in the present series of experiments. In our previous studies (Iwahara et al., 2003; Iwahara & Hatta, 2004), we tried to examine the effects of script type and font type on the slight related imagery feelings as for nuance not on the strong emotional feelings. In other words, it is plausible that the selection of a script or a font type can convey nuance such as feminine or exotic, but cannot transmit emotional states like pleasant or unpleasant. In this sense, the selection of a script or a font type is different from prosody or a pictograph, but we used it as measure of not nuance but emotional state.

These considerations invite the needs for further accumulation of the empirical evidences. The request for a new system to avoid miscommunication in written language communication such as e-mail message seems to be increasing more and more. Further researches concerning the encoding strategies that both a sender and an addressee can easily understand should be needed.

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11. Influence that the familiarity level and the position of the cutting in haiku gives to the retrieval process

Naohiro Minagawa

Abstract

The characteristic of a Japanese haiku poem is that it has three phrases: top 5 sounds phrase (in Japanese, "Kamigo"), middle 7 sounds phrase ("Nakashichi") and bottom 5 sounds phrase ("Shimogo"). It was hypothesized that a haiku having such a structure is retrieved according to this order. Moreover, many haiku have a pause, namely cutting, between the "Kamigo" phrase and the "Nakashichi" phrase, or between the "Nakashichi" phrase and the "Shimogo" phrase. This study intended to verify these hypotheses with psychological methods. Two experiments, using a priming paradigm, were conducted and the phenomena that demonstrated the above hypotheses established.

Key words: haiku, familiarity level, cutting, retrieval process

1. Introduction

Japanese haiku is a powerful part of the culture of Japanese origins, and it is poetry with a fixed form of a minimum size that attempts to express empathy for the scenery of seasons with the limitation of 17 speech sounds. It is familiarized among many generations and among many countries. In recent years, haiku shows new evolution through the development of modern communication methods. There are two ways of enjoying haiku. One is by reading and appreciating the famous work of both past and modern times, and the other is by creating one's own work and communicating with others. However, there is also the view that the genuine delight of haiku is in the latter way of enjoying. Actually, a haiku is published by various kinds of media. Psychological analysis of haiku, which is part of the culture of Japanese origins, will become a way of approaching the nature of the Japanese mind.

Minagawa (2005a) indicated that a rhythm of 5-7-5, association with a seasonal words and scenery, “the duality of the meaning” between a description of scenery by the sketch in the surface and the psychological description in depth, and the expanse of the meaning of a poem with the combination of plural scenic images as factors which breed the above mentioned charm of a haiku and argued that such factors could be an object of research in psychology. In addition, Minagawa (2005b) mentioned that a 5-7-5 rhythm represented by a haiku is easily retained in the memory of people who use Japanese as a mother tongue, and investigated whether a 5-7 or a 7-5 rhythm is interacted with memory retention by using a psychological method.

Minagawa (2005b, Experiment 3) conducted an experiment by the free recall method, and demonstrated that most of the haiku existing in Japanese people’s semantic memory had 5-7-5 fixed forms. Furthermore, Minagawa (2005b, Experiment 4) conducted another experiment by a priming paradigm that was an influential research method of semantic memory, following an idea of Fukumoto (2001) in which the division among 5-7-5 three units in haiku was not equal in a row and there were more pauses, namely cutting (in Japanese, “Kire”), in the phrase between top 5 sounds phrase (in Japanese “Kamigo”) and middle 7 sounds (in Japanese “Nakashiichi”) or between middle 7 sounds phrase and bottom 5 sounds phrase (in Japanese “Shimogo”) was the important characteristic of the haiku. Haiku were presented visually with the cutting between “Kamigo” and “Nakashichi”. Haiku as stimulus materials were selected from the haiku of a well-known writer transcribed in elementary and junior high school textbooks, namely the haiku that settled in the semantic memory of many people. The results showed as follows: the reaction time in the regular order condition in which “Kamigo” and “Nakashichi” was presented in that order was faster than the reverse order condition in which “Nakashichi” and “Kamigo” was presented in that order. Especially, the reaction time in the condition which “Nakashichi” and “Shimogo” was presented in that order was the fastest. These results suggested that when people tried to remember the haiku of the fixed form, they searched it in the order of “Kamigo”, “Nakashichi” and “Shimogo”, and that the retrieval process stopped at one time at the cutting.

Minagawa (2005b) used only well-known haiku stored in the semantic memory of many Japanese people, but haiku have been written in sequence even today. In addition, Minagawa (2005b) used only haiku with the cutting between “Kamigo” and “Nakashichi”, but there are many haiku with the cutting between “Nakashichi” and “Shimogo”, too. Will the tendency that Minagawa (2005b) demonstrated be obtained too when readers attempt to memorize haiku written recently and are not yet fixed in semantic memory, or haiku with the cutting between “Nakashichi” and “Shimogo”? This study intends to verify these matters by using a priming paradigm. Experiment 1 examines the influence that the degree of familiarity of the haiku gives to a retrieval process. Experiment 2 examines the influence of the cutting and its location.

2. Experiment 1: The influence that the familiarity level of haiku gives to the serial characteristics of the retrieval process

2.1 Method

2.1.1 Participants

Twenty four normally-sighted graduate students (12 males and 12 females: average age 24.8 years old) participated in this experiment. They had normal or corrected-to-normal vision. They were randomly assigned into two groups: the textbook haiku group and the student’s haiku group which are explained below.

2.1.2 Stimulus materials

Ten famous haiku written in both historical and recent times (hereinafter called textbook haiku) and ten haiku written by modern junior high students (hereinafter called student’s haiku) were used as stimulus materials; three units of these 20 haiku were semantically independent of each other. Concerning the textbook haiku, the haiku with high familiarity and well-liked were investigated by Minagawa (2005b, Investigation 3). Concerning the student's haiku, the haiku which were easily understandable by five consultants were selected. Explanatory sentences of around 100 characters were made for all 20 haiku and were used at an experimental stage of understanding and memory.

2.1.3 Apparatus

A personal computer, which was connected to a keyboard and a monitor, was used to control this experiment. An experimenter operated the PC, and stimulation materials were shown on the monitor to the participant. Software E-prime (Psychology Software Tools Inc.) was used for experiment control.

2.1.4 Experiment design

The present experiment consisted of a between-participant factor (haiku type: text book haiku/student haiku) and a within-factor (six system conditions; see Table 1).

Table 1: Example of stimulus in six system conditions of the priming experiment

Condition	Yes trial		No trial	
	Prime	Target	Prime	Target
Top-middle	Natsukusaya	Tsuwamonodomoga	Natsukusaya	Tsukiwahigashini
Top-bottom	Natsukusaya	Yumenoato	Natsukusaya	hihanishini
Middle-top	Tsuwamonodomoga	Natsukusaya	Tsuwamonodomoga	Tsukiwahigashini
Middle-bottom	Tsuwamonodomoga	Yumenoato	Tsuwamonodomoga	hihanishini
Bottom-top	Yumenoato	Natsukusaya	Yumenoato	Nanohanaya
Bottom-middle	Yumenoato	Tsuwamonodomoga	Yumenoato	Tsukiwahigashini

2.1.5 Procedure

This experiment was composed of two phases and conducted individually.

(1) Experimental stage of understanding and memory

A haiku was shown on the center top part of the screen and the explanatory sentence of the haiku was shown on the center bottom. Participants were instructed to understand and memorize the presented haiku at their own pace. The next haiku and the explanatory sentence were shown when a key was pushed. The participant understood ten haiku and memorized them at their own pace. Of these, in the priming experiment given details later, two haiku were used as a practice trial and eight haiku were used for the main trial.

(2) Experimental stage of priming experiment
“Kamigo”, “Nakashichi” or “Shimogo” of the haiku that were memorized in the above mentioned first stage were shown as prime and target stimulus. In the individual trial, the fixation point (one second), prime (500 ms), a blank paper (500 ms), and a target was shown in that order on the center of the screen. The task of the participant was to judge whether prime and targets were the parts of the same haiku by pushing a key as quickly and accurately as possible. The target was shown until either the participant pressed the key or for five seconds. The fixation point of the next trial was shown after the 1.5 seconds. Table 1 shows the six conditions and their stimulus examples of the pairs of prime and target in the “yes” and “no” trials. Forty eight (8 × 6) “yes” trials and “no” trials were possible from eight haiku, and totaled 96 trials in all. A break of three minutes was inserted in the first half after 48 trials. Twelve practice trials were preceded by 96 main trials.

2.2 Results and discussion

Table 2 shows the average correct answer rates of all conditions in the “yes” and “no” trials. These results indicate that the answers of participants in the present experiment were accurate.

Concerning a correct answer in the “yes” trial, the average discrimination time according to experimental conditions was calculated. Concerning a correct answer in the “yes” trial, the average reaction time was calculated according to experimental conditions and shown in Table 3.

Using the reaction times for correct responses in the “yes” trial, an analysis of variance (ANOVA) of the haiku type (2) by the series conditions (6) was

Table 2: Average correct answer rates in each experimental condition (%)

		Prime-target condition					
Haiku type condition	Trial	Top-middle	Top-bottom	Middle-top	Middle-bottom	Bottom-top	Bottom-middle
Textbook haiku	Yes	93.8	93.8	91.7	95.8	90.6	91.7
	No	92.4	91.7	91.7	93.8	91.7	90.6
Student haiku	Yes	95.8	93.8	91.7	93.8	90.6	90.6
	No	93.8	92.4	90.6	92.4	90.6	91.7

Table 3: Average reaction times and their SDs for the "yes" trials in each experimental condition (ms)

		Prime-target condition					
Haiku type condition		Top-middle	Top-bottom	Middle-top	Middle-bottom	Bottom-top	Bottom-middle
Textbook haiku	Mean	877	880	1027	733	942	892
	SD	142	171	190	137	205	169
Student haiku	Mean	934	942	1054	935	1012	1008
	SD	142	150	230	212	176	162

conducted. The ANOVA showed a significant main effect of the system conditions (F (5, 110) = 18.671, p < .05) and a significant interaction between the two factors (F (5, 110) = 3.686, p < .05). The main effect of the haiku type was not significant (F (1, 22) = 1.845).

The reaction time of the regular order condition was faster than the reverse order condition. That is, the top-middle condition was faster than the middle-top condition, top-bottom condition was faster than bottom-top condition, and middle-bottom condition was faster than bottom-middle condition. These effects were found in both a textbook haiku condition and a student's haiku condition. Accordingly, a tendency to remember in regular order was identified in both haiku type conditions. It is thought that the interaction between two factors reflected the difference of the haiku type condition in the following points. The speed of the middle-bottom condition was remarkably faster and, in the regular order condition of the textbook haiku, excelled in comparison with the top-middle condition and the top-bottom condition. This is seriously concerned with the fact that the eight textbook haiku that were used in this experiment have cutting between the top 5 and middle 7, and have a continuity of the syntactic and semantic between the middle 7 and bottom 5. Cutting between the top 5 and middle 7 individualizes the relationship between middle 7 and bottom 5. On the other hand, only the difference of regular order and reverse order was found in student's haiku, and the superiority of the middle-bottom condition in regular order condition was not remarkable. In other words the effect of the cutting was mild.

3. Experiment 2: The influence that the position of the cutting in haiku gives to the retrieval process

Many haiku kept in Japanese semantic memory have a fixed form of 5-7-5 (Minagawa, 2005b). In addition, it is an important characteristic of haiku that there is space, namely cutting, between the top 5 and middle 7 which is called "Kamigogire haiku", or cutting between the middle 7 and bottom 5 which is called "Nakashichigire haiku" (Fukumoto, 2001). Therefore, it is hypothesized that we retrieve the top 5, middle 7, and bottom 5 in that order when remembering a haiku; however, the retrieval process for haiku that has cutting after the top 5 is different from the retrieval process for haiku that has cutting after the middle 7. In this study, the hypothesis mentioned above is inspected using a priming paradigm.

3.1 Method

3.1.1 Participants

Twelve graduate students (6 males and 6 females: average age 24.8 years old) participated in this experiment. All had normal or corrected-to-normal vision. No one participated in Experiment 1.

3.1.2 Stimulus materials

Fourteen famous haiku written in both historical and recent times (i.e., textbook haiku), which had three units semantically independent of each other, were used as stimulus materials. Seven haiku had cutting after the top 5. These haiku are called “Kamigogire haiku”. The other seven haiku had cutting after the middle 7. These haiku are called “Nakashichigire haiku”. Explanatory sentences of around 100 characters were made about all 14 haiku and were used at the experimental stage of understanding and memory.

3.1.3 Apparatus

Experimental device was the same as Experiment 1.

3.1.4 Experiment design

The present experiment consisted of two within-participant factors (haiku type: Kamigokire haiku / Nakashichigire haiku and six system conditions; see Table 4).

Table 4: Examples of stimulus materials in the six system conditions of the priming experiment

Condition	Yes trial		No trial	
	Prime	Target	Prime	Target
Top-middle	Medetasamo	Chukurainari	Medetasamo	Atsumetehayashi
Top-down	Medetasamo	Oragaharu	Medetasamo	Mogamigawa
Middle-top	Chukurainari	Medetasamo	Chukurainari	Samidarewo
Middle-down	Chukurainari	Oragaharu	Chukurainari	Mogamigawa
Down-top	Oragaharu	Medetasamo	Oragaharu	Samidarewo
Down-middle	Oragaharu	Chukurainari	Oragaharu	Atsumetehayashi

3.1.5 Procedure

As with Experiment 1, the present experiment composed of the following two phases.

(1) Experimental stage of understanding and memory
A haiku was shown on the screen’s center top part and the explanatory sentence of the haiku was shown on the screen’s center bottom. Participants

were instructed to understand and memorize the presented haiku at their own pace. The next haiku and the explanatory sentence were shown when a key was pushed. The participant understood ten haiku and memorized them at their own pace. Of these, in the priming experiment, two haiku were used for a practice trial and eight haiku were used for the main trial.

(2) Experimental stage of priming experiment
"Kamigo", "Nakashichi" or "Shimogo" of the haiku that were memorized in the above mentioned first stage were shown as prime and target stimulus. In the individual trial, the fixation point (one second), prime (500 ms), a blank paper (500 ms), and a target was shown in that order on the center of the screen. The task of the participant was to judge whether prime and targets were the parts of the same haiku by pushing a key as quickly and accurately as possible. The target was shown until either the participant pressed the key or for five seconds. The fixation point of the next trial was shown after 1.5 seconds. The participant understood 14 haiku at their own pace and memorized them in this way. Of these, for the priming experiment, 12 haiku ("Kamigogire haiku", "Nakashichigire haiku", 6 of each) for this exercise trial in two haiku (five slices, middle seven slices, 1 of each) were used. In this trial, seventy two (12 × 6) "yes" trials from 12 haiku were recorded and put together with a "no" trial of the same number, constituting 144 trials in all, as shown in Table 3. The 144 trials were divided into 3 blocks and carried out with a break of two minutes inserted every 48 trials. Preceding the main trial, 24 exercise trials (twelve (2 × 6) "yes" trials, a "no" trials of the same number), using two haiku, were conducted.

3.2 Results and discussion

Table 5 shows average correct answer rates of all conditions in the "yes" and "no" trials. These results indicate that the answers of participants in the present experiment were accurate.

Concerning a correct answer in the "yes" trial, the average discrimination time according to experimental conditions was calculated. Concerning a cor-

Table 5: Average correct answer rates in each experimental condition

		Prime-target condition					
Haiku type condition	Trial	Top-middle	Top-bottom	Middle-top	Middle-bottom	Bottom-top	Bottom-middle
Kamigogire haiku	Yes	94.5	93.8	91.7	95.9	90.3	93.1
	No	92.4	92.4	91.0	93.8	91.7	93.8
Nakashichigire haiku	Yes	95.9	93.1	92.4	92.4	91.0	90.3
	No	93.8	92.4	91.0	91.0	91.7	91.7

Table 6: Reaction time according to the experimental condition in the “yes” trial

		Prime-target condition					
Haiku type condition		Top-middle	Top-bottom	Middle-top	Middle-bottom	Bottom-top	Bottom-middle
Kamigogire haiku	Mean	878	882	1028	735	943	893
	SD	142	171	190	137	205	169
Nakashichigire haiku	Mean	803	938	901	927	1012	995
	SD	93	116	108	195	176	162

rect answer in the “yes” trial, the average reaction time was calculated according to experimental conditions and shown in Table 6.

An ANOVA of the haiku type (2) by the six system conditions was conducted with the reaction times for correct responses in the “yes” trail (6). The ANOVA showed a significant main effect of the six condition (F (5, 55) = 18.392, p < .01) and a significant interaction (F (5, 55) = 18.779, p < .01). The main effect of the haiku type condition did not reach significance (F (1, 11) = .716).

The reaction time of the regular order condition was faster than the reverse order condition. This effect was found in both the haiku type conditions (“Kamigogire haiku” and “Nakashichigire haiku”). Accordingly, a tendency to remember in regular order was identified in both haiku type conditions. These findings were consistent with those of Experiment 1.

Importantly, the significant interaction reflected the following points. In the haiku with the cutting after the top 5 (“Kamigogire haiku”), the reaction time for the middle-bottom condition was faster than the other system conditions. On the contrary, in the haiku with cutting after the middle 7 phrase (“Nakashichigire haiku”), the reaction time for the top-middle condition was faster than the other system conditions. These results demonstrated that there was a syntactic and semantic continuity between middle 7 and bottom 5 phrases in haiku with cutting after the top 5, and there is a syntactic and semantic continuity between the top 5 and middle 7 in haiku with cutting after the middle 7.

4. Conclusion

In this study, only a structure of haiku with “Kamigogire” or “Nakashichigire” was assumed to be a problem to be investigated. On the other hand, the popularity of haiku, the affective meaning or the image of a haiku was not assumed to be a problem to be investigated. However, it may be thought that such a factor as mentioned above, has an influence on the nature of haiku memory, namely a tendency to remember in the regular order found in this study. In addition, the present study was not sufficient in terms of the manipulation of familiarity of a haiku, because both well-known haiku and unknown haiku were included, however, haiku having a medium level of familiarity were excluded from the selection of stimulus materials in the present experiment. Furthermore, taking the variety of existent haiku into consideration, it cannot be said that this paper is enough because only top 5, middle 7 in terms of the point of cutting were examined. These are points that are assumed to be problems for future examination.

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Part IV: Family and education

12. A study on the recent change of Japanese family structure perceived by Japanese university students:
Comparison of the results of Family System Test

Kazuo Ikeda

Abstract

The purpose of this study was to investigate the recent change of Japanese family structure perceived by adolescents. Family System Test was administered to forty Japanese undergraduate students in 2006. The participants were required to portray their family structure by placing figures in the typical, ideal and conflict situations. The results were compared with those collected in 1996 with similar participants. The comparison on the classification of family structure and analyses of dyadic distances between figures showed little differences between two groups of samples as a whole although a few changes were found in the typical and the ideal representations. Most of the results indicated that the Japanese family structure has not changed drastically in this decade, but a few differences suggested a symptom of some change.

Key words: change of family structure, characteristics of Japanese family, Family System Test (FAST)

1. Introduction

Family has been regarded as a very significant group for most of people. Family structure and the interaction between family members must be influential to the behavioral and psychological aspects of each member. From a different point of view, the opinions how one's own family should be, or how each member should behave in her/his family could determine and change the structure of the family. The family structure is, with a broader outlook, settled on the cultural and historical context. In this sense, family must be various and dynamic system.

Recently, systemic approaches have been increasing to investigate family structure on different levels (e.g. Minuchin, 1985). In such researches, two fundamental dimensions are often adopted to describe the interpersonal structure of family system: cohesion and hierarchy. Cohesion is defined as emotional bonding or attachment between family members. On the other hand, hierarchy is referred to authority, decision-making power or the amount of influence exercised by one family member over another (Gehring & Marti, 2001). Theorists of family structure in Western countries claim that well-functioning families have clear cross-generational boundaries regarding both cohesion and hierarchy (e.g. Nichols, 1984). This means that father-mother relationship should be more cohesive than parent-offspring relationship, and that parents should have more power than their children. In contrast, troubled families have unclear generational boundaries (Wood & Talmon, 1983); they show cross-generational coalition where cohesion between a parent and children is stronger than between father and mother, and hierarchy reversal where the power of a child exceeds that of the parents.

As a method to investigate such interpersonal relationships in a family, symbol figure placement techniques (SFPTs) are useful and effective. SFPTs are relatively easy to administer and they provide the spatial representations which could be analyzed quantitatively and qualitatively.

Family System Test (FAST), developed by Gehring (1993), is a type of SFPT. In the FAST, the cohesion of a family is assessed by the closeness of figures placed on a board with a 9 × 9 grid, and the hierarchy is assessed by the difference between the heights of the lower parent and the highest child. In the next stage, it classifies a family into three types according to the assessments of the cohesion and hierarchy: balanced, labile-balanced or unbalanced.

Gehring and his colleagues performed the FAST with Swiss and Californian children and adolescents, and they found similar patterns in the results from the two samples (Gehring, 1993; Gehring & Feldman, 1988; Gehring

& Marti, 1993a, 1993b; Gehring & Wyler, 1986; Feldman & Gehring, 1988; Marti & Gehring, 1992). These results were also supportive to the prediction of the generational boundaries in well-functioning families described above.

Hatta (1977) developed another type of SFPT: Doll Location Test (DLT). In the DLT, participant is required to pin down figures representing her/his family members and other persons (e.g. classmates) on a 30 cm × 30 cm sheet on which a 27 cm-diameter circle and a center dot are printed. From the results of the DLT shown by Japanese students, Hatta and his colleagues (Hatta, 1994; Hatta & Tsukiji, 1993) suggested that the clear-cut generational boundaries did not exist in many Japanese families. That is to say, the cohesive relationship between mother and her children was found also in the normal family. They supposed that such difference in the family structure might be cross-cultural.

Cross-cultural difference has been studied also with the FAST. Ikeda started the research on the cognition of family structure by Japanese students using the FAST since 1995 (Ikeda, 1996).The comparison of Japanese results with those of Western countries have revealed several characteristics of Japanese family structure (see also Ikeda & Hatta, 2001). First, the distribution of structure by classification was not similar in the typical representation. That is, Japanese families were divided almost equally into balanced, labile-balanced, and unbalanced while most of Western families were classified into the balanced and fewer cases were classified into the unbalanced. These results of Japanese family were caused from relatively low cohesion and low hierarchy. In addition, low hierarchy at family level was brought about by the isolation of father in the Japanese typical situation. Second, a similar tendency was found from the analyses of dyadic distances; the father-child distance was longer than father-mother distance and mother-child distance in the typical representation, whereas in ideal representation the father-mother distance was shorter than both the father-child distance and mother-child distance. These results with the FAST also suggest the unique structure of Japanese family.

These characteristics of Japanese family structure might be brought by the social situation in the high-growth period in Japan. The parents of the students who participated in these studies were born just after the World War II: they were so-called “baby boomers”. Many of them grew up in a very competitive situation, and became parents in 70’s. They established the typical modern family which was composed of a farther as an earner, a mother as a full-time housewife and their children. In those times, Japanese fathers had been expected to give a higher priority to their business than to their family matters. As the results, mother mainly dealt with family matters and coordinated family members. Such social factors could be responsible for the absent of the father and the close cohesion between mother and children that brought about the cross-generational coalition. Most of participants in Ikeda (1996) were sons and daughters of parents in the baby boomer generation.

Now, about ten years have passed and the parents of the present university students belong to another generation: “post baby boomer” generation. Many of them became parents in 80’s. The number of two-income families began increasing since 80’s and some young fathers in the post baby boomer generation were getting more active in childcare than before (Kashiwagi & Wakamatsu, 1994). Such changes in the social situation could possibly have some effect on Japanese family structure perceived by university students. At the present, most of university students are sons and daughters of parents in the post baby boomer generation. Therefore, the family structure perceived by the present university students may be different from the structure of the past.

It must be worth comparing the family structure between two groups of samples with one decade interval. In this study, FAST was administered again to the similar adolescents as those of Ikeda (1996), and data collected in both research were compared in two ways: classification of family structure and analyses of dyadic distances. The purpose of this research was to clarify whether or not some changes exist with the representations of Japanese family structure in this decade

2. Method

2.1 Participants

Forty Japanese undergraduate students (24 female and 16 male) participated in this study. The mean age of the students was 21.3 years (ranged 19 to 22).

The samples consisted of thirty-one nuclear families, eight three-generation families and one four-generation family. The mean family size was 4.9 and ranged 3 to 7. It was first time for all the participants to take the FAST. None of the students and other family members had ever treated for a psychological disorder. The participants of sample 1996 (see note 1) were almost the same as those of this study (see note 2).

2.2 Procedure

FAST was administered according to the test manual (Gehring, 1993). The participants portrayed their family structures by placing male and female figures (8 cm high) on the board (45 cm × 45 cm) divided into eighty-one squares (5 cm × 5 cm) and by elevating the figures with blocks of 1.5 cm, 3.0 cm and 4.5 cm heights. They were instructed that the distance between figures represented the cohesion and the height difference of the figures indicated the hierarchy. The respondents completed typical, ideal and conflict representations in this order. The participant was tested individually in the laboratory between October and December 2006.

3. Results

3.1 Classification of family structure

For each representation, cohesion and hierarchy at family level were scored according to criteria of the FAST manual. Cohesion and hierarchy of a family structure was classified into three categories: low, medium or high. Cohesion was scored high if all figures were placed in adjacent squares and medium if all figures were placed within a 3 × 3 square area. If any figure was placed outside a 3 × 3 square area, cohesion of the family was classified low (see Gehring, 1993 for the details and exceptions). Hierarchy of the family was evaluated on the height difference between a lower parent figure and the highest child figure. If the difference was more than a 4.5 cm block, the hierarchy was scored high. If the difference was 1.5 cm or 3.0 cm, the hierarchy was classified medium. It was scored low if the difference was less than 1.5 cm block. The family structure which the elevation of a child figure surpassed that of a parent figure was called “hierarchy reversal”. Figure 1 shows the results of the evaluation of sample 2006 in the typical, ideal and conflict situations (for the comparison, see also Figure 2: the results of sample 1996). The numbers of hierarchy reversal cases are shown in the Table 1. The result of chi-squire test revealed no significant difference in the distribution between both samples.

Typical representation

HIERARCHY	Low	Medium	High
High	1	1	0
Medium	6	4	8
Low	12	4	4
	COHESION		

Ideal representation

HIERARCHY	Low	Medium	High
High	0	0	0
Medium	4	3	22
Low	1	4	6
	COHESION		

Conflict representation

HIERARCHY	Low	Medium	High
High	6	0	0
Medium	14	1	0
Low	15	1	3
	COHESION		

Figure 1: Evaluation of family cohesion and hierarchy (sample 2006)

Typical representation

HIERARCHY				
	High	0	0	0
	Medium	12	9	5
	Low	5	2	6
		Low	Medium	High
		COHESION		

Ideal representation

HIERARCHY				
	High	0	0	0
	Medium	3	11	10
	Low	2	5	8
		Low	Medium	High
		COHESION		

Conflict representation

HIERARCHY				
	High	3	0	0
	Medium	8	2	2
	Low	20	2	2
		Low	Medium	High
		COHESION		

Figure 2: Evaluation of family cohesion and hierarchy (sample 1996)

Table 1: Number and percentage of the hierarchy reversal cases in each representation

	Typical	Ideal	Conflict
sample 2006	7 (17.5 %)	1 (2.5 %)	11 (27.5 %)
sample 1996	13 (33.3 %)	3 (7.7 %)	9 (23.1 %)

From the combination of the previous estimates of cohesion and hierarchy, family structures were classified into balanced, labile-balanced, and unbalanced. This classification was also done according to the criteria of the FAST manual. Balanced family structure is medium or highly cohesive and medium hierarchical. A family structure with medium-level cohesion and low- or high-level hierarchy or with low-level cohesion and medium-level hierarchy is classified labile-balanced. If both cohesion and hierarchy were high or low, the family structure is considered unbalanced. Figure 3 indicates the distribution of three types of family structure with sample 1996 and 2006 in each situation. The analyses of the chi-squire test revealed no significant difference in any representation. These results indicated that perceptions of family structures were not different between two groups of samples.

3.2 Analyses of dyadic distances between figures

The cohesion between father, mother and child (i.e. participant) was analyzed by the dyadic distances. The distance was calculated by Pythagoras' theorem defining the adjacent distance as one. Mean distances and standard deviations are shown in the Table 2 (for the comparison, the results of sample 1996 were also shown in Table 3). To detect the differences in dyadic distance between two family members, analyses of variance were conducted on the data in each representation. The results showed that the main effects of typical and ideal representations were significant (typical: $F\ (2, 78) = 4.09$, $p < .05$; ideal: $F\ (2, 78) = 4.63$, $p < .05$). Subsequent analysis by Tukey method revealed that the father-child distance was significantly greater than the father-mother distance ($q = 4.02$, $p < .01$), and tended to be greater than the mother-child distance ($q = 2.42$, $p < .10$) in the typical representation. In the ideal representation, the father-mother distance was significantly shorter than the mother-child distance ($q = 4.30$, $p < .01$).

4. Discussion

It is more than ten years since the studies on family structure by using the FAST started in Japan. According to the results of early studies, several unique

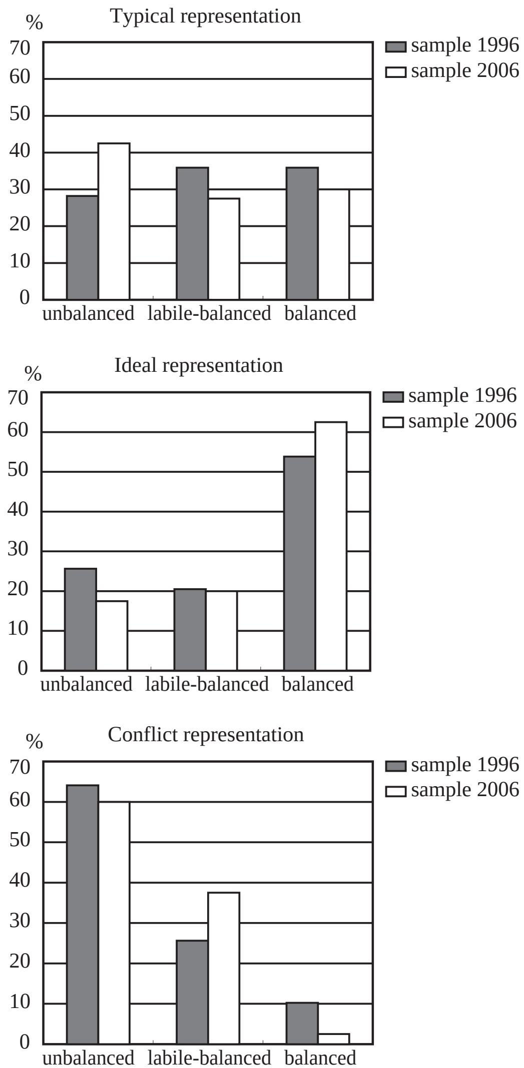

Figure 3: Classification of family structure in each representation

Table 2: Mean dyadic distances in each representation of sample 2006

Representation		father-mother	father-child	mother-child
Typical	mean	1.92	2.48	2.14
	SD	1.73	1.64	1.71
Ideal	mean	1.31	1.67	2.01
	SD	0.89	1.31	1.98
Conflict	mean	4.05	3.83	3.68
	SD	2.98	2.14	2.29

Table 3: Mean dyadic distances in each representation of sample 1996

Representation		father-mother	father-child	mother-child
Typical	mean	1.52	1.97	1.57
	SD	0.65	0.93	0.76
Ideal	mean	1.41	1.79	1.69
	SD	0.52	0.91	1.02
Conflict	mean	3.79	3.94	3.27
	SD	2.80	2.36	2.28

characteristics were found in the typical representation depicted by Japanese students. In the present study, FAST was administered to Japanese university students whose parents belong to post baby boomer generation. The results will be compared with those of sample 1996, in which the parents of the students belonged to baby boomer generation.

First, we shall discuss the results of the family structure classification. According to the classification in the ideal representation, it was found that the cases of the present study distributed into three types very similarly as sample 1996. That is, more than 60 % of the cases were classified into balanced type and about 20 % of the cases were classified into unbalanced- and labile-balanced types in both sample 1996 and sample 2006. Ikeda (2003) investigated, using the FAST, the family structure when the students would become a father or a mother of children. The results showed that more than 60 % of all cases were classified into the balanced type. Judging from these results, we may say that many Japanese students regards the Western style of parent-child relationship in which a certain power difference exists between parents and children as ideal family structure both 10 years ago, now, and in the case when they would become parents.

The classification of the conflict representation in this study was also almost similar as that of sample 1996, although the balance type tended to decrease and the labile-balance type tended to increase. It is usual that the cohesion between family members becomes lower and the hierarchy between parents and children diminishes when some trouble happens in the family. Consequently, unbalanced family type increases as a matter of course.

In the classification of the typical representation, some differences were found although it was not significant according to chi-squire test. That is, ratio of balanced type and labile balanced type decreased and ratio of unbalanced type increased in this decade. In the previous studies (Ikeda, 1996; Ikeda & Hatta, 2001), the distribution to the balanced type was not largest in number with typical representation; it was one of the characteristics in the result of FAST with Japanese university students. The results of the present study suggest that such a characteristic has become more conspicuous. As the typical representation is likely to change with the times most sensitively, the change of the distribution in future must be noteworthy.

Next, let us focus on the results of the analyses on the dyadic distance between two family members. In the conflict representation, every dyadic distance was so long as those of sample 1996. In addition, no significant difference was found between dyadic distances. Many kinds of troubles may cause the conflict in a family, and it is quite possible that the mental distances between family members become longer in various ways.

The analyses of ideal representation revealed some differences to a certain extent. In sample 1996, the distance between father and mother was the shortest and the father-child and mother-child distances were significantly longer, i.e. there was clear generational boundary concerning the cohesion. On the other hand with the data of sample 2006, significant difference was not found between the father-mother distance and the father-child distance, so that the mother-child distance was the longest. The reason for this difference is not clear, but students tended to put the mother figure in relatively distant places from themselves as the rebound of the close relationship between mother and themselves in their real lives. This might be the expression of conscious/sub-conscious avoidance from the generational coalition with their mothers.

The dyadic distances in typical representation of the present study were wholly longer than those of sample 1996, but the relationship between three figures was almost similar. The small change was that the mother-child distance became a little longer than before and that it was not clearly different from father-child distance. It is true that mother and child were still very cohesive because the distance was not significantly longer than father-mother distance just as found in sample 1996, but such results found in the present study may suggest a symptom of some change.

As discussed above, some small changes were found between sample 1996 and 2006. But the family structure as a whole has not changed drastically, and characteristics of Japanese family were still found also in this study. Ten years may be too short for such a social change to become obvious. It must be necessary to collect data continuously from now on so as to judge whether small changes found in this study is a symptom of a large and drastic change or not.

Notes

1. Precisely speaking, the tests were administered in 1995. But we call the sample of the previous test "sample 1996" hereafter as the paper was published in 1996.
2. The participants of sample 1996 were 39 (27 female and 12 male) undergraduate students of the same university as sample 2006. The samples consisted of twenty-six nuclear families, twelve three-generation families and one four-generation family.

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13. Adolescent egocentrism – sociocentrism and autism-spectrum quotient in Japanese people

Mayumi Yamamoto

Abstract

The Japanese version of the adolescent egocentrism-sociocentrism (AES) scale measures the egocentrism in adolescence. Egocentrism was used as a means to understand the character of Asperger syndrome. The autism-spectrum quotient Japanese version (AQ-J) predicated on Asperger syndrome is situated on the continuum from autism to normality. Autism-Spectrum continuum exists in normal subjects with individual differences. The purpose of this study is to examine the relation between the Japanese version of the scale of AES and the autism-spectrum quotient Japanese version. As a result, two factors of egocentrism Self-focuses and egocentrism Imaginary audience in the Japanese version of the AES scale are not related to the subscales of AQ-J. It was assumed that AQ-J measures spatial cognition and the Japanese version of the AES scale measures social cognition.

Key words: egocentrism, asperger syndrome, the Japanese version of the adolescent egocentrism-sociocentrism scale, autism-spectrum quotient Japanese version

1. Introduction

Egocentrism refers to a failure to differentiate or distinguish clearly between one's own point of view and another's in Piagetian terms. Piaget's original ideas on mental development have focused on egocentrism in early childhood, based on experimental studies such as the famous three mountains problem (Piaget & Inhelder, 1956). Here a child has to indicate which view an observer would have from a different position than the child's own. The abilities to reflect upon ourselves and other's psychological processes lead to new levels of empathy and advances in communication. The ability to understand someone else's thoughts, feelings, and points of view develops gradually as children become less egocentric and increasingly able to recognize and coordinate multiple dimensions of interpersonal experiences.

Elkind (1967) argued that adolescent egocentrism accounts for the proclivity among adolescents to be self-focused. According to Elkind (1967), adolescent egocentrism gives rise to three mental constructions: the imaginary audience, the personal fable and the focus of their thoughts. The imaginary audience is when others share the adolescents' self-concerns. The personal fable is a story where adolescents convince themselves that their emotions and experiences are entirely unique. The focus of their thoughts is inward toward the self, rather than outward toward other people.

Enright, Shukla, and Lapsley (1980) reported three aspects of adolescent egocentrism: the imaginary audience, the personal fable, and the self in general tendency (self-focus). The third one was the same as Elkind's focus of their thoughts (Elkind, 1967). As the adolescent matures, they gradually become more sociocentric, the adolescent focuses on the world of politics, government, society, and social perspective taking. The non-social focuses were included to see whether adolescents, as they progressively become more egocentric and then sociocentric, decline in their non-interpersonal or non-social focuses.

Adolescent egocentrism has been thought to be related with social cognitive ability (Coleman & Hendry, 1999). Role-taking and perspective-taking both have to do with social recognition. As for social perspective-taking, it is a means to understand how different viewpoints are mutually related and adjusted. This changes with age. In this way, the egocentrism was treated from the point of view of development.

Enright et al. (1980) made a scale of adolescent egocentrism-sociocentrism (AES). The scale of AES contained a total of 45 items, consisting of 15 egocentrism items, 5 of each in the subscales of the imaginary audience, the personal fable and the self-focusing of their thoughts, also 15 sociocentric or political items and 15 non-social focus items.

Recently, egocentrism is used as a means to understand the character of Asperger syndrome. Asperger syndrome is defined in terms of the individual, meeting the same criteria for autism but with no history of cognitive or language delay, and also not meeting the criteria for Pervasive Development Disorder (American Psychiatric Association, 2003).

Frith and de Vignemont (2005) reported as follows: Asperger syndrome tends to be most often used for the milder forms of autistic disorder combined with high verbal ability. Asperger syndrome individuals with normal or superior intellectual ability show the following features: difficulty in reciprocal social interaction, communication impairment, a lack of flexibility with obsessive tendencies, and a single-minded pursuit of narrow interests. Näive egocentrism is a common source of difficulty in social interchanges as experienced by individuals with Asperger syndrome. Asperger (1944/1993) described the children he identified with Asperger syndrome as “egocentric in the extreme”. That is, their successful mentalizing is limited by a high degree of egocentrism.

Autism and Asperger syndrome lie on a continuum of social-communication disability, with Asperger syndrome as the bridge between autism and normality. Baron-Cohen, Wheelwright, Skinner, Martin, and Clubley (2001) made autism-spectrum quotient (AQ). The scale predicated on Asperger syndrome is situated on the continuum from autism to normality. An autism-spectrum continuum exists in normal subjects with individual differences. Individuals who get a high AQ score show a high autism trend. If the autism trend and Asperger trend form a continuum, it can be assumed that individuals with a high Asperger trend, i.e. with high AQ, are people with high egocentrism.

AQ is a scale to examine the amount of autism trend. Autism-spectrum continuum exists in normal subjects with individual differences. AQ is formed by 5 different areas (social skill, attention switching, attention to detail, communication and imagination) that characterize autism.

Asperger syndrome forms a continuum with the autism trend, it is said to have a high egocentrism. It may be assumed that individuals with a high AQ score have a high degree of egocentrism. Among all these, a connection will only be recognized in the area related with egocentrism.

The purpose of this study is to examine the relation between the Japanese version of the AES scale (Yamamoto, Tomotake, & Ohmori, 2008) and the Autism-Spectrum Quotient Japanese version (Wakabayashi, Tojo, Baron-Cohen, & Wheelwright, 2004).

2. Method

2.1 Participants

The purpose of this study was explained in detail and 144 undergraduate students (77 males and 67 females) were asked to answer two questionnaires. Among them, the number of students who denied participation or had a defective reply were 14 (7 males and 7 females). Consequently the answers from these 130 students (70 males and 60 females) were evaluated. Their ages ranged from 18 to 24 (M = 19.1, SD = 1.1).

2.2 Procedure

The participants were firstly asked to complete the Japanese version of the AES scale. Next, they were given the Autism-Spectrum Quotient Japanese version. They were told that the responses would be treated confidentially and anonymously. The entire procedure took about 50 minutes.

2.3 Measurement

The Japanese version of the AES scale was employed. This scale consisted of four factors (Sociocentrism, Non-social focuses, egocentrism Self-focus and egocentrism Imaginary audience), 33 items. Fifteen items assess the sociocentrism, 8 items assess the non-social focuses, 5 items assess egocentrism Self-focus, and 5 items assess egocentrism Imaginary audience. For a Likert-type scale, the participant read a statement and decided on the degree of importance using a 5 point scale. The scoring of each item ranges from 1 (no importance) to 5 (great importance).

The Autism-Spectrum Quotient Japanese version (AQ-J) by Wakabayashi et al. (2004) was used. This questionnaire is a brief, self-administered instrument. This measured the degree to which an adult with normal intelligence has the traits associated with autistic spectrum. This measure is made of 50 items, with 10 items assessing 5 different areas: Social skills, Attention switching, Attention to detail, Communication, and Imagination. Each item is a 4-point Likert-type scale. "Definitely agree" or "slightly agree" responses scored 1 point on 25 items. "Definitely disagree" or "slightly disagree" responses scored 1 point on 25 items.

2.4 Statistical analysis

Statistical analysis was carried out with SPSS for Windows (Release 14.0 for Japanese edition). Reliability as internal consistency measured by Cronbach's coefficient alpha was tested for the two questionnaires and their subscales. Pearson correlation was used to prove the equivalence among two questionnaires.

3. Results and discussion

The reliability coefficient of four factors of the Japanese version of the AES scale, 5 subscales for the AQ-J, and total score of AQ-J is shown in Table 1. The reliability coefficient with Cronbach's alpha of the Japanese version of the AES scale was more than 0.7 in total and ranged from 0.92 (Sociocentrism) to 0.71 (egocentrism Imaginary audience). Reliability is high. The reliability coefficient with Cronbach's alpha of AQ -J was more than 0.7 with total (0.76) and the Social skills (0.77). However, the reliabilities of the Attention to detail (0.63) and the Communication (0.64) were slightly lower than 0.7. The reliabilities of the Attention switching (0.36) and the Imagination (0.39) were low.

Males score were higher than females at total score of AQ-J (t = 2.52, df = 129, $p < .05$).

There were correlations among the factors of the Japanese version of the AES scale and AQ-J (Table 1). The correlation coefficient between the Sociocentrism and the Social skills was significant for males ($\gamma = -0.24$, $p < .05$).

Table 1: Correlation coefficient between the Japanese version of AES scale and the autism-spectrum quotient Japanese version

	Internal consistency reliability	Sociocentrism 0.92		Non-social focuses 0.74		egocentriem Self-focus 0.77		egocentrism Imaginary audience 0.71	
Gender difference		Male	Female	Male	Female	Male	Female	Male	Female
AQ-J									
Total	0.76	-0.12	-0.12	-0.18	-0.14	-0.11	-0.05	-0.23	0.02
Social skills	0.77	-0.24*	0.06	-0.10	-0.30*	-0.05	-0.10	-0.23	0.09
Attention switching	0.36	-0.10	0.03	-0.07	-0.13	-0.19	0.08	-0.05	-0.05
Attention to detail	0.63	0.18	-0.29*	-0.19	0.28*	-0.18	-0.02	-0.10	-0.07
Communication	0.64	-0.09	-0.12	0.02	-0.13	0.02	-0.01	-0.07	0.06
Imagination	0.39	-0.08	-0.02	-0.20	-0.16	0.08	-0.12	-0.19	-0.02

AES: The Japanese version of AES scale
AQ-J: Autism spectrum quotient Japanese verion
Peason coefficient of correlation * $p < .05$

The correlation coefficient between the Sociocentrism and the Attention to detail was significant for females ($\gamma = -0.29$, $p < .05$). The correlation coefficient between the Non-social focuses and the Attention to detail was significant for females ($\gamma = 0.28$, $p < .05$). The correlation coefficient between the Non-social focuses and the Social skills was significant for females ($\gamma = -0.30$, $p < .05$).

Male scoring was higher than female scoring by total score in AQ-J. This result is consistant with the previous study (Wakabayashi, 2003). In fact, males may have higher autistic traits, relative to female.

The correlation results of the Japanese version of the AES scale and AQ-J were different in males and females. Males with a high level in the Sociocentrism are prone to have high Social skills. In other words, higher social interests show a tendency to higher Social skills.

In the case of females, the results showed that as the Sociocentrism is higher, the Attention to detail is lower, and that as the Non-social focuses is higher, the Social skills and the Attention to detail is higher. Intrinsically, sociality in females is higher than that in males, so there is no relationship with the Sociocentrism and the Social skills. It is said that higher Sociocentrism in females shows a tendency to take a holistic view of things (Kiriyama, Kawaharada, Yamashita, & Yamamoto, 2008; Wakabayashi, 2003). The Non-social focuses indicates preference to personal life rather than communicating with others. It may be proposed that because the females are concerned about others, communicates well to others, they pay Attention to detail and have high Social skills. This result is consistant with the previous study (Yamamoto et al., 2008). Therefore, it is reasonable that the correlation coefficients between the Non-social focuses and the Attention to detail and Social skills were significant in the present results.

Two factors of egocentrism Self-focuses and egocentrism Imaginary audience in the Japanese version of the AES scale are not related to the subscales of AQ-J. AQ-J checked the degree to which an individual adult of normal IQ may have autistic traits. The egocentrism has two levels: spatial cognition and social cognition. The author assumes that AQ-J measures spatial cognition and the Japanese version of the AES scale measures social cognition. Due to subtle mind-reading problems with an AS (Asperger Sydrome)/HFA(High Functioning Autism) person, the questionnaire of AQ included questions in both the social and communication domains, asking about the subject's preferences, rather than only asking to judge their own behavior (Wakabayashi et al., 2004).

In conclusion, the Japanese version of the AES scale, which was made by Enright et al. (1980), is a questionnaire which examines the egocentrism of adolescence. The contents of this questionnaire consisted of both: inner introspection and personal relations. Two questionnaires expressed these different levels of oneself and interpersonal relationship. Therefore, an extremely high correlation coefficient between the Japanese version of the AES scale and AQ-J was not obtained. Hereafter, the Japanese version of the AES scale will have to examine the items of inner introspection and personal relations considering cultural difference.

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14. The validity for the Nakatsuka Screening Scales of Autistic Tendencies (NSSAT)

Hisao Ohnishi and Zenjiro Nakatsuka

Abstract

Ohnishi et al. (2006) constructed the Nakatsuka Screening Scales of Autistic Tendencies (NSSAT) in order to detect autistic-spectrum disorders in early infancy. The NSSAT consists of the following seven scales: (1) Empathy toward Parents, (2) Responsiveness to Others, (3) Awareness of Others, (4) Response Persistence to Peculiar Stimuli, (5) Sleep/Arousal Pattern, (6) Responsiveness to Holding, and (7) Eating Habits. The present study aimed to examine whether the scales in the NSSAT were autistic-specific or common for developmentally disordered. The results demonstrated that the behaviors rated in the NSSAT were less manifested in healthy babies/infants. Furthermore, behaviors rated in Scales 1-5 were critical for autistic-specific ones, but those in Scales 6-7 were not specific for autistic individuals.

Key words: autism, screening scale, early infancy, the NSSAT, validity

1. Introduction

The Nakatsuka Screening Scales of Autistic Tendencies (NSSAT) was developed to measure the early symptoms of autistic individuals who are within 30 months of age (Ohnishi et al., 2006). In the NSSAT, the primary care-giver (almost always the mother) of developmentally individuals is required to rate the characteristics of his/her baby/infant's behavior retrospectively, that is, based upon the care-givers' memory.

Ohnishi et al. (2006) asked the care-givers of 26 autistic and 64 non-autistic developmental-disordered individuals (11 Down's syndrome, 12 cerebral palsy, and 41 other mental retardation) to complete the NSSAT. They demonstrated that the NSSAT, constructed of seven scales, each scale containing ten or seven items (see Appendix 1), are reliable and an available instrument as a rating-scale.

The present study aims to investigate the validity of the NSSAT. The NSSAT was administered to care-givers of normal individuals and the new data (normal controls) and the data (care-givers of autistic and non-autistic developmental disorders) obtained in the previous study was compared (Ohnishi et al., 2006).

2. Method

2.1 Participants

In addition to the original subjects (26 autistic and 64 non-autistic developmental-disordered individuals) recruited in the previous study (Ohnishi et al., 2006), seventy-one healthy infants at the age of 18 months were recruited as a normal control. The subjects' sex and age (range and mean) are shown in Table 1. Autistic children were assessed using the Nakatsuka Scales of Autistic Tendencies (NSAT, see appendix 2) in which Nakatsuka and Fujii (1985, 1986) and Fujii (1986) constructed rating scales to measure the characteristic behaviors (symptoms) of autism.

2.2 Procedure

The primary care-giver (almost always the mothers) of normal infants were asked to complete 61 items in the NSSAT on a three-point scale: In this study, as the age of all subjects was one and half years, the rating format was modified into "2 = often occurred/occurs," "1 = sometimes occurred/occurs," and "0 = never occurred/occurs." Data collected in the previous study (Ohnishi et al., 2006) was re-calculated across each scale for groups of the developmentally disordered.

Table 1: Subjects' age, sex and type of disorder

AGE (in year)	AUTISM		DOWN		CP		MR		CONTROL	
	BOY	GIRL	BOY	GIRL	BOY	GIRL	BOY	GIRL	BOY	GIRL
1.5									30	41
< 3							1			
< 4							2	1		
< 5		2					3			
< 6										
< 7	2									
< 8	1						3			
< 9					1	1	1	1		
<10	4		1							
<11	3	1		1			2			
<12	3		1	2		1	2			
<13	1				4		2	1		
<14	1		1	2		1	1	3		
<15	1	1		1		1	3			
<16	3						2	2		
<17	2			1		1	2	2		
<18						1	2	1		
<19	1				1		2	2		
<20				1						
Total	22	4	3	8	6	6	28	13	30	41

Note: DOWN/down's syndrome, CP/cerebral palsy, MR/mental retardation

3. Results

3.1 Discriminant validity

Table 2 shows the means and standard deviations (*SD*s) separately for the Autistic Group, Non-Autistic Group (combination of Down's syndrome, cerebral palsy, and other mental retardation), and healthy infants to elucidate the discriminant validity of the NSSAT.

Analyses of variances were performed separately for the scales. For all of the scales, there were significant differences between the groups (see Table 2). For all of the scales, F-values were reached at a significant level, so further

Table 2: Comparisons of means and standard deviations (in parentheses) for the groups on each scale

	AUTISM (A)	NON-AUTISTIC (N-A)				HEALTHY (H)	F (2, 158)	Results of further analysis
		DOWN	C P	M R	OVERALL			
NSSAT								
1. Empathy toward Parents	12.04 (5.39)	6.36 (5.42)	4.92 (5.20)	4.80 (5.36)	5.09 (5.37)	0.81 (1.63)	68.94**	A > N-A > H
2. Responsiveness to Others	9.73 (3.94)	3.27 (4.29)	5.75 (4.32)	3.83 (4.12)	4.09 (4.27)	0.73 (1.37)	72.45**	A > N-A > H
3. Awareness of Others	10.23 (4.70)	3.00 (3.33)	3.67 (4.19)	3.59 (3.32)	3.50 (3.51)	1.87 (1.94)	64.69**	A > N-A > H
4. Response Persistence in Peculiar Stimulus	5.62 (2.80)	2.55 (2.02)	2.92 (1.93)	3.49 (3.28)	3.22 (2.91)	3.64 (2.36)	7.54**	A > N-A = H
5. Sleep/Arousal Pattern	4.58 (3.05)	1.91 (1.38)	4.83 (3.31)	2.27 (2.10)	2.69 (2.51)	3.17 (2.53)	4.76**	A > N-A = H
6. Responsiveness to Holding	2.46 (2.72)	2.00 (2.22)	2.08 (2.98)	1.73 (2.51)	1.84 (2.56)	0.29 (0.68)	15.31**	A = N-A > H
7. Eating Habits	0.77 (1.78)	3.55 (3.45)	2.75 (2.95)	1.80 (3.26)	2.28 (3.31)	1.64 (2.09)	3.16*	A < N-A
NSAT								
1. Sharing of Emotion	12.92 (5.16)	5.64 (4.85)	4.25 (3.96)	4.02 (4.54)	4.34 (4.53)	–		
2. Nonverbal Communication	14.85 (3.74)	5.09 (4.46)	6.75 (4.83)	5.83 (5.17)	5.88 (5.01)	–		
3. Verbal Communication	15.58 (2.65)	6.73 (5.58)	9.33 (4.96)	8.22 (5.08)	8.17 (5.20)	–		

Note: DOWN/down's syndrome, CP/cerebral palsy, MR/mental retardation, Healthy/healthy infants

* $p < .05$, ** $p < .01$

multicomparison analyses, Tukey's *q* test (k = 3), were performed. For Scale 1 (Empathy towards Parents), the autistic showed higher scores than both the non-autistic and the healthy infants ($q' = 10.92$, $p < .01$; $q' = 17.56$, $p < .01$), further, non-autistic were higher than the healthy infants ($q' = 6.73$, $p < .01$). These results suggested that the autistic showed these behaviors more than the non-autistic, and the non-autistic more than the healthy babies/infants. Both Scales 2, (Responsiveness to Others), and 3, (Awareness of Others), also showed similar patterns among the groups (autistic – non-autistic, $q' = 11.35$, $p < .01$; autistic – healthy, $q' = 18.12$, $p < .01$; non-autistic – healthy, $q' = 6.77$, $p < .01$, for Scale 2: autistic – non-autistic, $q' = 13.85$, $p < .01$; autistic – healthy, $q' = 17.20$, $p < .01$; non-autistic – healthy, $q' = 3.35$, $p < .05$, for Scale 3). For Scales 4 (Response Persistence in Peculiar Stimulus) and 5 (Sleep/Arousal Pattern), although the autistic showed higher than the other two (autistic – non-autistic, $q' = 5.90$, $p < .01$; autistic – healthy, $q' = 4.86$, $p < .01$, for Scale 4: autistic – non-autistic; $q' = 4.75$, $p < .05$; autistic – healthy, $q' = 3.53$, $p < .05$, for Scale 5), there were no significant differences between the non-autistic and the healthy. These results suggested that each item in Scales 1-5 described the characteristic behaviors seen in autistic individuals at the time of early infancy. For Scale 6, (Responsiveness to Holding), although there were no significant differences between the autistic and non-autistic, there were significant differences between the autistic and the healthy ($q' = 11.00$, $p < .01$) and between the non-autistic and the healthy ($q' = 5.09$, $p < .01$). The lack of "Responsiveness to Holding" was rarely seen in healthy infants, but was a common behavior of developmentally disordered individuals, both the autistic and non-autistic. Scale 7, (Eating Habits), showed that there was only a difference between the autistic and non-autistic ($q' = 3.80$, $p < .05$). These problems in baby food were often manifested in the non-autistic developmentally disordered rather than in the autistic.

3.2 Distribution of scores in the NSSAT

Table 3 shows the distribution of summed scores in Factor I (Scales 1-3), which showed a higher F-value in each scale of the NSSAT and a critical difference

Table 3: Frequency distribution of summed-scores on scales 1-3 in the NSSAT and cumulative relative frequency distribution (in parentheses) for each group

Scores	AUTISTIC	NON-AUTISTIC DOWN	CP	MR	OVERALL	HEALTHY
0	0 (0.0)	1 (9.1)	0 (0.0)	3 (7.3)	4 (6.3)	17 (23.9)
1-0	0 (0.0)	4 (45.5)	4 (33.3)	14 (41.5)	22 (40.6)	44 (85.9)
6-10	1 (3.8)	1 (54.5)	1 (50.0)	6 (56.1)	9 (54.7)	5 (93.0)
11-15	2 (11.5)	1 (63.6)	2 (66.7)	7 (73.2)	10 (70.3)	3 (97.2)
16-20	3 (23.1)	0 (63.6)	0 (66.7)	3 (80.5)	3 (75.0)	1 (98.6)
21-25	1 (26.9)	2 (81.8)	2 (83.3)	0 (80.5)	4 (81.3)	1 (100.0)
26-30	5 (46.2)	1 (90.9)	1 (91.7)	3 (87.8)	5 (89.1)	
31-35	5 (65.4)	0 (90.9)	0 (91.7)	2 (92.7)	2 (92.2)	
36-40	3 (76.9)	1 (100.0)	0 (91.7)	1 (95.1)	2 (95.3)	
41-45	3 (88.5)		1 (100.0)	2 (100.0)	3 (100.0)	
46-50	1 (92.3)					
51-56	2 (100.0)					

Note: DOWN/down’s syndrome, CP/cerebral palsy, MR/mental retardation, Healthy/healthy infants

from other types of disorders, to discriminate the autistic from the non-autistic. When the cut-off point 10 was set up, sensitivity (co-positivity) was 96.2 % (25 of 26 autistic were diagnosed as autistic using the NSSAT), and specificity (co-negativity) was 54.7 %. On the other hand, if a cut-off point of 15 was set up, sensitivity was 88.5 % and specificity was 70.3 %. Considering the ratio of misdiagnosis in the non-autistic, the cut-off point should be set up at 15-point. However, considering the ratio of misdiagnosis in the autistic, 10-point should be established as the cut-off point. As the original purpose of constructing the NSSAT was to detect an autistic individual at the time of early infancy, the 10-point mark as a cut-off point in light of sensitivity and specificity values was adopted. In some cases, an individual who was not diagnosed as autistic might actually be a late-onset case.

3.3 Concurrent validity

To examine the concurrent validity of the constructed NSSAT, each scaled score of the NSSAT was correlated with each of the crucial scales of the NSAT (Scales 1-3 in the NSAT) for the autistic group. Each of the autistic group had been administered the NSAT to diagnose autism. As shown in Table 4, the correlations indicated significantly positive relationships between each of Scales 1-3 in the NSSAT and each of three crucial scales in the NSAT. Furthermore, the result showed significant correlations between Scale 6, (Responsiveness to Holding), and Scale 1 in the NSAT, (Community to Emotion), and between Scale 7, (Sleep/Arousal Pattern), and Scale 2 in the NSAT, (Nonverbal Communication). These results suggest that Factor I in the NSSAT is also a critical factor in measuring and assessing the autistic symptoms at the time of early infancy.

4. Discussion

The primarily construction and development of a rating scale, or the NSSAT, was designed to measure the early symptoms of autistic individuals, recognized within 30 months of age. Factor analyses revealed a five-factor solution for the NSSAT, and Factor I was classified into three sub-scales. Therefore, the NSSAT was constructed of seven scales, each scale consisting of ten or seven items. Scales making up the NSSAT are “Empathy towards Parents,” “Responsiveness to Others,” “Awareness of Others,” “Persistence to Peculiar Stimuli,” “Sleep/Arousal Pattern,” “Responsiveness to Holding,” and “Eating Habits.” According to Ohnishi et al. (2006), internal consistencies in each scale of the NSSAT are generally high.

The present study demonstrated that validation, such as discriminant validity and concurrent validity, are also satisfactory. Among these scales, although Scales 1-5, especially Scales 1-3, are primarily related to the symptoms at the time of early infancy, Scale 7 is not primarily related.

Confirmation of the characteristic symptoms at the period of early infancy, as previously reported in several articles, was also sought. Kanner (1943) described the fundamental disorders as children’s inability to relate themselves

Table 4: Correlations between scales scored on the NSSAT and scales scored on the NSAT for autistic group

NSAT \ NSSAT	1. Empathy toward Parents	2. Responsiveness to Others	3. Awareness of Others	4. Response Persistense to Peculiar Stimulus	5. Sleep/Arousal Pattern	6. Responsiveness to Holding	7. Eating Habits
1. Sharing of Emotion	.83 **	.47 *	.62 **	.03	.27	.50 **	.07
2. Nonverbal Communication	.55 **	.52 **	.64 **	.05	.42 *	.28	.15
3. Verbal Communication	.46 *	.48 *	.51 **	.01	.31	.34	.13

* $p < .05$, ** $p < .01$

in an ordinary way to people and situations. In addition, Ritvo and Freeman's (1978) and Rutter's (1978) criterion also proposed the essential features as the disturbances of capacities to relate to people or impaired social development. Furthermore, Ornitz and Ritvo (1968) argued that although autism may be present at birth, the first symptoms may not be recognized or recalled by his/her parents. They noted that babies with autism were unusually quiet, motorically inactive, and emotionally unresponsive at the immediate postnatal period. These symptoms should be considered in the framework of social relationships. These features are associated with the Scales 1-3, (Empathy toward Parents, Responsiveness to Others, and Awareness of Others), or Factor I, (Social Relating), in the NSSAT. These features are the primary and crucial symptoms in diagnosing autism in early infancy according to the results of our studies.

Disturbances of response to sensory stimuli as described in Ritvo and Freeman's criteria (1978) partially correspond to each item in Scale 4, (Persistence to Peculiar Stimuli), and Scale 6, (Responsiveness to Holding), in the NSSAT. For Scale 6, there were no differences among the type of disorders. Therefore, deficits in response of holding are common behaviors in the developmentally disordered individuals. Moreover, whereas several researchers reported problems in eating at the weaning period (e.g., Kanner, 1943; Ornitz & Ritvo, 1968; Rutter, 1978), which corresponds to Scale 7, (Eating Habits), these symptoms are specific in the non-autistic rather than in the autistic. Perhaps in the developmentally intact individuals, there may be no problems at the weaning period.

The NSSAT was constructed to measure the characteristic symptoms in the autistic as early as possible, and to assess the autistic as behaviorally homogeneously as possible. Each scale constituting the NSSAT satisfies the characteristic behavior described in previous research (e.g., Kanner, 1943, Ornitz & Ritvo, 1968, Ritvo & Freeman, 1978, Rutter, 1978). Behaviors have been agreed upon for the early symptoms of autism, however, it was found that they have included both crucial descriptions and the not-so-crucial in diagnosing autism. For example, although disturbances of eating at the weaning period and of response to being picked up and held were mentioned, these specific behaviors are not critical ones in the autistic, as opposed to the non-autistic and/or overall developmentally disordered. Although, generally, most of clinicians have diagnosed infants as autistic from the presence of only a few characteristic behaviors on the check-list, careful assessment and follow-up will be required.

The NSSAT was constructed and developed by depending on the direct care-givers' memories. Mednick and Shaffer (1963) evaluated the accuracy of the mother's retrospective report as the sources of child-rearing research. They indicated that mother's reports were quite unreliable in some areas (duration of breast feeding, age completion of toilet training, and age of walking) and quite reliable in others (the age of completion of weaning). As Ornitz and Ritvo (1968) described, there are two types of pathological course in autism. One was noted shortly after birth even though mothers were not always able to specify to the subtle nature of their baby/infant's strange behaviors. The other was that parents reported relatively normal development up to 18-24 months, and at 24-30 months the first symptoms were manifested. On the other hand, in Japan, all mothers have a Maternity Passbook, in which both mother's health status for the pre-natal, peri-natal, and post-natal periods and the child's developmental status during neo-natal to pre-school are put on record by medical/health professionals and/or the mother herself. Furthermore, in this study, the care-givers were asked about the presence or absence of very specific behaviors. Therefore, it can be argued that the care-givers' reports in our study can be used as reliable measures to evaluate behaviors.

In future research, prospective study should be conducted, that is, the NSSAT should be administered periodically on occasions, such as health examinations for young children, as a screening (using Scales 1-3) and as a differential instrument (using full scales).

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Appendix 1: The Nakatsuka Screening Scales of Autistic Tendencies (NSSAT)

Scale 1 (Factor I)	**Empathy towards Parents** The items in this scale primarily reflected that he/she had deficits in empathetic interaction with his/her parents emotionally.
Scale 2 (Factor I)	**Responsiveness to Others** This scale reflected deficient responsiveness to other personal stimuli, including deficits of imitation of voice and motion.
Scale 3 (Factor I)	**Awareness of Others** Each item represented a lack of awareness of, or interests in other people and so he/she showed a lack or absence of spontaneous activity toward other people.
Scale 4 (Factor II)	**Response Persistence to Peculiar Stimuli** Items on this scale represented that he/she hyper-responded to unusual stimulation.
Scale 5 (Factor III)	**Arousal/Sleep Pattern** Items on this scale represented that he/she demonstrated an impaired biological cycle, that is, there were tendencies of sleeping in the daytime and awaking in the night.
Scale 6 (Factor IV)	**Responsiveness to Holding** Items on this scale reflected that when he/she was picked up or held in the mother's arm, he/she would go limp or stiffen with peculiar posturing or abnormal muscle tone.
Scale 7 (Factor V)	**Eating Habits** Items on this scale reflected that when solid foods were introduced, or after dentition appeared, he/she refused to hold food in mouth, refused to chew and/or to swallow.

Appendix 2: The Nakatuka Scales of Autistic Tendencies (NSAT)

Factor I: Social Relationships

Scale 1 **Sharing of Emotion**
This scale shows that autistic individuals have deficits in sharing emotions with the primary care-giver, usually his/her mother. Examples of items included in this scale are “The concerned child: In a crowd does not grasp parent’s hand firmly; when lost does not change expression upon reunion with parents.”

Scale 2 **Non-verbal Communication**
This scale shows that autistic individuals have deficits in communicating to others non-verbally, using facial expression and gesture. An example is “The concerned child: Rarely makes eye-to-eye contact.”

Scale 3 **Verbal Communication**
This scale shows that autistic individuals have deficits in communicating to others verbally. An example is “The concerned child: Does not reply or show any sign of reaction when spoken to.”

Scale 4 **Human Relationships**
This scale shows that autistic individuals have deficits in relating to others. Examples are “The concerned child: Even when someone is by his/her side looks or walks past them as if they were not there; Rarely attempts to interact with other people.”

Factor II: Arousal Level and Sensory

Scale 5 **Activity Level**
This scale represents the abnormality of activity such as hyperkinetic or hypokinetic. Examples are “The concerned child: Has tendency to run out of the house, kindergarten, or school; Has a tendency to jump up and down; Will also spin around while doing something else.”

Scale 6 **Stimulus-Response Preference**
The concerned child requires strong and/or strange stimuli. Examples are “The concerned child: Likes to lick seasoning with very strong taste such as soy sauce, worstershire sauce, salt, curry powder, or toothpaste; Likes turning on and off lights, or playing with water in the sink.”

Scale 7 **Primitive Sensory**
This scale represents the abnormality of sense of smell, taste, and touch. Example is “The concerned child: Is sensitive to the smell of foods.”

Scale 8 **Higher Sensory**
This scale represents the abnormality of sense of vision (sight) and hearing. Examples are “The concerned child: Will stare at one point for a long time even though it’s not clear what he/she is looking at; Likes to look at smoke, a toilet being flushed, sand being dropped, etc.”

Factor III: Insistence on Sameness

Scale 9 **Response Persistence to Peculiar Stimulus**
This scale shows that the autistic child prefers or dislikes peculiar stimulus. Examples are “The concerned child: Enjoys looking at telephone-number books, newspaper (TV schedule, Stock selection, etc); Upon hearing a certain sound will clap his/her hands, jumps up and down with joy or fear.”

Scale 10 **Splinter Ability**
This scale represents a specific ability is high, such as having a good memory for machine operation. Example is “The concerned child: Remembers the routes and destinations of railroads or buses.”

Scale 11 **Persistence in Self-Rules**
This scale reflects that the individual is particular about being the same. Examples are “The concerned child: Has a tendency to place things at equal distances from each other, lining them up just right, and gets quite upset if someone disturbs them; Has certain rules for lining up his cars.”

15. The personal relations in a school: Bullying and a teacher's role

Yumiko Yamada and Asako Yamada

Abstract

In this paper, we reviewed and examined the problems occurring in a school, which often cause from the personal relations, using sociology theory. We pointed out first that bullying in Japan was to tend to continue to one target a long time, compared with a foreign country. Secondly we classified the type of the bullying and considered the feature and cause of three types of bullying. Then, it pointed out that the bully group selected the bullied child by the fabricated rule and teased to the feature which can generally also be the merit in many cases. That is, every child can be a bullied child.

Key words: personal relations, school, teacher's role, bulling, labeling theory

1. Introduction

Recently, a lot of problem has been occurring frequently in a school. Those problems cause from the personal relation in many cases.

A school is an important place for the developing children. The problem which occurred from the personal relations may plunge children into the serious situation. Bullying happens not only in a class but in the club activity or extracurricular activities. Moreover, if it becomes long-term bullying, he or she passes on to the next grade. Therefore, when considering bullying, we should consider as a problem of the whole school. Actually, they regarded the personal relations around them in a school as intolerable bullying, and, occasionally have resulted in suicide.

Then we intend to consider the personal relations in a school, analyzing a phenomenon using sociology theory.

2. About bullying

Morita (2001) compares bullying in Japan with bullying in United Kingdom, the Netherlands, and Norway, and is introducing the following figures (Figure 1 and Figure 2). From these Figure 1, we know that the ratio of the person experienced in damage by bullying has much in United Kingdom. However, in Japan and Norway, there are many students who were teased with high frequency and a long time. These figures show that many students have experienced bullying and the bullying does not last long in United Kingdom.

On the other hand, it is also shown that the bullied child is decided in a class and the bullying continues a long time in Japan. That is, there is a tendency that, once a certain child labeled “a bullied child”, the label cannot be removed easily in Japan.

As the example, we introduce the case of the bullying problem that people became thinking seriously after the case. In the case of Hirofumi Shikagawa who was a junior high school student of Tokyo reported in February, 1986, he was teased with the bullying “funeral play” from the classmate, and the teacher

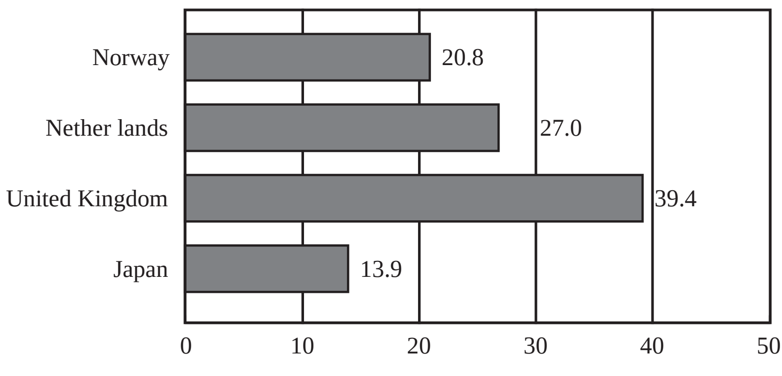


Figure 1: The ratio of the person experienced in damage by bullying

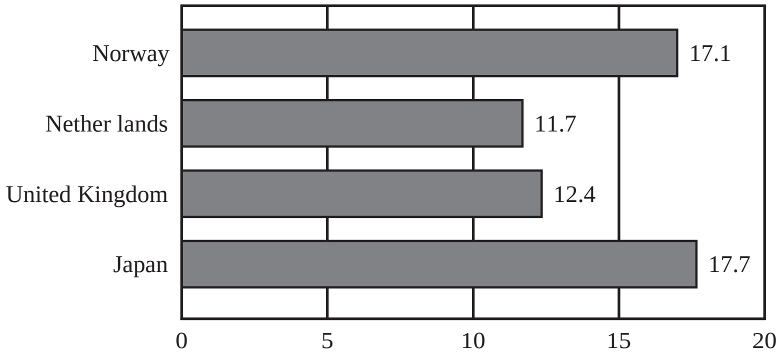


Figure 2: High frequency and a long period of time

had also joined the bullying. This case gave people a big shock.

Moreover, the case of Mr. Kiyoteru Okochi who was a junior high school student of Aichi reported in November, 1994, the bullying group violated him and had deprived him of millions of money. But teachers said that they have not noticed bullying. These facts show that both bullying was continued to the one student seriously a long time.

In addition to both, the case that the teacher's behavior induced bullying is reported in these days.

3. The kind of bullying

Morita and Kiyonaga (1994) have indicated that the structure of group in bullying is four-layer (Figure 3). Generally, it tends to be classified with bullies, bullied children, and surrounding children. Morita classified surrounding children into spectators and onlookers further. Spectators are children who look with fanning around in mock, although they bully directly, and onlookers are children who turn a blind eye.

Here, we classify about the kind of bullying and consider them.

3.1 Weak person bullying type

This type is a form of the conventional bullying. It is the type that a clear difference is between the bullied children and other children objectively in the

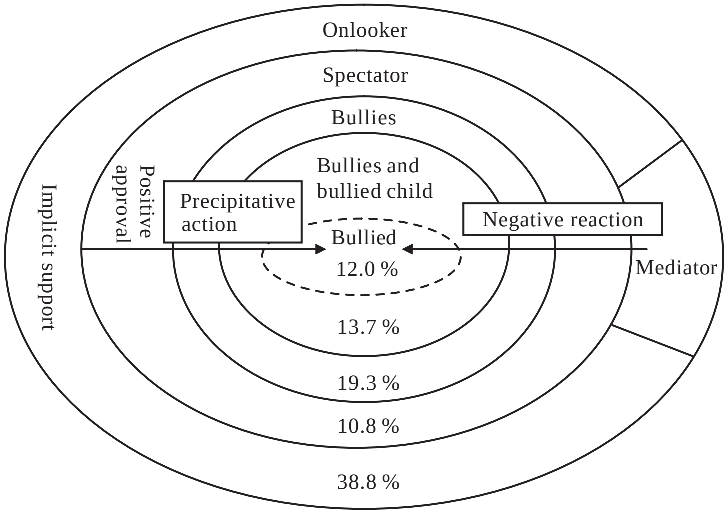


Figure 3: The structure of group in bullying

household economy, the school record, the physical defect, etc., and a bully teases a weak person from a predominance position. As a feature of this bullying, a bully is in more predominance position than a bullied child clearly, and takes out his stress on a bullied child. Further, surrounding children also admit for a bully to tease a bullied child in many cases.

3.2 Drag down type

This type is a form of bullying seen in recent years. There is no clear difference between a bully and a bullied child objectively. The bullying is performed for the purpose of positioning a child in a lower rank than a bully by finding out intentionally the defect of the child who is in a higher rank equally or slightly in the school record etc. It differs from the weak person bullying type by the following two points. The object of this bullying is a child equivalent to a bully or who is in a higher rank more slightly than a bully. By delivering an attack to the weak found intentionally in a group; a bully drops a target to a low rank, and takes out his stress out on a bullied child.

In this case, it can be said that the fabricated good and evil exist as there being no clear difference between a bullied child and a bully. Moreover, a clear difference is between a surrounding student and a bullied child also with the above-mentioned weak person bullying type. The difference should not be essentially seen as a defect. However, since the difference is regarded not as the individual characteristic but as the bullied child's defect, bullying starts. Thus, the rule of the good and evil fabricated by the bully exists in drag down type bullying, by making a bullied child into evil, the bully can justify himself.

The common background in bullying needs the approval of group first. In a weak person bullying type, since the difference with other children is clear and a bullied child is located in a low rank in a group, there is a situation where everyone can become a bully. In drag down type bullying, the bullying to a target begins from a small number of group first. In order that bullies justify the bullying, they make the situation where a target, that is to say, a bullied child, is evil, and bullies are good, and they spread bullying into the bigger group.

We can understand that the percentage in a class has more number of spectators and onlookers overwhelmingly than a bully group in the figure by Morita. If spectators and onlookers take a negative attitude against a bully, bullies are isolated in a class, so bullying is once came to an end. However, if spectators and onlookers fan around in mock or turn a blind eye, bullies will regard their attitude as the approval and bully still severer.

That is, in order to effectuate bullying, there must be more number which sides with a bully's group than the number which sides with a target. From this condition, we would like to point out that target change type bullying is one of the features of bullying in recent years.

3.3 Target change type

Target change type bullying is derivatively generated, when drag and taken-down type bullying is previously performed. Some students located in onlooker layer may notice the label to the bullied child is what it is intentionally labeled by bullies, and may have a question about the standard of the good and evil fabricated in the class. When they go into mediation of bullying, if the number of the students who are the mediator is the majority rather than a bully group, the standard of the good and evil in a class breaks, and the group who was bullying can be labeled as “evil”. On the contrary, if there are few students who are mediators than a bully group, since a bully group tries to label a mediator as “evil”, the target of bullying may interchange to a mediator.

4. Labeling theory

Since a bully labels “a bullied child” on a student and tease him, the form of bullying mentioned above is similar to the labeling in sociology theory.

There is a view that bullying is performed since the bullied child has an element teased originally, but we would like to investigate the cause of bullying with a labeling theory here. Therefore, we introduce labeling theory, assuming a bullied child to be the object recognized as the deviation person from society.

It tends to be thought that the process recognized as a deviation person in a group generally originates in his own behavior. However, according to the labeling theory, the process of deviation recognition is made by a surrounding people reaction.

Becker (1963) says that deviation is produced by a social group’s establishing the rule which will be made into a deviation person if it commits, applying the rule to specific people, and labeling them as an outsider. A surrounding person may establish a rule in order to make a deviation person intentionally. Such labeling process can be applied to the process of the bullying enhancement which has been a educational problem in recent years.

As a process of labeling, at first, a rule is applied to specific people and a deviation person is fabricated. To the person who deviated once, the others are afraid whether he deviates again, and eliminate him. Therefore, the opportunity for the eliminated person to live generally is closed, and he deviates again. And seeing it, the others assumed that their anticipation have been right, and strengthen the elimination to a deviation person. As a result, a deviation person thinks that it cannot but live as a deviation person increasingly, and follows the process in which a deviation identity is formed.

On the other hand, as a process of bullying enhancement, a certain student is first recognized as a bullied child by a bully for the reason of the deviation person from a fabricated rule. And the surrounding students in a class eliminates a bullied child so that they themselves may not be recognized as a bullied child by a bully for making friends with the student recognized as the bullied child. Or he becomes spectators who have fan at bullying and eliminates a bullied child.

By such elimination, the bullied child will be isolated from the surrounding students in the period which should normally study or play together with friends. Moreover, by seeing such a bullied child's condition where it was isolated, the surrounding students assume that it is a bullied child's essence, and deepen the recognition as a deviation person in a class further. A bullied child completely isolated from a class gives up the assimilation to a class further, and forms the identity as a deviation person in a class.

Thus, since labeling may have the serious influence for school life, we should pay attention. Having the knowledge of a labeling theory, bullying must be discovered and solved at an early stage.

5. A teacher's position in bullying enhancement

About the structure of bullying, Morita and Kiyonaga (1994) are described, if it is necessary to analyze after adding two layers, a teacher and parents, in addition to the group in bullying which mentioned above. However, we point out that a teacher and students constitute bullying in a classroom, and classify the relation between a teacher and bullying into five especially here.

(1) Simple action between children type bullying

In simple action between children type bullying, although children's interaction exists, a teacher's power does not act on the process in which bullying is produced, and the teacher cannot recognize bullying. This can be called fundamental type at the beginning of bullying, and almost all types of bullying is expected to finish in this stage.

(2) Teacher intervention type bullying

In teacher intervention type bullying, although children's interaction exists at first and a teacher's power is not acting on the process in which bullying is produced, the teacher recognizes bullying and is doing a certain intervention. When bullying advances considerably, it often sees, and it is bullying of the stage which began to become a problem of the whole class.

(3) Teacher nonintervention type bullying

In teacher nonintervention type bullying, although the teacher recognizes bullying, he does not intervene in it. Even if bullying begins to become a problem of the whole class, a teacher turns a blind eye, and in order to pretend indifference, the result which bullying aggravates further is seen.

(4) Teacher start type bullying

Teacher start type bullying has an interaction between a teacher and a bullied child, and the action becomes a factor teased intensively. A teacher sticks negative stigma on a certain student, or a teacher finds out a student on whom negative stigma is stuck ,then a student is assumed a target which bulling is permitted by the surrounding student in a class. That is, the teacher causes bulling at the beginning of bullying.

(5) Teacher cooperation type bullying

In teacher cooperation type bullying, there is an interaction between a teacher and a bully, and as a result of making the exchange in connection with subsequent bullying generating, bullying comes to be made. For example, a teacher leaves a part of a teacher's role to a certain student, and the student performs bullying with the authority as a teacher's proxy.

The above five classifications show that a teacher is also a constituent of the group in bullying in the scene of bullying.

In the pattern (1), since the teacher has not noticed bullying of the early stage in the class, he is positioned by the "onlooker" layer.

In the pattern (3), as Morita explains, since the teacher turns a blind eye to bullying in a class, he can be set in the position of the "onlooker" at the structure of group in bullying.

The pattern (4) shows that the teacher has played the important role. It is the teacher who stuck negative stigma on the bullied child as a cause of bullying at the beginning. However, those who are actually bullying are students since then. At the scene where bullying is actually performed, since the teacher has not participated in bullying positively, the teacher in this pattern can also position in an “onlooker” layer.

Moreover, in the pattern (5), the teacher leaves a part of a teacher’s role to a bully, since then, it follows the process in which a bully performs bullying by abusing the authority. Also in this case, the teacher does not perform bullying positively and is positioned by the “onlooker” layer.

Only in the pattern (2), the teacher is not in the “onlooker” layer but in the “mediator” layer out of the onlooker layer. However, when the teacher acts on a bully or a bullied child independently in this way, a bully makes friends with a bullied child then, and at the place not visible from a teacher, he may perform bullying continuously. Moreover, since the bullied child “told to the teacher”, bullying to him may become still severer.

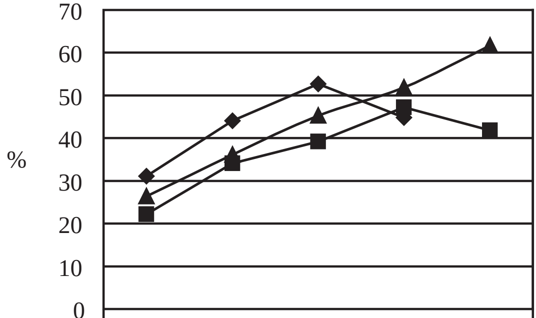
From the above fact, we understand that the teacher is located in the “onlooker” layer in the constituent of bullying structure. And it is suggested that the teacher becomes also a constituent of the permission atmosphere in bullying unconsciously. The teacher has to exert himself to slips out from such a situation, and to become a mediator for the conclusion of bullying.

However, like the pattern of above-mentioned (2), even if it thinks that the teacher came to an end in bullying, it is continued in the invisible place from teachers and may develop into more serious bullying.

In order to avoid such a situation, it is effective that the teacher approaches to the spectators and the onlookers who predominate in the figure by Morita about the structure in bullying at first, and leads to problem solving. It is because it will be thought that bullying leads to a conclusion if those students who are the majority in the structure make an exact judgment to bullying.

In Figure 4 and Figure 5, Morita (2001) shows that there is a tendency for the appearance of a mediator to become difficult as a grade progresses in Japan compared with other countries. Therefore, it is effective that a teacher becomes a mediator oneself, or a teacher acts on spectators and onlookers and urges the appearance of a mediator.

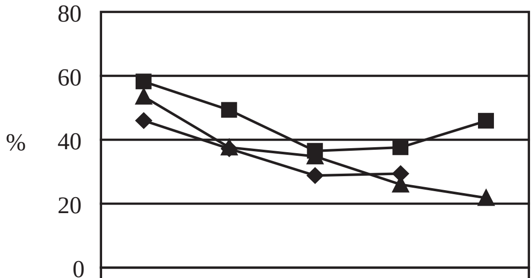
From such a reason, we think that it is an effective measure that a teacher approaches the student who is in spectators or onlookers layer. Moreover, we



	P.5	P.6	J.H.1	J.H.2	J.H.3
Netherland	31.1	44.1	52.7	44.8	
United Kingdom	22.2	34.1	39.2	47.2	41.8
Japan	26.4	36.1	45.3	51.9	61.7

Figure 4: Transition of the “onlooker” and the “mediator” by country (onlooker)

Note: P/Primary school, J.H/Junior high school



	P.5	P.6	J.H.1	J.H.2	J.H.3
Netherland	46.0	37.2	28.8	29.4	
United Kingdom	58.2	49.3	36.5	37.6	45.9
Japan	53.5	37.6	34.8	26.0	21.8

Figure 5: Transition of the “onlooker” and the “mediator” by country (mediator)

Note: P/Primary school, J.H/Junior high school considered that it becomes a major factor of bullying dissolution that the spectators and the onlookers who are the majority in a class stop recognizing a label "a bullied child".

Next, we use the theory of Parsons and examine what kind of correspondence is desirable.

6. Application of the theory of Parsons (1951, 1964)

Spectators and onlookers in bullying space are in the situation which was based on the bully group rather from the teacher. With such a situation, overthrow of bullying permission atmosphere cannot be overthrown, and bullying follows the process of enhancement.

Then, in order to remove spectators and an onlooker from the constituent of bullying permission atmosphere and to extinguish such a space, it is effective to strengthen student-teacher relations more. We apply the table of the social control theory of Parsons (1951, 1964) to bullying space. It is the table which he formulized referring to the process of psychotherapy, since doctor-patient relations have an important meaning for medical treatment in psychotherapy. We can draw one example of teacher's approach methods for spectators or onlookers from his table.

Table 1: The table of the social control theory

	Activeness	Receptiveness
Conformative dominance	Compulsive performance	Compulsive acquiescence
Social control	Interaction refusal	Operation of reward
Alienative dominance	Rebelliousness	Withdrawal
Social control	Support	Permission

Parsons (1951, 1964) mentions the conformative dominance type and the alienative dominance type as a type of deviation. On the bullying problem in a school, it is a serious problem with the excessive agreement behavior to a group from estrangement from a school.

So, in this paper, we consider the portion of the conformative dominance in the table by Parsons (1951, 1964). First, “compulsive performance” is a pattern which is going to carry out superfluous alignment actively to the institutionalized value pattern. It makes the serious strain for both personalities by burdening self and the others with excessive agreement. And it leads a mutual act system towards deviation gradually.

To “compulsive performance”, “Interaction refusal” has the purpose of attaining re-balance-ization to the execution needed. As an example of this pattern, the student of spectators’ role which is a constituent of the group in bullying above-mentioned Morita (2001) is mentioned. The student of spectators’ role is in the situation where they cannot judge fairly about bullying because of the superfluous alignment to a bully group. It is impossible therefore, for them to judge whether the bullied child originally has a defect either.

And Parsons (1951, 1964) mentions “interaction refusal” as a mechanism which controls such an excess and recovers balance. Applying this to a bulling problem, we can give the example that the teacher gives negative sanction to the student who fan around in mock agreeing excessively with the good and evil which the bullies fabricated ,in order to make him notice that he is not right.

Next, “compulsive acquiescence’s” is to led to distorting a normal value pattern, as a result of acting peaceably for fear of estrangement from a value pattern with avoiding the danger oneself. As this example, the student of an onlooker’s role which is a constituent of the group in bullying by Morita (2001) is mentioned. Even if the student of spectators’ role has noticed bullying is wrong, in order to the excessive agreement to the bullying role which bullies fabricate, he is in the situation which cannot take objection to a bully. Takahata (2002) are mentioned as this example the damage-to-property act in the school, school violence and a blind eye of bullying, etc, which happens from the excessive agreement to a group norm. To such behavior, it shall be effective to perform “operation of reward”, which a prize is not given to “peace-first policy” execution but is given when the positive corresponding to a standard is seen. On a bullying problem, the following example is mentioned: when an onlooker's student turns a blind eye, no reward is given from a teacher, but when you have noticed the wrong of bullying, for example, it protests against a bully or becomes a bullied child's ally, a teacher praise him saying that it is wonderful etc. A teacher should adopt such a method intentionally in the class government.

7. Conclusion

In this paper, we pointed out first that bullying in Japan was to tend to continue to one target a long time, compared with foreign countries. Secondly we classified the type of the bullying and considered the feature and cause of three types of bullying. Then, it pointed out that the bully group selected the bullied child by the fabricated rule and teased to the feature which can generally also be the merit in many cases. That is, every child can be a bullied child.

We mentioned that the process of such bullied-child selection is similar with the process of deviation identity formation of labeling theory, and compared with the process of deviation identity formation and the process of enhancement of bulling. Moreover, we considered the teacher's role in such bullying atmosphere. As a result, in almost all cases, the teacher was located in the "onlooker" layer and it pointed out that he is a constituent of bullying permission atmosphere. Then it is important that the teacher exerts himself to slips out from the "onlooker" and changes a role to the "mediator", and approaches the student who is in spectators or onlookers layer to urge the appearance of a mediator. We presented the table of deviation-social control of Parsons (1951, 1964) as an example of the way to do.

Of course, the method shown here is only a proposal. The personal relations in a school are also diversified with social complication. Needless to say, the solution suitable for each case is required.

We would like to continue examination for various cases and to consider the method of other correspondences as a next subject.

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16. Calculation skill and number representation for first and second graders in Japan

Masahiko Okamoto and Hisami Wakano

Abstract

This study examined the relationship between calculation skill and number representation in elementary school children in Japan. 17 first and 18 second graders were given two tasks. One was a magnitude decision task to assess number representation. The other was a calculation task to evaluate the childrens' calculation skill. The results indicated that the good calculators in the second grade had more stable structure of number representation than the poor calculators. These findings suggested that children's number representation relates to their calculation skill in early elementary arithmetic learning.

Key words: number representation, calculation skill, SNARC effect

1. Introduction

The calculation skills of addition and subtraction are the most important skills in elementary mathematics. Developmental studies on number acquisition in young children (e.g., Case & Okamoto, 1996; Resnick, 1983) argued that children acquire the representation of number, so called "mental number line", and then they acquire the calculation skill based on their number representation. Also, the concept of numbers is the decimal system, and the number 10 is a basic number (Greeno, Riley, & Gelman, 1984). Krueger and Hallford (1984) showed that response speed for addition problems including the number 10 (e.g., 10 + 3) is faster than that for another type of addition problem (e.g., 8 +

4). These studies indicated that the representation of numbers is the decimal system.

On the other hand, several studies suggested the number 5 is a basic number for children. For example, Yoshida and Kuriyama (1986) investigated the solution strategies of addition problems for Japanese pre-school children. They demonstrated that pre-school children acquired some addition strategies without a formal education, suggesting that children understand numbers to 5 as a privileged anchor. This finding suggested that Japanese children acquire a number representation different to the decimal system. Furthermore, Miura and Okamoto (1989) examined the differences in the representation of numbers between United States and Japanese first grade children. They indicated that first graders in the United States and Japan differ in their cognitive representation of numbers, and that the representation of number effects the mathematical performance in Japanese children. Yoshida and Kuriyama (1986) and Miura & Okamoto (1989) suggested that a qualitative difference of the number representation relates to mathematical performance. Although these studies argued the relationship between number representation and mathematical performance, they examined both children's number representation and mathematical performance in the same counting task or calculation task. Therefore, it is necessary to access number representation and mathematical performance independently.

There is some research that focuses on the relation between quality of the children's number representation and their mathematical learning (Berch, Foley, Hill, and Ryan, 1999; Booth & Siegler, 2006, 2008). Some tasks were used to investigate the quality of number representation in those studies. One of those is the Spatial Numerical Association of Response Codes (SNARC) effect. Cognitive studies on number representation for adults showed that the representation of number has a spatial structure, and that it may orient from left to right, that is, smaller numbers are represented at the left side of spatial representation, whereas larger numbers are represented at the right (Dehaene, Bossini, & Giraux, 1993; Ito & Hatta, 2004). These studies showed that viewers responded to large numbers faster with the choice on the right side than with that on the left side, this is called the SNARC effect. The SNARC effect suggested that people represent the cardinal number as a left-to-right-oriented analog number line, that is “1-2-3………8-9”.

Berch et al. (1999) examined whether the SNARC effect is exhibited in children ranging from second to eighth graders. They demonstrated that while the SNARC effect appeared in children who are older than the second grade, it did not in second graders. Although this result suggested that second grade children do not have number representation, it is not consistent with the developmental studies on number acquisition (e.g., Krueger & Hallford, 1984; Miura & Okamoto, 1989; Resnick, 1983). This inconsistency may be due to the difference in tasks used between Berch et al. (1999) and other studies (Krueger & Hallford, 1984; Miura & Okamoto, 1989; Resnick, 1983).

The SNARC effect is examined mainly by two tasks: the parity (i.e., odd-even) judgment task and the magnitude judgment task. However, the understanding of magnitude precedes that of the parity in the early structure of number representation (Dehaene et al., 1993). Also, because the first graders in Japan learn the concept of parity in the class of arithmetic, it is difficult for first and second grade children to answer which number is odd or even. Therefore, the magnitude judgment task is more appropriate to assess number representation for first and second graders.

The purpose of this study is to examine (1) whether or not the SNARC effect is observed for first and second grade children in Japan, and (2) how the qualitative difference in the mental representation of number relates to addition skills.

2. Method

2.1 Participants

Participants were 17 first grade (mean age: 6.75) and 18 second grade (mean age: 7.63) children from a public elementary school in Osaka, Japan. These children had no difficulties with academic learning.

2.2 Tasks and procedure

The calculation task and the magnitude decision task were used in this study.

The calculation task was the measure of mathematical performance. This task included 27 one-digit addition problems for first graders and 27 two-digit addition problems for second graders. These problems were printed on a sheet and the children were asked to answer the problems in one minute.

The magnitude decision task was the measure of mental representation of number. In this task, the children were presented with a number pair, e.g., “5-7”, and they were asked to judge which number is bigger.

Four number pairs, “2-5”, “3-5”, “7-5”, and “8-5” were used. Each number pair was presented with two alignments: e.g., “5-7” and “7-5”, therefore eight number pairs were constructed. The experimental session had 4 blocks of 8 number pairs, in total 32 trials.

The schedule of each trial was as follows. Firstly, a fixation cross (“+”) was presented at the center of a screen for 500 ms. Next, the prime number (“5”) appeared at the center of the screen. After 500 ms, from the onset of the prime, a target number (e.g. “2”) was presented at the left or right of the prime “5”. The distance between the prime and the target was 4 cm on the screen. The participants were instructed that “If the right number is bigger, then press the red key ‘6’ of the keyboard. If the left number is bigger, then press the green key ‘4’ of the keyboard”. All response times were measured from target onset to key response. The target and the prime were presented until the viewer’s response. The next trial started immediately after the viewer’s response. The prime number (“5”) was presented on every trial to activate viewers’ mental number line. Figure 1 shows the time schedule for each trial.

The stimulus presentation and the response time recording were controlled by the PsyScope on apple iMacDV and its keyboard. The participants were seated 40 cm away from the monitor and were told that both speed and accuracy was important in this task.

This experiment was carried out in November 2005, the end of the second semester in Japanese elementary school. The calculation task was carried out in a group and the magnitude decision task was conducted individually. Experimenters were university students.

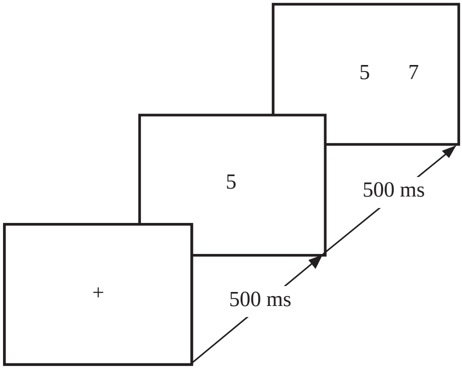

Figure 1: The time schedule for each trial

3. Result

3.1 Calculation task and grouping

The mean number of correct responses in the calculation task was 21.3 (*SD* = 5.6) for first graders and 18.7 (*SD* = 5.4) for second graders. Participants were divided into three groups on the basis of these scores. The good calculators (*N* = 6 for first graders, *N* = 4 for second graders) gained a score which is above 1 *SD* from the mean, average calculators (*N* = 9 for first graders, *N* = 10 for second graders) gained a score which is plus minus 1 *SD* from the mean, and the poor calculators (*N* = 2 for first graders, *N* = 4 for second graders) gained a score which is below 1 *SD* from the mean.

3.2 Calculation skill and number representation

The mean response times of the correct response were computed for each stimulus sets in magnitude decision task for each grade. Figure 2 shows the mean response time for first graders and Figure 3 shows it for second graders. An analysis of variance (ANOVA) of calculation skill (3) by number pairs (8) was carried out for the response time of the first graders. The main effects and the interaction were not significant. Also, the main effects and the interaction were not significant for second graders. These results indicated that the magnitude decision did not influence the calculation skill in both first and second graders.

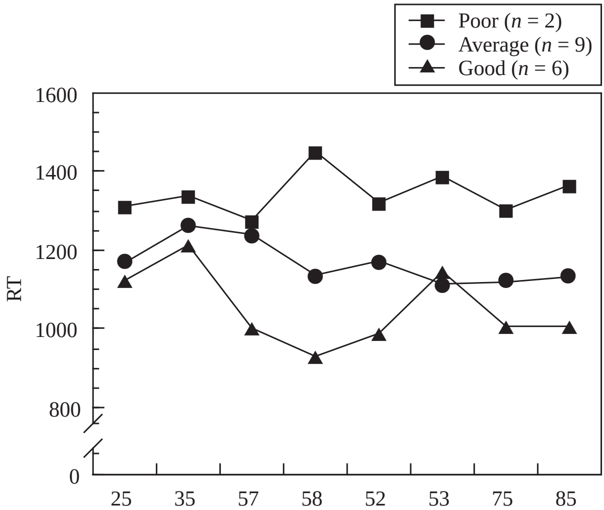

Figure 2: The mean response time for each calculation skill group in first grade

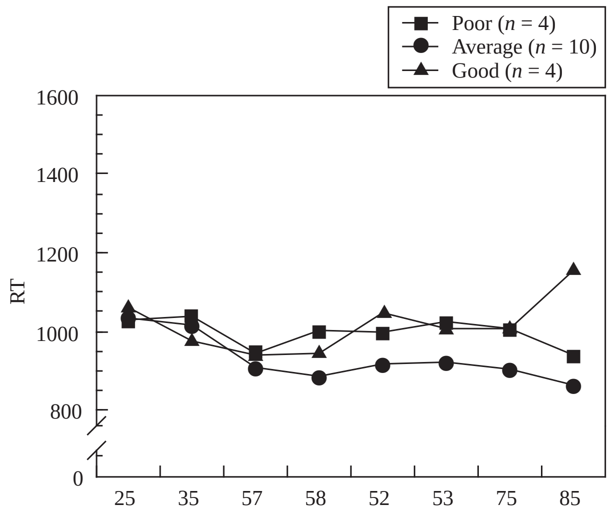

Figure 3: The mean response time for each calculation skill group in second grade

The result of a t test on the response times showed that the response speed was faster for second graders than for first graders ($t = 2.58$, $df = 33$ $p < .05$).

Figure 4 and Figure 5 show the "dRTs" for each calculation skill group in first and second graders. The dRTs was used as the index of spatial structure of numbers in previous studies (Dehaene, et al., 1993; Ito & Hatta, 2004). The dRTs was computed by subtracting the mean response time for a right large number pair, e.g. "5-7", from the mean response time for a left large number pair, e.g. "7-5". If there is a spatial structure of number representation, the response times for the right large number pair are faster than for the time of the left large number pair. Therefore, dRTs has a positive value for "2-5" or "3-5" and has a negative value for "5-7" or "5-8". If the participants did not have spatial structure of number representation, dRTs has nearly zero value.

The simple regression analysis for first graders revealed the following equations:

Poor: dRTs = – 62.20 + 12.27 (magnitude)

Average: dRTs = 71.98 – 0.95 (magnitude)

Good: dRTs = 182.47 – 30.32 (magnitude)

The regression weight of magnitude was not deviated from zero for poor and average calculators. However, the regression weight for good calculators was slightly deviated from zero ($t = –1.79$, $df = 22$, $p < .10$).

The simple regression analysis for first graders revealed the following equations:

Poor: dRTs = 23.83 – 2.63 (magnitude)

Average: dRTs = 146.30 – 17.58 (magnitude)

Good: dRTs = 67.94 – 28.91 (magnitude)

The regression weight of magnitude was deviated from zero for good calculators ($t = – 2.28$, $df = 15$, $p < .05$) and for average calculators ($t = – 1.69$, $df = 38$, $p < .10$), but not for poor calculators. These results suggested that good calculators have a strong spatial structure of number representation.

4. Discussion

The purpose of this study is to examine (1) whether or not the SNARC effect is

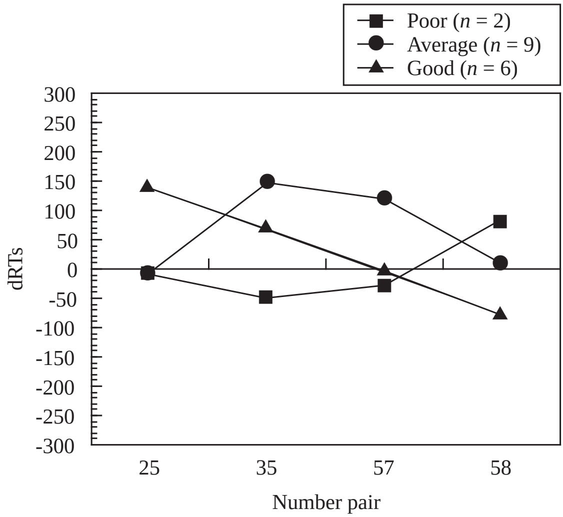

Figure 4: The dRTs (RT (right large number pair) – RT (left large number pair)) for each calculation skill group in first grade

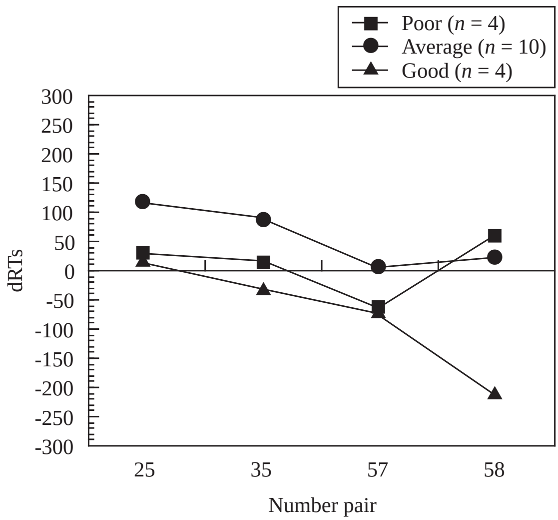

Figure 5: The dRTs (RT (right large number pair) – RT (left large number pair)) for each calculation skill group in second grade

observed for first and second grade children in Japan, and (2) how the qualitative difference in the mental representation of number relates to addition skills.

Considerable developmental studies on numbers have indicated that children acquired basic addition and subtraction skills on their number representation (Greeno et al., 1984; Miura & Okamoto, 1989; Yoshida & Kuriyama, 1986). However, the previous studies (Miura & Okamoto, 1989; Yoshida & Kuriyama, 1986) examined children's representation from the point of strategy in various mathematical tasks-counting, mental addition and so on. So, it is necessary to assess the number representation with an independent and quantitative measure.

In this study, the SNARC effect was used as the index of number representation. If the SNRAC effect is observed, it means the spatial structure of number is formulated. The SNARC effect was investigated using the magnitude decision task and the parity judgment task as used in previous cognitive studies for adults (Dehaene et al., 1993; Ito & Hatta, 2004). Although Berch et al. (1999) used the parity judgment task, the SNARC effect could not be found for second graders in USA. These findings suggest that the parity judgment task is difficult for second graders. The purpose of this study is to examine the relationship between a spatial structure of number and a calculation skill for first and second grade children, who are in the first stage of calculation skills. Also, because the parity concept is learned at first grade in Japan, the magnitude decision task was used to examine the SNARC effect.

The results of this study revealed the children's calculation skill level did not modulate the simple response time in the magnitude decision task, however, the calculation skill related to the number representation in second graders. The good calculators in the second grade showed a strong SNRAC effect, but the poor calculators did not. This finding is consistent with the previous findings that children acquire calculation skill based on their number representation (Miura & Okamoto, 1989; Yoshida & Kuriyama, 1986), also, the good calculators have a better spatial structure of number representation than the poor calculators. Therefore, it may be possible to use the dRTs as a predictor for future calculation skill in early elementary arithmetic.

Although the statistical significance was not found in the regression analysis, the positive dRTs for small numbers and the negative dRTs for large numbers were obtained from the good calculators in the first grade and from the average calculators in the second grade. It seems reasonable that the good calculators in the first grade and the average calculators in the second grade may be going to formulate their spatial structure of number representation from left to right, 1-9. The average and poor calculators in the first grade and the poor calculators in the second grade did not show the SNARC effect. However, it may not be concluded that these children do not have number representation at all. Therefore, further research is necessary to investigate immature number representation.

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Index

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