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<thead>
<tr>
<th>Title</th>
<th>Efficacy of a thematic mapping treatment on Cantonese-speaking aphasic patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Contributor(s)</td>
<td>University of Hong Kong</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Tsoi, Kong-yin; 蔡港燕</td>
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<tr>
<td>Citation</td>
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<td>Issued Date</td>
<td>2002</td>
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<td>URL</td>
<td><a href="http://hdl.handle.net/10722/56289">http://hdl.handle.net/10722/56289</a></td>
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</tbody>
</table>
Efficacy of a Thematic Mapping Treatment

on Cantonese-speaking Aphasic Patients

A dissertation submitted in partial fulfilment of the requirements for the Bachelor of Science

(Speech and Hearing Sciences), The University of Hong Kong, May 10, 2002.

Tsoi Kong Yin
Abstract

This paper reported the efficacy of a thematic mapping treatment on seven Cantonese-speaking aphasic patients with asyntactic comprehension. The 'Sentence query' approach used in Schwartz, Fink, Myers and Martin (1994) was adopted in this study. Efficacy was measured using a multiple baseline design manner. Training was conducted on five sentence structures following the sequence: actives, tsoeng-construction, subject-object relatives, passives and subject-subject relatives. Mixed results were found. Only three patients showed specific training effect on non-canonical sentence structures, and one of them failed to generalize beyond the training task. Limited generalization to production was revealed. A double dissociation between sentence comprehension and grammaticality judgement was also noted. Based on these findings, modifications to the selection criteria of patients receiving mapping treatment were suggested in order to maximize the efficacy of the treatment.
Introduction

The cognitive neuropsychological approach (CNP) in the study of aphasia has become increasingly popular in the West over the past two decades. This approach assumes that insights into the processing in human perception, language and memory will eventually lead to development of better therapies (Ellis & Young, 1988). It contributes to the treatment of aphasics by narrowing down the possible treatment choices based on the patient’s cognitive resources (Basso & Marangolo, 2000).

The investigation into sentence processing using CNP on English has a relatively long history and various therapies were developed. Yet, the applicability of CNP on Chinese is not well understood. In particular, sentence comprehension processing in Chinese is unclear and effective therapy on acquired sentence comprehension deficit for Chinese-speaking aphasic patients is lacking. Additionally, it is valuable to know if models and therapies developed for English-speaking patients can be applied to Chinese-speaking patients. This study aimed at investigating the efficacy of a thematic mapping treatment on Cantonese-speaking aphasic patients.

The following sections provided some background on the current understanding of sentence processing in aphasic patients, the mapping hypothesis and previous mapping treatment studies on English- and Cantonese-speaking aphasic patients.

Sentence processing in aphasic patients

Aphasic patients who show particular difficulties in comprehending semantically-reversible sentences are described as having asyntactic comprehension. Semantically-reversible sentence refers to a sentence in which either order of the two nouns in the sentence could form a plausible sentence (e.g. a boy pushes a girl). In that case, patients cannot use a heuristic based on semantic properties of nouns (the animacy contrast) or the order of the nouns to determine
the thematic roles in sentence contexts as in non-reversible sentences (e.g. a boy pushes a chair). Interpretation of semantically-reversible sentence requires syntactic as well as semantic processing of the sentence, thus it poses greater challenge to comprehenders. Asyntactic comprehension is present in many English-speaking aphasic patients with agrammatism, though the two deficits are dissociable (Schwartz, Saffran, Fink, Myers & Martin, 1994). Among reversible sentences, English-speaking asyntactic comprehenders generally performed better on canonical sentences (e.g. in 'A boy pushes a girl', the agent and patient are assigned to 'boy' and 'girl', respectively, in an order identical to the word order) than non-canonical sentences (e.g. 'A girl is pushed by a boy', a shift of arguments from their canonical positions is involved) (Caplan & Hildebrandt, 1988).

Asyntactic comprehension in Chinese-speaking aphasic patients has also been studied (Chen, Tzeng & Bates, 1992; Leung & Law, 1999; Law & Leung, 1998, 2000). These patients performed better on semantically non-reversible than reversible sentences. They also experienced more difficulties in comprehending full passives and subject-gap reversible sentences (non-canonical sentences) than active and object-gap sentences (canonical sentences). These findings confirm the presence of Chinese-speaking aphasic patients showing the comprehension pattern similar to that of English-speaking asyntactic comprehenders and thus raises the question about the possibility of applying therapies developed for English-speaking aphasic patients on Chinese-speaking aphasic patients.

Several theories have attempted to explain asyntactic comprehension. These include the Mapping Hypothesis (Schwartz, Linebarger & Saffran, 1985; Caramazza & Berndt, 1985), the Linear Strategy (Caplan, 1985; Caplan & Futter, 1986), the Trace-Deletion Hypothesis (Grodzinsky, 1986 & 1990; Beretta & Munn, 1998) and the Capacity Theory (Haarmann & Kolk, 1991; Just & Carpenter, 1992; Miyake, Carpenter & Just, 1994; Haarmann, Just &
Carpenter, 1997). Though none of these theories could fully account for the asyntactic comprehension observed in all languages, the mapping hypothesis was focused in this study since it is presumably universal for many different languages. In particular, the thematic mapping treatment, one of the forms of mapping treatment, was investigated in this study.

**Mapping Hypothesis**

One of the most recent descriptions of mapping process in sentence comprehension processing came from Mitchum, Greenwald and Berndt (2000)—the visual and auditory stimuli are encoded as the orthographic and phonological representation respectively; they are then processed at the positional level (encoding the surface syntactic representation) and finally the functional level (working out the semantic meaning and relations for each grammatical constituent). The mapping process refers to the translation between grammatical constituents (subject, object) at the positional level and the corresponding thematic roles (agent and patient/theme) at the functional level. It is generally assumed that procedures for mapping in sentence comprehension and production are in common.

The mapping hypothesis explains asyntactic comprehension by suggesting a delinkage between the positional and functional level (Schwartz et al., 1994). Patients with mapping deficit fail to perform thematic role assignment by demonstrating role reversal errors (Jones, 1986). They experience a greater difficulty in the comprehension of non-canonical than canonical reversible sentences (Byng, 1988; Schwartz et al., 1994, Leung & Law, 1999). The hypothesis carries the assumption that the patients’ sentence parsing ability, verb-argument structure, lexical and grammatical knowledge for mapping process are relatively intact (Schwartz, Linebarger, Saffran & Pater, 1987; Saffran & Schwartz, 1988). Their deficit in comprehension should not be accounted for by impairment in syntactic or semantic representation and therefore, they must possess a high accuracy in grammatical judgement and
knowledge of word meaning.

There are mainly two variants of the mapping hypothesis, namely the ‘lexical’ and the ‘procedural’ mapping hypotheses (Mitchum et al., 2000). The lexical mapping hypothesis accounts for errors on even simple reversible active sentences due to the loss of lexically-specified mapping information carried by the main verb. The procedural mapping hypothesis accounts for the failure in thematic role assignment in sentences with a shift of arguments from their canonical positions (e.g. passives). It is due to disruption of the procedures that link the thematic roles to their relevant noun phrases with reference to the syntactic functions (Saffran & Schwartz, 1988; Schwartz et al., 1987).

**Previous mapping treatment studies**

Based on the mapping hypothesis, different approaches of mapping treatment were developed. Two verb-centred treatments, the ‘Sentence query’ approach and the ‘Sentence ordering therapy’, put the focus on the verb; whereas the active/passive feedback procedure (A/P feedback) focuses on the specific system of feedback. All approaches aimed at improving asyntactic comprehension and different tasks were designed to link the syntactic and semantic representations together (see Mitchum et al., 2000, for a recent review on mapping treatment studies on English-speaking aphasic patients).

Jones (1986) and Schwartz et al. (1994) adopted the ‘Sentence query’ approach by using a probe-question technique to assist patients in identifying the verb and the noun phrases corresponding to different thematic roles. Patients had to respond to the questions by circling or underlining the relevant phrases. Among the seven patients receiving this therapy, only two of them, FO and EW in Schwartz et al. (1994), demonstrated significant extensive gains.

Nickels, Byng and Black (1991), Byng, Nickels and Black (1994) and Marshall, Chiat and Pring (1997) adopted the ‘Sentence ordering therapy’. The patients were instructed to identify
the thematic roles in a sentence anagram task to match with a presented picture. Among the six patients receiving this treatment, only BRB in Byng (1988) showed gains on most structures.

Mitchum, Haendiges and Berndt (1995), Haendiges, Berndt and Mitchum (1996) and Berndt and Mitchum (1997) adopted the A/P feedback approach to raise patients' awareness of the mapping process. During the treatment, active and passive sentences were presented alternately, in which the patient had to indicate if the spoken sentence shared the same meaning with the presented picture. None of the three patients receiving this treatment grew out of the mapping deficit for all sentences.

In terms of generalization beyond specific tasks and stimuli used in the treatment, all three patients receiving treatment using the A/P feedback approach demonstrated generalization to comprehension of non-canonical sentences with untreated verbs, compared to only three out of sixteen patients receiving verb-centred mapping treatment showing such gain. In contrast, generalization to production was only evidenced in verb-centred mapping treatments. Mitchum et al. (2000) suggested that such generalization appeared to be specific to treatment task, thus casting doubt on the assumption that mapping process for comprehension and production are common.

Mapping treatment adopting the probe-question technique was also applied on two Cantonese-speaking aphasic patients with asyntactic comprehension (Leung & Law, 1999). Only one patient demonstrated gains in the auditory sentence comprehension.

Given that only two Chinese aphasic patients’ outcomes of mapping treatment were reported and with divergent results, one purpose of this study was to examine the efficacy of the thematic mapping treatment on a larger sample of Cantonese-speaking aphasic patients with asyntactic comprehension. In addition, this study examined the occurrence of any generalizations from trained to untrained items and from comprehension to production.
modality. Findings of this study would shed light on sentence processing in Chinese. Clinical implications of aphasic rehabilitation would be discussed at last.

Methods

Subjects

Three female and four male Hong Kong Cantonese-speaking aphasic patients were invited to participate in this study. All subjects were right-handed with onset of aphasia ranging from four months to nine years. Table 1 presents their demographic information, including their clinical classification based on the Cantonese Aphasic Battery (CAB) (Yiu, 1992).

All subjects were assessed by a sentence comprehension screener (Law, 1994). The screener involved a sentence-picture matching task performed in visual and auditory modes separately. In each trial, the subject chose one picture out of two that matched with the sentence presented. The target picture was paired with a role-reversal distracter. The sentences were varied as a function of reversibility and canonicity. Canonical sentences included actives, tsoeng-construction and subject object-relative (SOR). Non-canonical sentence included passives and subject subject-relative (SSR). All subjects showed asyntactic comprehension, with greater difficulty on semantically reversible than non-reversible sentences, and non-canonical than canonical sentences.

Design of the study

A thematic mapping treatment similar to that used in Schwartz et al. (1994) was adopted in this study. A multiple baseline design was employed in which the same treatment paradigm using the ‘Sentence query’ approach was applied sequentially to five sentence structures (see figure 1).

Pre- and post- treatment assessment
Table 1
Demographic information of subjects

<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex</th>
<th>Age</th>
<th>Time post-onset</th>
<th>Clinical classification</th>
<th>Etiology</th>
<th>Education</th>
</tr>
</thead>
<tbody>
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<td>M</td>
<td>62</td>
<td>3 years</td>
<td>Transcortical motor</td>
<td>C.V.A.</td>
<td>Primary school</td>
</tr>
<tr>
<td>LauKH</td>
<td>M</td>
<td>42</td>
<td>4 months</td>
<td>Transcortical motor</td>
<td>C.V.A.</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>LLM</td>
<td>M</td>
<td>26</td>
<td>6 years</td>
<td>Anomia</td>
<td>C.V.A.</td>
<td>Secondary school</td>
</tr>
<tr>
<td>LKH</td>
<td>M</td>
<td>43</td>
<td>3 years</td>
<td>Wernicke's</td>
<td>Close head injury</td>
<td>High school</td>
</tr>
<tr>
<td>LWY</td>
<td>F</td>
<td>53</td>
<td>2 years</td>
<td>Anomia</td>
<td>C.V.A.</td>
<td>High school</td>
</tr>
<tr>
<td>CVR</td>
<td>F</td>
<td>59</td>
<td>7 years</td>
<td>Transcortical motor</td>
<td>C.V.A.</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>HSM</td>
<td>F</td>
<td>40</td>
<td>9 years</td>
<td>Transcortical motor</td>
<td>Brain tumor</td>
<td>High school</td>
</tr>
</tbody>
</table>

C.V.A. = Cerebro-vascular accident

Pre-treatment assessment: Language Assessment Package (LAP)

Pre-training on probe-questions

Pre-treatment baseline: Baseline/ generalization test

Training and multiple baseline during treatment:
- Phase A training—actives
  - Baseline/ generalization test
  - Phase B training—tsaeng-construction
  - Baseline/ generalization test
  - Phase C training—subject object-relative (SOR)
  - Baseline/ generalization test
  - Phase D training—passives
  - Baseline/ generalization test
  - Phase E training—subject subject-relative (SSR)

Post treatment baseline: Baseline/ generalization test

Post treatment assessment: LAP

Figure 1. Summary of the design of the mapping treatment
Language Assessment Package (LAP) was conducted before and after the treatment. The package included:

1. **a sentence comprehension test**. It was to measure the generalization beyond training task and stimuli. Comprehension of nine sentence structures, including four canonical, three non-canonical sentences, truncated passives (TrP) and SSR with a truncated passive (SSR-TrP), were assessed. Canonical sentences included actives, tsoeng-construction, subject object-relative (SOR) and subject subject-relative with a full passive in the relative clause (SSR-Pass). Non-canonical sentences included full passives, subject subject-relative (SSR) and SSR with a tsoeng-construction (SSR-tsoeng). A sentence-picture matching task similar to that in the sentence comprehension screener was performed in visual and auditory modes separately.

2) **a sentence anagram production test**. It was to measure the generalization to production by assessing the subjects' production of 30 actives, passives and tsoeng-construction each. The test was presented in visual mode. On each trial, the subject had to re-arrange several sentence fragments into a sentence which matched with the picture presented. An active sentence was broken down into two noun phrases and a verb. A passive or tsoeng-construction sentence was broken down into two noun phrases, a verb and ‘pei’ or ‘tsoeng’.

3) **a grammaticality judgement test**. It was to monitor the ability to make grammaticality judgement in a contrastive judgement task. The subject had to choose the one that sounded more ‘natural’ out of two sentences presented in visual and auditory modes simultaneously.

4) **two short-term memory tests for digit span** (Christensen, 1974). It was to monitor the short term memory in visual and auditory modes via digit recall and matching.

For detail description on the first three tests, readers should refer to Law and Leung (2000).
Pre-training

The treatment program began with one pre-training session to familiarize the subject with the probe questions and mode of response. Only non-reversible active sentences were used. Three probe questions were asked by the clinician verbally: (1) 'Where is the main verb?', (2) 'Where is the agent?' and (3) 'Where is the patient/theme?'. Question one was always the first question to be attempted, followed by either role question on the agent or the patient/theme at random. The subject was required to underline the phrase corresponding to each probe question with different color pens. No feedback was given. The criterion for finishing this training was at least eight correct out of ten consecutive trials on the first role question.

Baseline/generalization test

Comprehension of 50 written sentences was assessed via a set of probe questions targeting on the verb and the roles (agent and patient/theme) as in the pre-training session before and after training for each phase. These 50 stimuli consisted of ten sentences in each of the following sentence types containing untrained verbs: actives, tsoeng-construction, SOR, passives and SSR. No feedback was given.

Training

The training consisted of five sequential phases, from phase A to E, targeting on canonical sentences and then non-canonical sentences. Twenty sentences of the corresponding target sentence type were trained in each session. On each trial, the written sentence was read aloud by the clinician and the patient, in sequence. Then, the patient attempted the probe questions as in the pre-training session. If necessary, correct answers and explanations were given to the patient immediately. Criterion of leaving one phase to the next was committing no more than four errors out of twenty trials on the first role question for five out of six consecutive sessions (N.B. For LLM and LauKH, treatment was reverted to the previous phase since inconsistent
performances on trained sentences were detected in the baseline/ generalization test. This was to ensure that they had consolidated skills learnt in previous phases). The treatment sessions were scheduled three times a week, 1 to 1.5 hours each. The therapy was terminated when the subject finished all five phases of training consistently or when fifteen weeks were up, whichever came first.

**Materials and Equipment**

Materials included LAP, a portable Macintosh computer for running the HyperCard in LAP, and stimuli cards for the pre-training, the baseline/ generalization tests and the training. Sentences used in the baseline/ generalization test and the training were randomly chosen from a large sentence bank. Padded sentences were included in order to avoid the patient adopting order-based heuristics. Readers should refer to Leung and Law (1999) and Law and Leung (2000) for details.

**Data analysis**

The percentage correct was calculated on the sentence comprehension test, sentence anagram production test and grammaticality judgement test. For sentence comprehension test and grammaticality judgement test, level of performance for above-chance and below-chance were set at ≥ 75% accuracy and ≤30% accuracy, respectively. The subjects’ performances in LAP before and after the treatment were compared and analyzed using the McNemar’s test for related samples, with the level of significance set at 0.05 (two-tailed test).

**Results**

To evaluate the efficacy of the mapping treatment, performances before and after the treatment were compared in terms of the attainment in the baseline/generalization test, the sentence comprehension and anagram test. Measures in grammaticality judgement test and
short-term memory tests were used as controls, as no change in these areas was expected.

**Baseline/ generalization test**

Table 2 summaries the subjects' treatment profiles. Most subjects achieved criterion within ten sessions in each phase, except TFH who required seventeen sessions for training in phase A. Most patients got above 80% correct on canonical sentences after the treatment, except LKH who performed at chance level, with 53.3% correct. In contrast, only three patients, TFH, LauKH and LLM, reached above-chance performance on non-canonical sentences.

By comparing the multiple baselines over the course of training with the pre-treatment baseline, three patterns of generalizations with improvement from chance to above-chance level were revealed. Only LauKH demonstrated extensive generalizations within both canonical and non-canonical sentences as well as across these two types of sentences. LWY and HSM, demonstrated generalization within canonical sentences on type C sentences after phase A; however, their performances dropped after phase B. TFH, LLM, LKH and CVR showed no generalization within or across sentence types.

**Sentence Comprehension test**

Table 3 summaries the subjects' performances on the sentence comprehension test as a function of sentence structure and presentation modality before and after the treatment. Only two subjects, TFH and LauKH, demonstrated generalization to various trained non-canonical sentence types with untrained verbs and significant improvement on TrP and SSR-TrP, which were not included in the training. No patient generalized to untrained non-canonical structures.

For TFH, significant improvement was revealed on SSR presented visually (from 45% to 80%, $z=2.33$, $p<0.05$) and TrP presented aurally (from 50% to 85%, $z=2.11$, $p<0.05$). For LauKH, significant gains were revealed on SOR presented visually (from 45% to 85%, $z=2.53$, $p<0.05$), actives (from 62.5% to 92.5%, $z=3$, $p<0.005$) and tsoeng-construction presented
<table>
<thead>
<tr>
<th>Patient</th>
<th>Number of session</th>
<th>% accuracy in canonical sentence</th>
<th>% accuracy in non-canonical sentence</th>
<th>Generalization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Phase Phase Phase Phase Phase</td>
<td>Pre-tx Post-tx Overall change</td>
<td>Pre-tx Post-tx Overall change</td>
<td>Within canonical sentences</td>
</tr>
<tr>
<td>TFH</td>
<td>52 17 9 9 6 11</td>
<td>10 93.3 83.3</td>
<td>10 85 75</td>
<td>No</td>
</tr>
<tr>
<td>1LauKH</td>
<td>60 7 5,5,6 5,5 7,5,5 5</td>
<td>73.3 83.3 10</td>
<td>15 85 70</td>
<td>Yes</td>
</tr>
<tr>
<td>1LLM</td>
<td>33 6 5 5 6 5,6</td>
<td>23.3 96.7 73.4</td>
<td>25 95 70</td>
<td>No</td>
</tr>
<tr>
<td>LKH</td>
<td>29 8 6 5 5 5</td>
<td>30 53.3 23.3</td>
<td>25 45 20</td>
<td>No</td>
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<tr>
<td>LWY</td>
<td>30 6 5 6 6 7</td>
<td>53.3 93.3 40</td>
<td>45 60 15</td>
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<tr>
<td>CVR</td>
<td>30 6 6 6 6 6</td>
<td>100 93.3 -6.7</td>
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<tr>
<td>HSM</td>
<td>31 10 5 5 6 5</td>
<td>60 83.3 23.3</td>
<td>25 30 5</td>
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</table>

1In case of more than one training block on one phase, the number of session for each block was listed sequentially.
Table 3

<table>
<thead>
<tr>
<th>Patient</th>
<th>Modality</th>
<th>Time</th>
<th>Trained sentence structures</th>
<th>Untrained sentence structures</th>
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<tr>
<td></td>
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<td>Actives (40)</td>
<td>Tsoeng-constructon (20)</td>
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<td>Visual</td>
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<td>0.850</td>
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<td></td>
<td></td>
<td>Post</td>
<td>0.975</td>
<td>0.850</td>
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<td></td>
<td>Auditory</td>
<td>Pre</td>
<td>0.925</td>
<td>0.650</td>
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<td></td>
<td></td>
<td>Post</td>
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<td>0.900</td>
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<td>LauKH*</td>
<td>Visual</td>
<td>Pre</td>
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<td>0.650</td>
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<td></td>
<td></td>
<td>Post</td>
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<td>Auditory</td>
<td>Pre</td>
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<td></td>
<td>Post</td>
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<td>0.900</td>
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<td>LLM</td>
<td>Visual</td>
<td>Pre</td>
<td>0.975</td>
<td>0.950</td>
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<td></td>
<td></td>
<td>Post</td>
<td>0.975</td>
<td>0.900</td>
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<tr>
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<td>Pre</td>
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<td></td>
<td></td>
<td>Post</td>
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<td>0.650</td>
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<td>Visual</td>
<td>Pre</td>
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<td>0.950</td>
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<td>Post</td>
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Table 3. (Cont'd.)

<table>
<thead>
<tr>
<th>Patient</th>
<th>Modality</th>
<th>Time</th>
<th>Trained sentence structures</th>
<th>Untrained sentence structures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Actives</td>
<td>Tsoeng-constructi</td>
</tr>
<tr>
<td>LWY</td>
<td>Visual</td>
<td>Pre</td>
<td>0.975</td>
<td>0.850</td>
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<td></td>
<td></td>
<td>Post</td>
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<td>0.700</td>
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<td>HSM</td>
<td>Visual</td>
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<td>Post</td>
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<td>Pre</td>
<td>0.550</td>
<td>0.450</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post</td>
<td>0.450</td>
<td>0.750</td>
</tr>
</tbody>
</table>

For subjects LauKH, L1M, LWY and CVR, 20 SSR-tsoeng were added to the sentence comprehension test performed:

- **increase in performance from chance to above-chance level and reached statistically significance**
- **increase in performance from chance to above-chance level yet did not reach statistically significance**
- **decrease in performance from above-chance to chance level and reached statistically significance**
- **decrease in performance from above-chance to chance level yet did not reach statistically significance**
aurally (from 70% to 90%, \(z=2, p<0.05\)). Generalization to untrained structures were also revealed on SSR-TrP presented visually (from 55% to 95%, \(z=2.83, p<0.005\)) and TrP presented aurally (from 70% to 100%, \(z=2.45, p<0.05\)).

The other five subjects' performances remained stable on most sentence structures; in particular, LKH and LWY showed no significant progress at all. CVR and HSM showed significant gains, respectively, on TrP presented visually (from 30% to 75%, \(z=2.50, p<0.05\)), and tsoeng-construction presented aurally (from 45% to 75%, \(z=2.45, p<0.05\)). LLM showed significant decrease on SSR-TrP presented visually (from 75% to 40%, \(z=2.11, p<0.05\)).

**Sentence anagram production test**

Table 4 presents the subjects' performances on the sentence anagram test. All subjects showed achieved above 80% correct on actives before and after the treatment. For tsoeng-construction, LLM and LWY showed a marked increase (from 0% to 57.5%, \(z=4.69, p<0.001\) in LLM, and from 0% to 70%, \(z=5.29, p<0.001\) in LWY); whereas TFH showed a marked decrease (from 58% to 28%, \(z=2.11, p<0.05\)). A closer look at the data revealed that LLM and LWY improved on constructing well-formed tsoeng-construction sentences, with error rate dropped from 40/40 to 13/40 and from 40/40 to 10/40, respectively. In contrast, TFH failed to construct well-formed tsoeng-construction, with error rate increased from 11/40 to 26/40. For passives, all subjects, except CVR, remained unchanged and got below 30% correct. CVR showed a significant progress (from 5% to 65%, \(z=4.71, p<0.005\)). A closer look at the data revealed that CVR error rate on the role assignment dropped greatly from 38/40 to 14/40.

**Grammaticality judgement test**

Table 5 summaries the subjects' performances in the grammaticality judgement test. LLM, LauKH, LKH and LWY showed above-chance performance before and after the treatment. HSM and CVR improved from chance to above-chance level, in which gains shown
by CVR was significant (from 64% to 78%, $z=2.83$, $p<0.005$). TFH performed at chance level before and after the treatment.

Table 4

**Proportion correct over various sentence conditions in the sentence anagram test**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Actives</th>
<th>Tsoeng-construction</th>
<th>Passives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-tx</td>
<td>Post-tx</td>
<td>Pre-tx</td>
</tr>
<tr>
<td>TFH</td>
<td>0.800</td>
<td>0.875</td>
<td>0.575</td>
</tr>
<tr>
<td>LauKH</td>
<td>0.825</td>
<td>1.000</td>
<td>0.850</td>
</tr>
<tr>
<td>LLM</td>
<td>0.800</td>
<td>0.900</td>
<td>0.000</td>
</tr>
<tr>
<td>LKH</td>
<td>1.000</td>
<td>1.000</td>
<td>0.000</td>
</tr>
<tr>
<td>LWY</td>
<td>1.000</td>
<td>0.975</td>
<td>0.000</td>
</tr>
<tr>
<td>CVR</td>
<td>0.975</td>
<td>0.825</td>
<td>0.925</td>
</tr>
<tr>
<td>HSM</td>
<td>0.950</td>
<td>0.975</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 5

**Proportion correct in the grammaticality judgement test**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Pre-tx</th>
<th>Post-tx</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFH</td>
<td>0.70</td>
<td>0.72</td>
</tr>
<tr>
<td>LauKH</td>
<td>0.95</td>
<td>0.97</td>
</tr>
<tr>
<td>LLM</td>
<td>0.93</td>
<td>0.93</td>
</tr>
<tr>
<td>LKH</td>
<td>0.96</td>
<td>0.95</td>
</tr>
<tr>
<td>LWY</td>
<td>0.88</td>
<td>0.87</td>
</tr>
<tr>
<td>CVR</td>
<td>0.63</td>
<td>0.78</td>
</tr>
<tr>
<td>HSM</td>
<td>0.71</td>
<td>0.80</td>
</tr>
</tbody>
</table>

**Short-term memory tests**

Table 6 shows the subjects' performances on the short-term memory tests. Most of the patients had digit span of four to five in the digit recall and digit-matching test. LLM showed relatively more impaired auditory short-term memory as shown by his markedly reduced digit span when stimuli were presented aurally. Digit span after the treatment remained unchanged.
for most patients, except LauKH who showed an increase in his digit span from four to seven in
digit recall when presented visually and digit matching, and from five to seven in digit recall
when presented aurally.

Table 6

<table>
<thead>
<tr>
<th>Performance on the short-term memory tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>TFH</td>
</tr>
<tr>
<td>LauKH</td>
</tr>
<tr>
<td>LLM</td>
</tr>
<tr>
<td>LKH</td>
</tr>
<tr>
<td>LWY</td>
</tr>
<tr>
<td>CVR</td>
</tr>
<tr>
<td>HSM</td>
</tr>
</tbody>
</table>

Discussion

The present study found mixed results in the application of the thematic mapping treatment
on Cantonese speaking aphasic patients using the ‘Sentence query’ approach. In general, the
success rate was low. This is consistent with a recent review on efficacy of mapping therapy on
English-speaking aphasic patients (Mitchum et al., 2000). Nevertheless, the patterns of success
and failure provide guidance for future studies of mapping hypothesis on Chinese aphasic
patients. We first began by considering specific aspects of the findings; this was followed by a
discussion of the clinical implications.

Treatment outcomes

In addition to the baseline/ generalization test, sentence comprehension test was also
necessary to evaluate the efficacy of the mapping treatment. During training and the baseline/
generalization test, simultaneous processing of the question and the sentence was needed. The processing was different from that in the sentence-picture matching task, which requires processing of a picture and a sentence. Any gain in the sentence comprehension test would therefore indicate a generalization beyond training task and stimuli.

In our study, four out of seven patients failed to achieve above-chance performance on non-canonical sentences in contrast with their progress on canonical sentences in the baseline/generalization test. Not surprisingly, they did not show obvious improvement in the sentence comprehension test on the target sentence structures, in particular the non-canonical sentences. Even significant improvement was revealed in one sentence structure, the performance just barely reached above-chance level. Of the seven patients, LKH was the least responsive to the treatment; he demonstrated the least progress in the baseline/generalization test and no change was revealed at all in the sentence comprehension test.

While failure in the training task has consistently been associated with a failure in other sentence comprehension test, success in the training task did not guarantee good performance in the sentence comprehension test. Among the three patients who showed positive specific training effect on non-canonical sentences in the baseline/generalization test, LLM failed to show significant positive change in the sentence comprehension test. One of the explanations could be that LLM’s ability to comprehend non-canonical sentences was not stabilized. However, this possibility was rejected as LLM was given supplementary training on phase E in view of his unstable performance on non-canonical sentences in the baseline/generalization test and he eventually achieved nearly flawless performance (95% correct). Another account could be due to LLM’s unawareness of the relationship between the training and sentence comprehension test. Alternatively, he could have suffered from non-mapping related deficits that impact sentence comprehension. To verify the cause, further investigations are necessary.
Extensive gains in both the baseline generalization test and the sentence comprehension test were revealed only in TFH and LauKH, in which genuine gains was only achieved in TFH. This is because LauKH demonstrated an increase in short-term memory measures. Also, he began the training with only four-month post-onset time, which suggested that LauKH may have undergone spontaneous recovery during the treatment.

A closer look at the data before and after the treatment inspired re-interpretation of the cognitive neuropsychological profiles of our five unsuccessful cases, and thus shed light on the possible components contributing to their poor response to the treatment.

LLM's significant reduction in his auditory-verbal retention (a digit span of two in auditory mode versus about four for other patients) might have contributed to his chance level performance on all sentences presented aurally in the sentence comprehension test before and after the treatment, in contrast to his relatively better performance in visual modality. The importance of auditory-verbal retention in sentence comprehension was thus illustrated. Apart from memory deficit, three patients, LKH, LWY and HSM, appeared to rely on strategies in sentence comprehension and thus continued to exhibit asyntactic comprehension. All of them showed above-chance performance on most canonical sentences, in contrast with the below-chance performance on nearly all non-canonical sentences in the sentence comprehension test presented visually before and after the treatment. This pattern led to the hypothesis that they might have made use of a heuristics assigning the first and second noun phrases the agent and patient roles, respectively. For the chance performance in the sentence comprehension test demonstrated by CVR in both presentation modes and LLM in visual mode, the underlying reason is not well understood. The result from both of these patients, together with patients relying on strategies, makes the prediction of therapy outcome even more difficult since the parameters contributing to their failure in the treatment are not clear.
In examining the generalization from comprehension to production, only limited improvement was revealed in the sentence anagram production test. Gains in constructing well-formed sentences were only revealed in two patients on tsoeng-construction sentences. Greater success was reported from studies on English-speaking aphasic patients receiving verb-centered mapping treatment, in which structural gains in sentence production were revealed in ten out of eleven patients. One plausible explanation for the limited generalization to production in this study is that the sentence anagram production test may not be sensitive enough to capture changes in language ability. Unlike picture description and story-telling tasks used in mapping therapy studies on English-speaking patients, the verb and arguments of the sentence were provided to the patients in the anagram production test. There was no room for omitting any of the argument structure in the anagram test; thus structural changes in the production of verb-argument structures could not be revealed. To better monitor the changes in sentence production, story-telling or picture description task should be added.

Although the changes in production revealed by the anagram test were limited, the data from TFH and LauKH provided an interesting comparison with their performances in the sentence comprehension test. On one hand, both of them showed extensive gains in the sentence comprehension test after the training, including actives, tsoeng-construction and passives. On the other hand, TFH had poor syntactic representation in tsoeng-construction (error rate 26/40, post-treatment) and LauKH continued to show role reversal errors in passives (error rate 31/40, post-treatment) in the anagram test. These findings contradicted the general assumption that mapping process resources were in common for both comprehension and production. In fact, Mitchum et al. (2000) also suggested the generalization across processing modalities reported in previous studies to be task specific rather than a common functional source of thematic mapping in sentence comprehension and production.
Another interesting finding in this study was the contrastive performance in the grammaticality judgement and sentence comprehension test as revealed in TFH and LKH. TFH performed at above-chance level in the sentence comprehension test but at chance level in the grammaticality judgement test. In contrast, LKH performed at chance level in the sentence comprehension test but at above-chance level in the grammaticality judgement test. These opposite patterns constituted a double dissociation between sentence comprehension and grammaticality judgement. Similar findings were previously reported in Law and Leung (2000). Such findings suggest the original assumption of the mapping hypothesis stated in Schwartz et al. (1987) that grammatical knowledge of patients with mapping deficit is relatively intact needs to be re-examined.

Clinical implications

Strictly speaking, only one of the seven patients receiving the thematic mapping treatment demonstrated desired gains in sentence comprehension which was unlikely to be resulted from spontaneous recovery. Despite the low success rate in both the multiple baselines and sentence comprehension test, success in TFH provides some support for the existence of mapping hypothesis and potential benefits of mapping treatment on Cantonese-speaking aphasic patients with mapping deficit. The low success rate raises the question of how to maximize the efficacy of the mapping treatment.

Based on the data of this study, three suggestions are made on the selection criteria to better identify potential aphasic patients with mapping deficits for this treatment. Firstly, in addition to intact sentence parsing ability, verb-argument structure and lexical knowledge, the criterion of no significant reduction in short-term memory should be included in order to exclude patients suffering from severe memory deficit, given that they were shown to be unable to benefit from the treatment. Memory tasks like digit recall and digit matching could be used to
identify such patients. Secondly, intact grammaticality judgement should not be used as one of the selection criteria since double dissociation was revealed between the grammaticality judgement and sentence comprehension in this study. Lastly, one should be more aware of patients with heavy reliance on strategies. For patients who developed strategies during the training, Mitchum et al. (2000) suggested that materials and tasks with demands that differ slightly from those of the training tasks could serve as probes to identify patients with heavy reliance on strategies. Modification of the training task or introduction of new task may be necessary to discourage their reliance on strategies.

As for future studies, one could investigate the efficacy of this treatment by adopting the suggested selection criteria for potential candidates. Moreover, double dissociation between sentence comprehension and grammaticality judgement was observed. The role of grammaticality judgement in sentence comprehension deserves further investigation.

Conclusion

This paper reported mixed results of the thematic mapping treatment using the ‘Sentence query’ approach on Cantonese-speaking aphasic patients. Although the success rate was low, it lends some support to the existence of the mapping process and potential benefits of the mapping treatment on a subset of Cantonese-speaking aphasic patients. The data also shed light on sentence processing and selection criteria of patients receiving mapping treatment.

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References


Conference. Florida, USA.


