Effects of Lexical Spatial-Temporal Metaphors on Mandarin and Cantonese Speakers' Temporal Conceptualizations

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Abstract. This study investigated whether and how different types of temporal metaphors in the lexicon and individual reading habits influence native Chinese speakers' conceptualizations of time. The results indicate that the Cantonese- and Mandarin-speaking participants constructed time expressions differently to some extent. Both groups responded faster on the transverse axis than on the vertical one, which was in accordance with the reading habits produced by the major writing/printing directions in both Mandarin and Cantonese. However, the Cantonese participants made judgments significantly faster than the Mandarin participants did in non-canonical conditions on the vertical axis. This finding, though surprising, is in line with a finding of our linguistic survey that Cantonese speakers use linguistic terms on the vertical axis to express time concepts much more often than Mandarin speakers do. This suggests that, even in the case of Chinese languages, speakers' space and time associations can to some extend be influenced by the use of different temporal metaphors in their lexicon.

Keywords: Temporal compound, spatial-temporal metaphor, Cantonese, Mandarin, temporal conceptualization.

1 Introduction

People's conceptualization of time has been of great interest in language studies. How do people conceptualize time and express temporal concepts? And how do their language systems and cultures influence those processes [1-5]? Two potentially important factors are spatial-temporal metaphorical expressions adopted in a language system, and reading-writing habits of individual speakers of that language. Accordingly, this paper reports the results of two studies, a survey, and an implicit-task experiment, which were aimed at ascertaining how native speakers of Beijing Mandarin and Hong Kong Cantonese express concepts related to time.

Some studies have reported that people who often use vertical metaphors to express time prefer to think about time vertically, whereas those who tend to use horizontal expressions tend to think about time horizontally [1, 6-9]. However, the results of some other studies that used the same type of spatial-priming paradigm did not support this view [6]. Sometimes, Chinese morphemes can exhibit divergence in

the representation of spatial axes. Yet, different temporal terms were used in different studies. For instance, some used only *yue* 'month' [10]; some used *xingqi* 'week', *yue* 'month', and *jidu* 'quarter' [6]; some used *tian* 'day' [11]. Moreover, these studies often indulged in direct comparisons of fundamentally dissimilar temporal expressions, for example, words in phrasal expressions of time in English (such as 'ahead' in 'the good times ahead of us') and morphemes in temporal compounds in Mandarin (such as *qian* 'front' in *qian-nian* 'last year'). While speakers of different languages are reasonably assumed to use different linguistic devices in their temporal expressions, it remains unclear what inferences can be directly drawn from such comparisons, given that phrasal processing and lexical processing are usually considered to be distinct, and that the effects of L1-L2 transfer may not be easily identified. Thus, ideally, the cognitive association between linguistic forms and temporal conceptualization may be more effectively observed based on comparisons of languages with discrepancies in their temporal expressions at the same linguistic level. Chinese languages provide us with such an ideal environment of comparisons. In this study, we investigated Hong Kong Cantonese and Beijing Mandarin, which are culturally closely related but linguistically distinct.

It is well-known that Cantonese differs sharply from Mandarin on some linguistic levels, such as pronunciation and the lexicon, as well as in temporal expressions. For example, the concept of 'last year' is expressed in Hong Kong Cantonese as *soeng-nin* 'up-year', and in Beijing Mandarin as *qu-nian* 'backward-year'; while the concept of 'next year' in Cantonese is *haa-nin* 'down-year', and in Mandarin is *ming-nian* 'tomorrow-year'. Crucially, these examples show that Mandarin and Cantonese use morphemes that express categorically different spatial metaphors to form compounds with the same temporal meaning. To the best of our knowledge, however, no prior study has focused on such differences in temporal metaphors across two or more Chinese languages. Besides the collocations with 'year' noted above, other differences between Cantonese and Mandarin temporal expressions exist, and it is worth asking whether and how they affect the construction of temporal concepts by speakers of these two languages.

Individuals' reading and writing habits, meanwhile, have been considered a major factor in temporal conceptualization on the transverse axis (e.g., left/right in English). As opposed to sagittal (backward/forward) and vertical spatial terms, transverse spatial terms are extremely uncommon in temporal expressions cross-linguistically. However, some studies have reported that people's mental representations of time are consistent with the writing direction of their native languages [12-15]. These studies compared pairs of languages with opposite writing directions, including English/Arabic and Spanish/Hebrew. This factor is also potentially relevant to the current study, insofar as (apart from some recent official documents) Hong Kong Chinese tends to be printed vertically – whether on shop signs, in newspapers, or in books – and the lines are read transversely from right to left; whereas most Mandarin speakers only read horizontal and transverse left-to-right texts. Thus, if human constructs such as writing and reading directions can influence readers' mental representations of time, one can reasonably expect that such representations will differ across Cantonese and Mandarin speakers.

In the following section, we report the results from a survey of temporal expressions in Hong Kong Cantonese and Beijing Mandarin, focusing on the lexical similarities and differences on the use of the sagittal and vertical axes in temporal compounds. Then, in section 3, we report the results from an implicit-processing experiment, examining how two groups of speakers associate time concepts with the transverse and vertical axes. In section 4, we briefly conclude our study.

2 Experiment 1: Survey on Spatial Collocations

To facilitate our comparison of the use of temporal compounds which consist of sagittal vs. vertical terms for various sizes of time units, we collected the spatial collocations in temporal compounds in Hong Kong Cantonese and Beijing Mandarin through a questionnaire designed by the research team. This approach was adopted for the following reasons. First, not many Cantonese corpora are available, and the two existing corpora – *the Hong Kong Cantonese adult language corpus* of spontaneous speech recordings [16] and *the Hong Kong Cantonese corpus* of conversations [17] – contain just four temporal expressions (26 tokens in total) that are of interest to the present study. This number is so small that we needed to conduct our own language survey as a supplement. In the case of Beijing Mandarin, although there are some temporal expressions with an extremely high frequency in the corpora created by the Center for Chinese Linguistics at PKU, they are used rarely in spoken Mandarin and are mostly found in journalism. Therefore, we used one parallel questionnaire for Cantonese and Mandarin, which were more likely to capture the current colloquial uses of temporal expressions that would be best suited to our research aims.

2.1 Participants

All participants were asked to fill out a questionnaire about their language background prior to receiving the experiment invitation. We used a self-reported 7-point Likert Scale (1 = "do not know the language", and 7 = "native fluency") for the participants to rate their language fluency in Mandarin and Cantonese. There were 90 Beijing Mandarin speakers (58 females and 32 males) aged 18-30 and living in Beijing; and none had a good command of Cantonese (average fluency rating of Cantonese: 1.08). In another group, 50 Hong Kong Cantonese speakers (28 females and 22 males) aged 18-30 and living in Hong Kong were invited; none of them had learnt Mandarin before the age of six or had received formal Mandarin education (average fluency rating of Mandarin: 4.32); and the language that they feel most natural and comfortable to use is self-reported as only Cantonese.

2.2 Survey Materials and Procedure

Across Chinese languages, the concepts of 'month' and 'week' are often expressed by vertical spatial metaphors such as *shang* 'up' and *xia* 'down', whereas the concept of 'day' is more commonly associated with *qian* 'front' and *hou* 'back'. To avoid system-internal bias being introduced through the stimuli, our questionnaire explored the differences in core/common space-time metaphors used by speakers of Beijing Mandarin and Hong Kong Cantonese involving the four spatial-metaphorical terms (i.e., *qian* 'front', *hou* 'back', *shang* 'up', and *xia* 'down') and 11 time units: *shiji* 'century', *nian* 'year', *jidu* 'quarter', *yue* 'month', *xingqi* 'week', *zhou* 'week', *tian* 'day', *ri* 'day', *xiaoshi* 'hour', *fenzhong* 'minute', and *miao* 'second'. For each time unit, six spatial-metaphoric combinations were created by adding a measure word 'ge', resulting in 66 sets of target items in the survey. For example, a time unit like *shiji* 'century' had six combinations with each of the spatial-metaphorical terms. The six combinations formed by *shiji* with *qian* 'front' are shown in (1). Six similar expressions were created for *shiji* and each of the other three spatial-metaphorical terms, and we created items for the other 10 time units listed above in the same manner.

(1) *shiji* 'century' with the spatial-metaphorical term *qian* 'front':
   a. *qian* 'front' + *shiji*
   b. *qian* 'front' + *ge* 'MW' + *shiji*
   c. *qian* 'front' + *ban* 'half' + *shiji*
   d. *qian* 'front' + *yi* 'one' + *shiji*
   e. *qian* 'front' + *ban.ge* 'half.MW' + *shiji*
   f. *qian* 'front' + *yi.ge* 'one.MW' + *shiji*

All participants were given the task of judging which of the spatial-metaphorical terms was appropriate to each of the six combinations mentioned above in (1). Participants were allowed to accept more than one combination for each time unit. They provided their answers on a hardcopy printout of the survey form.

2.3 Survey Analysis and Results

The questionnaires completed by 21 Mandarin-speaking and 18 Cantonese-speaking subjects were deemed invalid due to incompleteness or the same response being given to all questions. 69 Mandarin and 32 Cantonese results were valid for analysis.

Among the 66 sets of items, 12 ungrammatical sets were included as control items. These were *ge nian* / *yi ge nian* 'one year', *ban ge nian* 'half year', *ge tian* / *yi ge tian* 'one day', *ban ge tian* 'half day', *ge fen zhong* / *yi ge fen zhong* 'one minute', *ban ge fen zhong* 'half minute', *ge miao* / *yi ge miao* 'one second', and *ban ge miao* 'half a quarter'. The participants' acceptability ratings for these items were extremely low, suggesting that they were concentrating adequately when making their acceptability judgments.

The ratings assigned to these 12 sets were excluded from further data analysis. Although the combinations of "spatial metaphors + *xiao shi* 'hour' / *fen zhong* 'minute' / *miao* 'second'" are not considered grammatical in Mandarin, these three sets were analyzed because more than 50% of the Cantonese participants rated them as grammatical. Among the remaining sets, those containing *tian* 'day' and *ri* 'day' were treated as one category for analytical purposes; and the same was done for *xingqi* 'week' and *zhou* 'week'. Finally, a total of 42 sets were analyzed.

We began by calculating the number and proportion of participants who selected sagittal metaphors and vertical metaphors in each group. We took preference for vertical metaphors as the baseline, and obtained a value for it by subtracting the percentage of sagittal metaphors from that of the vertical metaphors selected by the participants on each item. Interestingly, both groups demonstrated a strong preference for vertical metaphors when it came to longer time units (ranging from *xingqi* 'week' to *shiji* 'century'), as shown in Figure 1, except *nian* 'year' for which the Mandarin group preferred sagittal metaphors and the Cantonese group had no clear preference. This discrepancy could be related to lexical differences between the groups. That is, Mandarin only uses *qian* 'front' and *hou* 'back' to form compounds with *nian* 'year' and *tian* 'day' directly. Likewise, Cantonese *cin* 'front' and *hau* 'back' can form compounds with *nin* 'year' and *tin* 'day' (e.g., *cin nin* 'last year'). Unlike Mandarin, Cantonese speakers also use very commonly the vertical metaphors *soeng* 'up' and *haa* 'down' when forming compounds with *nin* 'year' (i.e., *soeng nin* 'last year'). As for the shorter time units (ranging from *miao* 'second' to *xiaoshi* 'hour'), as shown in Figure 1, the Cantonese participants tended to prefer vertical metaphorical expressions, while the Mandarin counterparts exhibited no clear preference. The only exception to this among time units shorter than one week was *tian* 'day', for which both groups preferred sagittal metaphors.

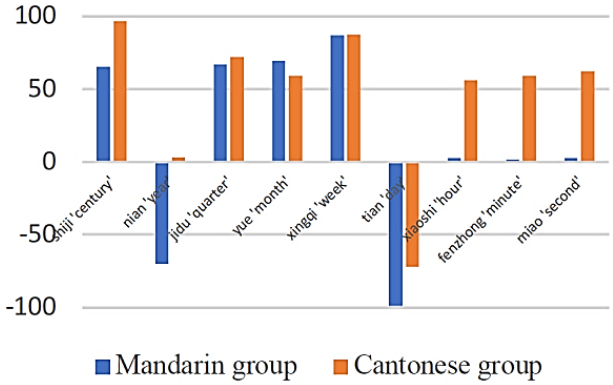

Fig. 1. The overall preference of Mandarin and Cantonese groups for vertical metaphors on time units (x-axis); the y-axis presents the percentage.

We further analyzed the similarities and differences between the two participant groups in their preferences for temporal expressions by items, and found some interesting mixture of temporal expressions. Among the 42 sets of survey items (Table 1), the 20 sets of temporal expressions for which the Mandarin group had a sagittal preference contained all the 8 sets for which the Cantonese group also had a sagittal preference, as well as all the 9 sets for which the Cantonese group expressed unclear preferences. The 8 sets for which both groups had a clear sagittal preference were (7 of the terms in which 'half' modified a shorter time period): *fenzhong* 'minute', *xiaoshi* 'hour', *xingqi* 'week', and *yue* 'month', and *(yi) tian* '(one) day.' Conversely, the 25 sets of temporal expressions for which the Cantonese group had a clear vertical preference contained all the 16 sets for which the Mandarin group had a vertical preference, and all the 6 sets for which the Mandarin group had unclear preferences. The 16 sets for which both groups had a clear vertical preference were the terms of a full longer time period (i.e., *shiji* 'centry', *jidu* 'quarter', *yue* 'month', *xinqi* 'week') and *ge xiaoshi* 'one hour'.

	Sagittal preference	Vertical preference	Unclear preference
Mandarin	20	16	6
Cantonese	8	25	9

Table 1: Spatial-metaphor preferences, by group.

We examined the differences between the two language groups within each type of preferences. We found that the choices of Mandarin speakers seem to be more linguistically compositional, while that of Cantonese speakers' were based more on the temporal concepts expressed by the terms. Firstly, when the concept 'half' was used to modify a temporal term, the Mandarin group preferred sagittal metaphors for most of the terms, even for that of longer time periods (e.g., *shiji* 'centry', *jidu* 'quarter', and *xinqi* 'week'), whereas the Cantonese group's preference was more vague but they still tended to prefer vertical metaphors. Secondly, the term *ge xiaoshi* 'one hour' was rated with vertical preference by both groups. However, when the numeral *yi* 'one' was used, the Mandarin group preferred the sagittal metaphors for 'hour', while this did not affect the Cantonese groups' judgments. In sum, the results of our survey suggest that, of these two groups, Mandarin speakers use sagittal metaphors more frequently and Cantonese speakers use vertical metaphors more

frequently, and some more influences of linguistic forms were found with the Mandarin group.

3 Experiment 2: Implicit-Processing Experiment

The results of our survey showed that the Cantonese participants were more inclined to use vertical terms to express time, so we adopted an implicit-processing experiment – the key-pressing-based judgment tasks devised by Fuhrman [4]– as a further test of possible differences between the two groups' temporal conceptualizations.

The participants were instructed to press the keys on a nine-button USB keypad, which was connected to a computer and attached to a tripod mount with a rotating ball head. This enabled the keypad to be placed perpendicular to the table, facing to the participant. The middle key was masked with a blue sticker. In the canonical condition, the left key of the centre row was masked with a black sticker and labelled "earlier", and the right key was masked with a pale grey sticker and labelled "later". In the non-canonical condition, the right key was labelled "earlier" and was masked with a black sticker, and the left key meant "later" and was masked with a pale grey one. The remaining buttons were not labelled. The keys were not labelled by using verbal forms so that the participants would not be disturbed by the linguistic expressions. A picture presenting a middle time point (e.g., an apple being eaten: Fig. 2) was shown on the screen, followed by a picture showing either an earlier time point (e.g., a whole apple) or a later time point (e.g., an apple core). The participants needed to press the key corresponding to their judgments regarding whether the second picture shows a conceptual time point earlier or later than the one expressed by the first picture.

In theory, people who automatically access the canonical key mapping should respond faster when the keys are in a canonical condition; and their performance will be slower or otherwise hindered when the keys are in a non-canonical condition. Based on our survey results, we expected that Cantonese speakers would make judgments faster than Mandarin speakers in the vertical timeline, and that members of the former group would respond faster than the latter group when the keypad was presented in a top-earlier/bottom-later format. Also, because right-to-left reading order is common in printed materials in Hong Kong, we expected that on the transverse axis Cantonese speakers would make judgments faster when given the right-earlier/left-later keypad format than Mandarin speakers, who normally read from left to right.

Fig. 2. An example set.

3.1 Experiment Participants

The participants were asked to fill out a questionnaire covering their language background and reading habits prior to receiving the invitation to the experiment. We used a 7-point Likert Scale to rate how often the speakers of the two groups read vertical text, with 1 = "never" and 7 = "all the time". For the Mandarin group, only

those who selected 1 or 2 were invited; for the Cantonese group, only those who selected 6 or 7 were invited. The participants in the Mandarin experiment included 30 native speakers of Beijing Mandarin, who were aged 18-30 and university students in Beijing; none of them had participated in our survey; none had a good command of Cantonese (the mean of their self-reported fluency in Cantonese was 1.03, using a 7-point scale: 1 = "do not know the language" and 7 = "native"); and all read vertical texts rarely. The Cantonese experiment included 30 native speakers of Hong Kong Cantonese (the mean of their self-reported fluency in Mandarin was 4.3, using a 7-point scale: 1 = "do not know the language" and 7 = "native"), who were aged 18-30 and university students in Hong Kong; none of them had participated in our survey; none of them had learnt Mandarin before the age of six; and all of them did not have language-understanding and expression barriers.

3.2 Experimental Materials and Procedure

The materials included 40 sets of pictures created by the research team, all illustrating temporal progressions similar to the set shown in Figure 2. The participants were tested individually in a quiet lab with a Thinkpad laptop computer and keypad. Taking the transverse axis as an example, at the beginning of each trial, the participant was instructed via a message on the laptop screen to press the blue button to start the trial. Then, this message was replaced by a picture presenting a middle time point for 2000ms; and that picture, in turn, was replaced by another one showing either an earlier or a later time point. The participant was instructed to press the key corresponding to his/her judgment of whether the second picture showed a time-point earlier or later than the first one. The second picture remained on the screen until the participant made this judgment or – if s/he did not press any key – for 4000ms. All participants completed four test blocks, each consisting of 40 trials, with two blocks covering the transverse axis (left-earlier/right-later key mapping and its opposite) and two covering the vertical axis (top-earlier/bottom-later key mapping and its opposite). The order of the four blocks was counterbalanced with each item appearing once in each axis. Before each test block, the participants were instructed to perform 10 practice trials to familiarize themselves with the task. The items used in the practice trials were not repeated in the subsequent test blocks.

3.3 Data Analysis and Results

The accuracy of the 60 participants' responses was 99.96%. Linear mixed effects models were created using log-transformed reaction times (log RT) with the lme4 package (Bates et al., [18]) in R (R Team, [19]). The models first included random intercepts for an item and a subject, and then three fixed effects – i.e., Language, SpatialAxis (Vertical vs. Transverse), and Canonicality – and their interactions were then added (powers = .99). Language refers to Mandarin or Cantonese. Canonicality refers to the conditions in which a left or top key was designated as "earlier" and a right or bottom key as "later", while in non-canonical conditions, a left or top key was designated as "later" and a right or bottom key as "earlier". The significance of the main effect was evaluated by likelihood-ratio testing, and post-hoc Tukey's comparisons were conducted using the multcomp package (Hothorn et al., [20]) in R.

The results revealed that SpatialAxis with vertical conditions seemed to be processed more slowly than with transverse conditions, but this effect was not statistically significant (B=.022, SE=.012, p=.078). Canonical key-mapping was processed faster than its non-canonical counterpart (B=.023, SE=.012, p=.064), an effect that was marginally significant. Our analysis revealed significant interaction

effects of SpatialAxis, Canonicality, and Language. While both Cantonese and Mandarin speakers processed transverse-axis items with canonical key-mapping significantly faster than items on the same axis with non-canonical key-mapping (*p*s<.001), differences were found with respect to vertical-axis conditions. Post hoc tests verified that Mandarin speakers processed vertical canonical conditions faster than non-canonical ones, as expected (although such differences were not statistically significant, *p*=.5), but surprisingly, Cantonese speakers processed non-canonical vertical mapping conditions significantly faster than canonical ones (*p*=.016).

We also observed significant differences between the Mandarin and Cantonese groups' processing of items with non-canonical key-mapping on the vertical axis (*p*=.042), with the Cantonese group being faster. No other inter-group comparisons revealed significant differences in reaction time (*p*s>.168). Analysis of within-group SpatialAxis differences showed that speakers of both languages processed transverse-axis items in the canonical condition significantly faster than vertical-axis items in the same condition (*p*s<.001). While the same SpatialAxis tendency was found within each language group in the non-canonical condition, those differences were not significant (Cantonese, *p*=1; Mandarin, *p*=.57). Figure 3 illustrates the overall results.

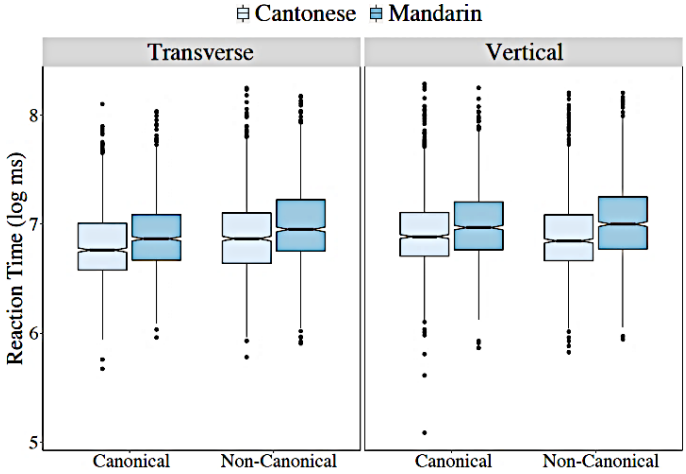

Fig. 3. Boxplots of log-transformed reaction times, by Language, Canonicality, SpatialAxis.

4 Discussion and Conclusion

The current study has resulted in interesting findings about the relation between speakers' conceptualization of time and spatial dimensions in temporal compounds in Hong Kong Cantonese and Beijing Mandarin and in individuals' reading and writing habits.

First, we found some language-specific tendencies. Concerning the vertical and the sagittal axes, both groups demonstrated strong vertical preferences for longer time units (such as *xingqi* 'week' and *shiji* 'century'), and sagittal preferences for shorter time units (such as *miao* 'second' and *xiaoshi* 'hour'). However, while the Cantonese group tended to prefer vertical-spatial metaphorical expressions, the Mandarin group's judgments could be influenced by the linguistic forms of time.

Concerning the time association on the transverse and the vertical axes, the Cantonese-speaking participants processed items on the vertical axis in the condition of non-canonical key-mapping significantly faster than those on the same axis in canonical key-mapping. Mandarin speakers, on the other hand, tended to disregard whether key-mapping was canonical or not, but tended to process items on the transverse axis faster than those on the vertical axis. We speculate that these differences between the groups were related to the fact (as reported in our survey) that Cantonese speakers are more likely to use vertical terms to express time concepts than Mandarin speakers do. Therefore, the Cantonese speakers in our experiment exhibited more flexibility than their Mandarin-speaking counterparts when it came to expressing time concepts on a vertical axis, and they reflected shorter reaction times for the task.

Second, if the reading habit created by texts' printing orientation is indeed one of the main factors influencing space and time associations, then one would reasonably expect that individuals will process an item faster if it is in accordance with their own language's major writing and printing conventions. Our results support this idea. Both Beijing Mandarin and Hong Kong Cantonese speakers often read texts in the transverse axis (though in different directions: Beijing Mandarin words are printed from left to right horizontally, and Hong Kong Cantonese lines are often printed from right to left vertically). Also, we found that for both of these language groups and in both key-mapping conditions, the items on the transverse axis were mostly processed faster than those on the vertical axis.

We therefore incline to conclude that our results reflect some effects of lexical differences between Hong Kong Cantonese and Beijing Mandarin on speakers' conceptualization of time – that is, Cantonese speakers employ relatively more frequently vertical metaphors in linguistic expressions of time than Mandarin speakers do.

For future research, it would also be interesting to study how such lexical-internal spatial differences may influence learners' language acquisition, and whether and how training of specific spatial metaphorical association has effects on L2 word/phrase acquisition.

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