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Aspectual Asymmetries in the Mental Representation of Events: Significance of Lexical Aspect

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Abstract

Aspect contributes important temporal information for the construction of situation models in the human mind. Previous studies examining the effect of grammatical aspect on accomplishment verbs (e.g. *bake a cake*) show that perfective sentences/utterances are processed faster than imperfective ones (Madden & Zwaan, 2003; Chan et al., 2004; Yap et al., 2004, in press). The present study, however, shows strong interaction between lexical aspect and grammatical aspect. More specifically, the results show that perfective facilitation is found on accomplishment verbs, while imperfective facilitation is found on activity verbs. We suggest that this is because the inherent atelic nature of activity verbs matches the unbounded features associated with imperfectives.

Keywords: aspect; temporal processing; situation models

Introduction

We construct situation models in our mind as we listen to narratives, using various cues such as temporal and spatial information, agent intentionality, and causality, among many others (Zwaan & Radvansky, 1998). With respect to temporal information, aspectual cues are known to play a very important role in cognitive representations.

Aspect refers to different ways of viewing the temporal properties of a situation (Comrie, 1976). There are two major types of aspect—namely, lexical aspect and

grammatical aspect. Lexical aspect refers to situation types that are distinguished on the basis of temporal properties such as dynamism, durativity, and telicity. Vendler (1967) distinguishes four basic situation types, namely states (e.g. *know*), activities (e.g. *play*), accomplishments (e.g. *bake a cake*), and achievements (e.g. *break*). Others have often included a fifth category, often referred to as semelfactives (e.g. *cough* or *skip*, iteratively). Table 1 distinguishes each verb type based on their temporal characteristics.

Table 1: Situation types denoted by verbs and their temporal properties (Smith 1991)

| | Dynamic | Durative | Telic |
|----------------|---------|----------|-------|
| State | - | + | - |
| Activity | + | + | - |
| Accomplishment | + | + | + |
| Achievement | + | - | + |
| Semelfactive | + | + | + |

Grammatical aspect, on the other hand, allows us to view a situation as *bounded* or *unbounded*, *telic* or *atelic*, i.e. whether or not our temporal focus includes an initial or final endpoint (Comrie 1976; Smith 1991). We often make a two-way distinction for grammatical aspect: perfective and imperfective. As defined in Comrie (1976), perfective aspect allows us to view an event as a whole (hence ‘bounded’ or ‘external view’), while imperfective aspect constrains us to focus on the internal stages of an event (hence ‘unbounded’ or ‘internal view’).

Different aspectual cues have been shown to have differential effects on processing. Magliano and Schleich (2000) showed that imperfectives yield slower decay rates in memory recall tasks. More recently, Madden and Zwaan (2003) have shown that there is an advantage in processing speeds for perfective constructions in English. That is, perfective aspect (e.g. *He wrote a letter*) is processed faster than imperfective aspect (e.g. *He was writing a letter*).

Perfective facilitation was also found in tenseless languages such as Cantonese and Mandarin. In Cantonese, aspectual asymmetry in processing was manifested as follows: sentences with perfective *zo2* were processed significantly faster than those with imperfective progressive *gan2* (Chan, Yap, Shirai & Matthews, 2004). Similar results were also found in Mandarin, where sentences with perfective *le* were processed significantly faster than those with imperfective progressive *zai* (Yap, Chan, Shirai, Tan, Matthews & Li, 2004). A similar study on Japanese likewise showed that sentences with perfective *-ta* were processed faster than those with imperfective *-teiru* (Yap, Inoue, Shirai, Matthews, Wong & Chan, in press).

Note that in all these studies, verbs used to compare the effect of grammatical aspect were accomplishments, and the role of lexical aspect itself has yet to be examined. In the present study, we investigate the effect of lexical aspect (as well as grammatical aspect) in the construction of situation models by examining whether perfective facilitation holds across other verb types. In particular, we extend our study to activity verbs.

Current Study

Temporal reference system of Cantonese

Cantonese is a Chinese dialect spoken in the southern part of China. It lacks grammaticalized tense but is rich in aspectual distinction. Temporal reference is generally inferred from information provided through temporal adverbs (e.g. *ji5cin4* ‘before’, *ji1gaal* ‘now’, *ting1jat6* ‘tomorrow’), lexical aspect, and grammatical aspect markers (Matthews & Yip, 1994).

Specific objectives of the present study

In this study, we examine whether different verb classes—accomplishments and activities—have different effects on cognitive processing. Accomplishment verbs are dynamic, durative and telic (i.e. bound by an inherent endpoint), while activity verbs are dynamic, durative but atelic (i.e. without an inherent endpoint). Examples (in Cantonese) are shown in (1) and (2) below:

- (1) Accomplishment (ACC): [+durative] [+telic]
sik6 go3 ping4gwo2
 eat CL apple
 ‘eat an apple’
- (2) Activity (ACT): [+durative] [-telic]
jau4seoi2
 swim
 ‘swim’

We also examine the effects of 4 Cantonese grammatical aspect markers on activity and achievement verbs. These comprise of two imperfective markers, *gan2* and *hai2dou6*, and two perfective markers, *zo2* and *jyun4*. *Gan2* and *hai2dou6* denote a progressive sense—the former is more dynamic, being derived from a verb meaning ‘to hold tightly’; the latter is more stative, consistent with its derivation from a locative verb meaning ‘be here, at’. *Zo2* and *jyun4* induce a completive sense; the former highlights the relevance of a completed event to a subsequent or later situation (much like the English perfect *has + V-en*), while the latter focuses more on the sense of completion itself. Examples of an activity verb (*jau4seoi2* ‘swim’) with perfective aspect markers *zo2* and *jyun4* are shown in (3) and (4), and the same activity verb with imperfective *gan2* and *hai2dou6* are shown in (5) and (6) respectively.

- (3) Perfective zo2
Go3 laam4zai2 jau4-zo2 seoi2
 CL boy swim-ASP water
 ‘The boy has swum.’
- (4) Perfective jyun4
Go3 laam4zai2 jau4-jyun4 seoi2
 CL boy swim-ASP water
 ‘The boy has swum.’
- (5) Imperfective gan2
Go3 laam4zai2 jau4-gan2 seoi2
 CL boy swim-ASP water
 ‘The boy is swimming.’

- (6) Imperfective hai2dou6
Go3 laam4zai2 hai2dou6 jau4 sei2
 CL boy ASP swim water
 'The boy is swimming.'
 'The boy swims here.'

The aims of our study are thus twofold. First, we examine whether *perfective facilitation* in processing speed is observed across different perfective and imperfective markers. Second, we investigate if lexical aspect also influences processing speeds. More specifically, we examine if accomplishment and activity verbs yield different aspectual asymmetries, contra Madden and Zwaan (2003).

Overall Methodology

Forced-choice utterance-picture matching tasks were used in our experiments. Auditory stimuli (i.e. spoken utterances) instead of visual stimuli were used. We compared the reaction time and accuracy rate of perfectives and imperfectives. All the sentences constructed for testing are natural and frequent in the language. The combination of verbs and aspect markers is also natural. The participants in this study were native Cantonese speakers at grades 12 and 13 in local secondary schools in Hong Kong (mean age group approximately 18).

During the experiments, for each test item, the participants were first presented with an utterance involving either a perfective or imperfective marker. The participants were then immediately shown a pair of pictures with one picture depicting an ongoing action and another picture depicting a completed action. The participants had to match which of the pictures best describes the utterance they had just heard by pressing the corresponding key on the keyboard. If the correct picture appeared on the left, the subject had to press the **A** key. If the correct picture appeared on the right, the subject had to press the **5** key on the number pad to the right of the keyboard.

The ISI between the onset of stimulus and target is 2200ms. The pictures remained for a maximum of 3 seconds. Failure to respond within 3 seconds was regarded as an incorrect response. No outlying items were removed in the analyses. Reaction times were recorded using millisecond INQUISIT software. The mean reaction time was compared across matched perfectives and matched imperfectives, and the significance was tested by a series of ANOVAs. An extra 8 pairs of utterance-picture items were used as trials for the participants to practice at the beginning of the experiment. All the auditory and picture stimuli in the experiments were counterbalanced. In the analysis, only correct responses were analyzed.

Altogether, we conducted a series of 3 experiments using this methodology, with some configurational variations related to number of verb classes (to test for the effect of lexical aspect), type of grammatical aspect markers (to test for the robustness of different types of perfective and imperfective markers), number of participants, and number of sentences used (see Table 2 for a summary).

Figure 1: Utterance-picture matching task

- A. Presentation of either a perfective or imperfective utterance:



Go3 laam4zai2 taan4-gan2 kam4
 CL boy play-ASP piano
 'The boy is playing the piano.'



- B. Presentation of a pair of pictures depicting completed versus ongoing events:

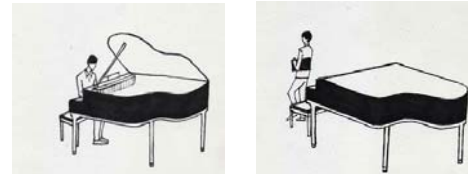


Table 2: Experimental setups

| Experiment | Verb Class | Aspect markers | No. of participants | No. of sentences* |
|------------|------------|------------------------|---------------------|-------------------|
| 1a | ACC | <i>zo2, gan2</i> | 18 | 20 |
| 1b | ACC | <i>jyun4, hai2dou6</i> | 18 | 20 |
| 2a | ACT | <i>zo2, gan2</i> | 18 | 20 |
| 2b | ACT | <i>jyun4, hai2dou6</i> | 18 | 20 |
| 3 | ACT, ACC | <i>zo2, gan2</i> | 32 | 24 |

ACC: Accomplishment; ACT: Activity

* (excluding trial sentences)

Experiment 1

Experiment 1 is conducted to establish a baseline of contrast between perfective and imperfective aspect for subsequent experiments in this study. Previous literature has indicated that a perfective advantage is observed with accomplishment verbs (Madden & Zwaan, 2003; Chan et al., 2004; Yap et al., 2004, in press). Previous work on Cantonese examined a perfective-imperfective contrast between *zo2* and *gan2* (Chan et al., 2004); the present study adds another perfective-imperfective set, namely *jyun4* and *hai2dou6* respectively). This allows us to examine whether the perfective advantage is robust across different types of perfective and imperfective aspect markers.

Methodology

A forced-choice utterance-picture matching task was used, as described above, with Experiment 1a testing for the effects of perfective *zo2* and imperfective *gan2* on accomplishment verbs, and Experiment 1b replicating the preceding study using perfective *jyun4* and imperfective *hai2dou6*.

Results

For experiment 1a, a one-way repeated measure ANOVA was conducted to compare the reaction time of perfective marker *zo2* and imperfective marker *gan2* in the context of accomplishment verbs. The dependent variable was subjects' reaction time in the picture-matching task. The within-subjects factor was grammatical aspect with 2 levels (perfective marker *zo2* and imperfective marker *gan2*). The effect of grammatical aspect was significant, $F(1,141) = 10.82$, $p = .001$. The result shows that the mean reaction time of the constructions with perfective *zo2* is significantly faster than those with imperfective *gan2*. The mean reaction time of the constructions with perfective *zo2* is 941ms (SD=242), while that of the constructions with imperfective *gan2* is 1032ms (SD=289). See Table 3.

Table 3: Results of experiments 1a and 1b

| | Experiment 1a | Experiment 1b |
|--------------------------|----------------------------|----------------------------------|
| Verb Class | Accomplishment | Accomplishment |
| Aspect markers | <i>zo2</i> vs. <i>gan2</i> | <i>jyun4</i> vs. <i>hai2dou6</i> |
| Mean length of utterance | 1.94 secs SD= .12 | 1.82 secs SD= .19 |
| Perfective | Mean=941ms SD=242 | Mean=964ms SD=295 |
| Imperfective | Mean=1032ms SD=289 | Mean=1113ms SD=396 |
| Significance | $p = .001$ | $p < .001$ |
| | Perfective advantage | Perfective advantage |

For experiment 1b, a similar one-way repeated measure ANOVA was conducted to compare the reaction time of perfective marker *jyun4* and imperfective marker *hai2dou6* in the context of accomplishment verbs. The dependent variable again was participants' reaction time in the picture-matching task. The within-subjects factors were grammatical aspect with 2 levels (perfective *jyun4* and imperfective *hai2dou6*). The effect of grammatical aspect was significant, $F(1,164) = 15.54$, $p < .001$. Results show that there is a perfective advantage. The mean reaction time of the constructions with perfective *jyun4* is significantly faster than those with imperfective *hai2dou6*. The mean reaction time of perfective utterances with *jyun4* is 964ms (SD=295), while that of utterances with imperfective *hai2dou6* is 1113ms (SD=396).

The results from both experiments 1a and 1b show that there is a perfective advantage with accomplishment verbs. This advantage is robust across two different types of perfective aspect markers in Cantonese, *zo2* and *jyun4*.

Experiment 2

We further examine whether the perfective advantage found with accomplishment verbs is persistent across other verbs, in this particular case, with *activity verbs*. Positive results would suggest that aspectual asymmetry in processing speed is strongly biased in favor of perfective aspect markers. However, a negative result (i.e. one that shows

imperfective facilitation), would indicate that our mental representations are influenced by subtle and complex interactions between both lexical and grammatical aspect.

Methodology

The same forced-choice utterance-picture matching task used in Experiment 1 above was adopted, with one important change to the configuration: *activity verbs* were used instead of accomplishment verbs. Again two pair-wise experiments were used to test for the robustness of aspectual asymmetry (if any) across different types of grammatical markers. Experiment 2a tested for the effects of perfective *zo2* and imperfective *gan2* on activity verbs, while experiment 2b tested for the effects of perfective *jyun4* and imperfective *hai2dou6* on the same set of verbs.

Results

Perfective advantage was *not* found for activity verbs in experiments 2a and 2b. In experiment 2a, the effect of grammatical aspect was significant, $F(1,165) = 5.09$, $p = .025$. For activity verbs, imperfective utterances were processed significantly faster than perfective utterances. The mean reaction time of imperfective *gan2* utterances (mean=1125ms, SD=367) is significantly faster than the mean reaction time of perfective *zo2* utterances (mean=1211ms, SD=379). In experiment 2b, the effect of grammatical aspect was also significant, $F(1,176) = 5.91$, $p = .016$. The mean reaction time of imperfective constructions with *hai2dou6* is 1064ms (SD=425), which is faster than the mean reaction time of perfective constructions with *jyun4* (mean=1171ms, SD=431). See Table 4.

Table 4: Results of experiments 2a and 2b

| | Experiment 2a | Experiment 2b |
|--------------------------|----------------------------|----------------------------------|
| Verb Class | Activity | Activity |
| Aspect markers | <i>zo2</i> vs. <i>gan2</i> | <i>jyun4</i> vs. <i>hai2dou6</i> |
| Mean length of utterance | 1.7 secs SD= .15 | 1.7 secs SD = .15 |
| Perfective | Mean=1211ms SD=379 | Mean=1171ms SD=431 |
| Imperfective | Mean=1125ms SD=367 | Mean=1064ms SD=425 |
| Significance | $p = .025$ | $p = .016$ |
| | Imperfective facilitation | Imperfective facilitation |

Discussion

Results from experiments 2a and 2b demonstrate that there is no perfective advantage for activity verbs. The findings indicate that inherent lexical aspect (accomplishment or activity) plays an important role in the formation of mental representation of events. Accomplishment verbs impose an inherent telic endpoint to the event, while activity verbs draw reference to an event without focusing on the endpoint(s). The intrinsic atelic nature of activity verbs

matches the features associated with imperfective aspect markers *gan2* and *hai2dou6*. Imperfective markers impose reference to the internal stages of the event, which matches the atelic nature of activity verbs. Processing time could be delayed when perfective markers impose an ‘induced’ endpoint on activity verbs.

On the other hand, perfective facilitation is observed for accomplishment verbs, as seen in experiments 1a and 1b. A perfective processing advantage is seen in accomplishment verbs but not in activity verbs since the telic nature of accomplishment verbs matches the characteristics of perfective aspect markers *zo2* and *jun4*. Perfective aspect markers are compatible with (and apparently reinforce) a ‘boundedness’ representation. We thus see that inherent lexical aspect plays a significant role in the construction of mental representations of events.

Experiment 3

This follow-up experiment examines whether aspectual asymmetry is found in environments involving two verb classes: activity and accomplishment. The asymmetrical relationship between perfective and imperfective constructions can be more clearly seen in pair-wise situations in experiments 1 and 2. As mentioned previously, perfective facilitation was found in experiments 1a and 1b with accomplishment verbs, while imperfective facilitation was found in experiments 2a and 2b with activity verbs. Experiment 3 is needed to determine if the above aspectual asymmetries persist in more complex environments where more than one verb type is found. More specifically, the research question is whether the same perfective advantage (found in experiments 1a and 1b) and imperfective facilitation (found in experiments 2a and 2b) can be found in a setting where both accomplishment and activity verbs are included in the stimuli set.

Methodology

The forced-choice utterance-picture matching task used above is expanded to include two (instead of one) verb types, namely activity and accomplishment verbs. In terms of grammatical aspect markers, perfective *zo2* and imperfective *gan2* were used.

Results

A two-way repeated measures ANOVA was conducted to compare the effect of grammatical aspect and lexical aspect on processing time. The dependent variable was participants’ reaction time in picture-matching task. The within-subjects factors were lexical aspect with 2 levels (accomplishments and activities) and grammatical aspect with 2 levels (aspect markers *gan2* and *zo2*). The main effect of grammatical aspect was significant, $F(1,167) = 6.63, p = .011$. The interaction of lexical x grammatical aspect effect was also significant, $F(1,167) = 5.79, p = .017$. The main effect of lexical aspect was *not* significant, $F(1,167) = .73, p = .394$. See Table 5.

Table 5: Results of experiment 3

| Lexical aspect | Grammatical aspect | |
|---------------------------|------------------------|--------------------------|
| | Perfective <i>zo2</i> | Imperfective <i>gan2</i> |
| Accomplishment (N=168) | Mean=1199 ms SD=376 | Mean=1193 ms SD=430 |
| Activity (N=168) | Mean=1239 ms SD=445 | Mean=1096 ms SD=326 |

Mean length of utterance = 1.8 secs; SD= .19

Main effect of grammatical aspect effect: $p = .011$

Main effect of lexical aspect effect: $p = .394$

Lexical x grammatical interaction effect: $p = .017$

A paired-samples *t*-test was conducted to investigate the significant interaction. The reaction time of imperfective marker *gan2* (1091ms) (SD=321) is significantly faster than perfective marker *zo2* (1241ms) (SD=435) within activity verbs, $t(178) = -4.063, p < .001$. The difference of reaction times of *gan2* and *zo2* within accomplishment verbs is *not* significant, $t(167) = -.146, p = .884$. See Table 6. Imperfective facilitation, but *not* perfective facilitation, was found in the presence of two verb classes. This shows that imperfective facilitation with activity verbs is more robust when compared to perfective facilitation with accomplishment verbs.

Table 6: Follow-up *t*-test on interaction effect of experiment 3

| | Perfective <i>zo2</i> | Imperfective <i>gan2</i> | Significance |
|----------------|-----------------------|--------------------------|--------------|
| ACC (N=168) | Mean=1199ms SD=376 | Mean=1193ms SD=430 | $p = .884$ |
| ACT (N=179) | Mean=1241ms SD=435 | Mean=1091ms SD=321 | $p < .001$ |

Note: The mean and SD of perfective *zo2* and imperfective *gan2* with activity verbs are different in Tables 5 and 6 due to differences in N. In Table 5, N =168; in Table 6, N=179.

Discussion

Neighborhood density appears to be a contributing factor, yielding a ‘squishing effect’. Since accomplishment verbs comprise of an ongoing phase and a telic (endpoint) phase, perfective facilitation in accomplishment verbs is more fragile. In this experiment, in which subjects are exposed to both activity and accomplishment verbs, the presence of activity verbs could be inducing subjects to become more responsive to the ongoing phase of accomplishment verbs. This could then sometimes ‘wipe out’ the perfective advantage often associated with accomplishment verbs.

An experiment of pair-wise design (like the ones in experiments 1 and 2) and a complex experiment with 2x2 design (like experiment 3) are conducted for different purposes. A pair-wise experiment can show the simple main effect of grammatical aspect in the context of one verb class. A complex experiment can show the behavior of grammatical aspect in the context of two (or more) verb classes. The results of our experiments show that perfective facilitation with accomplishment verbs can be teased out in the clinical environment of a pair-wise design. However,

experiment 3 of a complex design shows that perfective facilitation is more fragile in the context of two verb classes, while imperfective facilitation with activity verbs remains robust.

We also conducted an alternative way of analyzing the results of experiments 1 and 2, i.e. we combined experiments 1a and 2a for analysis. This is a split plot design in which the lexical aspect (with 2 levels: accomplishment and activity) is a between-subjects factor while grammatical aspect (with 2 levels: *gan2* and *zo2*) is a within-subjects factor. This way of analysis of combining experiments 1a and 2a is similar to the complex design of experiment 3, except that lexical aspect is a between-subjects factor. The results of this analysis (repeated-measures ANOVA) reveal the following: the main effect of grammatical aspect is significant ($p < .001$), the main effect of lexical aspect is *not* significant, and the interaction effect is *not* significant ($p=1.000$). (Crucially different, the interaction effect of experiment 3 is significant, $p = .017$).

The significant grammatical aspect effect and non-significant lexical aspect effect in this analysis is the same as those for complex experiment 3. What is different is the interaction effect between this analysis (which combined experiments 1 and 2) and the complex design of experiment 3. This could be explained by the fact that subjects in experiments 1 and 2 were exposed to one verb class only. The interaction effect found in experiment 3 could not be revealed in this combined analysis. A complex design which includes 2 (or more) verb classes mimics real-time processing in language comprehension. Thus, conducting a pair-wise experiment and a complex experiment provides different insights.

General Discussion

The accuracy rates of matched perfective and matched imperfective in the present study is higher than that in the English study by Madden and Zwaan (2003). In their study, participants were sensitive only to perfective cues. The accuracy rate of perfective constructions was 76% and that of imperfectives was 56%. However, different results were found for Chinese. Participants were sensitive to both perfective and imperfective cues in Cantonese and Mandarin (Chan et al., 2004; Yap et al., 2004; this study). In the Cantonese study (Chan et al., 2004), the accuracy rate for perfectives is 95% and that of imperfectives is 91%. In the Mandarin study (Yap et al., 2004), the accuracy rate of perfectives is 87% and that of imperfectives is 82%. In the present study on Cantonese, the average accuracy rate for perfectives and imperfectives is over 85% for each experiment. The results, as summarized in Table 7, show that there is high sensitivity to both perfective and imperfective cues in Mandarin and Cantonese, both of which are tenseless but rich in aspectual markings.

The Cantonese data also reveal that both perfective and imperfective facilitations were found in utterance-picture matching tasks. Imperfective facilitation was robust with activity verbs. Perfective facilitation was found with accomplishment verbs; however this perfective advantage

was fragile in complex environments involving more than one verb type. There is therefore an interaction between lexical aspect and grammatical aspect on cognitive processing and the construction of mental representation of events. Future work could further investigate the effect of other verb classes (e.g. achievements, states and semelfactives) in the processing of aspectual information.

Table 7: Accuracy rates in the present study

| Experiment | 1a | 1b | 2a | 2b |
|------------------|-------|-------|-------|-------|
| Verb Class | ACC | ACC | ACT | ACT |
| Perfective | 90% | 95% | 92% | 93% |
| Imperfective | 89% | 92% | 97% | 96% |
| Overall Accuracy | 89.5% | 93.5% | 94.5% | 94.5% |

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