Application of Future Sentence Reference Extraction in Support of Future Event Prediction

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• Future events:
  - Event ‘X’
  - Event ‘Y’

• options:
  1. Strategy option ‘A’ when both events ‘X’ and ‘Y’ happen.
  2. Strategy option ‘B’ when the event ‘X’ happens and the event ‘Y’ does not happen.
  3. Strategy option ‘C’ when the event ‘Y’ happens and the event ‘X’ does not happen.
  4. Strategy option ‘A’ when both events ‘X’ and ‘Y’ do not happen.
• **Future events:**
  - Event ‘X’
  - Event ‘Y’

• **Typical options:**
  1. Strategy option ‘A’ when both events ‘X’ and ‘Y’ happen.
  2. Strategy option ‘B’ when the event ‘X’ happens and the event ‘Y’ does not happen.
  3. Strategy option ‘C’ when the event ‘Y’ happens and the event ‘X’ does not happen.
  4. Strategy option ‘A’ when both events ‘X’ and ‘Y’ do not happen.

**supporting**
Background

• options:
  1. Strategy option ‘A’ when both events ‘X’ and ‘Y’ happen.
  2. Strategy option ‘B’ when the event ‘X’ happens and the event ‘Y’ does not happen.
  3. Strategy option ‘C’ when the event ‘Y’ happens and the event ‘X’ does not happen.
  4. Strategy option ‘A’ when both events ‘X’ and ‘Y’ do not happen.

Support of Future Event Prediction

Future reference sentences

knowledge including
• past stories
• current facts
• experiences
• survey results
• research
Relevant study: Future events extraction

- Extract the future events
  - method with explicit future tense expressions (for English) [1]
    - next year, in 20xx, later, from 20xx to 20xx, .. etc.

  “X may happen in 20xx”
  “X is scheduled to happen next week”
  “X will happen until 20xx”

- method with future word expressions (for English) [2]

  “may happen”
  “is scheduled to happen”
  “will happen”

1. **Automatic Extraction of future reference sentences based on mtorphosemantic.**

2. **Future prediction Support experiment**
Classification Method

Natural Language Sentences
(future / no future
each 130 sentences)

Morphosemantic Structure :MS

Morphosemantic Patterns :MoPs

Classifier (Future/ No future)

Test phase

Trading phase

Labeling

Generate

Training

Test data with MS

Classifier (Future/ No future)

Future Reference Sentences

Other Sentences

Test phase
propose method for classification of future reference sentences

Morphosemantic
Morphology + Semantic

Morphology

Japanese: “Taro ha Hanako ni hana wo okuru darou”
English: “Taro will give Hanako some flower.”

Morphology: “n pp n pp n pp v av av s” with morpheme

n: noun
pp: a postpositional particle
v: verb
av: auxiliary verb
s: symbol
propose method for classification of future reference sentences

**Semantic**

“Taro ha Hanako ni hana wo **okuru darou**”

“Taro will give Hanako some flower.”

based on **predicate argument** structure considered dependency between words

```
[Agent][Goal][Object][State-change]
```

“**[Agent]**[**Goal**][**Object**][**State-change**]” with semantic role labels

![Diagram](image)

- **semantic role labels**
- **predicate argument**
- **arguments**
Generating MoPs from a sentence

Natural Language Sentences

JR: “Taro wa/ Hanako ni/ hana wo/ okuru darou”.
E: “Taro will give Hanako flowers”.

MS: “[Agent][Goal][Object][State_change]”

MoPs: [Agent][Object]
[Agent][State_change]
[Point][State_change]
[Agent][Object][State_change]

• combine elements (1 ~ 6) of MS and “*”
• keep order elements of MS
Classification Method

Test data with MS

Classifying phase

Classifier

classify

Future Reference Sentences

Other Sentences

<with MS>
[Agent][Goal][Object][State_change]
[Time][Agent][Object][No_state_change][State_change]
[Object][Time][No_state_change]
[Place][Adverb][State_change]
[Organization][Noun][Place][Noun]
...

<FRS>
JR: “John wa Mary ni tegami wo okuru darou”.
E: “John will send Mary a letter”.

<Other sentences>
JR: “big apple” wa new york shi no nikkune-mu dearu”.
E: “The big apple is New York City’s nickname”.

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Evaluation

*Test data setting:* • 270 sentences from Mainichi Newspaper (1996)
  • 100 sentences and 170 sentences annotated by three people.
  • domain: Economics and International
  • Keyword: energy

*MoPsClassifire:* calculated with length awarded for Morphosemantic patterns

![Graph showing break-even point at 0.76](image)

Threshold values for classifying FRS
Future Prediction Support Experiment

- **Experiment setup**
  - 30 participants (male: 22, female: 8 [19~25 years old (28 people), 45~50 years old (2 people)])
  - 7 future event questions toward two years selected from FPCT[*1] in 2009
  - 17~30 FPSS for each the question, extracted automatically from Mainichi Newspaper in 2009.
  - Compared with correct rate with the result of FPCT

[*1]: Future Prediction Competence Test

- **typical human processing**

- **This Experiment**

  - Future reference sentences

  - Questions from FPCT

  - Future event happen/not

  - Prediction

  - Future event happen/not

  - Prediction

  - Future Event
The Future Prediction Competence Test

Future Predict Competence Test:
- prediction questions which future trend (events) toward one or two years.
- will correct the test 2 years later and certify as appropriate grade.

Purpose:
- to support people of increased public responsibility for examples, managers, politicians etc.
- people responsible of making decisions influencing civic life.

Format:
- 6 fields (politics, economics, international events, science and technology, society, leisure)
- answer at least 15 questions choosing from 30 questions.
- multiple-choice questions, answer predicting specific numbers and reasons.
- 8 points/a question (correct: 6 points, when requiring reasons: 2 points)

Allow something:
- browse any and all materials, and are free to seek the opinions of others.
- one year.

Question 1: Predict whether the following bills approve it at the end of June, 2010, and they are passed.

(1) Local franchise grant to a permanent residence foreigner:
   (a) be enacted  (b) not be enacted

answer: 【  】

Specify which sentence (number ID) from the prepared Future Prediction Support Sentences was most useful in making the above decision: 【  】

(2) Civil law revision in acknowledgment of a separate surname for a married couple:
   (a) be enacted  (b) not be enacted

answer: 【  】

Specify which sentence (number ID) from the prepared Future Prediction Support Sentences was most useful in making the above decision: 【  】
**Question form (2)**

**Question3**: Predict the stationing status of US forces in Afghanistan at the end of June 2011.

(A) The US forces will be still present and further reinforced comparing to October 2009.
(B) The US forces will be still present on similar level comparing to October 2009.
(C) The US forces will be still present but in decreased number comparing to October 2009.
(D) The US forces will be completely withdrawn.

**Answer:**

[ 1st candidate:___ / 3rd candidate:___ / 2nd candidate:___ ]

Specify which sentence (number ID) from the prepared Future Prediction Support Sentences was most useful in making the above decision:

1st candidate: [___] 2nd candidate: [___] 3rd candidate: [___]
Some examples show research participants FPSSs for question 3:

<table>
<thead>
<tr>
<th>No.</th>
<th>FPSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Other newspapers are also carrying the Mainichi Newspaper’s three-part feature on trilateral coordination between Japan, Korea, and the US on North Korean nuclear arms, cooperation between Japan and Korea on reconstruction aid to Afghanistan, and the establishment of regular meetings or “shuttle diplomacy” between the respective leaders of these countries.</td>
</tr>
<tr>
<td>2</td>
<td>Additionally, it revealed their intention to finish the Iraq War through the gradual withdrawal of US combat troops stationed there, and put full force into the War on Terror in Afghanistan.</td>
</tr>
<tr>
<td>3</td>
<td>Substantial negotiations toward realizing the campaign pledge to reduce the number of stationed US forces “within 16 months of inauguration” have begun, aiming for an early formulation of a comprehensive plan that includes sending more U.S. troops to Afghanistan, a key battleground in the War on Terror.</td>
</tr>
<tr>
<td>4</td>
<td>Ahmad Saif (29), an engineer in Baghdad, rejoiced that President Obama had reemphasized the need to focus on the War on Terror in Afghanistan, increasing the likelihood of an early withdrawal of U.S. troops from Iraq.</td>
</tr>
<tr>
<td>5</td>
<td>At a cabinet-level meeting between Finance and Foreign Ministers of each country, in addition to steps to be taken on the deterioration of public order in Afghanistan caused by formerly dominant Taliban forces, the agenda featured discussion of water resource development policies in response to the ongoing drought, and negotiations over assistance measures.</td>
</tr>
</tbody>
</table>
Experiment Result (1)

comparison the correct accuracy rate between this experiment and FPCT

![Bar chart showing correct accuracy rates]

- **Supporting Future Trend Prediction**
  - Average: 42.9
  - Highest: 85.7
  - Lowest: 6.7

- **The Future Prediction Competence Test**
  - Average: 33.4
  - Highest: 61.1
  - Lowest: 14.3
comparison pass the grade between this experiment and FPCT

<passing line>
1st grade: over 50%
2nd grade: over 40%
3rd grade: over 30%
number of referred each FPSS when question 3 was answered.
To verify practical effectiveness of our method for predicting future events, we performed the experiment in which 30 participants answered the questions excerpted from FPCT questions in 2009 by only reading FPSS. We also compared the results to the result of original FPCT.

- An average of 10% improvement over the results of the original FPCT.
- Background knowledge may influence it.
- The cost such reference information and time for answering can be reduced.
- Some sentences are helpful for predicting, some are not.
Future Works

• Extract FPSS with other corpora (other newspaper, column is wrote by expert, …)
• Apply to real-world problems (company management, economic trend, …)
• Analyze useful Future Predicting Supporting Sentences.
  ‣ sofisticate FPSS.
• Review about the experiment setting.
  ‣ no background knowledge effects.
Application of Future Sentence Reference Extraction in Support of Future Event Prediction

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Preliminary investigation on temporal expressions

- 270 sentences randomly collect from newspapers

<table>
<thead>
<tr>
<th>Future Expression</th>
<th>number of types</th>
<th>words</th>
<th>frequency: =1</th>
<th>frequency: &gt;2</th>
</tr>
</thead>
<tbody>
<tr>
<td>temporal</td>
<td>82</td>
<td>in the days ahead, in Y years, next month, within the next Y, after Y years, at an early date,…</td>
<td></td>
<td></td>
</tr>
<tr>
<td>word</td>
<td>256</td>
<td>aim to(mezasu), plan to (hoshin, mitooshi) increase(fuyasu), bring ~ to (tonyusuru), a possibility(kanouseiga are), …</td>
<td>80%</td>
<td>20%</td>
</tr>
</tbody>
</table>