The Processing of VP-Internal Scrambling in Japanese

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1. Introduction

1.1 Scrambling in Japanese

(1)  a. 太郎が花子に本をあげた。
    b. 太郎が 本を 花子に あげた。
    c. 本を 太郎が 花子に あげた。
    d. 花子に 太郎が 本を あげた。
    e. 花子に 本を 太郎が あげた。
    f. 本を 花子に 太郎が あげた。

Question

Are scrambled word orders such as (1b) harder to process than the canonical word order in (1a)?

2. Proposal

1. A dependency is posited on-line between the scrambled constituent and its gap (i.e., its canonical position).
2. Association of the gap to its antecedent is affected by the following factors.
   a) working memory load (Just and Carpenter1980)
   b) the distance between gap and antecedent (Gibson 1998)
3. Difficulty creating the dependency should be independent of the case marker being processed and the frequency of the constructions compared.
2.1 Basic Construction

(2) a. Canonical: Subject NP-\text{DAT} NP-\text{ACC} ditransitive-verb
b. Scrambled: Subject NP$_1$-\text{ACC} NP-\text{DAT} \text{[gap]}, ditransitive-verb

Advantages
1. Both word orders are commonly used.
2. Dative and accusative case markers do not differ as much in complexity.

3. Experiment 1: memory load

Complex constructions were used (the ditransitive clause was embedded twice).

Stimulus
(3) a. Canonical
\begin{center}
オフィスで / 職員が / 係長に / お茶を / 出した / 女性を / 丁寧に / 誓めたと / 相原さんが / 話していた。
\end{center}
b. Scrambled
\begin{center}
オフィスで / 職員が / お茶を / 係長に \text{[gap]} / 出した / 女性を / 丁寧に / 誓めたと / 相原さんが / 話していた。
\end{center}

Procedure
Self-paced reading experiment

Analysis
Residual reading times (Ferreira and Clifton 1986)

Result
“係長に” in the scrambled sentence significantly slower than “お茶を” in the canonical sentence (Ps < 0.05). No difference is observed in other regions.

Problems
1. Different case markers (accusative vs. dative) are compared.
2. Although frequent, the scrambled word order is still less frequent than the canonical word order (see Experiment 3).
3. Direct objects preferentially occur adjacent to the verb.
   a) English
   *Paul opened quickly the door. (Stowell 1981)
   b) Japanese
   Accusative case marker dropping becomes less natural if far from the verb.
   (Saito 1985)

4. **Experiment 2: distance between gap and antecedent**

**Stimulus**

(4) a. canonical accusative/adjacent
   物理学者は / 学会が / 行われた / 会場で / 学生に / 公式を / 説明した / そうだ。

b. scrambled accusative/adjacent
   物理学者は / 学会が / 行われた / 会場で / 公式を / 学生に [gap] / 説明した / そうだ。↓

   ↑

   ↓

c. canonical accusative/far
   物理学者は / 学生に / 学会が / 行われた / 会場で / 公式を / 説明した / そうだ。

d. scrambled accusative/far
   物理学者は / 公式を / 学会が / 行われた / 会場で / 学生に [gap] / 説明した / そうだ。↓

   ↑

1. Intervening adverbial XP (locative or temporal) increases distance between gap and antecedent in the long scrambling condition (4d) in comparison to the short scrambling condition (4b).

2. Position of the AdvP is not important in the canonical conditions (4a) and (4c).

**Advantages of the Present Design**

1. Same case maker (same word) is compared.

2. Adjacent constraint is equally violated in the scrambling conditions (4b) and (4d).

3. The two conditions with intervening AdvP (4c) and (4d) are infrequent (heavy NP shift; see Experiment 3)

**Procedure**

Self-paced reading experiment
Results
1. Comprehension performance (between 89% and 95%) did not differ significantly.
2. Residual reading times at region 4:
   a) interaction ($P_1 < 0.05; P_2 = 0.053$).
   b) the two canonical conditions (4a) and (4c) did not differ significantly in this region ($Fs < 1.2$)
   c) the long scrambling condition (4d) was slower than the short scrambling condition (4b) ($P_1 < 0.05; P_2 = 0.055$).
   d) The four conditions did not differ significantly at the ditransitive verb ($Fs < 1$).

5. Experiment 3: frequency counts

If frequency counts are a measure of the processing difficulty in Experiment 2, then:

\[
\frac{\text{freq(canonical acc/adjacent) (4a)}}{\text{freq(canonical acc/far) (4c)}} \leq \frac{\text{freq(scrambled acc/adjacent) (4b)}}{\text{freq(scrambled acc/far) (4d)}}
\]

Procedure
1. Sentences with 50 or less characters from the Mainichi Shinbun (1991-1995) and the Nippon Keizai Shinbun (1990-1996)
2. Sentences were automatically parsed using SLUNG (Mitsuishi, Torisawa and Tujii 1998)
3. 215,999 sentences with a clause containing a dative NP and an accusative NP
4. 5,102 sentences containing the verbs in Experiment 2 were manually checked by a native speaker to remove irrelevant cases (e.g., collocations, temporals marked with the -ni postposition, intervening nominative NPs)
5. the remaining 1,834 sentences were counted and classified according to whether the accusative NP was scrambled and whether an AdvP intervened between the two object NPs.

Results
(4a) canonical accusative, adjacent (NP-DAT NP-ACC): 1,202 sentences (65.55%)
(4b) scrambled accusative, adjacent (NP-ACC NP-DAT): 565 sentences (30.85%)
(4c) canonical accusative, far (NP-DAT AdvP NP-ACC): 46 sentences (2.55%)
(4d) scrambled accusative, far (NP-ACC AdvP NP-DAT): 21 sentences (1.2%)
Discussion
1. The scrambled word order (4b) is frequent but considerably less frequent than the canonical version (4a).
2. Relative frequency of the canonical conditions (4a)/(4c) = 26.1
3. Relative frequency of the scrambled conditions (4b)/(4d) = 26.9
4. Relative frequencies do not explain reading time patterns in Experiment 2

6. Conclusion
1. A dependency is created between a gap and its antecedent.
2. The processing of a dependency takes longer the farther the gap is from its antecedent.
3. The result is independent of factors such as the case marker processed, the frequency of the constructions, the adjacency constraint.
4. The result is compatible with the literature in English relating working memory and parsing (Gibson 1998; Just and Carpenter 1980)
5. The result is compatible with various syntactic proposals for scrambling (Hoji 1985; Takano 1996).
6. The result is not easily explained if NP-o NP-ni is base-generated (Miyagawa 1997).

7. Experiment 4: Probe Recognition
7.1 Previous Studies

MacDonald (1989): Trace Reactivation Experiments
(6) a. The new mayor at the centre podium was furious.
    b. [The new mayor at the centre podium], was shot [/gap].

    Probe: “mayor” ---> response faster for (6b)

Conclusion:
trace after “shot” in (6b) but not after “furious” in (6a)

Rationale:
1. Word is activated when read and slowly decays.
2. Gap re-activates antecedent.
Nakayama (1995)

(7) a. 今日 / 問題を / 出した / 先生が / 宿題を / 忘れた / 生徒を / 叱った。
   b. 今日 / 宿題を / 忘れた / 生徒を / 問題を / 出した / 先生が [gap] / 吼った。

Probe: “宿題” ---> response faster for (7a)

Problems:
1. (7a) is a garden-path.
2. Recency effects

7.2 Probe Recognition Experiment

Stimulus

1 2 3 4 5 6 7

(8) a. 学校で / 問題を / 出した / 講師が / とても賢い / 学生を / 見た。
   b. 学校で / 問題を / 出した / 講師を / とても賢い / 学生が [gap] / 見た。

Probe: “問題”

Advantages of the Present Design
1. Minimal pair ---> No priming effects
2. No recency effects

Result
Response faster for (8b) (Ps < 0.05).

Conclusion
A dependency is created during the on-line processing between the scrambled constituent and its gap (i.e., its canonical position).
References


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