Design and development of an RDB version of the *Corpus of Spontaneous Japanese*

Hanae Koiso† **Yasuharu Den**‡† **Ken'ya Nishikawa**§ **Kikuo Maekawa**†

† National Institute for Japanese Language and Linguistics, Japan
‡ Faculty of Letters, Chiba University, Japan
§ Riken Brain Science Institute, Japan
koiso@ninjal.ac.jp, den@cogsci.l.chiba-u.ac.jp, nisi012@nifty.com, kikuo@ninjal.ac.jp

Abstract

In this paper, we describe the design and development of a new version of the *Corpus of Spontaneous Japanese* (CSJ), which is a large-scale spoken corpus released in 2004. CSJ contains various annotations that are represented in XML format (CSJ–XML). CSJ–XML, however, is very complicated and suffers from some problems. To overcome this problem, we have developed and released, in 2013, a relational database version of CSJ (CSJ–RDB). CSJ-RDB is based on an extension of the segment and link-based annotation scheme, which we adapted to handle multi-channel and multi-modal streams. Because this scheme adopts a stand-off framework, CSJ–RDB can represent three hierarchical structures at the same time: inter-pausal-unit-top, clause-top, and intonational-phrase-top. CSJ–RDB consists of five different types of tables: segment, unaligned-segment, link, relation, and meta-information tables. The database was automatically constructed from annotation files extracted from CSJ–XML by using general-purpose corpus construction tools. CSJ–RDB enables us to easily and efficiently conduct complex searches required for corpus-based studies of spoken language.

Keywords: spoken corpus, relational database, segment and link-based annotation scheme

1. Introduction

The *Corpus of Spontaneous Japanese* (CSJ) is a large-scale annotated spoken corpus that was collaboratively developed by the National Institute of Japanese Language and Linguistics, National Institute of Information and Communications Technology, and Tokyo Institute of Technology between 1999 and 2003 (Maekawa, 2003). Since its release in 2004, CSJ has been used in various fields such as linguistics, speech and language technologies, psychology, and language education. This release of CSJ contains various annotations that are represented in XML format (Maekawa et al., 2004). The XML documents of CSJ, however, are very complicated, which hinders general use of CSJ in research fields such as humanities. To overcome this problem, we have developed and released, in 2013, a relational database (RDB) version of CSJ (CSJ–RDB), which enable a wider range of researchers to access various annotations more easily and efficiently. This paper describes the design and development of this new version of CSJ.

2. Corpus of Spontaneous Japanese

The CSJ contains about 625 hours of monolog speech that is mainly sourced from academic presentation speech and general speech on everyday topic. It also contains about 15 hours of dialog speech and about 20 hours of read speech. The speech material is transcribed, and part-of-speech (POS) analysis is applied based on two different types of words: short-unit word (SUW), which approximates dictionary item of ordinary Japanese dictionary, and long-unit word (LUW), which represents various compounds.

The *core* is a fully annotated subset of CSJ that contains around 44 hours of speech (Figure 1). In addition to transcriptions and POS information, the following annotations are included in it (NINJAL, 2006):

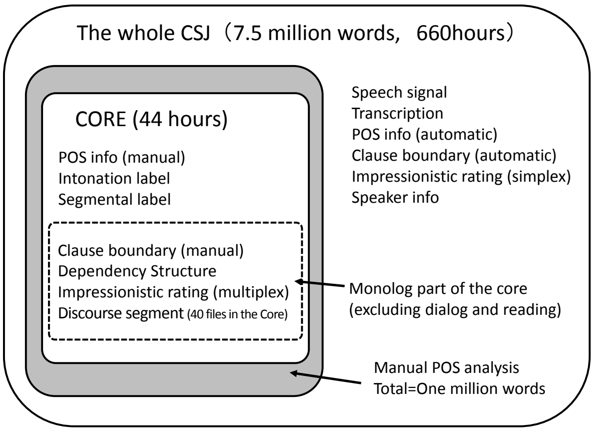

Figure 1: Layered structure of CSJ

Intonation label: The prosodic grouping of an utterance (e.g., accentual and intonational phrases) and its tonal events (e.g., word accents, phrase initial tones, and boundary tones) are annotated based on X–JToBI scheme.

Segmental label: Most labels are basically phonemic (e.g., 'a', 'o', 'k'), but some are phonetic (e.g., 'k^j').

Clause boundary label: The syntactic clause boundary, its type, and miscellaneous annotations such as inversion and parenthetical clause are labeled.

Dependency structure label: The dependency structure between bunsetsu phrases, which are basic phrasal units in Japanese, is labeled.

Impressionistic rating : Impression rating scores about talks, such as fluency, politeness, and spontaneity, are given by twenty raters.

Discourse structure label: The middle level of discourse structure (sub-story) is labeled based on a committee-based decision of discourse purposes.

```
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Figure 2: Example of CSJ–XML

These annotations are represented in XML format (CSJ–XML). The *core* part of CSJ–XML has a hierarchical data structure composed of six elements, as shown in Figure 2.

Each element has its own attributes; for example, an SUW-type element has POS information, a phone-type element contains a phone class such as “vowel” and “consonant,” and accentual phrase (AP)-type element includes a boundary tone category such as “falling” and “rising.”

Although CSJ–XML represents a large number of information in a systematic way, it suffers from some problems. Most seriously, there are two more hierarchies in addition to the inter-pausal-unit (IPU) layer at the top—one with a clause and the other with an intonational phrase (IP) at the top—, and features related to elements of these two hierarchies are necessarily crowded into the IPU layer. Searching across two or more hierarchies is also very difficult.

Moreover, the relation between IPUs and LUWs is not strictly hierarchical; some LUWs extend across more than one IPU, which is implemented in an ad-hoc way in CSJ–XML. These problems, caused by the hierarchical design, make CSJ–XML complex and inconvenient, and lead to occasional failure in extracting some features from it.

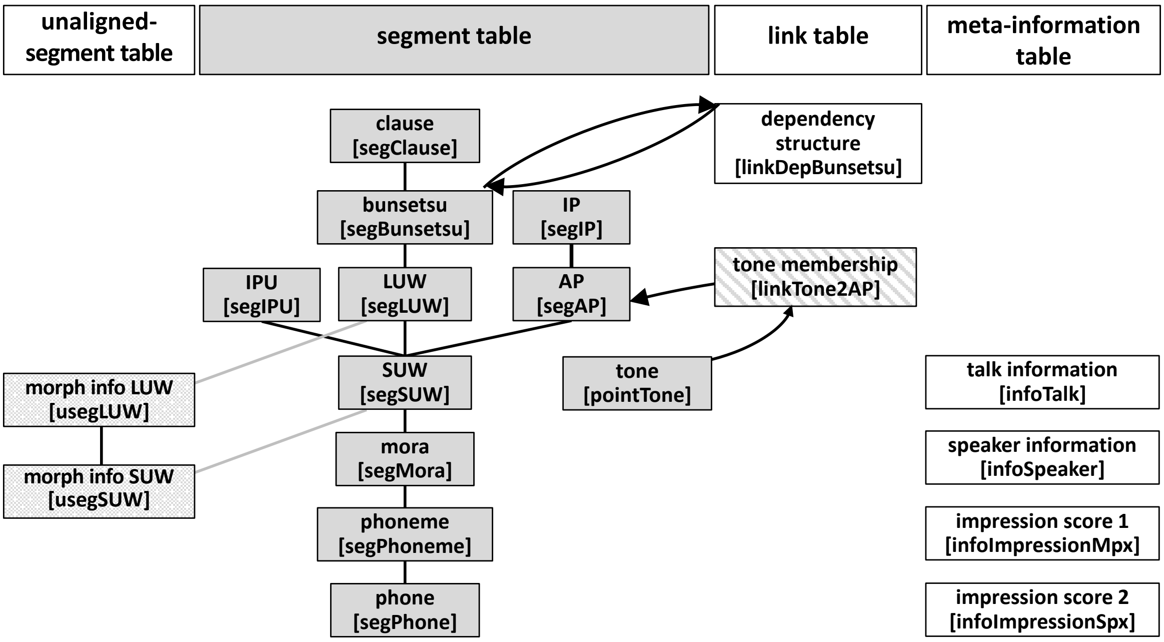


Figure 3: Data structure of CSJ–RDB

3. Design of CSJ–RDB

To represent the multiple hierarchies of the *core*, we developed a relational database (RDB) version of CSJ (CSJ–RDB) based on a segment and link-based annotation scheme (Noguchi et al., 2008; Kaplan et al., 2010). This scheme was originally developed for written corpora. We adapted it to spoken corpora, in particular, handling multi-channel and multi-modal streams (Den and Koiso, in press). In the modified scheme, a specific type of segment, such as an SUW-type segment, is defined as a region identified by the starting and ending times on a certain channel, and a link is defined as a relationship between the source and the destination segments. Because this scheme adopts a stand-off framework, the hierarchical relation between two segments can be extracted based on temporal inclusion. For instance, when a phoneme-type segment ‘k’ is temporally included in an SUW-type segment ‘kore,’ there is a hierarchical relation between the two segments. For further convenience, however, the hierarchical relations among segments are explicitly described in relation tables in CSJ–RDB, as mentioned below. By virtue of the stand-off framework, CSJ–RDB can represent the three hierarchical structures at the same time: IPU-top, clause-top, and IP-top.

Figure 3 shows the basic data structure of CSJ–RDB. CSJ–RDB consists of five different types of tables: segment, unaligned-segment, link, relation, and meta-information tables.

3.1. Segment tables

Segment tables are prepared for all morpho-syntactic, phonetic, and prosodic segments, as shown in Figure 3. Each segment table contains, at least, five attributes, which uniquely identify every segment:

(1) talk ID
(2) segment ID
(3) channel label
(4) starting time
(5) ending time

In addition, attributes specific to each segment table are included (Table 1).

There is another type of table called a point table. A point table is a special type of segment table with no duration, i.e., the starting and ending times are identical. A table named `pointTone` in Table 1 is the only point table in CSJ–RDB.

3.2. Unaligned-segment tables

In spontaneous speech, multiple words are occasionally assimilated, resulting in a contracted or reduced form such as “didja” (did you). In this case, it is impossible to identify the boundary between the component words. To deal with this problem, an assimilated form, whose starting and ending times can be specified, is treated as a segment, while original and unassimilated components of the segment are treated as temporally unaligned segment (Figure 4). The hierarchical relationship between (aligned) segments and unaligned segments is represented in the relation table to be described below.

Each unaligned-segment table contains, at least, three attributes:

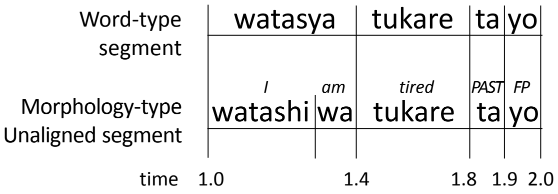


Figure 4: Example of unaligned segment

Table 1: Attributes specific to each segment table

table name	column name	synopsis	possible values / examples
segClause	Text	orthographic transcription	(F ま) 私生活もぼろぼろですから (*well, because my personal life is also miserable*)
	ClauseBoundaryLabel	clause type	/causal clause-*kara*/
	CU_ObligateComment	comment on special cases	parenthetical clause
segBunsetsu	Text	orthographic transcription	私生活も (*my personal life is also*)
segLUW	Text	orthographic transcription	私生活 (*personal life*)
segSUW	Text	orthographic transcription	私 (*personal*)
	PhonLabel	phoneme string	si
segIPU	Text	orthographic transcription	(F ま) 私生活もぼろぼろですから
segIP	Text	orthographic transcription	私生活もぼろぼろですから
	fbt	final boundary tone	L%, LH%, H%, HL%, or HLH%
segAP	Text	orthographic transcription	私生活も
	break	break index	2, 2+b, 2+bp, 3, etc.
	fbt	final boundary tone	L%, LH%, H%, HL%, or HLH%
	prm	prominence	PNLP, EUAP, FR, or HR
	misc	miscellaneous info	AYOR, QQ, or HBP
segMora	MoraEntity	mora entity	し
	PerceivedAcc	presence of accent nucleus	0 (absent) or 1 (present)
segPhoneme	PhonemeEntity	phoneme entity	s
segPhone	PhoneEntity	phone entity	sj
	PhoneClass	phone class	consonant, vowel, or special
	Devoiced	presence of devoicing	0 (absent) or 1 (present)
	StartTimeUncertain	uncertainty of start time	0 (certain) or 1 (uncertain)
	EndTimeUncertain	uncertainty of end time	0 (certain) or 1 (uncertain)
pointTone	tone	tone label	%L, H-, A, H%, etc.
	F0Uncertain	uncertainty of F0 value	0 (certain) or 1 (uncertain)
	CategoryUncertain	uncertainty of tone category	0 (certain) or 1 (uncertain)
	PositionUncertain	uncertainty of tone position	0 (certain) or 1 (uncertain)

(1) talk ID
(2) segment ID
(3) segment ID of the parent segment to which the segment belongs

In addition, attributes specific to each unaligned-segment table are included (Table 2).

3.3. Relation tables

The relation table represents the hierarchical relationship between two segments. As mentioned above, the hierarchical relation between two segments can be automatically extracted based on temporal inclusion. In spoken language, however, segments can be discontinuous due to the presence of intervening pauses, meaning that the ending time of the preceding segment and the starting time of the following segment are not always coincident. In such cases, an SQL query for extracting adjacent segments may become complicated.

We, thus, create relation tables that explicitly represent the hierarchical relationship between the ancestor and descendant segments. Each relation table contains five attributes:

(1) talk ID
(2) segment ID of the descendant segment
(3) segment ID of the ancestor segment
(4) location of the descendant segment within the ancestor segment
(5) total number of descendant segments included in the ancestor segment

Figure 5 shows examples of the segment tables for clause and bunsetsu phrases and the relation table between them. The relation table indicates that the bunsetsu phrase 00263240L is the second descendant (nth = 2) within the clause 00262895L, which contains four descendant bunsetsu phrases in total (len = 4), and so on.

3.4. Link tables

The link table represents the relationship between two segments. CSJ–RDB has two link tables, one describing the dependency structure between the modifier bunsetsu phrases and the modified bunsetsu phrases, and the other representing the relationship between tonal events and accentual phrases to which they belong.

Each link table contains, at least, three attributes:

(1) talk ID
(2) segment ID of the source segment
(3) segment ID of the destination segment

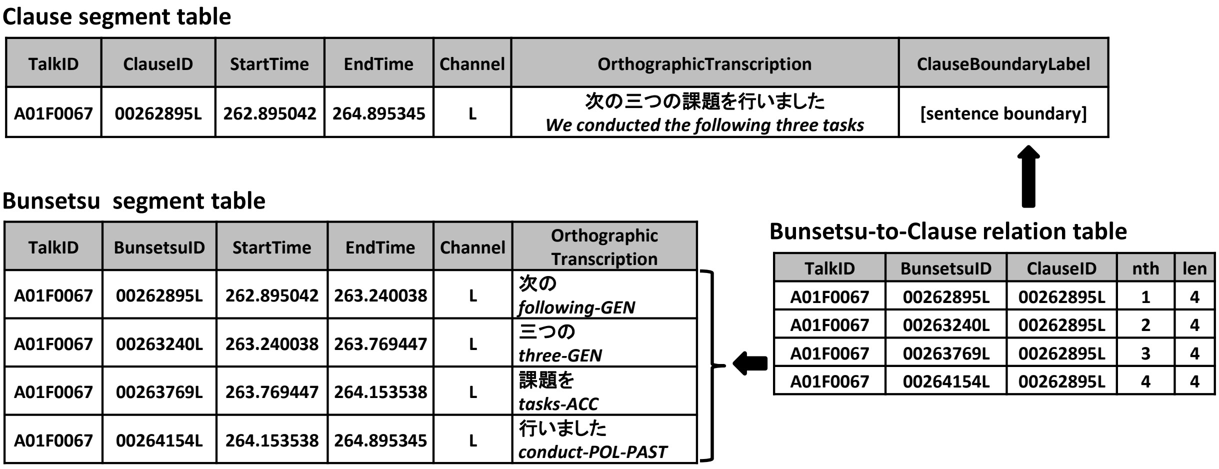
In addition, attributes specific to each link table, such as the type of dependency (“parallel,” “appositive,” “reversed,” etc.), may be included.

3.5. Meta-information tables

CSJ–RDB includes four meta-information tables, one containing information about talks (e.g., talk ID, speaker ID, talk type, genre, topic), one including attributes about

Table 2: Attributes specific to each unaligned-segment table

table name	column name	synopsis	possible values / examples
usegLUW	LUWDictionaryForm	dictionary form	イク (*go*)
	LUWLemma	lemma	行く
	LUWPOS	POS	verb
	LUWConjugateType	conjugate type	5-dan conjugation-*ka*
	LUWConjugateForm	conjugate form	adverbial form
	LUWMiscPOSInfo1	miscellaneous POS info 1	case particle
	LUWMiscPOSInfo2	miscellaneous POS info 2	consonant gemination
	LUWMiscPOSInfo3	miscellaneous POS info 3	collocation
usegSUW	PlainOrthographicTranscription	orthographic transcription w/o tags	行き
	PhoneticTranscription	phonetic transcription	イキ
	SUWDictionaryForm	dictionary form	イク
	SUWLemma	lemma	行く
	SUWPOS	POS	verb
	SUWConjugateType	conjugate type	5-dan conjugation-*ka*
	SUWConjugateForm	conjugate form	adverbial form
	SUWMiscPOSInfo1	miscellaneous POS info 1	sentence-final particle
	SUWMiscPOSInfo2	miscellaneous POS info 2	ellipsis
	SUWMiscPOSInfo3	miscellaneous POS info 3	reduced form
	ClauseBoundaryLabel	clause boundary label	<conditional clause-*to*>
	CU_preBracket	open bracket for the scope of inversion, quotation, etc.	<<
	CU_postBracket	close bracket for the case above	>>
	CU_OperationSign	unit operation sign	+
	CU_ObligateComment	comment on special cases	parenthetical clause



Clause segment table

TalkID	ClauseID	StartTime	EndTime	Channel	OrthographicTranscription	ClauseBoundaryLabel
A01F0067	00262895L	262.895042	264.895345	L	次の三つの課題を行いました *We conducted the following three tasks*	[sentence boundary]

Bunsetsu segment table

TalkID	BunsetsuID	StartTime	EndTime	Channel	Orthographic Transcription
A01F0067	00262895L	262.895042	263.240038	L	次の *following-GEN*
A01F0067	00263240L	263.240038	263.769447	L	三つの *three-GEN*
A01F0067	00263769L	263.769447	264.153538	L	課題を *tasks-ACC*
A01F0067	00264154L	264.153538	264.895345	L	行いました *conduct-POL-PAST*

Bunsetsu-to-Clause relation table

TalkID	BunsetsuID	ClauseID	nth	len
A01F0067	00262895L	00262895L	1	4
A01F0067	00263240L	00262895L	2	4
A01F0067	00263769L	00262895L	3	4
A01F0067	00264154L	00262895L	4	4

Figure 5: Examples of segment tables and a relation table

speaker (e.g., speaker ID, sex, birth generation, birth place), and two containing single- and multiple-rater-based impression ratings about talks (e.g., fluency, politeness, spontaneity).

4. Development of CSJ–RDB

CSJ–RDB was constructed by the following steps (Figure 6).

Step 1: The following three types of annotation files, which can be used for existing annotation tools, were extracted from CSJ–XML (version 3, released in 2011): (1) syntactic information including clause boundary labels, bunsetsu boundaries, and dependency structures, (2) morphological information including POS information of both SUW and LUW, and (3) segmental and prosodic information including segmental, tone, break index, and other miscellaneous labels, which can be edited by using Praat. These annotation files contain all the information required to create the database tables described in Step 3.

Step 2: Additional annotations were conducted: (1) syntactic annotations to dialog and read speeches, which were missing in CSJ–XML, and (2) marking of 'dislocated' tonal events, which are 'physically' located outside of the accentual phrases to which they 'logically' belong.

Step 3: All the annotation files were automatically converted to table files that can be directly imported into the

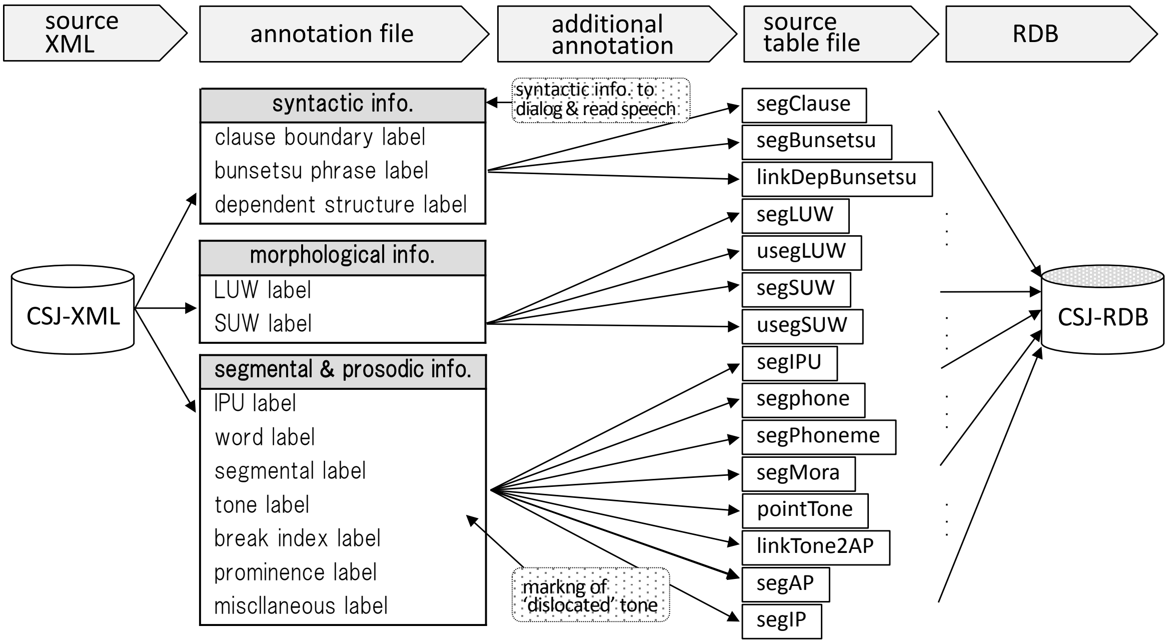


Figure 6: Construction process of CSJ–RDB

database. Relation tables were also automatically extracted based on temporal inclusion between segments.

Step 4: Finally, CSJ–RDB was constructed from the table files created in Step 3. CSJ–RDB was implemented using SQLite.

We developed general-purpose tools for conducting procedures in Steps 3 and 4 that are customizable according to different format of the annotation files and different configuration of the database (Den and Koiso, in press). We can employ these tools to create other spoken corpora database, e.g., multi-party, multi-modal conversation corpus.

5. Efficacy of CSJ–RDB

CSJ–RDB enables us to easily and efficiently conduct complex searches required for corpus-based studies of spoken language. In a typical situation in corpus-linguistic studies, we may want to extract the boundary tones (“falling,” “rising,” etc.) of the final accentual phrases in all the clauses ending with the final particle “ne.” This is very difficult in CSJ–XML, since such a query refers to two different hierarchies, i.e., clause-top and IP-top ones, which cannot be easily combined in CSJ–XML. With CSJ–RDB, simple joining of several segment and relation tables can achieve it. The simple data structure of CSJ–RDB significantly facilitates the management and the searching of the corpus.

Since its release in 2013, more than 170 researchers, including those with both computational and humanities backgrounds, have used CSJ–RDB. We believe that CSJ–RDB will greatly promote the development of corpus-based studies of spoken Japanese.

6. Acknowledgements

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