

# A Database of Relations between Predicate Argument Structures for Recognizing Textual Entailment and Contradiction

Suguru Matsuyoshi, Koji Murakami, Yuji Matsumoto and Kentaro Inui  
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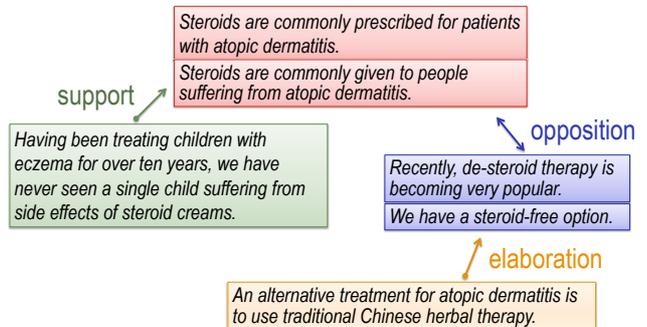
## Introduction



– “Is this statement in the Web page credible?”  
– To judge whether each statement about a topic is credible is not an easy job for Web users, who are provided only with the current type of search engines.

We present ...

## Textual statement map



## Our goal

Recognizing logical relations between statements requires a huge amount of knowledge about relations between various expressions such as nouns, verbs, adjectives, modality expressions, and so on. We develop a database of relations between predicate argument structures (PASs) in Japanese.

Table: Overview of the current status of development of our database

	Argument structure		Logical relation		
	Basic	With sub-event	Thesaurus	Between two	Otherwise
verb	14K words	1K words	4K words (Takeuchi et al. 2008)	46K relations	Logical relations among more than two PASs, e.g., the Perspective_on, Subframes and Precedes relations proposed in FrameNet (Ruppenhofer et al. 2006).
i-adjective	0.7K words	ケン is 明日京都に行こうと決意した。 (Ken decided to go to Kyoto tomorrow.)		2K relations	
na-adjective	2K words	ケン is アンに明日京都に行くように命令した。 (Ken ordered Ann to go to Kyoto tomorrow.)		5K relations	
predicative idiom	2K expressions (ongoing process)		3K relations (ongoing process)		
event noun	雨 (a rain), 電話 (a phone call), ...				

Table: Nine types of logical relations between two PASs in Japanese

Relation	Antecedent	Consequent	Num
near synonym	開ける [X>ガ <Y>ヲ] (open [X> (Subject), <Y> (Object)])	⇒ 開く [X>ガ <Y>ヲ] (open [X> (Subject), <Y> (Object)])	21,175
hyponym	使いこなす [X>ガ <Y>ヲ] (master [X> (Subject), <Y> (Object)])	⇒ 使う [X>ガ <Y>ヲ] (use [X> (Subject), <Y> (Object)])	11,823
inseparable	上げ下げする [X>ガ <Y>ヲ] (move up and down [X> (Subject), <Y> (Object)])	⇒ 上げる [X>ガ <Y>ヲ] (move up [X> (Subject), <Y> (Object)])	188
cooccur	流行る [X>ガ] (be popular [X> (Subject)])	⇒ 伝わる [X>ガ 次々ト] (travel [X> (Subject), widely])	4,746
means	沸かす [X>ガ <Y>ヲ] (boil [X> (Subject), <Y> (Object)])	⇒ 加える [X>ガ <Y>ニ 熱ヲ] (apply [X> (Subject), <Y> (Indirect object), heat (Direct object)])	5,532
antonym	開ける [X>ガ <Y>ヲ] (open [X> (Subject), <Y> (Object)])	⇔ 閉める [X>ガ <Y>ヲ] (close [X> (Subject), <Y> (Object)])	1,490
goal	メモする [X>ガ <Y>ヲ <Z>ニ] (write down [X> (Subject), <Y> (Object), on <Z>])	⇒ 忘れない [X>ガ <Y>ヲ] (not forget [X> (Subject), <Y> (Object)])	887
effect	起こす [X>ガ <Y>ヲ] (raise [X> (Subject), <Y> (Object)])	⇒ 直立する [Y>ガ] (stand [Y> (Subject)])	2,378
presupposition	言い逃れる [X>ガ <Y>ヲ] (dodge [X> (Subject), <Y> (Object)])	⇒ 問いつめられる [X>ガ <Y>ヲ] (be blamed [X> (Subject), for <Y>])	4,503

## Preliminary experiment

Table: Result for the topic "steroids"

	Precision	Recall
similarity	80.1% (822/1026)	63.2% (822/1300)
opposition	45% (14/31)	26% (14/54)

Table: Result for the topic "smoking"

	Precision	Recall
similarity	79.5% (501/630)	51.1% (501/980)
opposition	59% (20/34)	13% (20/158)

高まる [リスクガ 受動喫煙デ]  
(increase [risk (Subject), because of second-hand smoke])

上昇させる [受動喫煙ガ リスクヲ]  
(increase [second-hand smoke (Subject), risk (Object)])

similarity

呼びかける [φガ 禁煙ヲ 喫煙者ニ]  
(promote [φ (Subject), quitting smoking (Object), among smokers])

訴える [φガ 禁煙ヲ 国民ニ]  
(appeal [φ (Subject), quitting smoking (Object), to the public])

similarity

放出する [φガ ニコチンヲ φニ]  
(emit [φ (Subject), nicotine (Object), into φ])

吸引する [φガ ニコチンヲ]  
(absorb [φ (Subject), nicotine (Object)])

opposition

Low recall in this experiment results mainly from the fact that human beings can use logical relations between nouns for recognizing similarity and opposition between PASs but our system cannot.

なる [φガ ニコチン依存ニ]  
(become [φ (Subject), nicotine-dependent (Goal)])

なる [φガ ニコチン中毒ニ]  
(become [φ (Subject), a nicotine addict (Goal)])

similarity

## Related work

- In English
  - WordNet (Fellbaum 1998), FrameNet (Baker et al. 1998), MindNet (Richardson et al. 1998) and VerbOcean (Chklovski et al. 2004).
- In Japanese
  - Manually created: the *Bunrui Goi Hyo* thesaurus (NIJL 2004), a thesaurus of verb argument structures (Takeuchi et al. 2008) and Japanese WordNet (Bond et al. 2008).
  - Automatic collection (Kaji et al. 2002; Inui et al. 2005; Suzuki et al. 2005; Torisawa 2006; Abe et al. 2008).

## Future work

- To expand the thesaurus in the database by adding extra verbs and adjectives.
- To manually validate a huge scale of knowledge collected from a corpus by Abe et al.'s method (Abe et al. 2008).

## Acknowledgment

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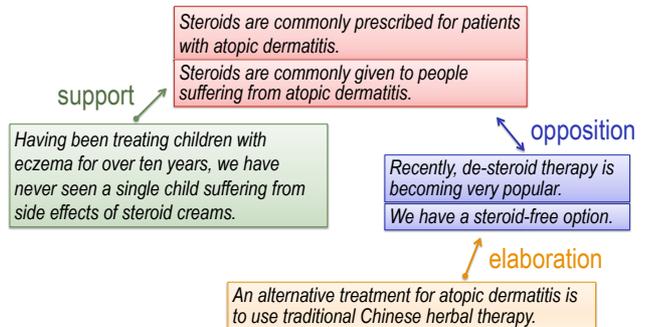


Steroids are commonly prescribed for patients with atopic dermatitis.

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i-adjective	0.7K words	- Ken wa <i>ashita</i> Kyoto ni <i>ikou</i> to <i>ketsui-shi</i> ta. (Ken decided to go to Kyoto tomorrow.)		2K relations	
na-adjective	2K words	- Ken wa An ni <i>ashita</i> Kyoto ni <i>iku</i> youni <i>meirei-shi</i> ta. (Ken ordered Ann to go to Kyoto tomorrow.)		5K relations	
predicative idiom	2K expressions (ongoing process)		3K relations (ongoing process)		
event noun		<i>ame</i> (a rain), <i>denwa</i> (a phone call), ...			

Table: Nine types of logical relations between two PASs in Japanese

Relation	Antecedent	Consequent	Num
near synonym	<i>akeru</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (open [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	$\Leftrightarrow$ <i>hiraku</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (open [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	21,175
hypernym	<i>tsukaikonasu</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (master [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	$\Rightarrow$ <i>tsukau</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (use [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	11,823
inseparable	<i>agesage-suru</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (move up and down [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	$\Rightarrow$ <i>ageru</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (move up [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	188
cooccur	<i>hayaru</i> [ $\langle X \rangle$ GA] (be popular [ $\langle X \rangle$ (Subject)])	$\Rightarrow$ <i>tsutawaru</i> [ $\langle X \rangle$ GA, <i>tsugitsugi</i> TO] (travel [ $\langle X \rangle$ (Subject), widely])	4,746
means	<i>wakasu</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (boil [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	$\Rightarrow$ <i>kuwaeru</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ NI, <i>netsu</i> WO] (apply [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Indirect object), heat (Direct object)])	5,532
antonym	<i>akeru</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (open [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	$\Leftrightarrow$ <i>shimeru</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (close [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	1,490
goal	<i>memo-suru</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO, $\langle Z \rangle$ NI] (write down [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object), on $\langle Z \rangle$ ])	$\Rightarrow$ <i>wasurenai</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (not forget [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	887
effect	<i>okosu</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (raise [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	$\Rightarrow$ <i>chokuritsu-suru</i> [ $\langle Y \rangle$ GA] (stand [ $\langle Y \rangle$ (Subject)])	2,378
presupposition	<i>inogareru</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (dodge [ $\langle X \rangle$ (Subject), $\langle Y \rangle$ (Object)])	$\Rightarrow$ <i>toitsumera-reru</i> [ $\langle X \rangle$ GA, $\langle Y \rangle$ WO] (be blamed [ $\langle X \rangle$ (Subject), for $\langle Y \rangle$ ])	4,503

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	Precision	Recall
similarity	79.5% (501/630)	51.1% (501/980)
opposition	59% (20/34)	13% (20/158)

*takamaru* [*risuku* GA, *zyudou kitsuen* DE] (increase [risk (Subject), because of second-hand smoke])

*zyoushou-sa-seru* [*zyudou kitsuen* GA, *risuku* WO] (increase [second-hand smoke (Subject), risk (Object)])

similarity

*yobikakeru* [ $\varphi$  GA, *kin'en* WO, *kitsuensya* NI] (promote [ $\varphi$  (Subject), quitting smoking (Object), among smokers])

*uttaeru* [ $\varphi$  GA, *kin'en* WO, *kokumin* NI] (appeal [ $\varphi$  (Subject), quitting smoking (Object), to the public])

similarity

*houshutsu-suru* [ $\varphi$  GA, *nikochin* WO,  $\varphi$  NI] (emit [ $\varphi$  (Subject), nicotine (Object), into  $\varphi$ ])

*kyuuiu-suru* [ $\varphi$  GA, *nikochin* WO] (absorb [ $\varphi$  (Subject), nicotine (Object)])

opposition

Low recall in this experiment results mainly from the fact that human beings can use logical relations between nouns for recognizing similarity and opposition between PASs but our system cannot.

*naru* [ $\varphi$  GA, *nikochin-izon* NI] (become [ $\varphi$  (Subject), nicotine-dependent (Goal)])

*naru* [ $\varphi$  GA, *nikochin-chuudoku* NI] (become [ $\varphi$  (Subject), a nicotine addict (Goal)])

similarity

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