Prototype Algorithm for Estimating Agents and Behaviors in Plot Structures

Hajime Murai
Future University Hakodate
Hokkaido, Japan
h_murai@fun.ac.jp

ABSTRACT: *Quantitative indicators of narrative analysis can be used to enhance the objectivity of story analysis. However, conventional narrative descriptions are not suitable for extracting the narrative functions of a story as a whole, nor have complex stories with parallel narrative structures been analyzed. With the ultimate goal of developing an automatic plot analysis method suitable for describing parallel storylines and punchlines, this paper proposes a prototype algorithm for automatic plot structure extraction focusing on agent vocabulary and behavior expressions. In the proposed prototype algorithm, categories and dictionaries for identifying agents and behaviors in story texts are constructed in Japanese and algorithms for extracting propositions and divisions of scenes are implemented based on the resulting agent and behavior vocabulary and expressions. Further, omitted agents are reproduced based on knowledge about agents and general rules of discourse. This enables the processing of fundamental data about story structure and the categorization of behaviors and scene divisions.*

Keywords: Plot Structure Extraction, Narratology, Story Text, Agent Vocabulary

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1. Introduction

The development of information processing technologies in recent years has enabled a substantial body of quantitative literature analyses, including bibliometrics, to be carried out in various ways. Although it is presently difficult to capture all story structures and their interpretations using machines, it is possible to utilize quantitative indicators of narrative analysis to enhance the objectivity of story analysis.

In recent years, “distant reading” [9] which utilize text mining techniques for literature analysis has attracted attention. However, “distant reading” doesn’t aim to realize quantitatively “close reading”. On the other hand, there are several approaches utilizing traditional narratological methodologies for automatic story analysis. For instances, automatic script extraction has been tried [3] based on frameworks of classical cognitive science [19]. In other research, characters’ roles and relationships in story text have been tried to extract automatically [1]. Those researches aim for extracting specific information within story text. Therefore, basis of those analysis is literary information such as frequency and co-occurrences of appeared words that are processed by natural language processing techniques.

However, story texts include much esoteric expressions, for example rhetoric, pragmatics in dialogues, and colloquial expressions. Therefore, even very fundamental information that "who did what" in specific scene in a story cannot be clarified by literal word analysis. It is the cause of the low precision rate of automatic interpretation methods script analysis or characters' role extraction. In order to realize automatic quantitative interpretation and semantic analysis, it is minimum requirement to extract fundamental time sequential plot data from story texts. In other words, the precision rate of extracting "who did what" should be improved for more profound narrative analysis.

To this end, an eclectic approach to quantitative and traditional humanities' methods, such as structural analysis [2], conventional plot analysis [17], relationships between characters [4], characteristics of narrative structure, and changes in narrative pattern can be adopted for extraction [10], [11]. However, the narrative descriptions produced to date only focus on identifying individual plot functions. Therefore, such descriptions are not suitable for extracting the narrative functions of the story as a whole, including motivation, behaviors, outcome, and rhetorical devices such as irony. Moreover, complex stories with parallel narrative structures have not been analyzed.

The ultimate goal of this research project is to develop an automatic plot analysis method suitable for describing parallel storylines and punchlines (see [11] for detailed explanation and examples of describing punchlines). If it may become possible to describe punchlines in complex stories, a database suited to capturing general narrative structure could be realized. Moreover, automatic extraction of punchlines from proposed plot descriptions would facilitate qualitative comparisons of stories and the automatic creation of "elaborate" story structures by artificial intelligence [8].

1.1 Goal of Automatic Plot Extraction

The ultimate goal of this research is automatic extraction of story structures. Although there are many methods of describing story structures, they are here taken to mean a list of proactive character behaviors ordered by description and further divided into the scenes of a story. For instance, Table 1 shows a story structure comprising characters, behaviors, recipient/object, and result for each scene. This type of description is the final goal of the automatic extraction of story structure towards which this research is headed.

	Agent	**Behavior**	**Recipient / Object**	**Result**
1	Satan	Command	Devil / work	Success
	Devil	Refusal	Work	Failure
2	Devil	Agreement	Man 1 / contract	Success
	Man 1	Agreement	Devil / contract	Success
3	Man 1	Default	Devil / contract	Failure
4	Devil	Agreement	Man 2 / contract	Success
	Man 2	Agreement	Devil / contract	Success
5	Man 1 and Man 2	Intimidation	Devil	Success
	Devil	Request	Man 1 and Man 2	Failure
	Man 1 and Man 2	Default	Devil / contract	Success
	Devil	Abandonment	Work	Success
6	Devil	Contempt	Man 1 and Man 2	Success

Table 1. Example of story structure in "Contractant," by Shinichi Hoshi

If these elements could be automatically extracted from story texts and arranged in each scene, then automatic story structure extraction would be successful. However, there are many and various expressions of abridgement and aliases in story texts. For instances, it is not rare that the agent of some conversation is not depicted. Moreover, it is also general in story texts that some agent is called by many different names. Therefore, it is necessary to develop estimation algorithms to compensate for omitted

expressions and to identify aliases in order to enable valid automatic extraction of story structures. Because it is difficult to conduct these estimations to a high degree of accuracy with current technology, a prototype program for automatic extraction of story structure was developed in this research [14], and the feasibility of valid automatic extraction examined. By utilizing a prototype program, the specific questions associated with automatic extraction of story structure can be resolved—such as what type of data and algorithms are necessary and what method can accurately and effectively estimate omitted objects. In this study, a prototype program for analyzing Japanese novel texts was developed in JAVA, and its validity examined.

1.2 Diagram of Automatic Plot Extraction

In this research, story structures are described as behaviors of agents (proactive characters in a story) in each scene. Thus, expressions about agents and behaviors were extracted, and story structure was estimated on the basis of these expressions. An outline of this research is shown in Figure 1.

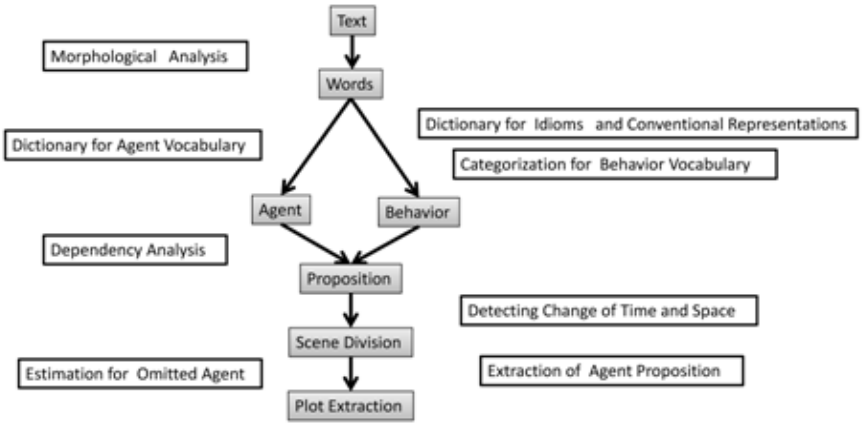

Figure 1. Outline of process for extraction of story structure

2. Agent Detection

In order to extract a story's structure, it is necessary to identify who the agents are that appear in the story. This involves identifying general expressions in story text for story agents and analyzing pronouns, omissions, and the aliases of agents.

Agents in story texts are generally proactive beings who have a will, although there may be some exceptions. In many cases, the agents are human beings. However, there are also various other agents, such as aliens, space creatures, devils, ghosts, robots, and automated machines, depending on the genre of the stories.

Further, in cases where the agents are human beings, they are not referred to by general proper nouns and personal pronouns. There are many other types of vocabulary for indicating agents. For instance, there are agent words in story texts that indicate familial relationships (father, mother, sister, brother, etc.), vocational relationships (president, employee, etc.), and general nature of relationships (enemy, ally, friend, etc.). In some stories, it is not only individuals but also specific groups, organizations, regions, states, tribes, and nations that become agents.

As outlined above, there is a wide range of agent vocabulary (agent vocabulary signifies word group which indicates agent in this paper) indicating proactive beings in story texts. Nevertheless, it is possible to extract these agent words from a story text and to construct a database list. Moreover, it may be possible to develop a machine-readable, structured database based on the categorization of type of vocabulary and relationship. Utilizing the developed agent vocabulary database, candidates for text expressions that may indicate agents and their behaviors in story texts could then be easily identified. If likely candidates for agents and their behaviors could be detected, they could become the foundation for more precise story structure analysis.

Therefore, agent vocabulary appearing in story texts and general vocabulary from dictionaries that can be used as agent vocabulary were collected in this study. The vocabulary was then categorized and a structured agent vocabulary list developed [12] (Table 2).

General	Gender	Gender of an agent
	Age	Comparative age of an agent
	Plurality	Number of agents
	Respect	Honorific expressions, contempt expressions
	Position	Social, professional status or ranks
	Dynamics	Person of pronoun
	Relative behaviors	Behaviors characterizing that agent in general
	Species	Animals and plants, tribes in Sci-Fi or fantasy
	World setting	Backgrounds about era and cultures
	Proper noun	Can become proper noun?
	Job category	Can be used as job category?
	Place/Organization	Can be used as the name of a place or organization?
Family	Generation	Comparative generation
	Distance	Closeness of blood relatives
	In-law	In-law relationship or otherwise
	Lover	Girlfriend/boyfriend, spouse, ex-wife/ex-husband

Table 2. Structure and examples of agent vocabulary

Two items constitute large categories: “General” and “Family.” The “General” category includes the twelve small categories below:

• Gender: For instance, “She” signifies that the agent is female. Gender information is especially important in anaphora resolution. Moreover, conversational styles can often be changed according to the gender of an agent.

• Age: “Old person” or “baby” signifies the ages of agents. In order to estimate agents, age information is very useful in cultures with a seniority system such as in Japan.

• Plurality: “They” or “We” signify plurality of agent words. This is also useful for anaphora resolution.

• Respect: Some agent words are used to show respect; for instance, “Sir” or “Professor.” Some agent words conversely show contempt. In the Japanese language, there are many respectful agent words. They can be utilized to estimate relationships and feelings between some agents.

• Position: The “Position” category is similar to the “Respect” category in some respects. “President” signifies that an agent has a high social status even if the speaker does not have any respect for that person. The social or professional status affects the relationships between agents. For instance, agents in higher position often command or instruct other agents.

• Dynamics: Dynamics is an attribute for pronoun words. It includes first, second, third, and interrogative. That information is important to estimate omitted agents. For instance, first-person agent words signify speaker, and second-person agent words signify listener in dialogue texts.

• Relative Behavior: Some agents often appear in stories in conjunction with specific behaviors. For instance, “salesperson” explains and sells products. These relative behaviors are useful when behaviors are described but agent words are omitted.

• Species: In Sci-Fi or fantasy stories, some specific species that are different from human beings in many ways appear. Those differences are also useful for estimation and identification of agents.

• World Setting: The differences in the described world in stories may become clues in some cases. Agents in chivalric romance behave differently from agents in New York in the 21st century.

• Proper Noun: Proper nouns are useful for identifying the unique name of some agents. Whereas other agent words may often change, proper nouns rarely change.

• Job Category: Agent words associated with job categories often appear in story texts. Because each job has a social role, those agent words about job category are strongly connected to specific behaviors. Therefore, that information is also useful for estimation tasks.

• Place/Organization: Some agent words signify a place or an organization along with agents. “White House” is a place, but it is often used as a president or government organization. The possibility of those multiple meanings should be described as an attribute for precise estimation and extraction of agents in story texts.

The “Family” category includes the four small categories below:

• Generation: In familial relationships, there are differences in generations. Grandfather and grandmother belong to an older generation than father and mother, whereas son and daughter belong to a younger generation than father and mother. As a matter of course, those differences are comparative. For instances, “Generation” attribute of “grandfather” is +2, that of “father” is +1 and that of “son” is -1 and that of “grandson” is -2.

• Distance: Closeness of blood relatives is parametrized as a “Distance.” Combined with “Generation,” a position in familial relationships is depicted.

• In-law: The “In-law” attribute is used to describe relationships such as mother-in-law.

• Lover: The “Lover” attribute is used to signify love relationships, which also include attributes about marriages and divorces. Since divorce is a type of past negation form of love.

In addition, categorization included prefixes and suffixes (which are attached before or after a word, respectively) conveying information on the functions of the agent word. When the prefixes and suffixes appeared in the story text, modified neighboring words were extracted with the prefixes and suffixes. Agent affix are Japanese words with functions such as Mr. and Ms. in English.

This gave rise to 12500 words categorized as agent vocabulary and 76 words as agent prefixes and suffixes [15]. The categorized words can be extended as the need arises.

3. Behavior Detection

3.1 Dictionary for Behavior Vocabulary

When agents’ behaviors are classified and registered in a database, it is useful to ascribe attributes to them in order to compare their functions across similar stories. For example, if the relationship between the protagonist and antagonist is hostile, the representation of hostility can take various forms, such as destruction of property, damage of reputation, or physical harm. It is desirable that these representations be categorized in a unified manner.

In order to identify the changes in plot structure, it is useful to identify the active agent, hereafter A, who is the person given agency, and the recipient or intended victim of the action, hereafter B.

In this prototype, the behavior of the agents is categorized according to three attributes: focus, polarity, and dynamic [11]. The focus is the type of behavior. The polarity is the negativity or positivity of the effect of the behavior. The dynamic is the relationship between A (the agent) and B (the intended recipient) in the story.

Firstly, concerning the focus of behaviors, five major categories (Target, Self, Situation, Intention, and Evaluation) are adopted in this part of the study. Included in the major categories are 16 sub-categories. Secondly, concerning polarity, at least two attributes, negative and positive, are required. In some cases, it is also necessary to attribute the extent of the polarity involved. In this paper, a bipolar attribute (positive-negative) is employed for the sake of simplicity. Thirdly, concerning the behavioral dynamic, a first-person situation is one in which A’s behavior plays the most important role. A second-person situation is one in which the relationship between B and the other characters is assumed. Third-person situations occur when the active agent of the behavior is unclear or unknown.

Focus		Polarity	First person	Second person	Third person
Target(about a concrete object)	**Information**	*Positive*	Investigation, Discovery	Question, Explanation	Observation, Watch
		Negative	Concealment, Forgetfulness	Lie, Pretense	Ignorance
	Material	*Positive*	Creation	Donation, Purchase	Generation
		Negative	Destruction	Theft	Collapse
	Work, Play	*Positive*	Labor	Employment	Service
		Negative	Laziness	Resignation	Unemployment
Self(about the agent itself)	**Entity**	*Positive*	Birth	Summons	Appearance
		Negative	Death	Killing, Exile	Exit
	Body	*Positive*	Growth, Eating	Healing, Dosing	Strengthening Beautification
		Negative	Decline	Harm	Deterioration
	Identity	*Positive*	True colors	Resemblance	Equality
		Negative	Transform	Alternation	Uniqueness
	Perception	*Positive*	Arousal	De-brainwashing	Sanity
		Negative	Dream, Hallucination	Brainwashing	Madness
Situation(about the agent's environment)	**Movement**	*Positive*	Moving	Transportation	Transportation
		Negative	Stillness	Constraint	Safekeeping
	Time, Speed	*Positive*	Being on time	Hastening	
		Negative	Lateness	Putting off	
	Relationship	*Positive*	Safety	Friendship, Victory	Peace
		Negative	Risk	Competition	Disturbance
	Circumstance	*Positive*	Satisfaction	Marriage	Prosperity
		Negative	Depression	Exploitation, Divorce	Downfall
Intention (behavior that affects behaviors)	**Order, Promise**	*Positive*	Compliance	Agreement	Establishment
		Negative	Violation	Default	Obsolescence
	Imperative	*Positive*	Request, Command	Permission	Proposal
		Negative	Restraint	Ban	Criticism
	Assist	*Positive*	Effort	Help	Wish
		Negative	Abandonment	Interference	Curse
Evaluation(about the agent's evaluation)	**Assessment**	*Positive*	Confidence	Praise	Popularity
		Negative	Regret	Contempt	Unpopularity
	Approval	*Positive*	Boastfulness	Love	Strong point
		Negative	Self-denial	Hatred	Weak point

Table 3. Categorization and examples of behaviors

It is expected that the list of behaviors will vary by genre and author. Hence, it is impossible to prepare a comprehensive list of all behaviors from the outset. Therefore, this paper only lists the behaviors necessary for the analyses conducted to date by

analyzing about 300 short stories manually. Although Table 3 does not provide a complete list of behaviors in all stories, it is anticipated that the list and classifications will be appropriately extended in future analyses.

Table 3 shows the current categorization based on the three attributes outlined above. For example, when the major focus of the behavior is the target and the sub-category is information, positive behavior is related to actions about obtaining information, while negative behavior concerns the concealment of information. In addition, in the case of positive behavior with respect to behavior (Investigation) that A displays, the most important role is categorized as that of firstperson. Behavior (Question) that requires another character to satisfy its condition is categorized as second person. Behavior (Watch, such as watch TV) for which the source of the information is unclear, is categorized as third person.

In table 3, there are some behaviors which are not typical actions of story agents. For instances, “Identity” category includes behaviors about disclosure of true colors. “Time” category includes behaviors about tardiness, hurrying up, and falling behind schedule. Although those behaviors are not actions, but conditions and situations, those behaviors are important for analysis of functions of story element. In this paper, those words which signify specific change of conditions and situations are also included as behaviors.

3.2 Dictionary for Idiomatic Behavior Expression

The functions and behaviors of some agents in story texts cannot be easily identified solely by extracting verbs in sentences. One reason for this is the fact that, in general, languages (not only Japanese or English) have idiomatic expressions. Therefore, a specific combination of verbs, nouns, or prepositions in a sentence creates a completely different meaning from that of the stand-alone words. For example, “stand” on its own can signify being in an erect position, whereas “stand over” can indicate behavior such as watching over, and “stand for” conveys meaning about representation. Such idiomatic expressions have been collated in the field of natural language processing and corpus linguistics.

In addition, there are many patterns that are not recognized as general idioms, but the combinations of verbs and nouns indicate particular meanings. In this research, these combinations were also collated as idiom-like patterns. Further, in the case of the Japanese language, pragmatic functions (such as questions, instructions, or criticism) of utterances in dialogue can be changed by adding specific combinations of particles or auxiliary verbs. For instance, the pragmatic functions of the Japanese verb “hanasu” (“talk” in English) can be changed by adding “nayo” after it to communicate prohibition to talking. When “nasai” is added after “hanasu,” the pragmatic function is that of the instruction to talk. In these examples, the function of the agent’s behavior is completely the opposite of the stem verb.

In the automatic extraction of story structure, these expressions about an agent’s behavior should be identified and extracted on the basis of the characteristics of the relevant patterns of idiomatic and pragmatic expression.

As a data source for such idiomatic patterns, “Pentathlon sheets basic idiom” [18] was utilized, with which idiomatic patterns that were not general idioms were combined. As a result, 2185 patterns were registered as data for idiomatic patterns. As a data source for such pragmatic ending patterns in utterances, “Sentence patterns of spoken language 1: Research by dialogue material” [16] was utilized, and 197 patterns were registered.

Figure 2. Example of an idiomatic pattern

Data structures of idiomatic patterns are divided in phrase units as shown in Figure 2. Each phrase unit can include different spellings, expressions, and honorific expressions. For verb representation, in addition to the verb itself, adverbs and particles indicating the passive, negation, and other grammatical meanings, can be coded.

In the idiomatic patterns identification process, words dependent on the last verbs are checked against the registered pattern first. If they do not match any pattern, phrases near to the last verb are checked next to find if they match a registered pattern. Therefore, not only the basic expression, but also a type of expression that deviates slightly from convention can be flexibly detected.

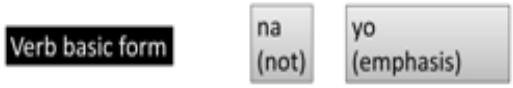

Figure 3. Example of pragmatic ending pattern

The data structure for pragmatic ending patterns is divided into word units, as shown in Figure 3. In the pragmatic ending patterns identification process, the longest match is searched for in inverse order from the last word of the target sentences. In pragmatic ending patterns, the inflected forms of each word are included as valid matching patterns [13].

4. Scene Division, Agent Estimation, and Plot Extraction

4.1 Dividing Text into Propositions

Because story structures are composed of the behaviors of agents, the relationships between agents and these behaviors should be extracted as combinations from source story texts. These minimum units comprising subjects and behaviors are generally called propositions in general (see [20] for detailed discussion). If propositions can be extracted from story texts, and if central functions in story telling can be selected from those propositions, the fundamental story structure can be extracted.

Ingeneral, to make propositions, it is necessary to carry out morphological and dependency analyses of the target text. However, these dependency relationships include compound nouns and modification by an adjective (a combination of adjective and noun). Therefore, only propositions that appeared to be the behaviors of agents in the story were extracted, utilizing the agent dictionary and the behavior dictionary. Otherwise, expressions including the verbs of being (such as “taigen-dome” in Japanese) correspond to the function of “identity” in the behavior category. In addition to dependency-based propositions, these expressions were also extracted as propositions.

Specifically, JUMAN and KNP [7] were utilized for morphological and dependency analyses, respectively, and propositions were extracted based on the resultant dependency relationships.

4.2 Dividing the Story into Scenes

Story structures are generally described as a unit of scenes by dividing story texts according to certain criteria. Although there are various definitions of scene criteria, story texts are, in many cases, divided into scenes when there are spatial or temporal changes. Moreover, the arrival and departure of agents may become the point of scene divisions.

In this version of the prototype program, the three conditions below were adopted as the criteria for scene division.

- Division by the author of the text (with demarcation such as a blank line)
- Expressions about the transfer of agents
- Expressions about the passage of time

The prototype program extracts agents and behaviors to extract transfer and time passage expressions. Expressions about the transfer of agents are identified if behaviors match the category “Movement,” and if the subjects of propositions are agents. Expressions about the passage of time are identified when propositions include behaviors about the category “Time, Speed,” and if the subjects of those behaviors are nouns about time (year, month, week, day, hour, minute, second, etc.).

4.3 Dividing Scenes into Blocks

According to the division of the scenes, the inner narrative structures of each scene are also extracted in order to estimate agents in story texts. First, the story text is divided into blocks of two types: descriptive part and dialogues. In the next step, dialogues are divided into sub-blocks comprising each utterance. Finally, the descriptive parts are divided based on the scene division criteria discussed in Section 4.2. This process is depicted in Figure 4.

General readers can estimate the speaker by utilizing various pieces of information, such as appeared agents in that scene. Moreover, the names of agents can change in each utterance in response to the characteristics of the speaker. Therefore, those block divisions become the basis of detailed analysis of appeared agents.

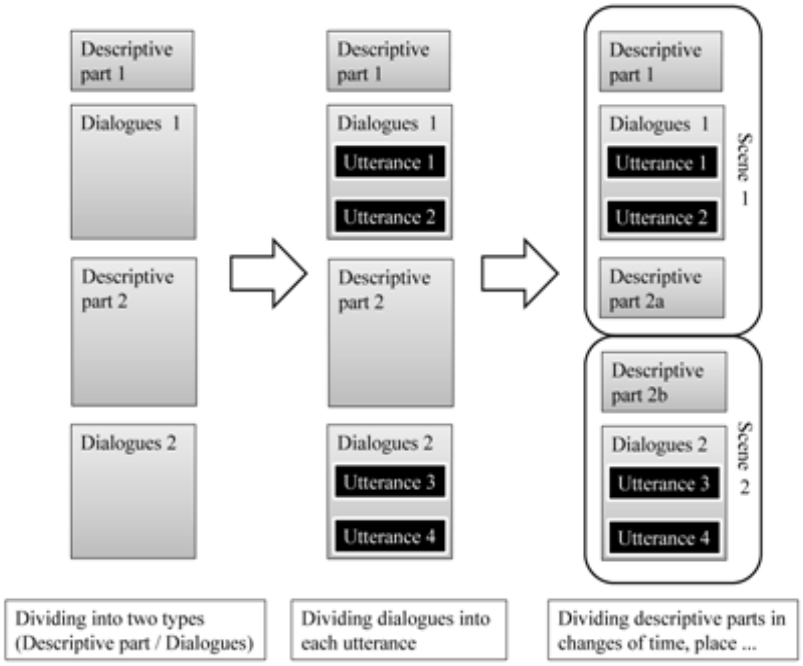

Figure 4. The text division process

4.4 Agent Estimation

In Japanese text, the omission of agent vocabulary in sentences occurs frequently. Therefore, it is necessary to estimate the omitted agent words in order to extract the story structure. Moreover, the speaker and listener are not clarified in the dialogue texts of many stories. In such cases, the estimation of agents is also necessary.

These estimation tasks regarding agents are very complex and the accuracy of the results is insufficient, even with recent technologies[5], [6].Nevertheless, some agent estimation tasks were undertaken as a trial run for further examination in this research. The specific processes involved are elaborated below.

First, the agents that explicitly appeared were analyzed in each scene and first estimation for agents (e.g., anaphora resolution) carried out. After listing the agents that appeared, the unknown omitted agents and speakers were estimated with the listed agents.

4.4.1 Anaphora Resolution

In order to identify anaphora expression, correspondences of attributes and distance between an anaphora and a pronoun were mainly considered. First, agent word pronouns were listed and the conditions of attributes of those words extracted based on agent word dictionary from story texts. In essence, information about gender, plurality, and person dynamics can be obtained from agent pronoun words.

When agent pronouns appeared in utterances, if the dynamic was first person, the pronoun was deemed the speaker of that utterance. If the dynamic was second person, the pronoun was deemed the listener. According to the result of speaker and listener estimation below, the results of anaphora resolution were updated.

When agent pronouns appeared in descriptive parts, if the dynamic was first person, that agent was deemed the protagonist or the narrator of that story.

In other cases, the estimation program first sought agent words containing no contradicted attributes against the target agent pronoun in the same block (same descriptive part or dialogues). If the behavior of the target agent pronoun was real (i.e., not recollected behavior or behavior in an explanation sentence), the appeared agents in that scene also became candidates. If there

were several candidate agent words, the similarity of the behaviors of those candidate agents was calculated and the most similar candidate was selected as the referred agent of that agent pronoun.

4.4.2 Speaker and Listener Estimation

Most of the utterances in story textsdo not have explicit speaker information. However, clues are presented in various forms in the text itself. These clues include calling, turn taking, utterance styles, situation, and relationships between agents.

In speaker and listener estimation, explicit information was first extracted. If an utterance was located adjacent to a descriptive part, and that descriptive part also included some behavior that was categorized in "information" (in Table 3), the agent with that behavior was deemed the speaker, and the recipient was deemed the listener.

In the next step, calling expressions were extracted from each utterance. Calling expressions are expressions such as "John!" and "Sir." If an utterance had calling expressions, the called agent was deemed the listener of that utterance.

If there were serial utterances that did not include estimated utterances, those utterances were labeled based on principles of speaker alternation. That is, the speaker and the listener alternated.

If there were only two agents in that scene, and the speaker or the listener was estimated, the other agent was deemed the rest role.

Furthermore, if there were some hierarchical relationship (as in the "Respect" or "Position" attributes in Table 2) between appeared agents, the hierarchical relationship of the utterances were estimated based on characteristic behaviors such as "command," "instruction," and "criticism," and the speaker and the listener of those utterances were estimated in accordance with hierarchical relationships.

4.5 Extracting Plot Structure

Scene 1: Agent: Satan, Devil
Devil: True colors: Devil
Devil: Discovery-Passive: Satan
Satan: Criticism: Devil
Satan: Ban: Devil
Devil: Eating
Devil: Transportation
Devil: Moving
Satan: Command: Devil: (Devil: Human: Transportation)
Scene 2: Agent: Man, Devil
Devil: Appearance: Man
Devil: Discovery: Man
Man: Jump
Devil: Investigation: Man
Devil: Proposal: Man: (Man: Restraint)
Man: Ban: Devil
Man: Behavior: Money
Person: Curse: Person: (Person: True colors)
Devil: Proposal: Man
Devil: Effort: : (Devil: Proposal: Man)
Man: Agreement: Devil
Devil: Explanation: Man: (: Contract:)

This story can be summarized like below: Devil make a contract with a man to take the soul in return for giving victory in the game. But devil cannot observe the contract because he took the same agreement with two men and they compete with each other. Therefore, devil abandoned their soul and blamed them.

Table 4. Example of resultant extracted story structure in "Contractant," by Shinichi Hoshi

After additional estimations, in each scene, propositions including both the agents and categorized behaviors were extracted. Table 4 depicts an example of the output of the prototype story structure analysis program. For readability, the results were translated into English (the original list is in Japanese). Each scene is depicted with appeared agents in that scene and the included proposition list. One line in Table 4 corresponds to one proposition. For instance, "Satan: Criticism: Devil" means "Satan criticized the devil." In some cases, propositions have nested structure; for example,in "Satan: Command: Devil: (Devil: Human: Transportation)," the nested proposition example means "Satan commanded the devil to transport human beings (to hell)."

The results in Table 4 are moderately accurate with regard to behaviors and scene division. Moreover, estimation of the speakers of conversational sentences succeeded in that example. In scene 1, utterances do not have explicit information about the speaker and the listener; however, the hierarchical relationships between Satan and the devil became the clue for precise estimation. That result however still has some mistakes (italic boldface part in Table 4) in identifying and extracting some behaviors and agents in those scenes. In that error sentence, rhetorical expression (irony) was utilized; therefore, the estimation program cannot detect valid relationships between agent words and behavior expression.

In addition to above example, several Hoshi's short stories were processed similarly. As a result, simple short stories, in which conversation and descriptive sentences were concise, were analyzed relatively accurately. However, if there are long conversational sentences, long descriptive sentences about situational explanation, and multiple different names for one character, the accuracy decreased. Long sentences often include rhetorical phrases and various literary expressions which are not directly related to the plot structure. Moreover, this prototype version doesn't have the function to infer the relationships between various aliases of some character. Therefore, the accuracy become lower when those expressions were included more.

5. Conclusion

In this study, a prototype program for automatic story structure extraction was developed. Utilizing that prototype program, expressions indicating agents and behaviors of agents in story texts were extracted, and propositions created from those agents and behaviors. Further, based on the extracted propositions, story texts were divided into scenes and rough story structures were automatically extracted. The pronoun agents and omitted agents in utterances were analyzed based on attributes in an agent word dictionary and a behavior category table. However, the aliases of agents in story texts could not be extracted with sufficient accuracy. In addition, rhetorical expressions were not analyzed correctly. In order to carry out automatic valid story structure extraction, the accuracy in estimation algorithms has to be improved.

In this study, in order to avoid incorrect estimation, only explicit bases (such as callings or clarification of speakers) were utilized for agent estimation. However, other clues (such as the content of dialogue and gender-related features or other features of speaking style in utterances) should be included for a more accurate and wide-ranging estimation.

In addition to the described clues explained above, undescribed clues, called "common sense," are utilized when we understand story text. For instance, if someone said "May I help you?" in a store, we would think that speaker is a salesperson even if there was no other explicit clue. In order to realize automatic story structure extraction, it is also necessary to develop a database and algorithm of "common sense."

It is anticipated that a more detailed and nuanced identification of story elements, such as agents, behaviors, and plotlines, will thus enable enhanced automated analysis of story structures in the future.

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