# Investigation of the Effects of Nonverbal Information on Werewolf

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*Abstract*—Werewolf is one of the popular communication games all over the world. It treats ambiguity of human discussion including the utterances, gestures and facial expressions in a broad sense. In this research, we pay attention to this imperfect information game werewolf. The purpose of the research is to develop an intelligent agent "AI werewolf" which is enabled to naturally play werewolf with human. This paper aims to investigate how behavior contribute to victory of own-side players by using machine learning as a first step. As the results of investigation and analysis of the playing movie, we found that nonverbal information in the game of werewolf has importance to winning or losing the game.

## I. INTRODUCTION

WEREWOLF is the popular communication game all over the world. The researchers about werewolf have been working in recent years[1][2][3]. However, these conventional researches about werewolf attach importance to not nonverbal information like human behaviors or facial expression but conversational contents or mathematical model or statistical analysis.

In this research, we pay attention to this imperfect information game werewolf. The purpose of the research is to develop an intelligent agent "AI werewolf" which is enables to play werewolf with human naturally. In this paper, our research objective is the analysis of nonverbal information in the game of Werewolf which is one of conversational table games, and investigate how behavior in the game contribute to victory of own-side players. We analyze what effect nonverbal information on the game play to victory or defeat of the game.

## II. WEREWOLF

### A. What is Werewolf?

Werewolf is one of the popular party games all over the world. Werewolf card sets like "Are You a Werewolf?" and "Lupus in Tabula" etc. are released and have been played still now in the world (Fig. 1). The abstract of the game is

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Fig. 1. The popular conversational table game Werewolf.

explained below.

Players are divided into human-side and werewolf-side players. Human-side players will have win when all were dead. Werewolf-side players will have win when the number of human-side players are equal to or lower than werewolf-side players. Human-side players can't learn much about the side of other players at the onset of the game. However, the players who is the role of werewolf can learn about who are werewolf.

The game consists of daytime phase and nighttime phase. In the daytime phase, all players discuss about who are werewolf and decide one player who will be executed person at the day by voting. All players talk freely for the discussion. Executed players are treated as deceased person and are excluded from the game. The deceased persons are not able to speak till the end of the game and have a part in the voting. In the nighttime phase, werewolf-side players can select one player from human-side players and make an attack the player. The attacked player are treated as deceased person too and are excluded from the game. Game players repeat daytime phase and the nighttime phase and decide which side players are winner.

### B. Role of Players

Table 1 shows special ability of roles. Game players are divided into human-side players and werewolf-side players. In human-side players, there are *villager* who has no special ability other than voting and *Seer*, *Medium*, *Bodyguard*, *Freemason*, *Possessed*, *Werewolf* who has special ability. In werewolf-side players, there are *Werewolf* who can make attack human-side players and *Possessed* belong to werewolf-side but is human.

## III. TAGGING OF NONVERBAL INFORMATION

In this research, we perform tagging to the contents of

TABLE I
ABILITY OF ROLES ON *WEREWOLF*

| Role | Ability |
|------|---------|
| *Villager* | Nothing special. |
| *Seer* | In every nighttime, *Seer* select one of the arbitrary player and can learn about which side player. However *Seer* cannot learn the role of the player. If *Seer* select *Possessed* then learn the player is a human-side player. |
| *Medium* | In every nighttime, *Medium* can learn about whether the executed person in the day before is human-side player or werewolf-side player. However *Medium* cannot learn the role of the player. If *Medium* select *Possessed* then learn the player is a human-side player. |
| *Bodyguard* | In every nighttime, *Bodyguard* select one of the arbitrary player and can guard the player. However *Bodyguard* cannot guard own self. If *Bodyguard* is attacked by *werewolf* then *Bodyguard* will be dead. |
| *Freemason* | There are two *Freemasons* in the game. Freemasons know each other that they are *Freemasons* and human-side players in the first nighttime. |
| *Possessed* | *Possessed* is a human who has no special ability, but the player belongs to werewolf-side. If werewolf-side has win the game then *Possessed* will have win too. *Possessed* is counted as a human at the judgment of victory or defeat of the game. Moreover, Possessed is identified by the ability of *Seer* and *Medium*. When *Possessed* is attacked by *werewolf* then *Possessed* will be dead. |
| *Werewolf* | In every nighttime, *Werewolf* select one of the arbitrary player and attack the player. *Werewolf* know each other that they are *Werewolf* and can huddle together with only *Werewolf* in the nighttime. |

utterances and nonverbal information that expressed in the utterances in the game of werewolf. We adopt the tags are using at the previous study about analysis of BBS werewolf focused on the contents of utterances [1] as the tag concerning with the contents of utterances. The tags of nonverbal information represent the features of gestures and facial expression. We performed a behavioral analysis of the players in the prepared videos of the game of werewolf. We can analyze the detail of nonverbal information the players expressed by tagging to the nonverbal information. We can discuss what behavior and facial expression has importance in the judgment of victory or defeat of the game through the results of the analysis.

### A. Policy of Tagging

Tags are made on the policy outlined below:

1) Tagging expressed nonverbal information to the contents of utterances which is believed to be concerning with winning or losing deeply. The selection about the utterances which is believed to be concerning with winning or losing deeply use the previous study about analysis of BBS werewolf focused on the contents of utterances [1] as a reference.

2) Tagging the roles which have a high influence on winning or losing refer to statistical analysis of werewolf game data [2] on a priority basis. We do not perform tagging to *Villagers* because the role of *Villagers* have relatively little effect on winning or losing.

3) Tagging to utterances when expressed gestures and facial expression. However we except for the behavior like a habit always expressed.

4) Utterance tags are made refer to [1] as same as the policy 1).

5) The expression of the tag is "Role-Utterance Tag-Gesture Tag-Facial Expression Tag". Here, we distinguish gestures and facial expressions because there are cases that an especial facial expressions represents when a certain gesture is performed.

6) Except for the utterances have relatively little effect on winning or losing like the utterances have no relationship to the game and the reactive utterances to the utterances have no relationship to the game for the tagging.

### B. Utterance Tag

Utterance Tags which are given to the utterances are defined as follows refer to [2]. From *FAKE* tag to *argument* tag are newly added the tags:

--*CO*:
  Given to the utterances about coming out of the own role.
  Ex.) How about *CO* today?

a.) *CO-time-role*
   The utterances about timing and time that the *role* coming out.
   Ex.) When Seer should be CO?
      [CO-time-Seer]

b.) *CO-me-role*
   The utterances about coming out that own self is the role.
   Ex.) I am Seer.
      [CO-me-Seer]

c.) *CO-role*
   The utterance about coming out the role.
   Ex.) How about CO of Seer?
      [CO-Seer]

--*reason*:
  Given to the reason to utterance.
  Ex.) He was attacked last night because he was interrupted *werewolf*.

--*suspect*:
  Given the utterances suspect someone.

a.) *suspect-role*
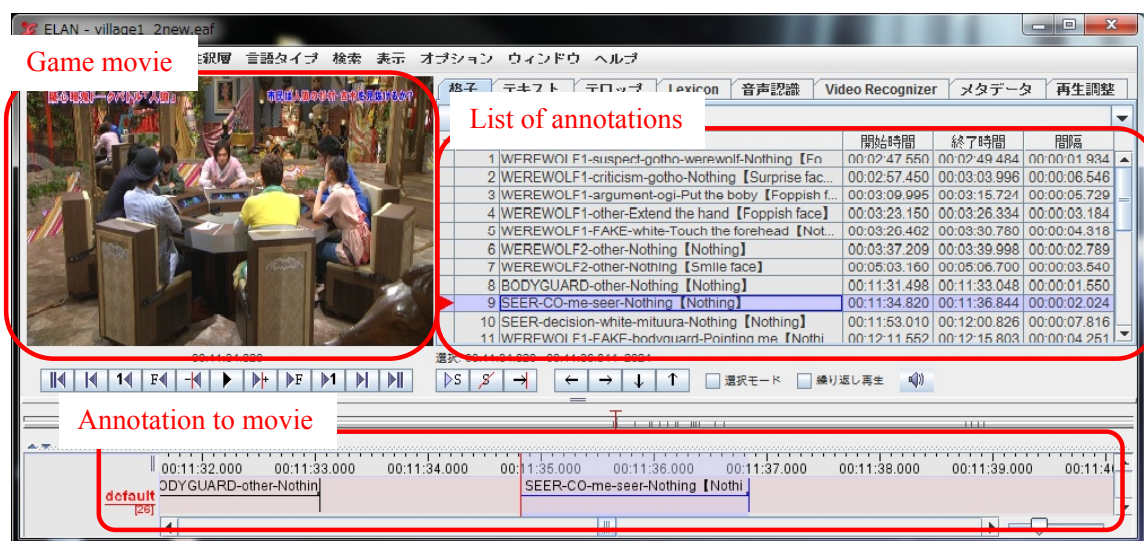   The utterances suspect as role.
   Ex.) Who are Werewolf?

Fig. 2. Annotation by ELAN.

[suspect-Werewolf]

b.) *suspect -role-person*
The utterances suspect a person as role.
Ex.) I think A is werewolf.
[suspect-Werewolf-A]

--*criticism*:
Given to the utterances that criticize an opinion and a behavior of others.
Ex.) No, I don't think so.

a.) *criticism-person*
The utterances criticize an opinion and a behavior of a person.
Ex.) I disagree the opinion of A.
[criticism-A]

--*decision*:
Given to the utterances of the results of Seer and Medium and the utterances that Freemason coming out the other Freemason.

a.) *decision-role-person*
The utterances make an assertion that a person is the role.
Ex.) I can tell you that A is a human.
[decision-white-A]
Ex.) I can tell you that A is a werewolf.
[decision-Werewolf-A]

--*attack*:
Given to the utterances about the attack of werewolf.

a.) *attack-target-person*
The utterances that a person is the target.
Ex.) I will be the target to attack by werewolf.

[attack-target-me]

--*fortune-telling*:
Given to the utterances about fortune telling by Seer.

a.) *fortune-telling -target-person*
The utterances about an opinion that want to tell the fortune of a person.
Ex.) I think that A should be told his fortune.
[fortune-telling-target-A]

b.) *fortune-telling -target-consent*
The utterances about an allowing of fortune-telling of own self.
Ex.) I don't care that you perform fortune-telling to me.

c.) *fortune-telling -result*
The utterance about the results of fortune-telling.
Ex.) How is the result of fortune-telling at the last night?

--*makeSpeak*:
Given to the utterances that require an opinion to others.
Ex.) Please tell me about the target of fortune-telling at tonight.

--*consent*:
Given to the utterances that agree with others' opinion or behavior.
Ex.) I agree with the opinion of A.
[consent-A]

--*other*:
Given to the utterances about the other in the game except for all tags mentioned before.

--*FAKE*:
Given to the utterances that werewolf performed fake

coming out.
Ex.) I am Seer.
[FAKE-Seer]

--*T_decision*:
Given to the utterances that werewolf perform fake coming out and tell a true decision.
Ex.) A was a human.
[T_decision-villager-A]

--*F_decision*:
Given to the utterances that werewolf perform fake coming out and tell a false decision.
Ex.) A was a werewolf.
[F_decision-werewolf-A]

--*argument*:
Given to the utterances argue or make opinion against the utterances of the person.
Ex.) I(A) am not werewolf.
[argument-A]

*C. Behavior Tag*

Given to behaviors to an utterances. Behavior tag are divided into gesture tag and facial expression tag.

*1) Gesture Tag*
--Touch the hand
Given when a person touches the head.

--Touch the forehead
Given when a person touches the forehead.

--Touch the nose
Given when a person touches the nose.

--Touch the mouth
Given when a person touches the mouth.

--Touch the chin
Given when a person touches the chin.

--Touch the arm
Given when a person touches the arm.

--Raise the hand
Given when a person raises the hand.

--Shake the hand
Given when a person shakes the hand.

--Extend the hand
Given when a person extends the hand.

--Extend the hands
Given when a person extends the hands.

--Fold the arms
Given when a person folds the arms.

--Pointing char
Given when a person points character.

--Put the body
Given when a person put the body ahead.

--Lower the body
Given when a person lower the body back.

--Face down
Given when a person face down onto the table.

*2) Facial Expression Tag*
--Foppish face
Given when a person express foppish face. It is difficult to distinguish between foppish face and smile face. In this paper, we defined foppish face when can't hear laughter and smile face when can hear laughter.

--Smile face
Given when a person express smile face.

--Anger face
Given when a person express angry face.

--Surprise face
Given when a person express surprise face.

*3) Others*
--Nothing
Given when a person did not express a gesture.

*D. Example of the Tagging*

Examples of the tagging shows as follows. Examples are about tagging of the utterances and behaviors.

--I think that A is werewolf. It is obviously suspicious since a short while ago. - extends the hands - nothing
[ Villager - suspect - wolf - A - Extending the hands - Nothing ]

--I think that execution should be A at tonight. - touch the chin - Nothing
[ Seer - execution - A - Touch the chin - Nothing]

--That's not the case. - Nothing - Foppish face
[ Werewolf - criticism - A - Nothing - Foppish face]

IV. ANALYSIS OF GAME MOVIE AND RULE GENERATION

In this chapter, we analyze expressed behavior and face expression through counting tags from game play movies. Moreover we discuss what effect nonverbal information on the game play to victory or defeat of the game.
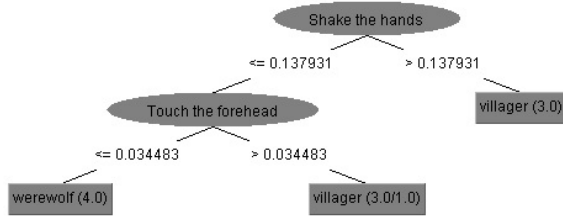
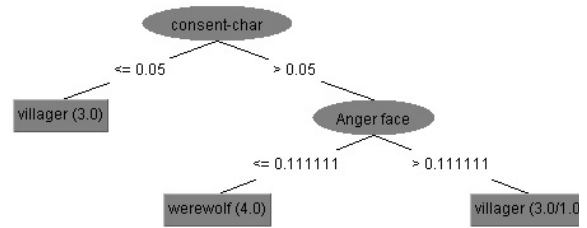Fig. 3. The decision tree about gestures of *Werewolf*.



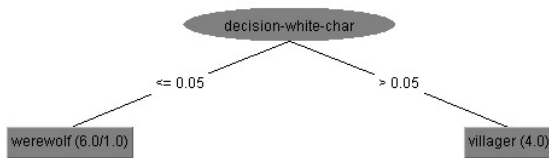Fig. 5. The decision tree about facial expressions of *Werewolf*
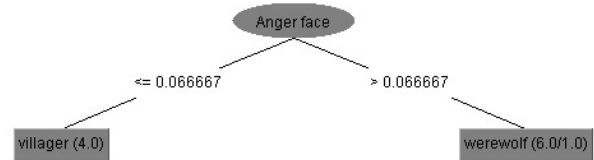


Fig. 4. The decision tree about gestures of *Seer*



Fig. 6. The decision tree about facial expressions of *Seer*.

### A. Game Movie

Actual game play movies are counted tags. These game play movies are 10 games from village01 to village04 of "JINRO – Who is the liar? –"[5] televised Fuji TV Japan.

--village01 2013.3.27 midnight released
--village02 2013.5.17 midnight released
--village03 2013.5.24 midnight released
--village04 2013.6.24 midnight released

### B. Movie Analysis Method

Tagging are performed based on lists of utterance tag and behavior tag. We use ELAN which is one of the annotation tool for tagging. Fig.2 shows appearance performing annotation by using ELAN.

### C. Analysis Results

We made annotation to 10 games in game play moves mentioned before. Human-side has 5 wins and werewolf-side has 5 wins respectively.

We performed tagging to each movies for three roles, *Seer, Bodyguard, and Werewolf* except for *Villagers*. The analysis results of 10 game playing movies.

The number of total utterances is 542. Moreover, the number of utterances for each role is *Seer* 196, *Bodyguard* 88 and *Werewolf* 258 respectively.

In this section, we performs discussion about decision tree made by tags are given to game playing movie. We make decision tree of expressed gestures and facial expressions of *Seer* and *Werewolf* by using J48 in machine learning tool Weka.

#### a.) Gestures of Werewolf

Fig.3 shows decision tree made by gesture tags *Werewolf* expressed. If *Werewolf* express Shake the hands then werewolf-side will be loose the game. If *Shake the hands* is less and *Touch the forehand* is much then werewolf-side will be loose the game too. However, if Touch the forehead is much then werewolf-side will be win the game.

This results means human-side will be suspicious to *Werewolf* when *Werewolf* express *Shake the hands* much because upset of *Werewolf* transfers to human-side. On the other hand, human-side can not recognize upset or atmosphere of werewolf-side and werewolf-side will be win when *Shake the hands* or *Touch the forehand* are less expressed.

#### b.) Gestures of Seer

Fig.4 shows decision tree made by gesture tags *Seer* expressed. Decision-white-char is the utterances that *Seer* tell fortune-telling to others. However, we cannot acquire any rules about gestures of *Seer*. This results means gestures *Seer* expressed has less influences to

the game. The contents of the utterances *Seer* will be important more than gestures *Seer* expressed.

*c.) Facial Expressions of Werewolf*

Fig.5 shows decision tree made by facial expression tags *Werewolf* expressed. If the number of the utterances about consent-char is less then werewolf-side will be lose the game. If *Werewolf* expressed anger face much then werewolf-side will be lose the game when *Werewolf* consent with an opinion of other player. On the other hand, if *Werewolf* expressed anger face less then werewolf-side will be win the game. As the results, if werewolf expressed anger face then *Werewolf* will be executed at daytime or *Werewolf* will be target by fortune-telling by Seer.

*d.) Facial Expressions of Seer*

Fig.6 shows decision tree made by facial expression tags *Seer* expressed. If Seer expressed anger face then human-side will be lose the game. As the results, it was found that facial expression has importance to the game while Seer is making a speech. In this case, if *Seer* become emotional then *Seer* will be not trusted by others. It will be lead to lose of human-side.

## V. CONCLUSION

As the results of investigation and analysis of the playing movie, we found that nonverbal information in the game of *Werewolf* has importance to winning or losing the game. However, it is still not obviously how gestures and facial expressions to a concern utterance is important. In near future, we will investigate the relationships between verbal information and nonverbal information and clarify the impact of these information on the winning or losing.

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