

IYASHI Recipe: Cooking Recipe Recommendation for Healing based on Physical Conditions and Human Relations

Takuya Yonezawa
Kyoto Sangyo University
Kyoto, Japan
i2186249@cc.kyoto-su.ac.jp

Shion Yamaguchi
Kyoto Sangyo University
Kyoto, Japan
shion.y.1019@gmail.com

Yuanyuan Wang
Yamaguchi University
Ube, Japan
y.wang@yamaguchi-u.ac.jp

Kazutoshi Sumiya
Kwansei Gakuin University
Sanda, Japan
sumiya@kwansei.ac.jp

Yukiko Kawai
Kyoto Sangyo University/ Osaka
University
Kyoto, Japan
kawai@cc.kyoto-su.ac.jp

ABSTRACT

In this paper, we propose a recipe recommendation method that can heal both the provider and the recipient of food. In particular, we focus on the motivation of recipe contributors, and propose a recipe recommendation method that can heal both parties by considering not only the recipe procedure but also the relationship between the provider and the recipient, and their health conditions. Specifically, we extract feature words by learning from the items in the recipe data that contain a lot of information other than the cooking procedure, such as "title," "introduction of the recipe," "one-point information," and "trigger." In addition, each item of the recipe is analyzed for sentiment, and ranked based on the extracted feature words and sentiment values of the physical condition and relationship. We validate the usefulness of the proposed method by evaluating the relationship and physical condition feature words extracted by the proposed method and by evaluating the recipe ranking using Rakuten's recipe data.

CCS CONCEPTS

• **Information systems** → **Multimedia streaming**; *Recommender systems*; *Social recommendation*.

KEYWORDS

cooking recipe, recipe recommendation, recipe search

ACM Reference Format:

Takuya Yonezawa, Shion Yamaguchi, Yuanyuan Wang, Kazutoshi Sumiya, and Yukiko Kawai. 2021. IYASHI Recipe: Cooking Recipe Recommendation for Healing based on Physical Conditions and Human Relations. In *Proceedings of the 13th International Workshop on Multimedia for Cooking and Eating Activities (CEA '21)*, August 21–24, 2021, Taipei, Taiwan. ACM, New York, NY, USA, 8 pages. <https://doi.org/10.1145/3463947.3469239>

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

CEA '21, August 21–24, 2021, Taipei, Taiwan

© 2021 Association for Computing Machinery.

ACM ISBN 978-1-4503-8532-9/21/08...\$15.00

<https://doi.org/10.1145/3463947.3469239>

1 INTRODUCTION

The Internet is home to a vast number of cooking recipe websites where users can post recipes with ingredients, cooking procedures, images, and even videos, and can also search for a posted recipe data using keywords such as the name of the dish. However, there are instances where different recipe data are posted on the Internet under the same name, mainly because of differences in ingredients, cooking time, procedures, and the viewpoint of the user who cooked the food. Therefore, a simple search based on the dish name cannot cope with such differences, and to find the exact dish, the user must search for similar ingredients and cooking procedures from the titles and contents of more than several hundred search results. In the present study, by modifying the expression of the title and extracting typical elements by analyzing the relationship between the modified expression and the ingredients and cooking utensils of the recipe, we were able to develop a naming concept involving expressions such as "recipes that make children happy." [1]. Furthermore, we proposed an automatic title generation method based on review information [2]. We also proposed a method to determine the difficulty level of cooking recipes by extracting the editing intention of the camera as a difficulty factor and calculating the difficulty level based on the time characteristics of the cooking program. We verified the influence of each factor on the difficulty level of the cooking program [3].

In this study, we focus not only on the content of cooking recipes, such as titles and cooking procedures, but also on the circumstances and motivations for making dishes. As shown in the red frame in figure 1, Rakuten recipe ¹ includes information on the motivation and one-point information, and Cookpad ² includes information on the background. We aim to provide recipes that promote "healing" by extracting from the recipe data positive physical and mental emotions (characteristics) of the person being served (see Figure 2). This enables us to recommend recipes corresponding to expressions such as "recipes for me when I am tired" or "recipes for my father when he has a cold," which cannot be found by conventional AND or OR searches on the Internet. In this study, we generated learning models and feature vectors for the titles, recipe introductions, and triggers of Rakuten recipe data, and created and validated the

¹<https://recipe.rakuten.co.jp/recipe/1510019982/>

²<https://cookpad.com/recipe/2264011>

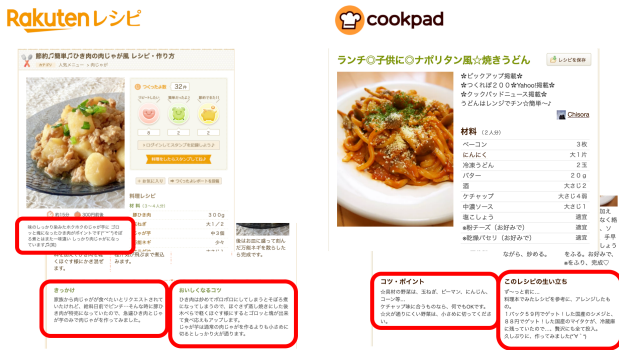


Figure 1: Examples for various items in recipes: Rakuten recipe (left) and Cookpad (right).

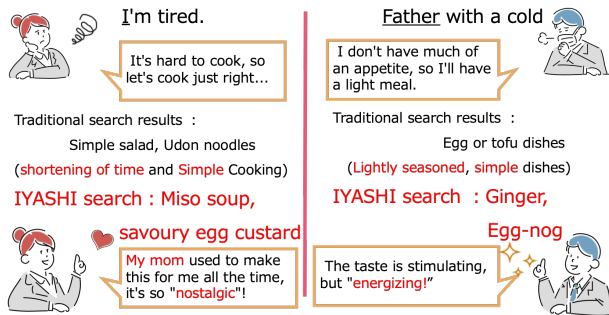


Figure 2: The flow for recommending IYASHI recipes.

rankings of recipe recommendations using cosine similarity and sentiment analysis, with the aim of realizing recipe recommendations that promote healing.

2 RELATED WORK

In recent years, much research has been conducted on the retrieval and recommendation of cooking recipes. In particular, here, we would like to introduce previous research that aims to reduce the burden (stress) of cooking.

In particular, there are many studies that seek the degree of cooking difficulty of cooking recipes, and among them, the following three papers are described as related studies in this issue.

Fujisaki and Miyoshi [4] recommended recipes for users who want to learn cooking, according to the appropriate cooking level of the user. They classify recipes into three categories: ease of cooking, technical difficulty, and clarity of the recipe text. They then use an algorithm that estimates the difficulty level of each category [5]. In the present study, to estimate the ease of a cooking recipe, we focus on the words used to describe the ingredients, cooking utensils, and cooking methods [6].

Iwamoto and Miyamori [7] believe that novice cooks can efficiently grasp which recipes they can cook. Their study focused on the skills necessary for cooking and proposed a search system that allows users to search for the difficulty level of each recipe. They similarly, propose a search system that allows users to search for

recipes based on the difficulty level of each recipe. Specifically, we extract cooking motions from the cooking procedure of each recipe available on the Internet, classify them based on the home cooking skill test, and calculate the score based on the number of cooking motions and weight.

Kusu et al [8], proposed a difficulty calculation method for cooking recipe retrieval based on cooking motions, because they believe that it will contribute to reducing the burden of cooking recipe retrieval from cooking motions. Specifically, to construct a search system that can seamlessly find cooking recipes that match the user's cooking skills, they extracted cooking motions from home economics textbooks prescribed for elementary schools, junior high schools, senior high schools, and senior high schools (specialized departments), and objectively defined the difficulty level of the extracted cooking motions.

In addition to the difficulty of the recipes, there have been studies on various other recipes.

Yamakata et al [9], proposed a method that focused on evaluating the typicality of the cooking procedure of the retrieved recipes and generated a typical cooking procedure. They introduce an algorithm that calculates the edit distance between ordered trees by arranging sibling nodes so that the similarity between two recipes matches the cooking procedure. We also propose a method for generating flow graphs from procedural text using dependency analysis to extract cooking actions performed on ingredients from the nodes corresponding to the ingredients until the end of the cook.

Furumoto et al. [10] presented a beginner-friendly recipe by generating advice to assist the user in the main cooking process. The recipes are analyzed using FastText and the advice is generated from similar recipe procedures based on cosine similarity.

In recent years, in addition to websites with text recipes, there has been an increase in users posting cooking videos, and the research on the analysis of cooking videos as well as text cooking recipes has been actively conducted. Otaki and Takano [11] proposed a method to calculate the cost of cooking by focusing on three essential elements, that is, cooking actions, utensils needed, and recipe ingredients. They then considered the number of times each of the three elements appears in the recipe (or video) and the number of times the dishes are moved.

In the above studies, burden scores were calculated for text recipes. In the present study, feature words are extracted from titles and cooking procedures as in these studies, but the present study is unique in that it also considers the relationship between the cook and the person being served, thereby enabling searches that trigger an increase in motivation to cook.

3 COOKING RECIPE RECOMMENDATION FOR RELAXING

In this study, we focus on the circumstances and motivations for cooking, and extract physical fatigue, mental fatigue, and human relationships from the cooking recipe data, to recommend recipes that make people feel physically and mentally "healed". The healing recipes in this study aimed to improve the physical and mental fatigue of those who served the food. The recommendation method is described as follows:

Table 1: Rakuten Recipe Data Items

Recipe ID	User ID	Category (Large, Medium, Small)
Name of dish	Recipe Title	Approximate cooking time ID
How many people	Recipe Release Date	Approximate cost ID
Tag (One to four words about ingredients and utensils)		
ID for any situation (8 cooking situations such as usual, hospitality, baby food, etc.)		
One-point information (Information about the process of making and after making)		
Recipe Introduction (Introduction to the recipe)		
Recipe inspiration (How I made the recipe)		

3.1 Dataset

This study targets recipe data posted by ordinary users to analyze not only the names of dishes and cooking procedures, but also the circumstances and motivations that led to the cooking. We used the publicly available Rakuten recipe data. The table 1 shows some of the Rakuten Recipe data items. In particular, the following four types of text are analyzed: "recipe title", "reason for the recipe," "introduction of the recipe," and "one-point information." These expressions were freely submitted by users in addition to set values (ID) such as cooking time, cost, and number of people. Free text tags were not included in this analysis as they are related to ingredients and cooking utensils.

3.2 Recommendation Flow

The process flow of our proposed method for recommending healing recipes is shown below.

- (1) Morphological analysis of search words and each item in the recipe to extract words
- (2) Generating a learning model for each item in a recipe by using bidirectional encoder representations from transformers (BERT)
- (3) Generating feature vectors of search words and items and calculating cosine similarity
- (4) Calculating the emotional value for each item in the recipe.
- (5) Ranking the recipe based on similarity and emotion values

The morphological analysis in (1) targets nouns and adjectives, and the feature vector in (3) is the average value of the word vector. In (4), we perform a sentiment analysis based on each recipe item. Finally, each recipe is ranked based on the similarity between the search word in (3) and each item of the recipe and the sentiment value.

3.2.1 Feature Vector Generation and Similarity Calculation. The proposed method generates feature vectors of search words and each recipe, and calculates their cosine similarity.

First, we generate a learning model from Wikipedia data using BERT. We then use the learning model to generate a feature vector v_K of search words. We also generate a feature vector v_i for each item D_j in the recipe.

Next, using the feature vectors, the evaluation value $Eval(D_j, i)$ for each item of the search word and the recipe is calculated as the cosine similarity as follows:

$$Eval(D_j, i) = \frac{\vec{v}_i \cdot \vec{v}_K}{|\vec{v}_i| \cdot |\vec{v}_K|} \quad (1)$$

D_j is the item of recipe i (e.g., $j=1$ is the title text, $j=2$ is the introduction text), the feature vector of the recipe item is v_i , and

the feature vector of the search word is v_K . From Eq. (1), the ranking value of recipe i , $Rank(i)$ is calculated as follows:

$$Rank(i) = \sum_{j=1}^n Eval(D_j, i) \times w_{D_j} \quad (2)$$

In this paper, Eq. (2) is used as the proposed method (1). w_{D_j} is the weight of item D_j , and the ranking value is the sum of products of item D_j of recipe i . In this study, equation. (2) was used as the proposed method (1).

3.2.2 Ranking by Similarity and Emotion values. To recover recipes for promoting healing, we consider not only the relationship between physical and mental fatigue, but also the emotional expression. The proposed method is defined as (2). For the sentiment analysis, the *score* and *magnitude* values are obtained for each recipe item using the Google Cloud Natural Language API³, and the sentiment value is calculated as $S(D_j, i) = score \times magnitude$, where *score* ranges from 1 to -1, and *magnitude* is the intensity of the emotion, which has a value greater than 0.

Using the similarity and sentiment values in Eq. (2), the ranking value of recipe i , $RankS(i)$ is calculated as follows:

$$RankS(i) = \sum_{j=1}^n Rank(i) \times S(D_j, i) \times w_{sntmt(D_j)} \quad (3)$$

Where $w_{sntmt(D_j)}$ is the weight of the emotion value $S(D_j, i)$ for item D_j .

4 EVALUATION BASED ON PHYSICAL CONDITIONS AND HUMAN RELATIONS

The purpose of this study is to extract physical and mental fatigue and relationship between the person cooking the dish and the person being served by analyzing the circumstances and motivations that lead to cooking, and to recommend recipes that promote physical and mental healing. In this section, we evaluate and verify the proposed method. We first examined the characteristic words related to the physical conditions extracted from each item of the recipe data. Next, we conducted a preliminary experiment to determine weights D_j for each item of the recipes in the proposed method. Finally, using the weights determined from the preliminary experiments, we verify the ranking of the proposed method (1) considering the physical condition and relationship, and the ranking of the proposed method (2) in terms of the emotion.

4.1 Verification of Feature Word Extraction

In this section, we examine the characteristic words related to the physical and mental conditions and relationships extracted for each item of the recipe. For feature word extraction, ja_ginza3.1.0 and Mecab0.996.5 were used for Japanese analysis, and spacy2.2.4, gensim3.8.0, pandas0.24.2, numpy1.16.4 and libraries were used. For the recipe data, we used 65,535 recipes from Rakuten Recipe Data for the 5-year period from October 1, 2010 to October 1, 2015.

Table 2 shows some of the results of the feature words extracted for the recipe items (e.g., title, trigger, introduction, and one-point information). The word "physical condition" is used as the word for physical fatigue and mental fatigue, and the word "relationship" is

³<https://cloud.google.com/natural-language>

Table 2: Examples of feature words related to physical fatigue and mental fatigue

	Vocabulary for physical fatigue	Vocabulary for mental fatigue	Vocabulary for relationships
Title	Fatigue, Pain, Fatigue, Fever, Illness, Fever, Immunity, Post-illness, Immunity, Cold (illness)	Tiredness, Boredom, Guilt	Father, Mother, Grandmother, Mother-in-law, Brother, Son, One's beloved daughter
Recipe introduction	Sickness, Pain, Fatigue, Upset Stomach, Immunity, Flu, Cold (illness)	Tiredness, Anxiety, Weariness, Be worried, Guilt	Father, Mother, Grandmother, Mother, Parent and child, Son
One point advice	Lifestyle disease, Pain, Eye strain, Enthusiasm, After sickness, Fatigue, Fever, Immunity, Stomach upset, Cold (illness)	Tiredness, Be worried, Anxiety, Weariness, Regret, Guilt	Father, Mother, Grandmother, Foster mother, Grandparents, Parent and child, I, Son, One's beloved daughter
Impetus	lifestyle disease, Pain, Eye strain, Sickness, After sickness, During sickness, Fatigue, Gastritis, Fever, Influenza, Heat stroke, Immunity, Immunity, Dental plaque, Toothache, Upset stomach, Cold(illness)	Tiredness, Weariness, Be worried, Anxiety, Guilt	Father, Mother, Grandmother, Grandfather, Grandparents, Parent and child, Brother, I, Kin, One's parents' roof, Close friend, Friend, Son, One's beloved daughter, Boss

used for relationships between the person cooking and the person being served the dish. The vocabulary for physical fatigue was extracted from all items, and "cold" in particular appeared in all of them. In addition, "fever," "immunity," and "heat stroke" appeared frequently. Many vocabulary words appeared for physical fatigue appeared in the "triggers" item, including many specific illnesses such as "toothache," "gastritis," and "influenza. As for mental fatigue, "tiredness" and "guilt" were extracted in all items. In terms of vocabulary for relationships, relatively many common words such as "father," "mother," "son," and "grandmother" were extracted. In conclusion, it was confirmed that the feature words that describe the physical condition and relationship between physical and mental fatigue can be extracted for each item.

4.2 Preliminary Experiment for Recipe Items

Next, we conducted a preliminary experiment to determine the weight of D_j in Eq. (2) for each item of the "title," "introduction," and "motivation" of a recipe. In the preliminary experiment, we first generated feature vectors of the search words by combining the extracted feature words and relations representing the physical condition, and then calculated the cosine similarity with the feature vectors for each item of the recipe using Eq. (1), and rank them. The recipes for each of these ranked items were presented to the subjects, who evaluated them, verified the accuracy of each item, and determined its importance. The search words/expressions used in the preliminary experiment were "cold" and "tiredness" (which were characteristic words for physical condition); "father" and "son" (which were characteristic words for relationships); and "father has a cold," "father is tired," "son has a cold," and "son is tired" (which were obtained by combining the four characteristic words).

The subjects of the study comprised seven male and seven female university students, who were asked to browse the top 10 recipes in order of similarity among the recipe data (including all items, images, etc.) posted on the Rakuten Recipe website, and to rate whether the recipes were compatible with the search keywords (e.g., "father has a cold") on a 5-point Likert scale. The mean of each evaluation value was used as the correct answer data (evaluation value), and the accuracy was verified using the Spearman rank correlation coefficient and nDCG. The nDCG was calculated using the following equation, which takes into account the same rank:

$$\frac{\sum_{i=0}^n \frac{(\text{Evaluation value of } i)^2 - 1}{\log_2 \text{Rank of } i}}{\sum_{i=0}^n \frac{(\text{Evaluation value of } i)^2 - 1}{\log_2 \text{Rank of correct answers for } i}} \quad (4)$$

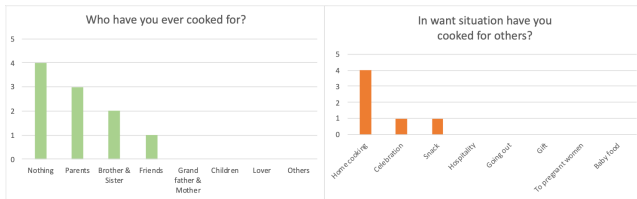
Table 3 shows the correlation coefficients and results of the nDCG. The results show that for "father has a cold," the correlation coefficient for "referral" is the highest, and for nDCG, the correlation coefficient for "trigger" is the highest. Similarly, for "father's fatigue," the correlation coefficient is the highest for "introduction" and in nDCG, the correlation coefficient is the highest for "trigger". For "son's fatigue," "introduction" had the highest correlation coefficient and nDCG. In contrast, "My son has a cold" showed the highest results in both the correlation coefficient and nDCG of "Title". Overall, nDCG at 10 was higher than 0.9, except for the trigger of "My son has a cold," suggesting that the ranking was based on physical condition and relationship. The reason for the low nDCG value of 0.63 for "trigger" for "My son has a cold" was probably due to the fact that there were six duplicate cases in the first place. In addition, the correlation coefficient for "My son has a cold" is low, which may be due to the same factor.

Table 4 shows the titles of the top 10 recipes for each item of "Father has a cold" and their evaluation rankings according to the subjects' rating values. The rankings ranked by the proposed method are the columns of "Rank," and the subject's evaluation rank, and the five-level evaluation value for each item are the columns of "Evaluation Rank." Note that although the subjects viewed the contents of the presented recipe pages (including all of the "title," "introduction," and "trigger"), only the "title" of the "introduction" and "trigger" recipes are listed in the table. The first rank by the proposed method using the "title" item was the lowest in the subjects' evaluation (10th place), but the results after the second rank were relatively good. This can be attributed to the fact that the first-ranked title contained vocabulary related to the relationship between "baby" and "fever" and physical condition, the second-ranked title contained only vocabulary related to the physical condition of "cold," and the third-ranked title contained vocabulary related to the relationship between "father."

The recipes that were ranked first by the proposed method using the "Introduction" item were also ranked first in the evaluation of the subjects, and the overall results were relatively good. In

Table 3: Correlation coefficient and nDCG@10

Search Keywords	Item	Correlation Coefficient	nDCG@10
Father has a cold	Title	-0.0121	0.9838
	Introduction	0.6061	0.9125
	Impetus	0.2667	0.9905
Father's fatigue	Title	-0.1455	0.9870
	Introduction	0.6000	0.9626
	Impetus	0.5273	0.9683
Son has a cold	Title	0.1212	0.9733
	Introduction	-0.2121	0.9128
	Impetus	-0.1939	0.6337
Son is tired	Title	-0.5030	0.9708
	Introduction	0.7394	0.9979
	Impetus	0.3455	0.9793

**Figure 3: The distribution of target people (left) and situations (right).**

the "trigger" category, the eighth place of the proposed method is the first place in the subjects' evaluation, and the first place of the proposed method was the fifth place in the evaluation. From the above, we set the importance of "introduction" as the highest, followed by "trigger" and "title."

4.3 Questionnaire on Subjects' Cooking Experiences

The purpose of this study was to recommend recipes for promoting healing in consideration of the relationships and physical conditions. We conducted a survey by asking the subjects if they had ever cooked for a third party (multiple answers possible) and what kind of food they had cooked for a third party (multiple answers possible). Figure 3 shows the questionnaire results. In response to the question, "Who have you ever cooked for?", 40% of the subjects answered "I have never cooked for anyone," but 60% had cooked for someone, (mostly for family members (50%) such as "parents," and "brothers and sisters"). Among those who had cooked for a third party, the most common answer to the question, "Under what circumstances have you cooked for them?" was "Everyday cooking" at 67%. This was followed by "celebration" and "snacks" at 17% each. Note that the "situation" was selected based on the "What time ID" of the Rakuten Recipe website.

4.4 Verification of Cooking Recipe Recommendation

In this section, we verify the recipe recommendation results of the proposed method by using the Spearman rank correlation coefficient and equation(4) nDCG@10.

From the preliminary experiments in the previous section, the weights of the items in Eq. (2), D_j , were set to $D_1 = 0.15$ for the title, $D_2 = 0.45$ for the introduction, and $D_3 = 0.4$ for the trigger.

Based on the results of the questionnaire on cooking experience and the feature words extracted in Table 2, we used "cold," "tiredness," and "anxiety" as the vocabulary for physical condition and "father," "son," and "mother" as the vocabulary for relationship, and then combined them to form nine search words/expressions.

There were 43 subjects: 18 college seniors and high school students, 15 college seniors, and 10 other age groups. The subjects evaluated the recommended recipes for three of the nine search terms. Subjects viewed the titles, introductions, and triggers of the recipes presented for the search words (e.g., "father has a cold"), and rated on a 5-point Likert scale whether they wanted to feed the recipes presented for the search words. The mean value of the evaluation data was used as the correct answer data, which was evaluated using the Spearman rank correlation coefficient and nDCG.

For comparison and evaluation, we used Eq. (2), which considers the similarity of feature vectors and the weights of items, as the proposed method (1), and Eq. (3), which considers the emotion values as proposed method (2). In the proposed method (2), the case where the weight $w_{sntmt(j)}$ for the emotion value is not considered (all 1) and the cases where the weight is considered were compared. The weights $w_{sntmt(j)}$ were set to $w_{sntmt(1)} = 0.15$ for titles, $w_{sntmt(2)} = 0.45$ for introductions, and $w_{sntmt(3)} = 0.4$ for triggers, as in the similarity weights of the preliminary experiments.

Table 5 shows the results of the proposed method (1), the results of the proposed method (2) considering the emotion values (2a), and the results of the proposed method (2) considering the weights of the emotion values (2b). Comparing the results for each physical condition (cold, fatigue, anxiety), the proposed method (1) is better for "cold" except for the relationship "mother," and the proposed method (2b) is better for "fatigue" for all relationships. For "anxiety," the proposed method (2a) and the proposed method (2b) were found to be good. Because the rank correlation was less than 0.4, there was no correlation. However, the nDCG is 0.825 on average, indicating a high rate of fit. This confirms the effectiveness of (3).

Comparing the results by relationship (father, son, and mother), the results for "father" and "son" varied depending on their physical condition, and on average, the proposed method (2b) was better. For "mother," the proposed method (2b) was found to be better except for "anxiety." The proposed method (2a) was better only for "anxiety," but on average, the proposed method (2b) was demonstrated to be better. Therefore, the proposed method (2b) is better than (2a), and the effectiveness of (3) is confirmed for the relationships. These results suggest the possibility of recommending recipes that consider the relationship and mental fatigue.

Next, we qualitatively verify the ranking results of the proposed method (1) with the evaluation rankings in Tables 6 and 8. In the cold condition shown in Table 6, the first and second rankings by the proposed method (1) were similar to the first and second rankings of the evaluation rankings for "father" and "mother," and the second rankings for "son" were the same, resulting in good accuracy for the high rankings.

In the case of the state of fatigue shown in Table 7, the rank correlation coefficients of the proposed method (1) in Table 5 show

Table 4: Correlation coefficients of the proposed method (1) and (2a) and (2b) and nDCG@10

	(1) without emotion		(2a) with emotion		(2b) with emotion and weight	
	Correlation Coefficient	nDCG@10	Correlation Coefficient	nDCG@10	Correlation Coefficient	nDCG@10
Father has a cold	0.2970	0.9430	-0.2848	0.7010	-0.1636	0.7477
Son has a cold	0.0545	0.7891	-0.5152	0.7646	-0.5515	0.7611
Mother has a cold	0.1091	0.9315	0.3273	0.7931	0.3636	0.8932
Average	0.154	0.888	-0.158	0.753	-0.117	0.801
Father's fatigue	-0.6727	0.7385	0.2727	0.9193	0.2970	0.9206
Son's fatigue	-0.5152	0.8053	0.2364	0.8600	0.3091	0.9307
Mother's fatigue	-0.1515	0.8431	0.2848	0.8721	0.3818	0.8869
Average	-0.446	0.796	0.265	0.884	0.329	0.913
Father's anxiety	-0.1394	0.6612	0.4061	0.8771	0.3576	0.8718
Son's anxiety	-0.0303	0.8033	-0.0667	0.8138	-0.2000	0.8067
Mother's anxiety	-0.2061	0.7213	0.0485	0.8203	-0.0727	0.7986
Average	-0.139	0.804	0.079	0.825	0.080	0.846

Table 5: Search keyword: Father has a "cold"

Ranking	Title	Method (1) Rank	Introduction	Method (2a) Rank	Impetus	Method (2b) Rank
1	For babies with fever: banana thickeners	10 (2.429)	Miso soup - leek and tofu	1 (4.571)	Pickled cucumber	5 (3.286)
2	When you have a cold and lack energy: Eel rice porridge	1 (4.286)	Stewed udon	1 (4.571)	Rice ball with soboro and red ginger	4 (3.429)
3	For the father who works at the branch office: Fried shishamo smelt	4 (2.857)	Pork Piccata" dinner in 10 minutes	8 (2.857)	Rice ball with salted kelp and cucumber	3 (3.571)
4	Wake up refreshed: Spicy coffee	6 (2.714)	Even those who don't like it will fall in love with it! Kinpira bitter gourd	6 (3.000)	Mid-late stage of weaning: Porridge with lettuce and minced pork	7 (3.000)
5	My grandchildren are very happy: Soft vermicelli	6 (2.714)	Easy and Super Quick "Wok-fried Pork & Cabbage	4 (3.286)	Tossed salad	2 (3.714)
6	During and after illness!: Chinese-style noodles with wax gourd and sausage	2 (4.000)	Homemade Tuna Mayo "On toast or baguette	6 (3.000)	Simple Ingredient Muffins	9 (2.571)
7	Fujiko's snacks	8 (2.571)	A simple roasted green bell pepper tastes like a shishito pepper.	4 (3.286)	Spring Roll with Meat Miso and Quail Egg	7 (3.000)
8	Hay fever? For easy lunch: Chirimen shiso leaves	3 (3.143)	Milk pudding (not pudding) to fight a cold	3 (3.714)	Easy: Chilled Tsukimi Soba	1 (3.714)
9	Squid rice style with baby squid	8 (2.571)	Fresh Cream Banana Toast	9 (2.286)	For snacks: Tsukudani with beef burdock	9 (2.571)
10	Refreshing teriyaki that goes well with rice	4 (2.857)	Tiramisu on French bread.	10 (1.857)	Beautiful pink jako rice balls	5 (3.286)

no correlation in any of the relations, but this may be due to the fact that the vocabulary of "weaning food" is at the top of the list.

In the case of the state of anxiety in Table 8, the rank correlation coefficients of the proposed method (1) in Table 5 show no correlation in any of the relations, but as with "tiredness," the vocabulary of "weaning" appears not only at the top but also in many of the relations, suggesting that it is a factor.

In the future, it will be necessary to construct a learning model that includes not only wikipedia but also recipe data to improve the accuracy. In conclusion, although there is a need to improve the accuracy of the learning model, the proposed method (2), which uses "title," "introduction," and "trigger" in addition to the recipe procedure, has demonstrated a certain usefulness in recommending

recipes that take into account the physical and mental condition of the person being served the food.

5 CONCLUSION

In this study, we focused not only on the content of the recipes, such as the titles and cooking procedures, but also on the circumstances and motivations for making the dishes, and used the recipe data to infer recipes that make people feel healed based on the physical and mental condition of the person serving the food, the relationship with the subject being served, and positive emotional expressions. This study aimed to evaluate the effectiveness of the "healing" method. The proposed method focuses on the "title," "introduction," and "trigger" of a cooking recipe, as well as the process before and after cooking, and extracts feature words for each item

Table 6: When the other person’s condition is a "cold" in relation to people

Condition	Rank	Recipe Title	Evaluation Rank
Father has a cold	1	Miso soup - leek and tofu	2
	2	Stewed udon	1
	3	Pork Piccata for Dinner in 10 Minutes	6
	4	Even those who don't like bitter melon will fall in love with it	9
	5	Easy and Super Quick "Wok-fried Pork & Cabbage"	6
	6	Homemade Tuna Mayo *On toast or baguette	9
	7	Fried egg with lettuce	5
	8	A simple roasted green bell pepper tastes like a shishito pepper	4
	9	Stewed sansho nuts in soy sauce	8
	10	Milk pudding (not pudding) to fight a cold	3
Son has a cold	1	Potato Oyaki	7
	2	Baby Food: Small Potatoes, Carrots and Onions	2
	3	Extra Thick Milk Bread	5
	4	Deep-fried Juicy Chicken Tatsuta	9
	5	Microwave Chicken Dumpling Hand-held Meal	4
	6	Sauteed Vegetables with Oyster Sauce	6
	7	Easy! Green beans with sesame paste	2
	8	Spicy! Green pepper with sesame paste	7
	9	Tomato porridge *weaning food	1
	10	Cheese Takoyaki with Memories	10
Mother has a cold	1	Miso soup - leek and tofu	1
	2	Stewed udon	2
	3	Homemade Tuna Mayo *On toast or baguette	9
	4	Fried egg with lettuce	7
	5	Pork Piccata" dinner in 10 minutes	10
	6	Easy and Super Quick "Wok-fried Pork & Cabbage"	5
	7	A simple roasted green bell pepper tastes like a shishito pepper	6
	8	Even those who don't like bitter melon will fall in love with it	7
	9	Spicy Wakame Udon	4
	10	Mellow Chinese soup with Chinese cabbage	3

and generates a learning model to realize the retrieval of physical condition and relationship. From the evaluation experiments, we were able to extract the characteristic words, which are physical and mental fatigue and relationships between the cook and the person being served the food. The mean value of nDCG was higher than 0.9 for all the proposed methods, confirming the effectiveness of the recipe recommendation by considering the physical condition and relationship. In the future, we aim to improve the accuracy of the healing recipe model by testing it with more words related

Table 7: When the other person’s condition is a "fatigue" in relation to people

Condition	Rank	Recipe Title	Evaluation Rank
Father's fatigue	1	Easy and Quick Furikake Fried Rice	7
	2	Baby Food Soup with Chinese Cabbage and Harusame	10
	3	A simple roasted green bell pepper tastes like a shishito pepper	9
	4	Simmered pumpkin and chicken with minced chicken sauce weaning food	8
	5	Honey-pickled hazelnuts	2
	6	Soba noodles with shiitake mushroom soup	1
	7	udon noodles with wakame seaweed and bamboo shoots	2
	8	Pork Piccata" dinner in 10 minutes	6
	9	Curry Udon with Mushrooms in 5 Minutes	4
	10	Beautiful pink jako rice balls	4
Son's fatigue	1	Tuna Salad with Lettuce and Avocado	7
	2	Full of nutrition! Quick milk porridge with chopped vegetables	6
	3	Popeye toast	9
	4	Microwave Chicken Dumpling Hand-held Meal	3
	5	Simmered flavored flatfish	5
	6	Tomato Porridge *weaning food* (ok from early stage)	10
	7	Healthy Cabbage Roll Soup Made in the Microwave	8
	8	Easy Side Dish French Fries with Skin	4
	9	Potato Oyaki	1
	10	Grilled green onions	2
Mother's fatigue	1	Easy and Quick Furikake Fried Rice	7
	2	Late Baby Food Easy! Glutinous rice flour steamed bread	9
	3	Curry Udon with Mushrooms in 5 Minutes	2
	4	Raisin Bread Style with Rice Cooker and Pancake Mix	1
	5	Simple Salted Black Bean Tea	6
	6	Weaning Food, Sweet Potato Milk	10
	7	Simmered pumpkin and chicken with minced chicken sauce weaning food	8
	8	Just mix and bake! Easy hash browns	4
	9	Udon noodles with wakame seaweed and bamboo shoots	3
	10	Even those who don't like bitter melon will fall in love with it	5

to mental fatigue and generating a learner that includes cooking information such as ingredients.

The methodology is simple but our proposed service is significantly useful for users in a modern environment, and the evaluation

Table 8: When the other person’s condition is a "anxiety" in relation to people

Condition	Rank	Recipe Title	Evaluation Rank
Father’s anxiety	1	Late Baby Food Easy! Glutinous rice flour steamed bread	7
	2	Fried egg with lettuce	10
	3	A simple roasted green bell pepper tastes like a shishito pepper	9
	4	Pumpkin Potatoes	8
	5	Healthy Cabbage Roll Soup Made in the Microwave	2
	6	Weaning Food : Banana and Apple Potato	1
	7	Sauteed eggplant and bean sprouts	2
	8	Baby Food Soup with Chinese Cabbage and Harusame	6
	9	Fried cabbage with spicy miso	4
	10	Chicken wing gyoza	4
Son’s anxiety	1	Even those who don’t like it will fall in love with it. Kinpira bitter gourd	7
	2	Summer Stamina! Simple Mozuku Soup!	6
	3	Sea Urchin Jellies	9
	4	Rice porridge with ume plum and leek	3
	5	Simmered pumpkin and chicken with minced chicken sauce weaning food	5
	6	Weaning Food: Sweet Potato Milk	10
	7	Grilled rice balls: Baby Star & Miso Sesame Flavor	8
	8	Pork Piccata" dinner in 10 minutes	4
	9	Kirikombu’s...	1
	10	The Secret Purple Sweet Potato	2
Mother’s anxiety	1	Simmered pumpkin and chicken with minced chicken sauce weaning food	7
	2	A simple roasted green bell pepper tastes like a shishito peppe	9
	3	Easy and Quick Furikake Fried Rice	2
	4	Weaning Food: Sweet Potato Milk	1
	5	Even those who don’t like it will fall in love with it. Kinpira bitter gourd	6
	6	Pork Piccata for Dinner in 10 Minutes	10
	7	Shortcake-like Potato Salad	8
	8	Summer Stamina! Simple Mozuku Soup!	4
	9	Fried egg with lettuce	3
	10	Late Baby Food: Easy! Glutinous rice flour steamed bread	5

ACKNOWLEDGMENTS

The research was supported by ROIS NII Open Collaborative Research 19FC03 and 20FC01.

REFERENCES

- [1] A. Tachibana, S. Wakamiya, and K. Sumiya, "Extraction of naming concepts focusing on modifiers of food names in cooking recipe websites (in japanese)," in *The 5th Forum on Data Engineering and Information Management (DEIM Forum 2013)*, C4-4, mar 2013.
- [2] M. Kanauchi, H. Nanba, and K. Sumiya, "Automatic generation of dish titles based on review information for recipe submission websites (in japanese)," in *The 8th Forum on Data Engineering and Information Management (DEIM Forum 2016)*, P3-2, 2016.
- [3] I. Akiguchi, Y. Wang, Y. Kawai, and K. Sumiya, "Determining the difficulty level of cooking recipe videos by extracting their temporal characteristics (in japanese)," in *The 10th Forum on Data Engineering and Information Management (DEIM Forum 2018)*, C4-4, mar 2018.
- [4] Y. Fujisaki and Y. Miyoshi, "Algorithm for estimating the difficulty of cooking recipes based on the ingredients, utensils, and cooking methods used (in japanese)," in *JSiSE Student Research Presentation 2015*. Japan Society for Information and Systems in Education, 2016, pp. 137–138.
- [5] Y. Miyoshi, K. Suzuki, K. Shiota, and R. Okamoto, "Evaluation of difficulty estimation for learning materials recommendation," in *Proc. of the 22nd International Conference on Computers in Education (ICCE 2014)*, 2014, pp. 71–76.
- [6] Y. Miyoshi, Y. Fujisaki, K. Suzuki, K. Shiota, and R. Okamoto, "Estimating the difficulty of cooking recipes by analyzing user–recipe relationship in the social network," in *Proc. of E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*, 2015, pp. 420–425.
- [7] J. Iwamoto and H. Miyamoto, "Proposal for a recipe search system that takes into account the level of difficulty of cooking (in japanese)," in *The 4th Forum on Data Engineering and Information Management (DEIM Forum 2012)*, E1-3, mar 2012.
- [8] K. Kusu, H.-I. Choi, T. Kambara, T. Kinoshita, T. Shioi, and K. Hatano, "Searching cooking recipes by focusing on common ingredients," in *Proceedings of the 19th International Conference on Information Integration and Web-Based Applications & Services*, ser. iiWAS '17. New York, NY, USA: Association for Computing Machinery, 2017, p. 95–101. [Online]. Available: <https://doi.org/10.1145/3151759.3151797>
- [9] Y. Yamakata, S. Imahori, S. Mori, and K. Tanaka, "Evaluating typicality of recipes and generating typical recipes using workflow representation (in japanese)," in *Transactions of the Institute of Electronics, Information and Communication Engineers*, 2016.
- [10] K. Furumoto, H. Nanba, and K. Sumiya, "Recipe presentation method complemented by cooking advice (in japanese)," in *The 9th Forum on Data Engineering and Information Management (DEIM Forum 2017)*, C1-3, 2017.
- [11] K. Otaki and K. Takano, "A method for determining cooking costs from cooking videos focusing on cooking behavior, utensils, and ingredients (in japanese)," *The 79th National Convention Lecture and Paper Series*, vol. 2017, no. 1, pp. 539–540, mar 2017. [Online]. Available: <https://ci.nii.ac.jp/naid/170000174516/>

and discussion would be effective and helpful for information scientists as well as sociologists and psychologists.