MODIFYING FOOD RECIPES FOR READERS WITH MILD OR TEMPORARY DISABILITIES THAT IMPACT READING COMPREHENSION

by

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ABSTRACT

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Recipes can be important for accomplishing preparatory activities for eating, a major life activity and sometimes an important social occasion. Disabilities that cause reading problems that impact comprehension can make it difficult for an individual to read and understand recipes. A simplified recipe would reduce the mental effort required to read and execute the recipe. There are resources for individuals who have more severe impairments, but these are not suitable for individuals with more mild impairments.

A proof-of-concept software system for extracting information information from cookie recipes was created. The system uses a combination of rules and a statistical model to make a recipe's oven preheat temperature, baking duration and required tools easier to identify; format actions in bold typeface; and separate multi-sentence steps into sub-steps. The statistical model uses named entity recognition. The system was evaluated in a pilot user study.

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1 Introduction

Eating is a major life activity. In addition to being important to an individual's daily life, it can also be an important social occasion. Preparing for this occasion requires menu planning, shopping and cooking—all instrumental activities of daily living. Recipes can be important for all three of these preparatory activities: providing options for dishes to serve, lists of ingredients to buy and steps to prepare the dishes.

Disabilities that cause reading problems that impact comprehension can make it difficult for an individual to read and understand recipes. These include learning disabilities, such as dyslexia or autism; acquired disabilities, such as a traumatic brain injury; or even as a consequence of the normal process of aging. Visual disabilities, such as mild or moderate accommodative dysfunction, can also impact reading comprehension.

Even disabilities that cause mild impairments could mean that an activity cannot be easily completed. For example, someone with postconcussional syndrome might have headaches, dizziness, fatigue and difficultly concentrating [Car+04]. This person does not need to be told how to read a recipe or shown how to execute the steps, but reading and executing a recipe might be intolerably fatiguing.

A simplified recipe would reduce the mental effort required to read and execute the recipe. One way of simplifying recipes is to make them superficially similar to each other by applying the same formatting and layout rules, as might be done for any cookbook; this could be done without having to understand the content of the recipe. A further way of simplifying recipes is to make the contents of recipes simpler and more consistent, as well as highlighting important information.

Most aids and research relating to disabilities and recipe reading focus on helping those with more severe impairments. Some of these aids are static and not adaptable to new situations, such as cookbooks for individual with traumatic brain injuries that are participating in a day services program [Dan12], visual cookbooks or cookbooks that only use a microwave; static systems, unfortunately, provide a limited repertoire. KogniChef [Neu+17], a cognitive system, uses sensors to provide feedback to the user as a human chef might, but recipes have to be specially prepared for the system. Let's Cook [Pap+18] is a augmented-reality game to teach cooking skills to children with cognitive impairments, but it does not provide assistance with any given recipe. In general, individuals cannot use these tools to adapt recipes on their own and many of the tools are intended to assist individuals who might otherwise need care in a retirement home or an institution.

The most relevant attempts of creating or modifying recipes for individuals with minor impairments are in the lay literature, either as specially prepared recipes [Sto18] or as a method for modifying recipes [For16]. These are unsatisfactory as the former does not lend itself to automation, as the process is not described, and the latter, while easier to imagine as an automated process, produces a table that is not a standard format for recipes. Additionally, the methods for evaluating the outcomes are unclear.

While there is not much research how to modify recipes for individuals with minor impairments, there is work for automatic information extraction for food recipes. The main basis for this system for modifying recipes uses a model that identifies the entities of a recipe's steps [YMC20].

1.1 Proposed Solution

Recipes have different parts, such as the title, the ingredients and the steps. There are also many different types of recipes, such as for main courses or desserts. This system for modifying recipes focuses on the recipe steps and cookie recipes, proposing to make it easier for individuals with disabilities that affect reading comprehension to read and execute a food recipe by:

1. Identifying tools the chef needs
2. Identifying actions the chef needs to take

3. Reducing the need to scan through the recipe to find information

    (a) The temperature to preheat the oven

    (b) The baking duration

    (c) Steps that could be broken down into separate steps

An example of what this might look like, a hand-edited example, is shown in Figure 1.1. (The unmodified recipe is shown in Figure 4.1 and the recipe as actually modified by the system is shown in Figure 4.2.)

In order to modify a recipe in such a manner requires solving two main problems: information extraction and display. The first problem can be solved using natural language processing, using both rules and statistical models (that is, machine learning). For the second problem, the extracted information must be reformatted and the recipe displayed to a user. In order for the system to be evaluated, it must be able to display both modified and unmodified recipes.

The extracted information can be used to change the formatting of the text and add additional text to make explicit what was previously only implied. The text can be reformatted in three ways. The first is to bold actions, such as "Once the flour has been incorporated, **add** the second half". The second is to separate steps that consist of several sentences into separate steps, such as "Wrap with plastic; chill 1 hour" into "Wrap with plastic" and "chill 1 hour". Additional information about the recipe can be added in two

Belgian Spice Cookies

Preheat:

- 350°F

Bake duration:

- about 8 minutes

Ingredients

- 2 cups all purpose flour
- 1 tablespoon ground cinnamon
- 1 1/2 teaspoons ground ginger
- 1/2 teaspoon ground cloves
- 1/2 teaspoon baking powder
- 1/2 teaspoon salt
- 1 1/4 cups (packed) dark brown sugar
- 1/2 cup (1 stick) unsalted butter, room temperature
- 1 large egg
- 2 ounces good-quality white chocolate (such as Lindt or Baker's), melted
- Red colored sugar

Procedure

1. **Gather** what is needed
    - **Gather** tools
        - bowl
        - beater
        - plastic wrap
        - 2 large baking sheets
        - oven
        - timer
        - knife
        - miniature cookie cutter
        - oven mitts
        - cooling rack
    - **Gather** ingredients
2. **Combine** first 6 ingredients in medium bowl.
3. Using electric mixer, **beat** brown sugar and butter in large bowl until light.
4. **Add** egg and **beat** until fluffy.
5. Gradually **add** dry ingredients and **beat** just until combined.
6. **Divide** dough in half.
7. **Flatten** each half into rectangle.
8. a. **Wrap** with plastic;
   b. **chill** 1 hour.
9. a. **Preheat** oven to 350°F.
   b. Lightly **butter** 2 large baking sheets.
10. **Roll out** 1 dough piece on lightly floured work surface to 13 x 9-inch rectangle.
11. **Trim** edges to form 12x8-inch rectangle.
12. **Cut** into 24 4x1-inch rectangles.
13. Lightly **press** miniature cookie cutter into each rectangle to make imprints (do not cut through dough).
14. **Arrange** cookies on prepared baking sheets, spacing 1 inch apart.
15. **Bake** until edges begin to darken, about 8 minutes.
16. **Transfer** cookies to rack and **cool**.
17. **Repeat** with remaining dough piece.
18. Working with 1 cookie at a time, **brush** imprints with melted white chocolate.
19. **Sprinkle** colored sugar generously over chocolate.
20. **Let stand** until chocolate sets, about 2 hours.
21. **Shake off** excess colored sugar.
22. (Can be made ahead. **Store** in airtight container at room temperature up to 1 week, or **freeze** up to 1 month.)

Figure 1.1: Exemplar for the “Belgian Spice Cookies” Recipe.

places. The first is before the ingredient list, adding the preheat temperature and baking duration. The second is before the first step, listing the tools that are either explicitly named in the steps or implied through actions.

It is hoped that the process for simplifying recipes also leads to a universal design—that the recipes are also easier to use by individuals without impairments. While there are discussions of how to write a good recipe [AR16] or how to evaluate a recipe that has already been written [RS02], they are subjective. Objective measures of readability, such as the Flesch–Kincaid readability tests, are better suited to longer texts, such as for expository or prose writing. Alternatively, a system can be evaluated through a user study where participants read examples of recipes in unmodified and modified formats and we measure the impact on accuracy and the time it takes to read the recipes. The features and evaluation of the system focus on cookie recipes due to the author's familiarity and preferences.

2 Background

Implementing the solution requires developing a theoretical framework for reading comprehension and text simplification. For recipes to be modified, a knowledge representation for food recipes must be developed. Finally, the framework must encompass evaluation of the simplifications and be adaptable to food recipes and for readers of recipes.

2.1 Reading Comprehension and Text Simplification

There are several factors that influence reading comprehension—learning and understanding a text—including the characteristics of the text itself and the characteristics of the reader [LKM13]. These factors include the perceived difficulty and the actual difficult of comprehending of a text. Measurement characteristics, the differences between the perceived and actual difficulty, are an additional factor.

Perceived difficultly is related to the willingness of a reader to read a text. A reader might, for example, evaluate the perceived difficulty of a recipe on whether they recognize the dish from the title, the familiarity of the

ingredients and by scanning through the recipe's steps. The evaluation might even include things outside the text itself, such as judging the attractiveness of the completed dish in a photograph. While this is important—a recipe that is perceived as too difficult might never be used—the actual difficulty must also not be too great.

Actual difficulty is related to how a reader understands a text. For a recipe, this encompasses the ability of a reader to use the recipe in any given context, such as menu planning, shopping or cooking. The formal characteristics of the text can be used to score its actual difficulty. The Flesch-Kincaid readability tests, using word and sentence lengths to compute a score for a text, are among the most well-known methods of using formal characteristics; the longer the words and sentences are, the more difficult the text is. This sort of test might not always be the best measure for all texts, though, as text with shorter words and sentences might actually be more difficult to understand.

Lexical simplification and coherence enhancement are two ways to decrease a text's reading difficulty. Leroy, Kauchak, and Mouradi proposed a semi-automated system for simplifying medical texts using these techniques. While their system requires a human writer, it suggests techniques that could be applied automatically.

Lexical simplification identifies difficult terms in a text, generates possible

replacements and selects the best one. One of ways of identifying a difficult word is identify its part-of-speech and determine its difficulty based on how frequently it appears in the Google Web Corpus. A dictionary, in addition to providing definitions, is used to identify synonym and hypernyms; if a word is more popular in the corpus than the synonyms or hypernyms, it is retained. In the final step, synonyms can be substituted directly, hypernyms can be inserted between commas or parentheses, and definitions can be added as separate sentences.

Lexical simplification can sometimes reduce the flow of a text by making it choppier and less coherent. Leroy, Kauchak, and Mouradi improved the local coherence, the coherency of adjacent sentences, in the medical texts by adding pronouns to show links between sentences. The global coherence, the coherence of the entire text, was improved by adjusting the spacing of text based on Gestalt principles, that there is "one idea per chunk of text". If different chunks of text have disjoint ideas, for example, they can be separated into new but different paragraphs. If different chunks of text have related ideas, on the other hand, they can be changed to enumerations, with each idea being indented in the paragraph on separate lines.

The Flesch-Kincaid readability tests are not good measures for evaluating the effects of lexical simplification and coherence enhancement: the techniques can either increase or have no effect whatsoever on the reading

difficulty as measured by the tests. Leroy, Kauchak, and Mouradi measured the perceived difficulty of sentence pairs by asking participants of a survey to judge each of the sentences using a five-point Likert scale where one is the easiest and five is the most difficult; their modified sentences were consistently perceived as easier even though the Flesch-Kincaid scores were similar. They measured actual difficulty by using a Cloze measure, where words are removed from a sentence and a survey participant must supply them, as in a fill-in-the-blank test.

2.2 Dataset and System for Modifying Recipes

RecipeScape [Cha+18b] is a system for comparing the structure of many recipes with each other. It uses part-of-speech tagging to label the verbs and nouns in a recipe, and then creates a tree to link them together. It was originally investigated as a tool to measure a recipe's structure and complexity and, moreover, to see how changing the recipe changed any measurements. Unfortunately, while the project's dashboard [KAI22a] still functions and the source-code [KAI22b; KAI22c] is still available, the documentation was insufficient to get the system running.

RecipeScape uses a simple JSON format for recipes, consisting chiefly of a structured title, list of ingredients and a list of sentences. In addition to

providing a computer format for recipes, it includes two sets of recipes that were collected through Web searches. The chocolate-chip cookie dataset [Cha+18a] consists of 489 recipes, though not all of them are chocolate-chip cookie recipes.

RecipeScape uses part of speech tagging, but this presents challenges for extracting information from recipes. Recipes, being instructional texts, are written in the imperative mood while most texts are written in the indicative mood. The word *whisk*, for example, could be a noun or a verb, but in a recipe it might be more likely to be a verb than in other texts. Even when the tagging is correct, it might not be sufficiently precise; a correctly tagged verb, for example, does not specify whether the verb is an action of the chef or the food, and a correctly tagged noun does not distinguish between an ingredient or a tool. Named entities, a "parts-of-speech" vocabulary for a particular domain, can help address this problem.

Recipe named entities [YMC20] is a vocabulary for describing the entities in a food recipe. Instead of having only nouns, for example, recipe named entities, or r-NEs, can describe a recipe has having foods, tools, durations and quantities. Instead of having only verbs, r-NEs can differentiate between actions by the chef and actions by the food. The complete list of r-NEs, as well as their abbreviations, is shown in Table 2.1. An entity can be made up of several words or tokens. An entity's first token is said to begin it (abbreviated

as “B”) and the subsequent tokens are said to be inside it (abbreviated as “I”). The two sets of abbreviations allow the entity “parchment paper” to concisely described as “B-T, I-T”, a tool entity consisting of two tokens. Tagged entities can be used to extract information from a recipe in order to modify it. Accumulating the entities tagged as tools, for example, can be used to display a list of tools and entities that are tagged as actions by the chef can be used to format them.

Tag	Meaning	Explanation
F	Food	Things that can be eaten or their intermediate products
T	Tool	Knife, container etc.
D	Duration	Duration of cooking
Q	Quantity	Quantity of food
Ac	Action by chef	Chef’s action
Ac2	Discontinuous Ac	Second, non-contiguous part of an action by chef
Af	Action by food	Food’s action
At	Action by tool	Tool’s action
Sf	Food state	Food’s state
St	Tool state	Tool’s state

Table 2.1: Recipe named entity (r-NE) tags [YMC20].

In addition to describing recipe named entities, Yamakata, Mori, and Carroll trained a statistical model for tagging r-NEs in a recipe. spaCy is a freely available, open-source library for natural language processing that can use the trained model. It works by taking text and applying a processing pipeline to it. A processing pipeline is a sequence of components.

While spaCy comes with builtin components, some of which provide value out-of-the-box and others which must be programmed or configured, it is also possible to write custom components and add them to the pipeline. spaCy's builtin components include ner (named entity recognition), which recognizes named entities using a trained model; entity ruler, which recognizes entities using static rules; and sentencizer, which separates a text into separate sentences. These components, along with additional custom components, can be used to modify recipes. (The complete processing pipeline for the system is shown in Figure 2.1.)

As the recipe named entities do not include temperature as a concept, temperatures must identified some other way. A temperature in a recipe is a number with an explicit or implied unit. Even when the units are explicit, there are still many ways for the units to be expressed, but a common and easy-to-recognize way is a single-letter abbreviation for Celsius or Fahrenheit, sometimes prefixed with the degree symbol. Applying this rule before named entity recognition allows the entity to be identified indivisibly, as shown in Table 2.2 using an example from Yamakata, Mori, and Carroll. Having temperature as a separate entity, rather than simply a tool state, allows temperatures to be consistently formatted regardless of how they are formatted in the unmodified recipe.

Entities	Preheat	oven	180	C	Gas	mark	4
Original r-NE	B-Ac	B-T	B-St	I-St	B-St	I-St	I-St
Modified	B-Ac	B-T	TEMP		B-St	I-St	I-St

Table 2.2: An Example Sentence with a Temperature Entity.

As the tools needed to execute a recipes are only sometimes named explicitly, there needs to be a way of identifying tools whose uses are implied. Some tools are implied by an action. If a reader is directed to whisk something, for example, a whisk is needed to accomplish the task. These implied tools can be readily identified from a list of actions mapped to a tool. A timer is implied by the existence of a duration in a recipe. Some tools, such as containers, can be identified as a special class. While containers are tools, the model does not always identify them correctly. While this could be addressed by retraining the model, identifying them outside the model has, as second advantage, a way to simplify the container for the providing a list of tools by removing unnecessary adjectives. For example, a "large baking sheet" can be described as merely a "sheet", which might be easier to understand. The named and implied tools can be accumulated to provide a list of tools needed to execute the recipe.

Additional information can extracted about the recipe by applying domain knowledge about the type of recipe. A model for describing the steps of a cookie recipe are shown in Table 2.3. If a step contains the "preheat"

action by the chef, for example, it can be identified as a preheat step; if a preheat step contains a temperature entity, it can be inferred that this is the preheat temperature. If a step contains a "bake" action to identify it as a bake step, a duration can inferred to be the baking duration.

Step Type	Description
Preheat	Preparing an oven
Mix	Combining ingredients
Containerize	To put ingredients into a container
Bake	To cook in an oven
Cool	Stopping the baking process by removing from the oven
Unknown	Steps that cannot be classified as another type

Table 2.3: Step Types.

Even though the steps of a recipe in the RecipeScape format are called sentences, some of the "sentences" in the dataset are in fact made up of several sentences. Decomposing these into "subsentences" provides an simple way to break down a step into several shorter steps. The subsentences are easier to classify by step type as they are shorter and less likely to encompass multiple types. spaCy provides two main ways of re-sentencizing, using either a dependency parser component or the previously-mentioned sentencizer component. The former would require introducing a second trained model while the latter is rule-based, being able to separate sentences based on punctuation.

Some of the processing steps use the output of other steps, so the steps

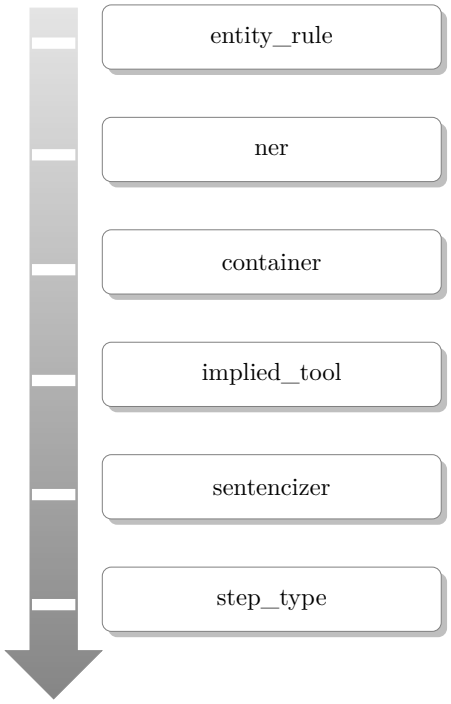

Figure 2.1: Natural Language Processing Pipeline in spaCy.

must be properly ordered. Determining the step type relies firstly on the recipe named entities tagging and secondly on the multi-sentence steps being broken into separate sentences. Identifying containers, implied tools and identifying temperatures relies on recipe named entity tagging. One possible ordering is shown in Figure 2.1.

The output of the spaCy pipeline can be used to used to extract, simplify and reformat a recipe. Information can be extracted from the recipe, for example, by displaying the preheat temperature and baking duration at the top of the recipe. The recipe can be simplified, for example, by removing

superfluous adjectives for container names. The recipe can be reformatted, for example, by using a bold font for actions.

2.3 Survey

The user study to evaluate the system must measure the reading characteristics of the participants and the characteristics of the recipes.

2.3.1 Reader Characteristics

Leroy, Kauchak, and Mouradi measured reader characteristics in three ways: questions about demographics ("age, gender, race, ethnicity, languages spoken, education level, linguistics or medical knowledge"), questions about reading habits and the S-TOFHLA (Short Test of Functional Health Literacy in Adults) [LKM13]. The latter two are not well-suited for reader characteristics for food recipes as they are about reading in a different context.

Lavelle et al. developed and validated assessments [Lav+17] for an individual's cooking and food skills using surveys. Cooking skills are the mechanical skills of cooking methods and food preparation while food skills "include the knowledge and skills to be able to select and prepare food with the available resources, to produce a nutritionally balanced, age appropriate

and satisfying meals". The surveys are intended to evaluate these skills in a home environment in order to determine both where community interventions might be needed and whether such interventions were effective.

The original assessments were designed for two different presentation methods: computer-assisted personal interviews and traditional pen-and-paper. For the personal-interviews presentation, the participants were first asked if they used a skill and then, "On a scale from 1 to 7 where 1 means very poor and 7 means very good, please say how good are you at…", which requires the participant to make a value judgment. The cooking skill survey consists of 14 questions while the food skills survey consists of 19 questions. One question in the food skills assessment, "How often do you prepare or cook a healthy meal with a few ingredients on hand?", requires the participant to make several value judgments as to what is a healthy and how many ingredients is only a few. As the survey were developed in Ireland, some of the word choices, such as *tinned*, are more common in Hiberno-English than in American English.

While the cooking skills survey asks the participant about recipe use, "How often do you follow recipes when preparing food?" and "How often do you cook more or double recipes which can be used for another meal?", neither the cooking skills nor the food skill survey ask the participant about general demographic information, general reading skills or disabilities than

affect reading comprehension. While the participant could be ask about these specifically, this would require self-identification of sensitive information, potentially limiting the audience of the survey. Additionally, the level of disability would need to be compared. As one of the goals for the system for modifying recipes is a universal design, this is not desired. An alternative to asking about reading disabilities is to ask about something that might, at least occasionally, happen to anyone reading a recipe: how often the participant re-reads a recipe, either from the beginning to find the current step or a single step several times.

2.3.2 Recipe Evaluation

The parts of a recipe only have meaning when taken as a whole, which complicates evaluating perceived reading comprehension, even if non-textual elements common to recipes, such as photographs, are ignored; the ingredient list does not have meaning without the procedure and the procedure is not (always) useful without the ingredient list. While local coherence between steps is important, the Likert-scale questions used by Leroy, Kauchak, and Mouradi for comparing modified and modified sentences used sentences in isolation from the larger text. Recipes rely more on context. Additionally, as stated before, a reader might use non-textual elements for evaluating a recipe's perceived difficulty.

Actual reading comprehension can be assessed by using a multiple-choice questions for recipes with and without modifications. Assessing whether modifying the recipe changes actual reading comprehension is complicated by the fact that the chosen recipes might not be of comparable difficulty to begin with; if the modifications influence reading comprehension, any differences in responses to the test should be because of the modifications. Instead of having the same participant evaluate different recipes with and without the modification, different participants can evaluate the same recipe, with half of them evaluating a modified modified recipe and the other half the same recipe unmodified. The reader characteristics, the results of the cooking and food skills surveys, can be used to compare the two groups.

The evaluated recipes must illustrate the modifications the system makes. As the proposed modifications aim to improve global coherency, each change does not need to be evaluated individually, though having the system make all of the modifications does complicate determining whether any given modification is helpful. The proposed solution is to add the baking temperature to the top of the recipe, to add the baking temperature to the top of the recipe, and to make several modifications to the recipe's procedures. A single recipe can be chosen for each of these aspects:

1. the baking temperature is listed only the later in the steps
2. the baking duration is listed only later in of the steps

3. the action by the chef is at the the beginning of the sentence (to help with scanning) and could be replaced with a synonym

3 Methods

3.1 Dataset and System for Modifying Recipes

RecipeScape's "Chocolate Chip Cookie" dataset of recipes in JSON format [Cha+18a] was selected and, from this dataset, a further selection of three recipes, "World Peace Cookies", "Oatmeal, Chocolate Chip, and Pecan Cookies" and "Belgian Spice Cookies", made to highlight different aspects of the software system. The JSON fields in the dataset that are used are the title of the recipe, the list of ingredients and the list of "sentences".

A system for modifying recipes was implemented using version 3.9.5 of the Python programming language and spaCy 3.0.6. The Python requirements file is shown in Appendix C. The spaCy model was trained with the recipe named entity data [YMC20], which was converted to spaCy's format using its iob converter. The system, as shown in Figure 3.1, has three main phases of execution: parsing the recipe dataset, applying the spaCy pipeline and

Figure 3.1: High-level Overview of System Execution.

formatting the output.

The system parses the recipe dataset from JSON into Python objects using the dataclass-json package [lid]. The classes for the objects are POPOs, plain old Python objects, that match the fields in the recipe dataset.

```
__PATTERN = [{'LIKE_NUM': True},
            {'LOWER': {'IN': ['degree', '°']}, "OP": "?"},
            {'LOWER': {'IN': ['f', 'c']}}]
```

Listing 3.1: Pattern-matching for Temperatures (TEMP).

The system then applies the spaCy pipeline, as shown in Figure 2.1, creating and adding information to spaCy objects. The first two components, both of which are built-in spaCy components, define ner entities. The entity_rule component is configured to identify temperatures. As shown in Listing 3.1, a temperature is a number token followed by either Fahrenheit or Celsius units. The ner component applies the trained spaCy model.

The container component uses tokens that were identified by the ner component as tools and a list of containers, shown in Listing 3.2, to further identify tools as containers.

```
__CONTAINER_WORDS = ['bowl',
                     'bowls',
                     'dish',
                     'dishes',
                     'kettle',
                     'kettles',
                     'pan',
                     'pans'
                     'pot',
```

```
                    'pots',
                    'sheet',
                    'sheets',
                    'wok',
                    'woks']

__CORRECTION_PATTERN = [{'LOWER': {'IN': ['large']}, 'OP': '?'},
                        {'LOWER': {'IN': ['baking',
                                          'prepared']}},
                        {'LOWER': {'IN': __CONTAINER_WORDS}}]
```

Listing 3.2: Pattern-matching for Containers.

The implied_tool component uses tokens that were identified by the ner component as actions or durations to add to the set of tools. The mapping of action to tool is shown in Listing 3.3. The implication of a timer, which is not shown in the figure, is determined by the existence of any duration entity.

```
__ACTIVITY_IMPLICATIONS = [(['beat'], 'beater'),
                           (['bake'], 'oven'),
                           (['sift'], 'sifter')]
```

Listing 3.3: Actions Implying Use of a Tool.

The sentencizer component, which is built-in to spaCy, is used to separate steps that contain multiple sentences in separate substeps. Its configuration is shown in Listing 3.4.

```
config = {'punct_chars': ['.', ';', '?', '!']}
```

Listing 3.4: Configuration for the sentencizer Component.

The final component in the spaCy pipeline, step_type, uses the output

of the ner component to classify a recipe step by one of five types: preheat, mix, containerize, bake or cool. As shown in Listing 3.5, a step's type is determined by matching an activity entity to a list of words for each type. Descriptions of the step types are shown in Table 2.3.

```
def __get_pattern(lower: list[str]):
    return [{'ENT_TYPE': EntityType.Activity.value,
             'LOWER': {'IN': lower}}]

matcher = Matcher(nlp.vocab)

def __add_pattern(step_type: StepType,
                  lower: list[str]):
    add_words_to_vocab(nlp, lower)
    matcher.add(step_type.value, [__get_pattern(lower)])

__add_pattern(StepType.Preheat, ['preheat'])
__add_pattern(StepType.Mix, ['mix',
                             'combine',
                             'add',
                             'stir',
                             'whisk',
                             'spoon',
                             'beat',
                             'pulse',
                             'drizzle',
                             'fold',
                             'sift',
                             'beat'])
__add_pattern(StepType.Containerize, ['drop',
                                      'place'])
__add_pattern(StepType.Bake, ['bake'])
__add_pattern(StepType.Cool, ['cool',
                              'remove',
                              'stand',
                              'chill'])
```

Listing 3.5: Step-type Matcher.

Finally, the system formats the recipes for output in HTML and CSS. The formatter accepts parameters to the control the output: whether multiple sentences in a step should be displayed as sub-steps; whether gathering the tools, either named or inferred from actions in the recipe steps, should be added as the first step of the recipe; and whether the actions should be in bold typeface.

The system was applied to the chosen recipes from the dataset, outputting them both with and without the modifications.

3.2 Survey

The system was evaluated by means of a online user survey. The survey, which was implemented using the Web-based Qualtrics XM software [Qua22], consists of five parts:

1. Informed consent
2. Questions about how the participant prepares food
3. Questions about the participant's food skills
4. Questions about the the participant's use of recipes
5. Evaluations of recipe formatting

The survey is shown in full in Appendix B.

A hidden timer on each page of the survey to capture the time it took the

participant to first click on the page, the time of the last click on the page, the time it took for the page to be submitted and the number of clicks on the page. The participant's Web browser and other technical information is captured by a hidden question on the first page.

After obtaining consent to participate in the survey, the participant is asked to identify whether they use a stovetop, an oven or a microwave for cooking; if none of these are used, the participant is asked to name what they do use to prepare food. Additionally, the participant is asked whether how often they are the preparer of food in their household.

The survey evaluates the participant's cooking and food skills by using a modified version of the survey created by Lavelle et al. [Lav+17]. The questions were rephrased to be in the form of "How often do you..." with the possible answers of "Never", "Sometimes", "About half the time", "Most of the time" and "Always". The question "How often do you prepare or cook a healthy meal with a few ingredients on hand?" was substituted with "How often do you prepare or cook a meal with five or fewer ingredients?" Words were also changed to use use American English, such as by changing *tinned* to *canned*.

For the questions about recipe use, the participant is asked whether each of these statements does not describe them, describes them slightly well, describes them moderately well, describes them very well or describes them

extremely well:

1. I use recipes when I prepare food.
2. When I read a recipe, I often re-read a single step several times before starting that step.
3. While cooking, I often re-read the steps of a recipe from the beginning to find the current step.
4. I sometimes forget to add ingredients to a dish, even though it was in the recipe.

For the final part of the survey, the participants are randomly to assigned to one of two groups. While one group evaluates unmodified recipes and the other group evaluates modified recipes, the recipes and questions are otherwise the same. The recipes are displayed one at a time. After viewing the recipe, the participant moves to the next screen to answer a question. The participant is allowed to move between the recipe and the question/answer page as many times as desired and there is instructional page before the first recipe page to tell them that "[if they] don't remember the answer to a question, **[they] can go back to re-read the recipe**".

The survey uses three recipes from RecipeScape's chocolate-chip cookie dataset [Cha+18a], the "World Peace Cookies" recipe, the "Oatmeal, Chocolate Chip, and Pecan Cookies" recipe and the "Belgian Spice Cookies" recipe. For each of these recipes respectively, the participant is asked:

1. What was the baking temperature, in degrees Fahrenheit (°F)?
2. How many minutes does the recipe say to bake the cookies?
3. Fill in the missing word: _____ in the oats, pecans, orange zest, and chocolate chips. (Add, Mix, Stir)

The survey and research plan was submitted to the institutional review board. After the plan was approved, the students taking a course taught by the thesis advisor were invited to take the survey via a posting on the course's online portal. As an incentive for taking the survey, the students were offered extra credit in the course. If they did want to take the survey, the student could have instead obtained an equivalent amount of extra credit by completing a homework assignment similar to their existing coursework.

4 Results

The results include the recipes that were modified for the survey, as well as the results of the survey itself.

4.1 Modified Recipes

An unmodified recipe, "Belgian Spice Cookies", is shown in Figure 4.1 and the same recipe with modifications is shown in Figure 4.2. The modified and unmodified "World Peace Cookies" and "Oatmeal, Chocolate Chip, and Pecan Cookies" recipes are shown in Appendix B as part of the survey.

4.2 Survey

There are 15 survey responses in total from the class of 25 students. The control group, consisting of individuals who saw unmodified recipes, consists of seven responses. The experimental group, consisting of individuals who saw modified recipes, consists of eight responses. All of the control group used a desktop device; for the experimental group, a single participant used a mobile device while the rest of the group used a desktop device.

Belgian Spice Cookies

Ingredients

- 2 cups all purpose flour
- 1 tablespoon ground cinnamon
- 1 1/2 teaspoons ground ginger
- 1/2 teaspoon ground cloves
- 1/2 teaspoon baking powder
- 1/2 teaspoon salt
- 1 1/4 cups (packed) dark brown sugar
- 1/2 cup (1 stick) unsalted butter, room temperature
- 1 large egg
- 2 ounces good-quality white chocolate (such as Lindt or Baker's), melted
- Red colored sugar

Procedure

1. Combine first 6 ingredients in medium bowl.
2. Using electric mixer, beat brown sugar and butter in large bowl until light.
3. Add egg and beat until fluffy.
4. Gradually add dry ingredients and beat just until combined.
5. Divide dough in half.
6. Flatten each half into rectangle.
7. Wrap with plastic; chill 1 hour.
8. Preheat oven to 350°F. Lightly butter 2 large baking sheets.
9. Roll out 1 dough piece on lightly floured work surface to 13 x 9-inch rectangle.
10. Trim edges to form 12x8-inch rectangle.
11. Cut into 24 4x1-inch rectangles.
12. Lightly press miniature cookie cutter into each rectangle to make imprints (do not cut through dough).
13. Arrange cookies on prepared baking sheets, spacing 1 inch apart.
14. Bake until edges begin to darken, about 8 minutes.
15. Transfer cookies to rack and cool.
16. Repeat with remaining dough piece.
17. Working with 1 cookie at a time, brush imprints with melted white chocolate.
18. Sprinkle colored sugar generously over chocolate.
19. Let stand until chocolate sets, about 2 hours.
20. Shake off excess colored sugar.
21. (Can be made ahead.
22. Store in airtight container at room temperature up to 1 week, or freeze up to 1 month.)

Figure 4.1: “Belgian Spice Cookies” without any Modifications by the System.

Belgian Spice Cookies

Preheat:

- 350°F

Bake duration:

- about 8 minutes

Ingredients

- 2 cups all purpose flour
- 1 tablespoon ground cinnamon
- 1 1/2 teaspoons ground ginger
- 1/2 teaspoon ground cloves
- 1/2 teaspoon baking powder
- 1/2 teaspoon salt
- 1 1/4 cups (packed) dark brown sugar
- 1/2 cup (1 stick) unsalted butter, room temperature
- 1 large egg
- 2 ounces good-quality white chocolate (such as Lindt or Baker's), melted
- Red colored sugar

Procedure

1. **Gather** what is needed
    - **Gather** tools
        - beater
        - timer
        - baker
        - freeze
        - oven
        - sheets
        - bowl
        - container
        - rectangle
    - **Gather** ingredients
2. **Combine** first 6 ingredients in medium bowl.
3. Using electric mixer, **beat brown** sugar and butter in large bowl until light.
4. **Add** egg and **beat** until fluffy.
5. Gradually **add** dry ingredients and **beat** just until combined.
6. **Divide** dough in half.
7. **Flatten** each half into rectangle.
8. a. **Wrap** with plastic;
   b. chill 1 hour.
9. a. **Preheat** oven to 350°F.
   b. Lightly butter 2 large baking sheets.
10. **Roll out** 1 dough piece on lightly floured work **surface** to 13 x 9-inch rectangle.
11. **Trim** edges to form 12x8-inch rectangle.
12. **Cut** into 24 4x1-inch rectangles.
13. Lightly **press** miniature cookie cutter into each rectangle to make imprints (do not cut through dough).
14. **Arrange** cookies on **prepared** baking sheets, **spacing** 1 inch apart.
15. **Bake** until edges begin to darken, about 8 minutes.
16. **Transfer** cookies to rack and **cool**.
17. **Repeat** with remaining dough piece.
18. **Working** with 1 cookie at a time, brush imprints with **melted** white chocolate.
19. **Sprinkle** colored sugar generously over chocolate.
20. **Let** stand until chocolate sets, about 2 hours.
21. **Shake off** excess colored sugar.
22. (Can be made ahead.
23. **Store** in airtight container at room temperature up to 1 week, or freeze up to 1 month.)

Figure 4.2: “Belgian Spice Cookies” as Modified by the System.

4.2.1 Reader Characteristics

Cooking and Food Skills

The cooking methods for the participants under both conditions are shown in Figure 4.15. All of the participants said they use at least one of the three methods.

The primary preparer of food in the participants' households under both conditions is shown in Figure 4.16. All of the participants said they are either the primary or occasional preparer of food.

The scoring of individual answers for the cooking and food skill surveys are shown in Table 4.1. The score for each of the two skills is computed by summing the score of the individual answers.

Answer	Value
Never	0
Sometimes	1
About half the time	2
Most of the time	3
Always	4

Table 4.1: Scoring of Answers for Cooking and Food Skills.

The distributions of cooking skills scores under both conditions are shown in Figure 4.3 and Table 4.2. The lowest possible score is zero and the highest possible score is 56. The responses to the question, "How often do you follow recipes when preparing food?", under both conditions are shown in Figure

4.4. (The responses to a similar prompt are shown in Figure 4.6.)

Group	Median	Average	Std. Dev.	Min.	Max.
Control	28	27.9	6.9	20	40
Experimental	27	27.1	4.7	12	36

Table 4.2: Summary of Cooking Skill Scores.

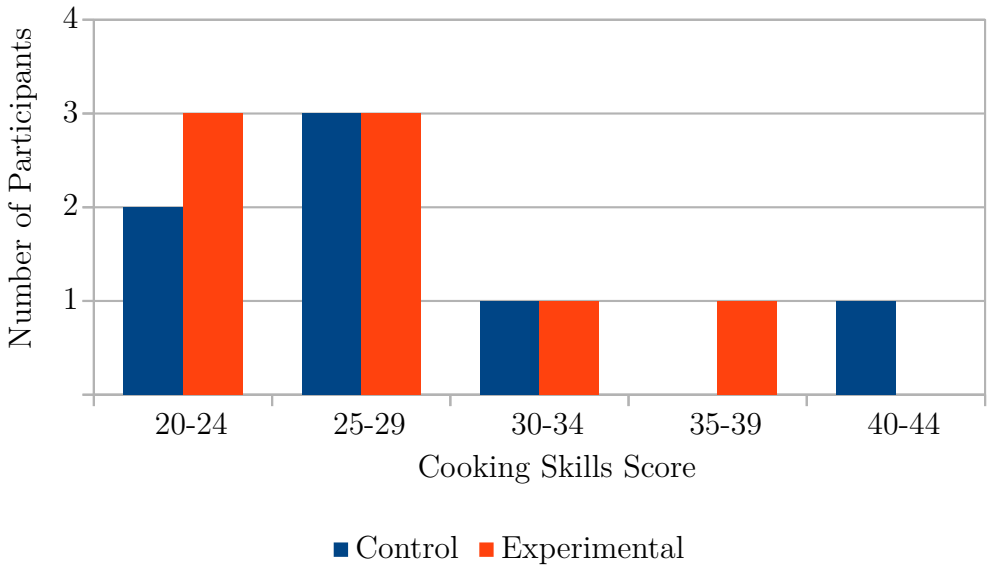

Figure 4.3: Number of Participants versus Cooking Skills Score.

The distributions of food skills scores under both conditions are shown in Figure 4.5 and Table 4.3. The lowest possible score is zero and the highest possible score is 60.

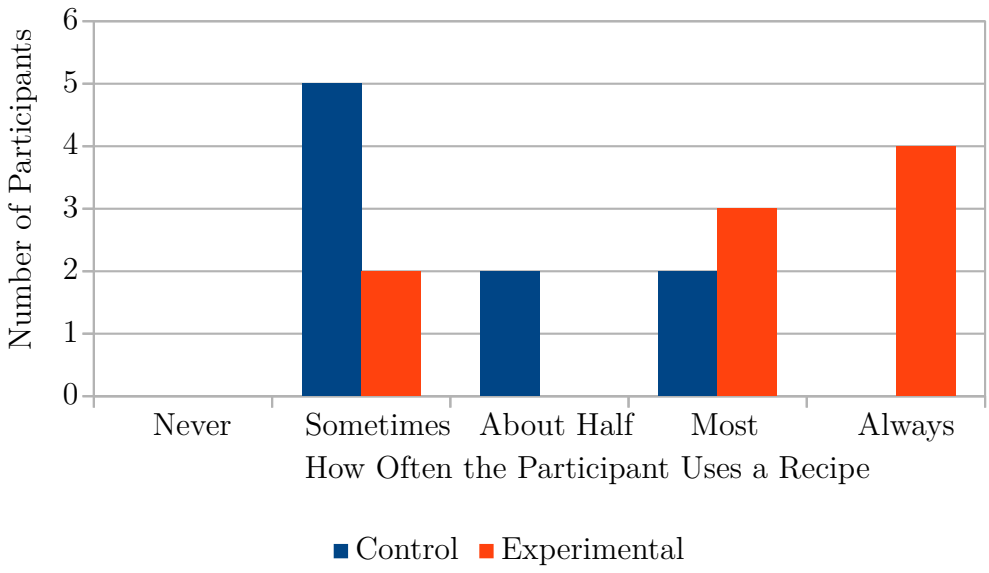

Figure 4.4: Number of Participants versus Use Recipes (Frequency).

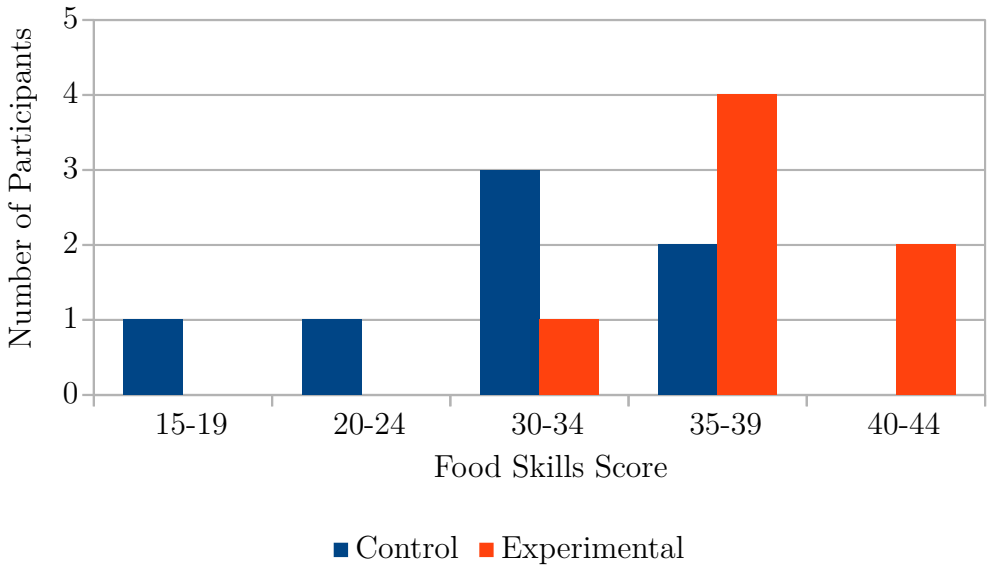

Figure 4.5: Number of Participants versus Food Skills Score.

Group	Median	Average	Std. Dev.	Min.	Max.
Control	33	30.9	8.0	17	39
Experimental	38	38.0	4.1	32	45

Table 4.3: Summary of Food Skill Scores.

Recipe Use

For both conditions, the answers to the statement, "I use recipes when I prepare food", are shown in Figure 4.6; the answers to the statement, "When I read a recipe, I often re-read a single step several times before starting that step" are shown in Figure 4.7; and the answers to the statement, "While cooking, I often re-read the steps of a recipe from the beginning to find the current step", are shown in Figure 4.8.

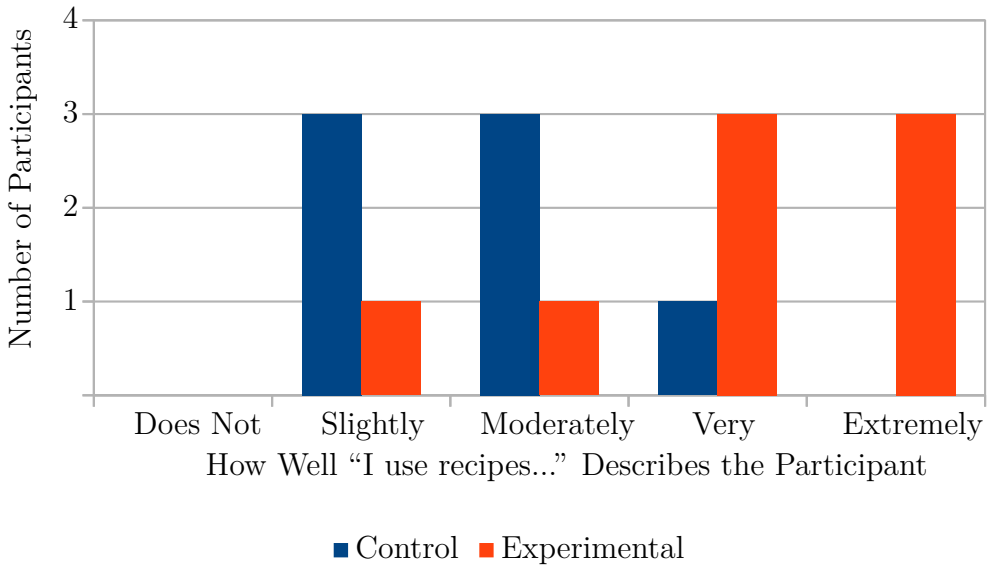

Figure 4.6: Number of Participants versus Use Recipes (Descriptor).

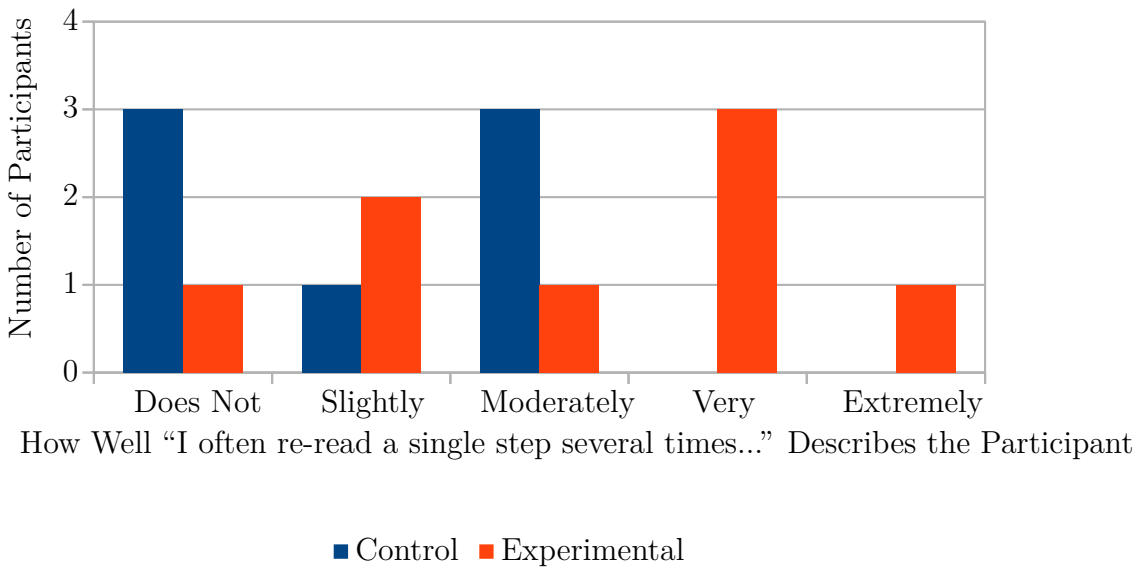

Figure 4.7: Number of Participants versus Re-reading Single Steps.

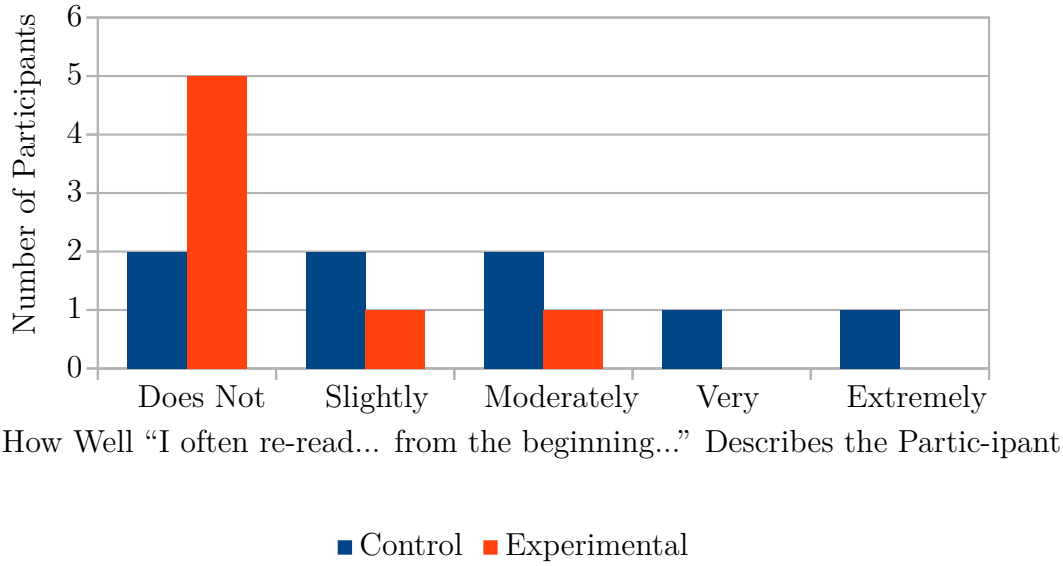

Figure 4.8: Number of Participants versus Re-read Steps from the Beginning.

4.2.2 Recipe Evaluation

For the "World Peace Cookies" recipe, the distribution under both conditions are shown in Figure 4.9 for the durations and Figure 4.10 for the click counts; every participant correctly answered the baking temperature for the recipe. For the "Oatmeal, Chocolate Chip, and Pecan Cookies" recipe, the distribution under both conditions are shown in Figure 4.11 for the durations and Figure 4.12 for the click counts; in the control group, one participant incorrectly selected the action that was in the recipe step while all other participants correctly selected the action that was in the recipe step. For the "Belgian Spice Cookies" recipe, the distribution under both conditions are shown in Figure 4.13 for the durations and Figure 4.14 for the click counts; every participant correctly answered the correct baking duration for the recipe.

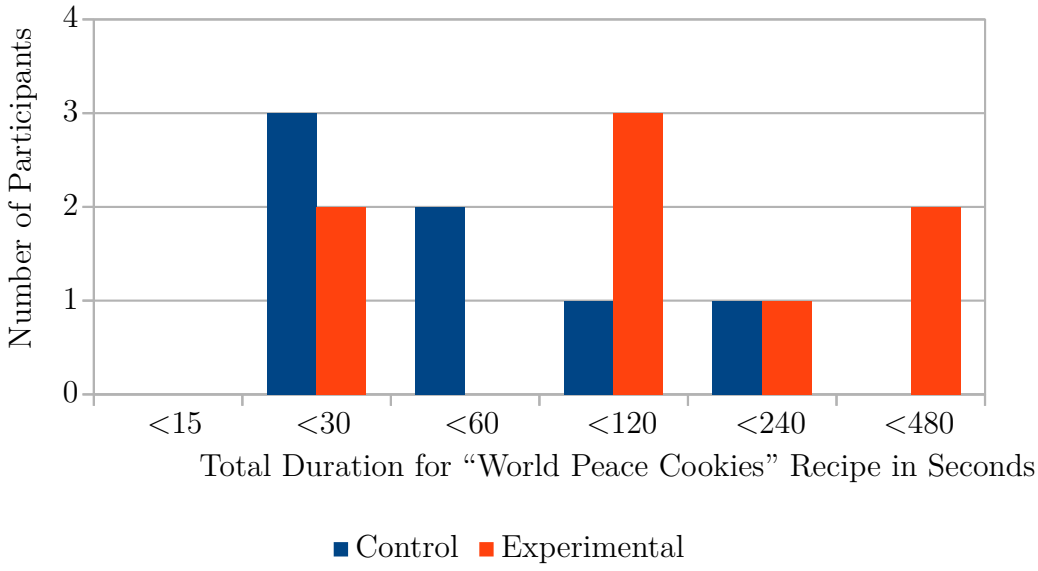

Figure 4.9: Number of Participants versus Total Duration for the “World Peace Cookies” Recipe.

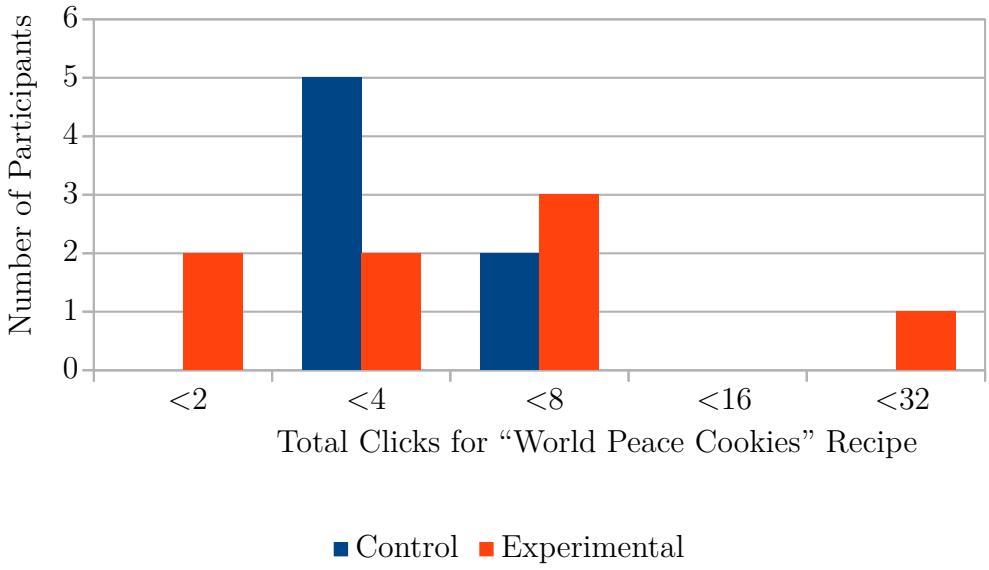

Figure 4.10: Number of Participants versus Number of Total Clicks for the “World Peace Cookies” Recipe.

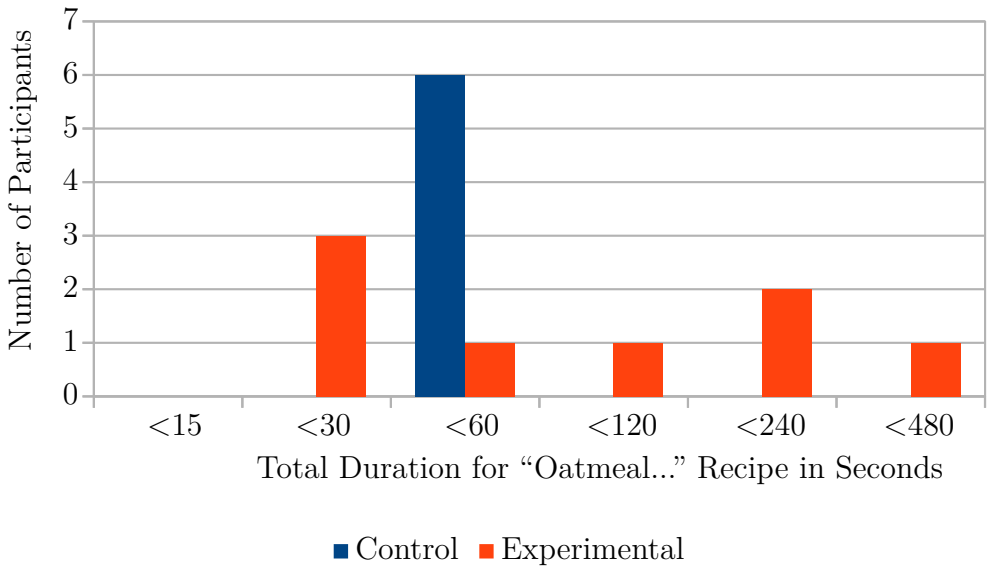

Figure 4.11: Number of Participants versus Total Duration for the “Oatmeal, Chocolate Chip, and Pecan Cookies” Recipe.

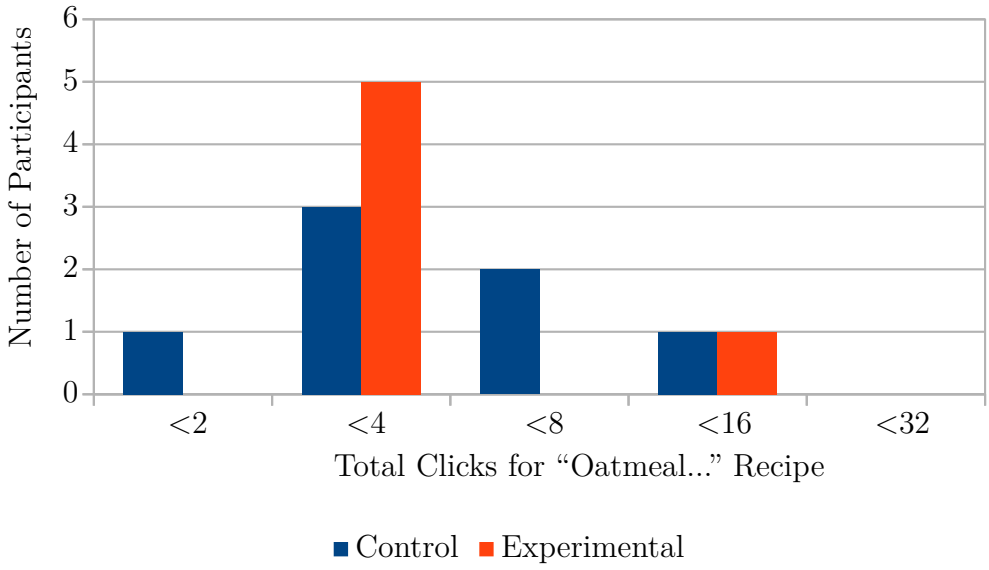

Figure 4.12: Number of Participants versus Number of Total Clicks for the “Oatmeal, Chocolate Chip, and Pecan Cookies” Recipe.

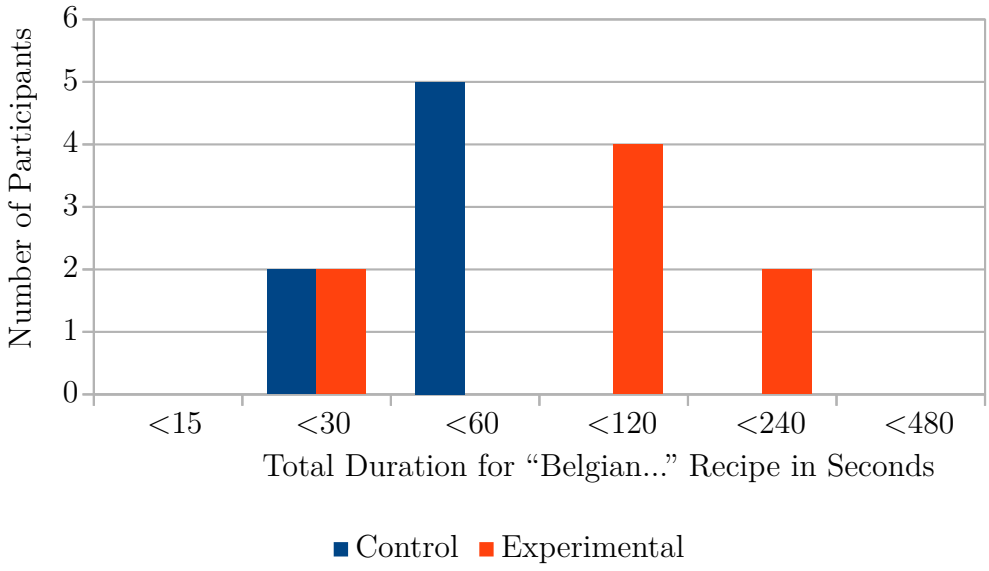

Figure 4.13: Number of Participants versus Total Duration for the “Belgian Spice Cookies” Recipe.

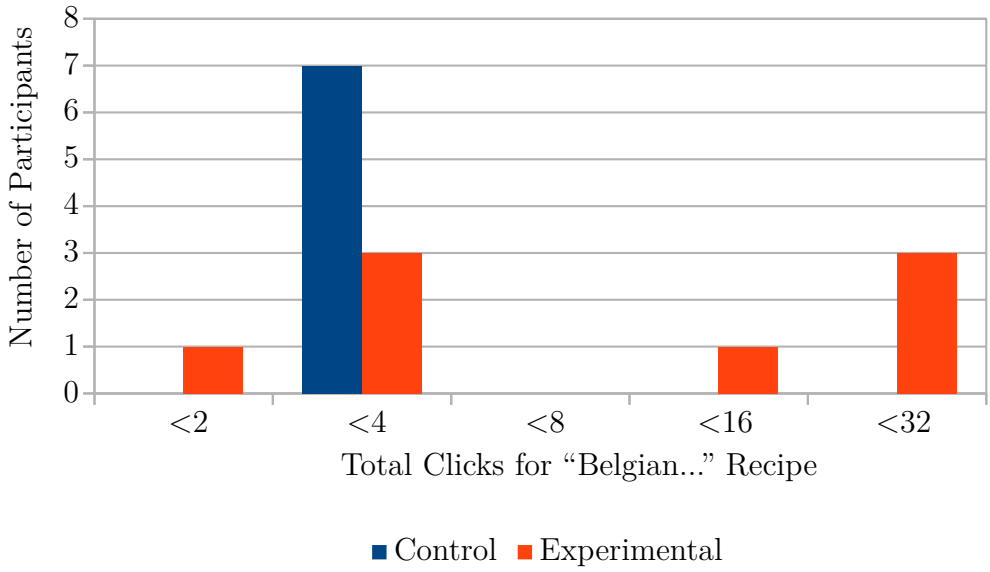

Figure 4.14: Number of Participants versus Number of Total Clicks for the “Belgian Spice Cookies” Recipe.

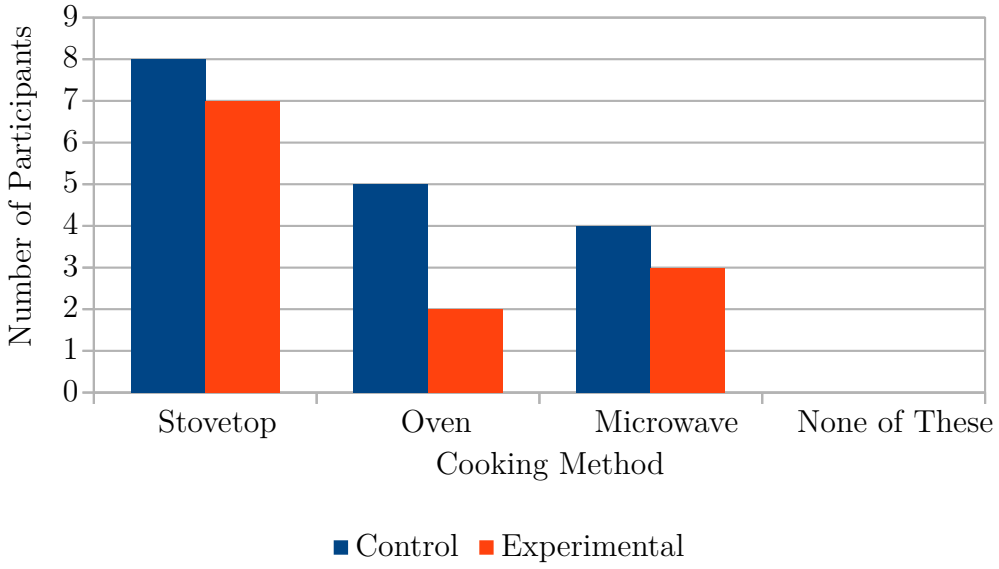

Figure 4.15: Number of Participants versus Cooking Method.

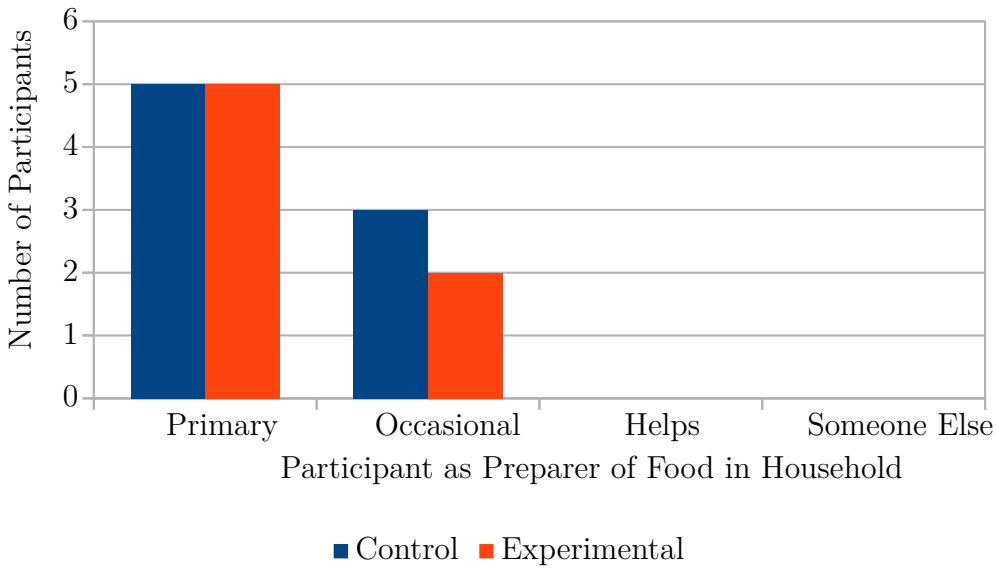

Figure 4.16: Number of Participants versus Participant as Preparer of Food in Household.

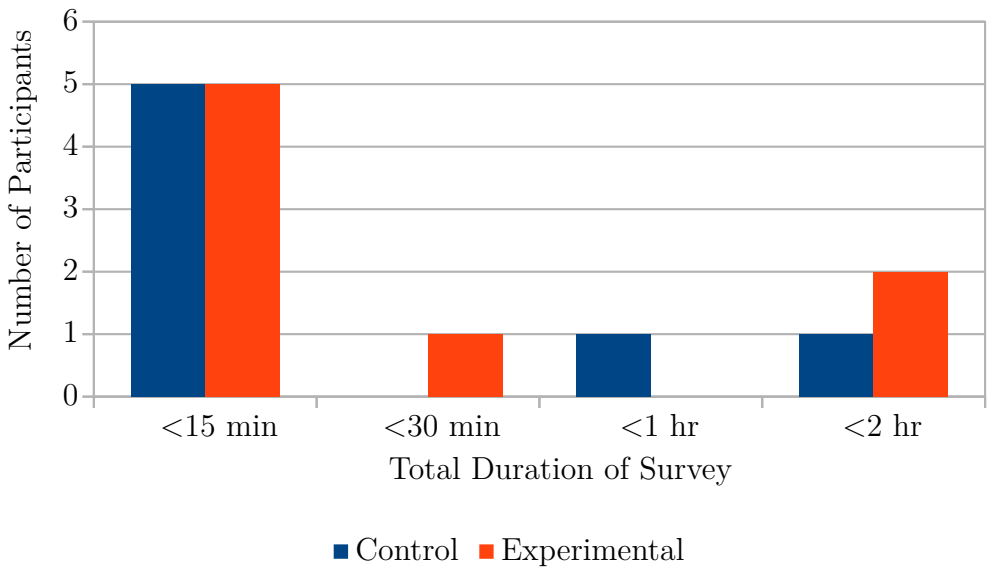

Figure 4.17: Number of Participants versus Total Duration of Survey.

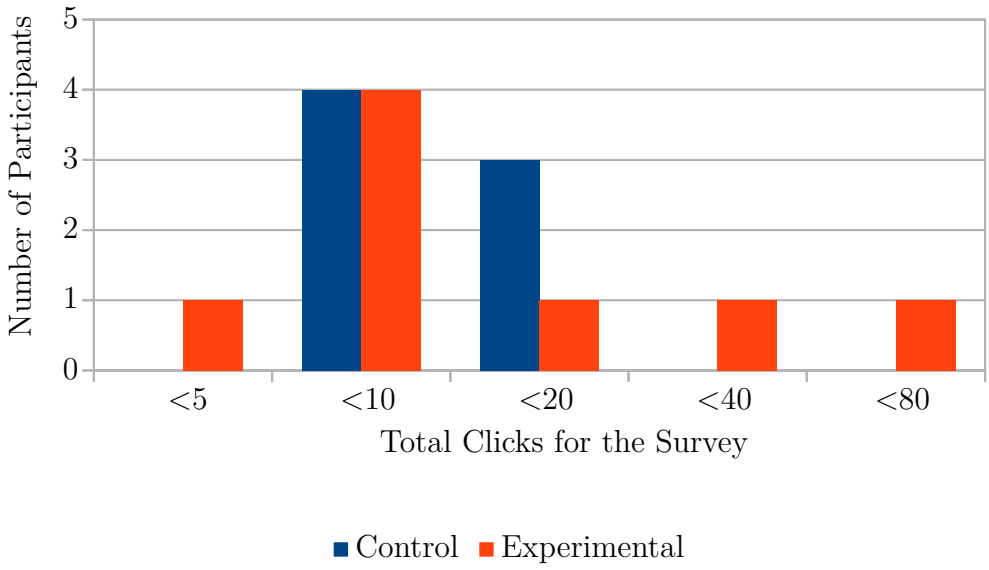

Figure 4.18: Number of Participants versus Total Clicks of Survey.

5 Discussion

For the selected recipes, the modifications by the system partially achieve the goal of identifying tools the chef needs and the actions the chef needs to take. The preheat temperature and baking duration were correctly identified and multi-sentence steps were broken apart, though the recipes were specifically selected for this.

The members of experimental group, viewing the modified recipes, answered the questions about the recipe more accurately, which was expected, but they did not do so more quickly, which was not expected.

5.1 Modified Recipes

The hand-modified version of the "Belgian Spice Cookies" recipe (Figure 4.2) varies in several ways from the system-modified version of the recipe (Figure 1.1). Not all the entities—tools and actions particularly—were correctly identified by the system. For the tools, this results in tools that are missing and non-tools that were added to the lists of the tools. For the actions, this results in actions not being bolded and non-actions being bolded.

As shown in Table 5.1, the "Belgian Spice Cookies" recipe has 11 tools: six which are named, five of which are implied, and one which is both named

and implied (the "wrap" in "plastic wrap" is implied by an action in the recipe while "plastic" is a tool). The system identified three of the four named tools and three of the five implied tools, but did not identify the tool that was both named and implied. Three entities were misidentified as tools.

Entity	Tool	Identified as Tool	Named or Implied
large baking sheets	Yes	Yes	Named
bowl	Yes	Yes	Named
container	Yes	Yes	Named
beater	Yes	Yes	Implied
oven	Yes	Yes	Implied
timer	Yes	Yes	Implied
cooling rack	Yes	No	Named
knife	Yes	No	Implied
miniature cookie cutter	Yes	No	Implied
oven mitts	Yes	No	Implied
plastic wrap	Yes	No	Both
baker	No	Yes	
freeze	No	Yes	
rectangle	No	Yes	

Table 5.1: Tools Identified, Missed and Misidentified for the "Belgian Spice Cookies" Recipe.

As shown in Table 5.2, the "Belgian Spice Cookies" recipe has 27 actions by the chef. (As "Gather" is added to the recipe by the system and not identified by the model, it is not shown in the table.) Of these, 21 were correctly identified by the system and two were partially identified ("beat brown" instead of "beat" and "Let" instead of "Let stand"). In addition to

four actions being missed, five entities were incorrectly identified as actions by the chef.

The hand-modified versions of the "World Peace Cookies" and "Oatmeal, Chocolate Chip, and Pecan Cookies", as well as the tools and actions in them identified by the system, are shown in Appendix A. A summary of the tools identified, missed and missed for the three recipes is shown in Table 5.3 and a summary of the actions identified, missed and missed for the three recipes is shown in Table 5.4. For all three recipe, some entities were missed, not correctly identified as a tool or action when they should have been, and some entities were missed, identified as a tool or action when the should *not* have been.

At least half of the named tools were identified for each recipe while at most half of the implied tools were identified for each recipe. It is not surprising that the named tools were more frequently identified correctly, as the mappings for implied tools is very short. Where a tool could be counted as named or implied, it was counted in the tables as named. In the "Belgian Spice Cookies" recipe, for example, "plastic wrap" tool is counted as named-only tool. In the "World Peace Cookies" recipe, some tools were identified multiple times; "parchment" and "Slipat", for example, are alternatives of each other while the "mixer" was identified as a named tool and "beater" as an implied tool.

5.2 Survey

The members of the experimental group reported that they use recipes more often than the members of the control group (Figures 4.4 and 4.6). Both groups had similar cooking skill scores (Figure 4.3) while the members of the experimental group had higher food skills scores (Figure 4.5). The members of the both the experimental and control groups answered the questions about the recipes similarly, with only one participant in the control group incorrectly answering a single question.

There are several limitations related to the survey, both in its design and how it was conducted. The survey was originally intended to be taken by a larger, potentially more general audience, making it difficult to draw any conclusions from the results of the survey. Besides the questions of the survey, the two other measures, click count and timing, do not seem to be useful. An in-person survey may make it feasible to ask the participants to complete more complicated tasks.

Prior to evaluating the system with thesis advisor's students, the survey was originally distributed on social media, first on a closed Facebook group and then on a public Reddit subreddit. As an incentive, participants could choose to have a donation made from a list of pre-selected public charities or a $5 gift-card to Amazon.com. After the survey was posted to Reddit,

unfortunately, the results were inundated with bots. These results were discarded as it was not possible to distinguish genuine responses from fraudulent responses. As the institution's subscription for the survey software did not include its anti-fraud features, the survey was repeated as much more limited closed pilot.

The click count, as implemented by the survey software, is not a useful measure. Some participants, for example, had only five clicks, which is far fewer than there are pages in the survey. It is not clear what it is counting. This unclearness is compounded by differences between desktop and mobile use. An improved survey would implement a better way of determining and how many times the participant went back to re-read a recipe.

Based on pilot testing, the survey was expected to take ten minutes or less but only ten of the 15 participants completed the survey in less than fifteen minutes, with three taking more than one hour. The survey software was configured to allow a participant to close the survey and re-open it in the same browser. For timing data to be useful, steps should be taken to ensure that the survey was taken in one sitting. Alternatively, the evaluations of the could be done first, which would follow more closely what was done by Leroy, Kauchak, and Mouradi.

The members of the control group answered the individual questions about the recipes in less than 480 seconds while all the members of the

experimental group answered the questions about the recipe in less than 240 seconds (Figures 4.9, 4.11 and 4.13). In general, the members of the control group answered the questions more quickly. This was not expected as the the food skills of the experimental group were higher and it was expected that modified recipes would be read more quickly. In retrospect, this might not have been a good assumption as the modified recipes are invariably longer due to the list of tools. A future survey might first inform the participant of the question on one page and then have the participant view the recipe and answer the question on a second page. The hypothesis for this revised design would still be that participants viewing modified recipes would answer the question more quickly with the assumption that they would scan the recipe for the answer instead of spending an arbitrary amount of time reading it without knowing what they are going to be asked about.

5.3 Future Work

5.3.1 User Interaction

The system would be more useful if it was easier to input and select recipes for formatting and easier to use the output. Recipes could be entered with an interactive user interface, for example, either as structured data or using document segmentation to identify the parts of the recipe. The system's

HTML output is suitable for display on a wide variety of devices, but a mobile application would allow a user to more easily to select a recipe for use in a kitchen-setting.

Allowing users to update the output themselves would allow them to make the modified recipe more useful without having to update the processing pipeline. Collecting the modifications would provide data to improve the system. User-directed modifications could include the ability to:

- Mark and unmark words as actions
- Add, remove, edit and reorder ingredients
- Edit prefatory information, such as the baking temperature and duration
- Replace terms with other, more preferred terms

The system could also do more to automate the last step.

5.3.2 Improve Existing Features

The existing core of the system could be improved by training the named entity model with a additional recipes. The spaCy components that are rule-based could have their rules expanded or be replaced by models.

5.3.3 Evaluation of Recipes and other Areas of Recipe Modification

It is difficult to evaluate the efficacy of the system's modifications using user surveys. It would be convenient if it there were measures of a recipe's complexity that could be automatically computed. As mentioned before, RecipeScape [Cha+18b] generates a tree of the verbs and nouns. The recipe named entities developed by Yamakata, Mori, and Carroll were extended to be used in a graph as well [YMC20]. Such a model would allow measuring modifications that, in particular, affect the recipe's structure.

A tree of a recipe's structure could also be used as a tool for reducing cognitive load by finding and elucidating links between parts of a recipe. The first step of the (unmodified) "Belgian Spice Cookies" recipe, for example, is to "combine [the] first 6 ingredients in [a] medium bowl", requiring the reader to either remember what those ingredients are or refer to the ingredient list. The system could either list those ingredients where they need to be referenced or, in an interactive system, provide a pop-up. The fourth step of the same recipe tells the user to "gradually add dry ingredients" without specifying what those ingredients are. In this case, the reader is unable to rely on memorization as to whether a ingredient is dry or not, as this information is not even in the recipe. There can also be actions that provide links between steps, which the action being implied by a previous step. In the

"World Peace Cookies" recipe, beating with an electric mixer starts in the second step, continues in the third step as additional ingredients are added, and concludes with the fourth step after even more ingredients are added. While this particular recipe includes the action in every step, the continuous action could be added to the text if it were missing. Steps could also be more radically restructured to emphasize that the action is continuous and the tool is unchanged. What is three steps in the "World Peace Cookies" recipe:

1. Using electric mixer, beat butter in large bowl until smooth but not fluffy.
2. Add both sugars, vanilla, and sea salt; beat until fluffy, about 2 minutes.
3. Add flour mixture; beat just until blended (mixture may be crumbly).

can be restructured to a single step with three substeps:

1. Beat using an electric mixer:
    (a) Starting with the butter in large bowl; until smooth but not fluffy.
    (b) Adding both sugars, vanilla, and sea salt; until fluffy, about 2 minutes.
    (c) Adding flour mixture; just until blended (mixture may be crumbly).

The measures for recipe difficulty could be compared to evaluations done by experts, perhaps using existing checklists. The checklist developed by

writing and evaluating recipes for "audiences with limited resources" [RS02], for example, suggests characteristics of a recipe can be evaluated. Some of these relate to the system's existing features; if a recipe mentions the action "baking" or the tool "oven" but does not mention the baking temperature or duration, for example, perhaps the recipe has a high reading difficulty or perhaps the system could be modified to identify concepts that it could not previously. Some of the checklist items also suggests ways a recipe, in addition to being evaluated, could also be modified. The system currently only uses the recipe's procedure. By using both the list of ingredients and the procedure, the system could verify that all the ingredients are listed and in the correct order, suggesting and re-ordering ingredients as needed.

Action in Recipe	Identified by System	Note (If not Correctly Identified)
Combine	Combine	
	Using	Misidentified
beat	beat	
Add	Add	
beat	beat	
add	add	
beat	beat	
Divide	Divide	
Flatten	Flatten	
Wrap		Missed
chill		Missed
Preheat	Preheat	
butter	butter	
Rollout	Rollout	
	surface	Misidentified
Trim	Trim	
Cut	Cut	
press	press	
Arrange	Arrange	
	prepared	Misidentified
	spacing	Misidentified
Bake	Bake	
Transfer	Transfer	
cool	cool	
Repeat	Repeat	
brush	melted	
Sprinkle	Sprinkle	
Let stand	Let	Partially Identified
Shakeoff	Shakeoff	
Store	Store	
freeze	freeze	

Table 5.2: Actions Identified, Missed and Misidentified for the "Belgian Spice Cookies" Recipe.

Recipe	Named		Implied		Misidentified
	Identified	Missed	Identified	Missed	
World Peace...	3	3	1	6	1
Oatmeal...	4	2	3	3	2
Belgian Spice...	3	2	3	3	3

Table 5.3: Tools Identified, Missed and Misidentified for the Three Recipes.

Recipe	Identified	Missed	Misidentified
World Peace...	20	2	4
Oatmeal...	15	0	5
Belgian Spice...	26	2	4

Table 5.4: Actions Identified, Missed and Misidentified for the Three Recipes.

6 Conclusion

A proof-of-concept software system for extracting information information from cookie recipes was created. The system uses a combination of rules and a statistical model to make a recipe's oven preheat temperature, baking duration and required tools easier to identify; format actions in bold typeface; and separate multi-sentence steps into sub-steps. The system was evaluated in a pilot study and suggestions were made for future work.

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A Exemplars for the Survey Recipes and the Tools and Actions Identified by the System

The exemplars were created by taking the output of the system and hand-correcting them. A summary for the tools and actions identified by the system for all three recipes in Tables 5.3 and 5.4 respectively.

A.1 World Peace Cookies

The exemplar for the "World Peace Cookies" recipe is shown in Figure A.1. The tools and actions identified in the system are shown in Tables A.1 and A.2 respectively.

World Peace Cookies

Preheat:

- 325°F

Bake duration:

- 11 to 12 minutes

Ingredients

- 1 1/4 cups all purpose flour
- 1/3 cup natural unsweetened cocoa powder
- 1/2 teaspoon baking soda
- 11 tablespoons (1 stick plus 3 tablespoons) unsalted butter, room temperature
- 2/3 cup (packed) golden brown sugar
- 1/4 cup sugar
- 1 teaspoon vanilla extract
- 1/4 teaspoon fine sea salt
- 5 ounces extra-bittersweet chocolate (do not exceed 85% cacao), chopped (no pieces bigger than 1/3 inch)

Procedure

1. **Gather** what is needed
    - **Gather** tools
        - sifter
        - bowl
        - electric beater
        - mixing spoon
        - plastic wrap
        - refrigerator
        - oven
        - timer
        - parchment paper
        - knife
        - sheets
        - oven mitts
        - cooling rack
        - airtight container
    - **Gather** ingredients
2. **Sift** flour, cocoa, and baking soda into medium bowl.
3. Using electric mixer, **beat** butter in large bowl until smooth but not fluffy.
4. a. **Add** both sugars, vanilla, and sea salt;
   b. **beat** until fluffy, about 2 minutes.
5. a. **Add** flour mixture;
   b. **beat** just until blended (mixture may be crumbly).
6. a. **Add** chopped chocolate;
   b. **mix** just to distribute (if dough doesn't come together, **knead** lightly in bowl to form ball).
7. **Divide** dough in half.
8. **Place** each half on sheet of plastic wrap.
9. **Form** each into 1 1/2-inch-diameter log.
10. a. **Wrap** each in plastic;
    b. **chill** until firm, about 3 hours.
11. DO AHEAD: Can be made 3 days ahead.
12. Keep chilled.
13. a. **Preheat** oven to 325°F.
    b. **Line** 2 baking sheets with parchment paper.
14. Using thin sharp knife, **cut** logs crosswise into 1/2-inch-thick rounds.
15. **Space** 1 inch apart on prepared sheets.
16. **Bake** 1 sheet at a time until cookies appear dry (cookies will not be firm or golden at edges), 11 to 12 minutes.
17. a. **Transfer** to rack;
    b. **cool**.
18. DO AHEAD: Can be made 1 day ahead.
19. **Store** airtight at room temperature.

Figure A.1: Exemplar for the “World Peace Cookies” Recipe.

Entity	Tool	Identified as Tool	Named or Implied
bowl	Yes	Yes	Named
oven	Yes	Yes	Named
parchment paper	Yes	Yes	Named
timer	Yes	Yes	Implied
electric beater	Yes	No (Identified as "electric")	Named
cooling rack	Yes	No	Named
plastic wrap	Yes	No	Named
sheets	Yes	No	Named
airtight container	Yes	No	Implied
knife	Yes	No	Implied
mixing spoon	Yes	No	Implied
oven mitts	Yes	No	Implied
refrigerator	Yes	No	Implied
sifter	Yes	No	Implied
log	No	Yes	

Table A.1: Tools Identified, Missed and Misidentified for the "World Peace Cookies" Recipe.

A.2 Oatmeal, Chocolate Chip, and Pecan Cookies

The exemplar for the "Oatmeal, Chocolate Chip, and Pecan Cookies" recipe is shown in Figure A.2. The tools and actions identified in the system are shown in Tables A.3 and A.4 respectively.

A.3 Belgian Spice Cookies

The exemplar for the "Belgian Spice Cookies" recipe is shown in Figure 1.1. The tools and actions identified in the system are shown in Tables 5.1 and 5.2 respectively.

Oatmeal, Chocolate Chip, and Pecan Cookies

Preheat:

- 350°F

Bake duration:

- 10-12 minutes or until golden

Ingredients

- 8 tablespoons unsalted butter, at room temperature
- 3/4 cup sugar
- 1 cup light brown sugar, firmly packed
- 1 teaspoon salt
- 1 teaspoon vanilla extract
- 2 large eggs
- 1 1/2 cups flour
- 1 teaspoon baking soda
- 1/2 teaspoon ground cinnamon
- 1/4 teaspoon ground nutmeg
- 1/8 teaspoon ground clove
- 1 cup quick-cooking oats
- 2 cups chopped pecans
- 2 teaspoons freshly grated orange zest
- 12 ounces semisweet chocolate chips

Procedure

1. **Gather** what is needed
    - **Gather** tools
        - oven
        - large cookie sheet
        - parchment or Silpat
        - electric mixet
        - 2 bowls
        - mixing spoon
        - timer
        - oven mitts
        - cooling rack
        - cookie jar or airtight container
    - **Gather** ingredients
2. a. **Preheat** oven to 350°F.
   b. **Line** a large cookie sheet with parchment or a Silpat (rubber nonstick baking mat).
3. Using an electric mixer, **beat** the butter in a bowl until light and fluffy.
4. **Add** both sugars, salt, and vanilla, and **beat** until well mixed, about 3 minutes.
5. **Stir** in eggs, one at a time.
6. **Sift together** the flour, baking soda, cinnamon, nutmeg, and clove in a separate bowl.
7. **Add** half of the flour mixture to the butter with the mixer on low speed.
8. Once the flour has been incorporated, **add** the second half.
9. **Stir** in the oats, pecans, orange zest, and chocolate chips.
10. **Drop** the dough, by the tablespoon, onto the cookie sheet and **bake** for 10-12 minutes or until golden.
11. **Remove** from the oven and **cool** the cookies on a rack.
12. **Store** at room temperature in a cookie jar or other airtight container.

Figure A.2: Exemplar for the “Oatmeal, Chocolate Chip, and Pecan Cookies” Recipe.

Action in Recipe	Identified by System	Note (If not Correctly Identified)
Sift	Sift	
	baking soda	Misidentified
	Using	Misidentified
beat	beat	
Add	Add	
	sea	Misidentified
beat	beat	
Add	Add	
beat	beat	
Add	Add	
mix	mix	
knead	knead	
Divide	Divide	
Place	Place	
Form	Form	
Wrap		Missed
chill		Missed
Preheat	Preheat	
Line	Line	
	Using	Misidentified
cut	cut	
Space	Space	
Bake	Bake	
Transfer	Transfer	
cool	cool	
Store	Store	

Table A.2: Actions Identified, Missed and Misidentified for the "World Peace Cookies" Recipe.

Entity	Tool	Identified as Tool	Named or Implied
mixer	Yes	No	Named
oven	Yes	Yes	
timer	Yes	Yes	Implied
parchment or Silpat	Yes	Yes, both separately	Named
bowl	Yes		
oven mitt	Yes	No	Implied
rack	Yes		
cookie jar or airtight container	Yes	No	Named
beater	No	Yes	Duplicates “mixer”
cookie	No	Yes	

Table A.3: Tools Identified, Missed and Misidentified for the “Oatmeal, Chocolate Chip, and Pecan Cookies” Recipe.

Action in Recipe	Identified by System	Note (If not Correctly Identified)
Preheat	Preheat	
Line	Line	
	sheet	Misidentified
	rubber	Misidentified
	Using	Misidentified
beat	beat	
	fluffy	Misidentified
Add	Add	
beat	beat	
Stir	Stir	
Sift together	Sift together	
	clove	Misidentified
Add	Add	
add	add	
Stir	Stir	
Drop	Drop	
bake	bake	
Remove	Remove	
cool	cool	
Store	Store	

Table A.4: Actions Identified, Missed and Misidentified for the "Oatmeal, Chocolate Chip, and Pecan Cookies" Recipe.

B Survey

B.1 University of Wisconsin-Milwaukee Informed Consent to Participate in Research

B.1.1 Study title

Modifying Food Recipes for Readers with Mild or Temporary Disabilities that Impact Reading Comprehension

B.1.2 Researchers

Susan W. McRoy, PhD and Benjamin Neumann, BSc

Department of Electrical Engineering and Computer Science

College of Engineering and Applied Science

We're inviting you to take a survey for research. This survey is completely voluntary. There are no negative consequences if you don't want to take it. If you start the survey, you can always change your mind and stop at any time.

B.1.3 What is the purpose of this study?

We want to understand how people read and comprehend food recipes.

B.1.4 What will I do?

This survey will begin by asking you questions about how you prepare food and read food recipes. Finally, it will ask you to read recipes and answer questions about them.

B.1.5 Risks

- Online data being hacked or intercepted: Anytime you share information online there are risks. We're using a secure system to collect this data, but we can't eliminate this risk.
- Breach of confidentiality: There is a chance your data could be seen by someone who shouldn't have access to it. We're minimizing this risk in the following ways:
  - We'll store all electronic data on a password-protected, encrypted computer.
- Some questions may be personal or upsetting. You can skip them or quit the survey at any time.

B.1.6 Possible benefits

There are no benefits to you other than to further research.

B.1.7 number of participants

500

B.1.8 How long will it take?

About 10 minutes.

B.1.9 Costs

There is no cost to you to participate.

B.1.10 Compensation

There is no compensation for participating in the survey.

B.1.11 Future Research

Your data won't be used or shared for any future research studies.

B.1.12 Funding source

By us (the researchers) personally.

B.1.13 Confidentiality and data security

We will collect information about your browser. This information is necessary for us to monitor the quality of the responses to the survey.

B.1.14 Where will data be stored?

On the servers for the online survey software (Qualtrics).

B.1.15 How long will it be kept?

Data will be kept until 22 November 2024.

B.1.16 Who can see my data?

- We (the researchers) will have access to the online survey responses. This is so we can analyze the data and conduct the study.
- Agencies that enforce legal and ethical guidelines, such as:
  - The Institutional Review Board (IRB) at UWM
  - The Office for Human Research Protections (OHRP)

We may share our findings in publications or presentations.

B.1.17 Conflict of interest

None of the researchers have a conflict of interest in this study

B.1.18 Questions about the research, complaints or problems

Contact Susan W. McRoy, PhD, at (+1) 414-229-6695 / mcroy@uwm.edu.

B.1.19 Questions about your rights as a research participant, complaints, or problems

Contact the UWM IRB (Institutional Review Board) at (+1) 414-662-3544 / irbinfo@uwm.edu.

Please print or save this screen if you want to be able to access the information later.

IRB #: 22.11

IRB Approval Date: 24 November 2021

B.1.20 Agreement to Participate

Your participation is completely voluntary, and you can withdraw at any time.

To take this survey, you must be:

- At least 18 years old
- Able to read and understand English
- Living independently and able to prepare food using recipes

- Have normal to corrected vision (glasses or contact lenses are acceptable)

B.2 University of Wisconsin-Milwaukee Informed Consent to Participate in Research

B.2.1 Study title

Modifying Food Recipes for Readers with Mild or Temporary Disabilities that Impact Reading Comprehension

B.2.2 Researchers

Susan W. McRoy, PhD and Benjamin Neumann, BSc
Department of Electrical Engineering and Computer Science
College of Engineering and Applied Science

We're inviting you to take a survey for research. This survey is completely voluntary. There are no negative consequences if you don't want to take it. If you start the survey, you can always change your mind and stop at any time.

B.2.3 What is the purpose of this study?

We want to understand how people read and comprehend food recipes.

B.2.4 What will I do?

This survey will begin by asking you questions about how you prepare food and read food recipes. Finally, it will ask you to read recipes and answer questions about them.

B.2.5 Risks

- Online data being hacked or intercepted: Anytime you share information online there are risks. We're using a secure system to collect this data, but we can't eliminate this risk.
- Breach of confidentiality: There is a chance your data could be seen by someone who shouldn't have access to it. We're minimizing this risk in the following ways:
  - Unless you choose to receive extra credit for completing the survey, data is anonymous
  - We'll store all electronic data on a password-protected, encrypted computer.
- Some questions may be personal or upsetting. You can skip them or

quit the survey at any time.

B.2.6 Possible benefits

There are no benefits to you other than to further research.

B.2.7 Estimated number of participants

50

B.2.8 How long will it take?

About 10 minutes.

B.2.9 Costs

There is no cost to you to participate.

B.2.10 Compensation

For completing the survey, you can choose to receive a 3pt extra credit in your Intelligent User Interfaces course.

B.2.11 If I don't want to be in this study, are there other options?

Instead of participating, you can submit a structured summary of a peer-reviewed research paper of your choosing according to class guidelines.

B.2.12 Future Research

Your data won't be used or shared for any future research studies.

B.2.13 Confidentiality and data security

If you choose to receive extra credit, we'll collect the following identifying information: your name. This information is necessary so that you can receive the extra credit.

B.2.14 Where will data be stored?

On the servers for the online survey software (Qualtrics).

B.2.15 How long will it be kept?

Data will be kept until 22 November 2024.

B.2.16 Who can see my data?

- We (the researchers) will have access to the online survey responses. This is so we can analyze the data and conduct the study.
- Agencies that enforce legal and ethical guidelines, such as:
  - The Institutional Review Board (IRB) at UWM
  - The Office for Human Research Protections (OHRP)

We may share our findings in publications or presentations.

B.2.17 Conflict of interest

None of the researchers have a conflict of interest in this study

B.2.18 Questions about the research, complaints or problems

Contact Susan W. McRoy, PhD, at (+1) 414-229-6695 / mcroy@uwm.edu.

B.2.19 Questions about your rights as a research participant, complaints, or problems

Contact the UWM IRB (Institutional Review Board) at (+1) 414-662-3544 / irbinfo@uwm.edu.

Please print or save this screen if you want to be able to access the information later.

IRB #: 22.11

IRB Approval Date: 24 November 2021

B.2.20 Agreement to Participate

Your participation is completely voluntary, and you can withdraw at any time.

To take this survey, you must be:

- At least 18 years old
- Able to read and understand English
- Living independently and able to prepare food using recipes
- Have normal to corrected vision (glasses or contact lenses are acceptable)

If you meet these criteria and would like to take the survey, choose that option and click the button below to start.

- I consent, begin the study
- I do not consent, I do not wish to participate

B.3 Your Food Skills

B.3.1 How You Prepare Food

Which of the following do you use for preparing food?

- Stovetop (boil/fry)
- Oven (bake/roast)
- Microwave
- None of the above

B.3.2 If you do not use a stovetop, oven or microwave for preparing food, what do you use?

B.3.3 Who prepares food in your household?

- I am the primary preparer of food
- I am an occasional preparer of food
- I help the primary preparer of food
- Someone else is usually the preparer of food

B.3.4 More About Your Food Skills

Food Preparation Methods

How often do you chop, mix and stir foods (e.g. chopping vegetables, dicing an onion, cubing meat, mixing and stirring food together in a pot/bowl)?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you blend foods to make them smooth, like soups or sauces (using a whisk/blender/food processor etc.)?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you steam food (where the food doesn't touch the water but gets cooked by the steam)?

- Never

- Sometimes
- About half the time
- Most of the time
- Always

How often do you boil or simmer food (cooking it in a pan of hot, boiling/bubbling water)?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you stew food (cooking it for a long time [usually more than an hour] in a liquid or sauce at a medium heat, not boiling, e.g. beef stew)?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you roast food in the oven (e.g. raw meat/chicken, fish, vegetables etc.)?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you fry/stir-fry food in a frying pan/wok with oil or fat using the hob/gas rings/hot plates?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you microwave food (not drinks/liquid) including heating ready-meals?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

B.3.5 Food Preparation Techniques

How often do you bake goods such as cakes, buns, cupcakes, scones, bread etc., using basic/raw ingredients or mixes?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you peel and chop vegetables (e.g. potatoes, carrots, onions, broccoli)?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you prepare and cook raw meat/poultry?

- Never
- Sometimes
- About half the time

- Most of the time
- Always

How often do you prepare and cook raw fish?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you make sauces and gravy from scratch (no ready-made jars, pastes or granules)?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you use herbs and spices to flavor dishes?

- Never
- Sometimes
- About half the time

- Most of the time
- Always

Food skills

How often do you plan meals ahead (e.g. for the day/week ahead)?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you prepare meals in advance (e.g. packed lunch, partly preparing a meal in advance?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you follow recipes when preparing food?

- Never

- Sometimes
- About half the time
- Most of the time
- Always

Shopping

How often do you shop with a grocery list?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you shop with specific meals in mind?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you plan how much food to buy?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

Budgeting

How often do you compare prices before you buy food?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you know what budget you have to spend on food?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you buy food in season to save money?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you buy cheaper cuts of meat to save money?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you cook more or double recipes which can be used for another meal?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you prepare or cook a meal with five or fewer ingredients?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you prepare or cook a meal with limited time?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you use leftovers to create another meal?

- Never
- Sometimes
- About half the time
- Most of the time
- Always

How often do you have basic items in your cupboard for putting meals together (e.g. herbs/spices, dried/canned goods)?

- Does not describe me
- Describes me slightly well
- Describes me moderately well
- Describes me very well
- Describes me extremely well

B.4 Your Use of Recipes

B.4.1 Your Use of Recipes

I use recipes when I prepare food.

- Does not describe me
- Describes me slightly well
- Describes me moderately well
- Describes me very well
- Describes me extremely well

When I read a recipe, I often re-read a single step several times before starting that step.

- Does not describe me
- Describes me slightly well
- Describes me moderately well

- Describes me very well
- Describes me extremely well

While cooking, I often re-read the steps of a recipe from the beginning to find the current step.

- Does not describe me
- Describes me slightly well
- Describes me moderately well
- Describes me very well
- Describes me extremely well

I sometimes forget to add ingredients to a dish, even though it was in the recipe.

- Does not describe me
- Describes me slightly well
- Describes me moderately well
- Describes me very well
- Describes me extremely well

B.4.2 Recipe Reading

Next, we are going to ask you to help us evaluate a system for displaying recipes. You'll be shown a recipe and then asked to answer a question about

it.

There's no need to guess. If you don't remember the answer to a question, **you can go back to re-read the recipe**.

B.5 World Peace Cookies

Preheat:

- 325°F

Bake duration:

- 11 to 12 minutes

B.5.1 Ingredients

- 1 1/4 cups all purpose flour
- 1/3 cup natural unsweetened cocoa powder
- 1/2 teaspoon baking soda
- 11 tablespoons (1 stick plus 3 tablespoons) unsalted butter, room temperature
- 2/3 cup (packed) golden brown sugar
- 1/4 cup sugar
- 1 teaspoon vanilla extract

- 1/4 teaspoon fine sea salt
- 5 ounces extra-bittersweet chocolate (do not exceed 85% cacao), chopped (no pieces bigger than 1/3 inch)

B.5.2 Procedure

1. **Gather** what is needed
    - **Gather** tools
        - beater
        - timer
        - baker
        - log
        - oven
        - paper
        - sheets
        - bowl
        - parchment
    - **Gather** ingredients
2. **Sift** flour, cocoa, and **baking soda** into medium bowl.
3. Using electric mixer, **beat** butter in large bowl until smooth but not fluffy.

4. (a) **Add** both sugars, vanilla, and **sea** salt;
   (b) **beat** until fluffy, about 2 minutes.

5. (a) **Add** flour mixture;
   (b) **beat** just until blended (mixture may be crumbly).

6. (a) **Add** chopped chocolate;
   (b) **mix** just to distribute (if dough doesn't come together, knead lightly in bowl to form ball).

7. **Divide** dough in half.

8. **Place** each half on sheet of plastic wrap.

9. **Form** each into 1 1/2-inch-diameter log.

10. (a) Wrap each in plastic;
    (b) chill until firm, about 3 hours.

11. DO AHEAD: Can be made 3 days ahead.

12. Keep chilled.

13. (a) **Preheat** oven to 325°F.
    (b) **Line** 2 baking sheets with parchment paper.

14. Using thin sharp knife, **cut** logs crosswise into 1/2-inch-thick rounds.

15. **Space** 1 inch apart on prepared sheets.

16. **Bake** 1 sheet at a time until cookies appear dry (cookies will not be firm or golden at edges), 11 to 12 minutes.

17. (a) **Transfer** to rack;
    (b) **cool**.

18. DO AHEAD: Can be made 1 day ahead.

19. **Store** airtight at room temperature.

B.6 World Peace Cookies

B.6.1 Ingredients

- 1 1/4 cups all purpose flour
- 1/3 cup natural unsweetened cocoa powder
- 1/2 teaspoon baking soda
- 11 tablespoons (1 stick plus 3 tablespoons) unsalted butter, room temperature
- 2/3 cup (packed) golden brown sugar
- 1/4 cup sugar
- 1 teaspoon vanilla extract
- 1/4 teaspoon fine sea salt

- 5 ounces extra-bittersweet chocolate (do not exceed 85% cacao), chopped (no pieces bigger than 1/3 inch)

B.6.2 Procedure

1. Sift flour, cocoa, and baking soda into medium bowl.
2. Using electric mixer, beat butter in large bowl until smooth but not fluffy.
3. Add both sugars, vanilla, and sea salt; beat until fluffy, about 2 minutes.
4. Add flour mixture; beat just until blended (mixture may be crumbly).
5. Add chopped chocolate; mix just to distribute (if dough doesn't come together, knead lightly in bowl to form ball).
6. Divide dough in half.
7. Place each half on sheet of plastic wrap.
8. Form each into 1 1/2-inch-diameter log.
9. Wrap each in plastic; chill until firm, about 3 hours.
10. DO AHEAD: Can be made 3 days ahead.
11. Keep chilled.
12. Preheat oven to 325°F. Line 2 baking sheets with parchment paper.
13. Using thin sharp knife, cut logs crosswise into 1/2-inch-thick rounds.
14. Space 1 inch apart on prepared sheets.

15. Bake 1 sheet at a time until cookies appear dry (cookies will not be firm or golden at edges), 11 to 12 minutes.
16. Transfer to rack; cool.
17. DO AHEAD: Can be made 1 day ahead.
18. Store airtight at room temperature.

B.6.3 What was the baking temperature, in degrees Fahrenheit (°F)?

B.7 Oatmeal, Chocolate Chip, and Pecan Cookies

Preheat:

- 350°F

B.7.1 Ingredients

- 8 tablespoons unsalted butter, at room temperature
- 3/4 cup sugar
- 1 cup light brown sugar, firmly packed
- 1 teaspoon salt
- 1 teaspoon vanilla extract

- 2 large eggs
- 1 1/2 cups flour
- 1 teaspoon baking soda
- 1/2 teaspoon ground cinnamon
- 1/4 teaspoon ground nutmeg
- 1/8 teaspoon ground clove
- 1 cup quick-cooking oats
- 2 cups chopped pecans
- 2 teaspoons freshly grated orange zest
- 12 ounces semisweet chocolate chips

B.7.2 Procedure

1. **Gather** what is needed
    - **Gather** tools
        - beater
        - timer
        - baker
        - oven
        - cookie
        - Silpat

    - mixer
    - bowl
    - parchment
  - **Gather** ingredients

2. (a) **Preheat** oven to 350°F.
   (b) **Line** a large cookie **sheet** with parchment or a Silpat (**rubber** nonstick baking mat).

3. **Using** an electric mixer, **beat** the butter in a bowl until light and **fluffy**.

4. **Add** both sugars, salt, and vanilla, and **beat** until well mixed, about 3 minutes.

5. **Stir** in eggs, one at a time.

6. **Sift together** the flour, baking soda, cinnamon, nutmeg, and **clove** in a separate bowl.

7. **Add** half of the flour mixture to the butter with the mixer on low speed.

8. Once the flour has been incorporated, **add** the second half.

9. **Stir** in the oats, pecans, orange zest, and chocolate chips.

10. **Drop** the dough, by the tablespoon, onto the cookie sheet and **bake** for 10-12 minutes or until golden.

11. **Remove** from the oven and **cool** the cookies on a rack.

12. **Store** at room temperature in a cookie jar or other airtight container.

B.8 Oatmeal, Chocolate Chip, and Pecan Cookies

B.8.1 Ingredients

- 8 tablespoons unsalted butter, at room temperature
- 3/4 cup sugar
- 1 cup light brown sugar, firmly packed
- 1 teaspoon salt
- 1 teaspoon vanilla extract
- 2 large eggs
- 1 1/2 cups flour
- 1 teaspoon baking soda
- 1/2 teaspoon ground cinnamon
- 1/4 teaspoon ground nutmeg
- 1/8 teaspoon ground clove

- 1 cup quick-cooking oats
- 2 cups chopped pecans
- 2 teaspoons freshly grated orange zest
- 12 ounces semisweet chocolate chips

B.8.2 Procedure

1. Preheat oven to 350°F. Line a large cookie sheet with parchment or a Silpat (rubber nonstick baking mat).
2. Using an electric mixer, beat the butter in a bowl until light and fluffy.
3. Add both sugars, salt, and vanilla, and beat until well mixed, about 3 minutes.
4. Stir in eggs, one at a time.
5. Sift together the flour, baking soda, cinnamon, nutmeg, and clove in a separate bowl.
6. Add half of the flour mixture to the butter with the mixer on low speed.
7. Once the flour has been incorporated, add the second half.
8. Stir in the oats, pecans, orange zest, and chocolate chips.
9. Drop the dough, by the tablespoon, onto the cookie sheet and bake for 10-12 minutes or until golden.
10. Remove from the oven and cool the cookies on a rack.
11. Store at room temperature in a cookie jar or other airtight container.

B.9 Fill in the missing word:

_____ in the oats, pecans, orange zest, and chocolate chips.

- Stir
- Mix
- Add

B.10 Belgian Spice Cookies

Preheat:

- 350°F

Bake duration:

- about 8 minutes

B.10.1 Ingredients

- 2 cups all purpose flour
- 1 tablespoon ground cinnamon
- 1 1/2 teaspoons ground ginger
- 1/2 teaspoon ground cloves
- 1/2 teaspoon baking powder

- 1/2 teaspoon salt
- 1 1/4 cups (packed) dark brown sugar
- 1/2 cup (1 stick) unsalted butter, room temperature
- 1 large egg
- 2 ounces good-quality white chocolate (such as Lindt or Baker's), melted
- Red colored sugar

B.10.2 Procedure

1. **Gather** what is needed
    - **Gather** tools
        - beater
        - timer
        - baker
        - freeze
        - oven
        - sheets
        - bowl
        - container
        - rectangle
    - **Gather** ingredients

2. **Combine** first 6 ingredients in medium bowl.

3. Using electric mixer, **beat brown** sugar and butter in large bowl until light.

4. **Add** egg and **beat** until fluffy.

5. Gradually **add** dry ingredients and **beat** just until combined.

6. **Divide** dough in half.

7. **Flatten** each half into rectangle.

8. (a) **Wrap** with plastic;
   (b) chill 1 hour.

9. (a) **Preheat** oven to 350°F.
   (b) Lightly butter 2 large baking sheets.

10. **Roll out** 1 dough piece on lightly floured work **surface** to 13 x 9-inch rectangle.

11. **Trim** edges to form 12x8-inch rectangle.

12. **Cut** into 24 4x1-inch rectangles.

13. Lightly **press** miniature cookie cutter into each rectangle to make imprints (do not cut through dough).

14. **Arrange** cookies on **prepared** baking sheets, **spacing** 1 inch apart.

15. **Bake** until edges begin to darken, about 8 minutes.

16. **Transfer** cookies to rack and **cool**.

17. **Repeat** with remaining dough piece.

18. **Working** with 1 cookie at a time, brush imprints with **melted** white chocolate.

19. **Sprinkle** colored sugar generously over chocolate.

20. **Let** stand until chocolate sets, about 2 hours.

21. **Shake off** excess colored sugar.

22. (Can be made ahead.

23. **Store** in airtight container at room temperature up to 1 week, or freeze up to 1 month.)

B.11 Belgian Spice Cookies

B.11.1 Ingredients

- 2 cups all purpose flour
- 1 tablespoon ground cinnamon

- 1 1/2 teaspoons ground ginger
- 1/2 teaspoon ground cloves
- 1/2 teaspoon baking powder
- 1/2 teaspoon salt
- 1 1/4 cups (packed) dark brown sugar
- 1/2 cup (1 stick) unsalted butter, room temperature
- 1 large egg
- 2 ounces good-quality white chocolate (such as Lindt or Baker's), melted
- Red colored sugar

B.11.2 Procedure

1. Combine first 6 ingredients in medium bowl.
2. Using electric mixer, beat brown sugar and butter in large bowl until light.
3. Add egg and beat until fluffy.
4. Gradually add dry ingredients and beat just until combined.
5. Divide dough in half.
6. Flatten each half into rectangle.
7. Wrap with plastic; chill 1 hour.
8. Preheat oven to 350°F. Lightly butter 2 large baking sheets.
9. Roll out 1 dough piece on lightly floured work surface to 13 x 9-inch

rectangle.

10. Trim edges to form 12x8-inch rectangle.
11. Cut into 24 4x1-inch rectangles.
12. Lightly press miniature cookie cutter into each rectangle to make imprints (do not cut through dough).
13. Arrange cookies on prepared baking sheets, spacing 1 inch apart.
14. Bake until edges begin to darken, about 8 minutes.
15. Transfer cookies to rack and cool.
16. Repeat with remaining dough piece.
17. Working with 1 cookie at a time, brush imprints with melted white chocolate.
18. Sprinkle colored sugar generously over chocolate.
19. Let stand until chocolate sets, about 2 hours.
20. Shake off excess colored sugar.
21. (Can be made ahead.
22. Store in airtight container at room temperature up to 1 week, or freeze up to 1 month.)

B.12 How many minutes does the recipe say to bake the cookies?

B.13 Incentive: Extra Credit

In order for you to receive extra credit for Intelligent User Interfaces, please share your name. If you do not want to receive extra credit, you can submit this page without providing this information.

B.13.1 Name

C Python Requirements File

The libraries used from pip, Python's package management system, are shown in Figure C.1.

```
bleach==3.3.0
blis==0.7.4
catalogue==2.0.4
certifi==2020.12.5
chardet==4.0.0
click==7.1.2
cupy-cuda112==8.6.0
cymem==2.0.5
dataclasses-json==0.5.3
fastrlock==0.6
filelock==3.0.12
idna==2.10
Jinja2==2.11.3
joblib==1.0.1
MarkupSafe==1.1.1
marshmallow==3.11.1
marshmallow-enum==1.5.1
murmurhash==1.0.5
mypy==0.812
mypy-extensions==0.4.3
numpy==1.20.2
packaging==20.9
pathy==0.5.2
preshed==3.0.5
pydantic==1.7.3
pyparsing==2.4.7
regex==2021.4.4
requests==2.25.1
sacremoses==0.0.45
six==1.15.0
smart-open==3.0.0
```

```
spacy==3.0.6
spacy-alignments==0.8.3
spacy-legacy==3.0.5
spacy-lookups-data==1.0.0
spacy-transformers==1.0.2
srsly==2.4.1
stringcase==1.2.0
thinc==8.0.3
tokenizers==0.10.2
torch==1.8.1
tqdm==4.60.0
transformers==4.5.1
typed-ast==1.4.3
typer==0.3.2
typing-extensions==3.10.0.0
typing-inspect==0.6.0
urllib3==1.26.4
wasabi==0.8.2
webencodings==0.5.1
```

Listing C.1: Python Requirements File.