Master's Thesis of Engineering

Research on the Perceived Credibility of News Contents by Gender of Agents

에이전트의 성별에 따른 뉴스 컨텐츠의 인지된 신뢰도 연구

August 2020

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Abstract

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In light of the previous studies related to voice agents, there are little and limited discussions on the content which is delivered by the agents. If the discussions on voice agents only aim general interactions between the agents and humans, so-called small talks, this cannot be used as a formative aspect in designing services that will be put into voice agents. In this study, a Wizard of Oz experiment was conducted to see people's idea of credibility in news contents related to the gender, which is the most intuitive aspect in voice agents, of the voice agents. A total of 45 students at the Seoul National University participated in this study. The results of this experiment suggest that depending on users' gender, there was a difference in credibility score tendencies. Based on the findings from both experiments and semi-structured interviews, a mental model during the use of voice agents as informants will be discussed in this paper.

Keyword : credibility, gender, mental model, news contents, voice agents
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Chapter 1

Introduction

The Korean telecommunication industry is expected to introduce more diverse AI (Artificial Intelligence) technologies and services of voice agents beyond the current services like playing requested music. They also foresaw the potential of voice agents which will be applied to more daily devices (Lee, 2020). In that respect, in the future, it is expected that more services based on the voice user interfaces (VUI) will be introduced than services based on the graphic user interfaces (GUI). Even if GUI seems separated from VUI, from the combination of these two stands out the strengths of voice interfaces. Voice agents itself have several advantages like speed, hands-free, intuitiveness, and empathy. Pearl addresses the advantages of voice user interfaces in her book called '*Designing Voice User Interfaces*'. Speed stands for usage efficiency in actual use. She also pointed out hands-free as one of the advantages of voice user interfaces. This advantage allows you to free your hands. You can do the cooking, driving, or even more things like reaching your device across the room—because you can just speak or call the agent. Empathy is another advantage of voice user interface and this advantage allows users to feel more emotion through voice—because the voice has tone, volume, intonation, and more other non-verbal communication factors. From text alone, we cannot

catch those. Intuitiveness is the last advantage of voice user interfaces. Pearl (2016) says of this:

"Everyone knows how to talk. Hand a new interface to someone and have it ask that person a question, and even users who are less familiar with technology can reply naturally" (p. 3)

AI speakers, or voice agents, have several advantages that voice recognition-based interfaces are intuitive compared to conventional text input or touch-based interfaces. This makes them convenient and easy to multi-task because users do not have to use their hands. Also, AI speakers utilize artificial intelligence technology to identify the gist of the voice name and provide various services such as music play, alarms, weather/schedule verification, smart homes, information search and shopping in a flexible and customized manner, just like personal secretaries (Park & Choi, 2018). These advantages of voice agents can be also easily found in our daily lives. For instance, if you know what song you want to listen to or which channel to turn on, you can just request it to your voice agent. This does not require special skills. This is a great example of the argument on 'voice agents' strengths are equally impactful to every generation and group'. To elaborate on the argument above, the fact that SK Telecom's NUGU expanded its services for elderlies who need assistance for living and well is suggesting us strengths of voice agents. These services

include '*Brain Talk-Talk'*, which presents dementia through cognitive training, news about the community, '*News Talk-Talk*', and medical information podcasts by medical staff at the Seoul National University College of Medicine. This is a piece of real-life evidence that the usage and needs of voice agents are formidable (Kwon, 2019). As such, the use of voice agents is on the rise, and voice agents are widely used as active carriers of information.

As I addressed above, people recently have dealt with deep concerns that voice agents have become live informants. For instance, people are wondering when and what persona leads them to give more credits to what content. In respect of the credibility, since the meaning of it is vary depending on the subject, it is important to set a focus a specific content. Baek, Park, Lee, and Kim (2019) team also designed voice agents with various age groups. In this study, the research team created two types of voice: the voice of the 20s and 60s. They also measured users' sense of intimacy and reliability of voice agents. In that regard, the authors did not set up a content-driven credibility but users' credibility towards voice agent. However, investigation on these respective is still insufficient. In light of the previous studies, insufficient discussions on personas of voice agents, which vary depending on the information or content delivered by the agents related to empathy should be more investigated. Specifically, it is necessary to learn about the reliability or credibility of information based on the nature or persona of agents and to

explore in what situation and information that users want to receive from which agent.

Gender and Voice Agents

In the earlier section, the advantages of voice was clearly presenting these days. Moreover, from the exploratory research by Baek, Park, Lee, and Kim (2019), we can argue that there are various ways to represent a persona and how the persona pulls out reliability or credibility. Nevertheless, since humans automatically recognize one's gender as soon as they hear a voice, the gender issue is another big branch in the discussion on the voice agents—most of the persona forms based on gender (Lee, 2018). If the formation of voice is heavily dependent on gender in the voice agents, gender cannot be overlooked when we consider designing those products and services. Lee (2018) raised an issue of gender-specification in the AI field, in the paper called '*Why Do Voice Activated Technologies Sound Female?*'. She argued that sound is a representation of our culture, society, and history. Since the agreement which was made on 'the voice of female agents is more preferable to users', the reasons why people prefer to interact with female-voiced agents were widely investigated in both the communication and HCI field. She started with the ARS to explain the history and culture formation between voice and gender. The voice of ARS (automatic response system) is heavily gender-specific—ARS used a very friendly and submissive female voice as representative. And this

type of service expended to our general or daily devices like rice cookers or elevator. The relationship we have with machines resembles the relationship between humans in reality, and in the end, the relationship between humans and machines will affect the relationship between humans again. Unlike other languages where people can choose the voices of the gender of the agents, the Siri in Korean was fixed to the female voice until 2018. Besides, the newly released voice recognition devices in Korea actively embody the voice of young women who is friendly, energetic, but still submissive (Lee, 2018).

Lee (2006) claimed that there were different tendencies in effects of genderlized-computers--in here, the gender was defined with both voices and images of each agent. The agents assisted participants with a purchasing decision making task by providing pieces of information to the participants. The results show that male participants who have a strong gender stereotype rated higher credibility to male agents compared to female agents. Likewise, there was a similar study regarding gender and credibility or trustworthiness. Lee, Nass, and Brave (2000) suggested that previous researches had already demonstrated that genderlized voice-computer can in fact lead its users to exhibit gender stereotypes. They generated computers with different genders--this time, the gender was defined with voices only, to see the different distributions in opinion acceptance, social attraction, and trustworthiness. From this study, the team confirmed that people showed even if the agents delivered the same contents to the participants, people took account of information which

delivered by male computers than female computers did--male computers showed higher credibility and likability. And this was consistent with participants' existing gender schema.

As we can infer from the previous paragraph, users' perception and feedbacks toward the male-voiced computer and the female-voiced computer showed significant differences. Despite these results from previous studies, however, as female voice agents act as informants these days, the question of 'preferable' and 'credible' gender of agents in a certain situation might have different tendencies compared to decades ago. Thus, in this study, I would like to confirm that as the function of active informants, the credibility of agents' gender will present dissimilar results from the prior studies by the different existing perceptions of users'. Even if it was confirmed that people prefer to interact with female voice agents because of the traditional social position of female (Lee, 2018), this does not necessarily mean that people have an antipathy to female agents who are active and intelligent. The research question of *Experiment 1* is 'will people show different news content credibility tendencies by the gender of voice agents?' and this experiment aims to find out how and what judgment people make when the voice agents who have different gender deliver the news. After the confirmation of gender credibility as a newsagent, I would like to find how users process their thoughts when they consume information through voice agents.

Chapter 2

Literature Review

2.1 The Voice of Voice Agents

As AI agents became more popular these days, the role of the agents has reached a point where designers should consider interactions in specific situations and contexts. Therefore, this study aims to confirm two things. First, in terms of the credibility issue of news, what gender is perceived as the most credible. Second, if the gender preference reflects its impact on the given news contents, it is crucial to know what mental process people go through during the use of voice agents. If we are able to confirm these two, we can design a news voice agent based on actual users' mental models.

In designing voice agents and its services, consideration of voice is the most important component of all—because, obviously, that is the only way to show what character the agents have. In this respect, the presentation of voice has to be the first priority when you think of creating a persona (Lee, 2018). However, as Lee addressed in her paper '*Why Do Voice Activated Technologies Sound Female?*', gender is the most intuitive factor in deciding the character of voice agents. Also, she pointed out that traditionally, gender is an important indicator of communication. The history starts with ancient period when the

communication style of female is solely limited to submissiveness. Thus, in the forms of voice agents, gender and voice cannot be separated. When we discuss the designing of voice agents, it is very important to concern about gender.

Park, Hwang, and Lee (2019) suggests that in designing conversational agents for children, the agents must have various reactions for the users and non-verbal element should be applied to them. The authors of this study also argued there are insufficient explorations on the conversational method and aspects specifically voice, content, and non-verbal. And also, the application of social cues in the respect of communication is still lacking. The researchers also suggest that empirical researches on this subject—because it needs more investigation (Park, Hwang & Lee, 2019). As Lee (2018) addressed in her research, non-verbal aspects seem core parameters in the perception of users toward the voice of voice agents. In this respect, in terms of voice recognition, the gender of agents' voices can make a huge impact on the perception of users.

Baek, Park, Lee, and Kim (2019) research team designed interactive agents by age group, the 20s, and 60s, to attempt exploratory research on the reliability and intimacy of AI agents according to their age. A total of 10 participants participated in the study, and then the interactions between voice agents and participants were observed. As a result, in the case of emotional intimacy, all participants in their 20s felt deeper intimacy with voice synthesized voices in their 20s similar to themselves. On the other hand, participants in their 60s did not show much homogeneity toward voice

synthesized voices. Female participants in their 60s showed deeper intimacy with voice synthesized voices in their 20s with relatively high tones. However, for the reliability of interactive agents, participants preferred agents with voices in their 60s (relatively lower than those in their 20s) for reasons such as 'accurate pronunciation' and 'low tone' for reasons of preference for tone. Despite the limitations which were pointed out by the researchers, such as the level of speech synthesis (e.g., clear pronunciation of words or natural connection between sentences and sentences), this experimental study provides us a great clue of what persona studies should be like. The reliability of an agent can be thought of as linking it to the reliability of the information it is delivering, which can have a profound impact on activities such as information acquisition and consumption (Baek, Park, Lee & Kim, 2019). From this research, we can infer that people have a preference in a specific voice of voice agents. But, in order to narrow down the scope, it is also important consider what contents will be delivered by voice agents.

2.2 News and Voice Agents

In 2016, Alyssa Appelman and S. Shyman Sundar, who are communication and media scholars, conceptualized and constructed the message credibility scale of news articles. Furthermore, they validated the scale so that it can measure the message's credibility correctly and efficiently. They also pointed out that credibility is an essential concept in persuasion and

communication study (Appelman & Sundar, 2016). In the following sections, I will be discussing what news is and how news content and voice agents can be related.

If we take a look at the history of news consumption, the medium which delivers news was heavily dependent on a physiological form like paper. We are living in a society that people can dive into the sea of information anytime they want. In other words, it is now the era of 'diving into the sea of information limitlessly'. And of course, this changed the consuming pattern of news. As we know already, people can reach out to news on any platform like mobile phones, televisions, and AI speakers these days. The characteristic of these platforms or mediums is that they are available day and night. This means that we do not have to worry about reaching out to information when we are away from home or traditional workstations.

Even though news and voice agents seem different, the invention and development of news share few similarities with the invention and development of voice agents. As this study aims to measure and explore the credibility of the news contents which are delivered by various voice agents, it is necessary to learn about the factors that led to the invention and development of the two—news and voice agents.

Ever since the concept of news has risen, people's desire for which they want to be informed gets stronger. As the desire for being informed gets stronger, trusting the messenger who delivers or carries the information or

message naturally became important. When the discussion comes to the credibility issue, we should remind ourselves that the diversified channels of news content are significantly different from one and another. Especially if we try to compare such messengers as traditional news. From these backgrounds, we now know that the characteristics of channels vary, but the essential factors of making people believe news from its messenger are clear to define—no matter what channels we are talking about, these factors should be considered.

When we think about what character news has from the beginning, the news industry has been on the extensive profit- compatible world. Also, that made the growth of news. The growth of news has led industrialization of news. This proves that news became a business and market. Unfortunately, the credibility of the report is closely linked to the reputation of the messenger or teller. This important link in the fast-growing mass market has changed people's integrity, sights, as well as their perception of news content. Nevertheless, interestingly, the news was accepted as a part of the entertainment. Not only the news delivers or tells information, but also it conveys entertaining aspects of the facts--or sometimes what the news delivers is for entertainment alone (Pettegree, 2014).

These characteristics of news and voice agents are easy to tie with. First, they sometimes simply meant for information consumption. They do not interfere with the other media this time. Second, they also provide and have to provide the contents with social cues and signs while the delivery. In delivery,

it is important to implant social cues into contents because the receivers or users perceive them not only personally but also socially. Moreover, because both consuming news content and using voice agents are related to media interaction.

Like it was mentioned in the earlier section, information consumption and news consumption through agents share some similarities. Because both of the news consumption and using voice agents to consume information seek out entertainment and information, we should pay careful attention to the subsets of news and voice agents. When we consider the implementation of news content into voice agents, it becomes more important. And, as news and agents have several common denominators, it seems important to deal strictly with these common denominators in their combination.

2.3 Credibility of News

Credibility is such a concept that has various definitions and symbols. Depending on which field you are talking about, the meaning of credibility can be very different. Thus, this section aims to address how the use of the concept of credibility builds up--because this study specifically focuses on the credibility of news contents.

Aristotle conceptualized a paradigmatic concept called '*modes of persuasion*', and this is linked to credibility or *ethos* (McCroskey, 1966). The credibility or *ethos* comes under *modes of persuasion*. This concept formed and constructed a general definition or meaning of credibility—meaning this is not

only plausible in philosophical discussion and also general subjects. Aristotle's claim on credibility is currently widely accepted and used. In general, when we talk about media credibility, two different concepts that fall under *modes of persuasion* should be used--*pathos* and *logos* (McCroskey, 1966). Taken together, it seems like the concept of credibility can vary depending on which context and setting you are in.

Nevertheless, in journalism, the concept of credibility is quite similar to Aristotle's idea. In journalism, credibility is heavily focused on the message. Sundar (2016) quoted, 'Message credibility can be analyzed as a state, rather than as a structure or process… In addition, message credibility can be analyzed as an effect, rather than as a cause or mediator'. This argument can be supported by his earlier work, '*The MAIN model: A heuristic approach to understanding technology effects on credibility.'* Sundar claimed that social cues could be bases of perception on the credibility of each individual (Sundar, 2008).

Sundar outlines a model by which the technological affordance of media (i.e., modality, agency, interactivity, and navigability) cue cognitive heuristics that affect credibility assessments. Sundar's argument suggests that credibility is an individuals' judgment in a context of communication state. And this perception of credibility can be based on social cues (Sundar, 2008). This is the reason why if we want to talk about media credibility or news content credibility with agents, social cues are important. In this respect, we have to concern about how social cues would be applied to agents and their services.

Researchers who are in the Human-Computer Interaction field focus on credibility in a very specific context or setting. Typically, for instance, Fogg, Marshall, Kameda, Solomon, Rangnekar, Boyd, and Brown (2001) brought the credibility issues in web sites and articles on the web. The results of their study suggested that the presence of unfamiliar banner advertisements can lower the credibility of online articles. Also, having informal photographs of the author on the web, like a profile photo of the author, might affect how people perceived the article. And the perception of the article forms perceived credibility (Fogg, 2001). The results of this study suggest that the perspective of credibility in the Human-Computer Interaction field is heavily dependent on perception or reaction to certain contexts.

In light of the previous studies related to voice agents, there are still little and limited investigations on the content which is delivered by the agents. The discussions on voice agents should aim the components that form users' perceptions during the use of voice agents. Like Lee (2018) claimed that the gender of agents is the most intuitive aspect of the agents, so the verification of gender of voice agents should be discussed first in designing voice agents. This directly links to a mental model of users.

Chapter 3

Experiment

The purpose of this simulational experiment is to answer this following research question; will people rate the credibility of news content differently by the gender of voice agents? To answer this question, a within-subject experiment was conducted to test the credibility of proposed news articles through gender-controlled voice agents. The experiment was conducted on legal adult males and females who attended Seoul National University for about 3 weeks from December 3, 2019, to December 24, 2019. With the approval of the IRB (*the Institutional Review Board*) of the researcher's institution, participants were recruited from online websites for students who are enrolled in Seoul National University called Mozip.snu.ac.kr and SNUlife. A total of 45 students participated in the experiment, and 42 data with no data errors were analyzed. The demographic results of the participants were 21 males (50%) and 21 females (50%), and the age ranged from 20 to 29 years old. Each participant was compensated 5,000 won for their participation. All participants were notified to stop and leave the experiment whenever they feel overwhelmed or uncomfortable. The experiment was conducted for about 3 weeks from December 3, 2019, to December 24, 2019.

3.1 Methodology

Pilot Experiment

Before the actual experiment, a pilot experiment was conducted to see if the methodology of using previous research results is plausible. The goal of this pilot test was to decide the types of articles or subjects of article and length of the articles which will be presented by various voice agents. Five registered students at Seoul National University listened three articles. After the listening activity, a semi-structured interview was also conducted.

After participants finished with listening articles from the voice agents, I let them read the articles. Participants argued that even though the number of words is limited from 250 to 500, the perceptual difference exists. Interestingly, during the in-depth interview, the majority of the participants claimed that it was too hard to focus on the articles because it was too short. This represents that there is a perceptual difference between listening and reading. From the in-depth interview, it was obvious that the two activities, listening and reading, were significantly different activities. Therefore, reflecting the results of the pilot experiment, the actual experiment featured a minute or so of news articles for the participants so that they can pay more attention to the content.

Procedure

In this experiment, a total of three news articles were applied to agents with three personas (personas which made up of three different gender). To

avoid the effect of contents bias, the articles were presented to participants randomly--in other words, this was to control the connection of characteristics of a particular voice to specific article.

Before the experiment, specific instructions and procedures of this study were explained to the participants. They were guided to answer their biological sex first. After that, instruction for session 1 is as follows.

> "You will be listening to three news articles through this AI speaker. As you may see, the questionnaires are all adjectives. Each adjective can be scored 1 to 7 points. How well do the following adjectives describe the content you just heard--from 1 = describes very poorly to 7 = describes very well? Please fill out the questionnaire as soon as you finish listening to one."

Appelman and Sundar (2016) suggested asking participants how well the adjectives describe the given news article one by one. This way, participants can only focus on one article at a time. It is important to give the participants time to fully focus on one article—both its contents and voice.

In this study, a within-subject experiment was conducted to test the credibility of the proposed news articles through the AI speaker. An AI speaker called 'Smart ThinQ Hub' from LG Electronics was used as a voice agent in this experiment. This experiment was controlled by using a Wizard of Oz (WoZ)

as its methodology which is a well-known methodology in the Human-Computer Interaction (HCI) field. What Wizard of Oz does is that participants did not know the entire experiment and the system is controlled by moderators. In this study, news articles were played, and participants did assume that the AI speaker was playing on its own.

Article Selection

According to a study published in 2016 by Alyssa Appelman and S. Shyman Sundar, measuring the credibility of an article has few criteria. Before their research, there was no clear measurement to rate media credibility. They sought to measure the message credibility of news articles. They recruited their participants from Amazon Mechanical Turk (MTurk) and gave each participant two different types of articles. One had low credibility and the other one had high credibility. By comparing the reaction of these two types of articles, the researchers could construct profound indicators to measure the message credibility of news (Appelman & Sundar, 2016). This was also tested by professional journalists. The articles were given with no affiliation, name of the writer, and any other information or sources that could show additional cues for the article itself. In this way, they successfully extracted the message only. The purpose of this study was to measure the message credibility of a news article. The researchers claimed that in this type of experiment it had to use articles that are not biased. The 'biased' meant not sourly delivering a one-sided source but

any kind of subjects that one can have his or her own opinion. For instance, to measure the credibility of an article, you should not give the participants anything political which can always be perceived in a different manner. Also, the article should not exceed more than 500 words. (Appelman & Sundar, 2016).

For my experiment, three articles were presented to the participants. Also, the given articles were from a highly credible publishing company in South Korea. As Alyssa Appelman and Sundar Shyman addressed in '*Measuring message credibility: Construction and validation of an exclusive scale* (2016)', use of articles which have decent quality is the key of this experiment. In this experiment, to avoid biased opinions or having personal perspectives toward a topic, articles were selected randomly from the health, environment, technology, regulation and economics section.

Designing Agents' Voice

Generally, the fundamental frequency of adult males has 108.05 Hz. On the other hand, in the case of adult females, the range of fundamental frequency Hz shifts higher than man; the spontaneous speaking was 188.85 Hz for females (Hudson & Holbrook, 1982). But there is an argument that in the speaking, people tend to have different fundamental Hz depending on age and sex (Traunmuller and Eriksson, 1995). As Cyril R. Pernet and Pascal Belin asserted that pitch and timbre are the main variable to categorize human voices

(Pernet & Belin, 2012). In this experiment, the voice of agents was designed based on the average range of the fundamental frequency Hz of each sex. Since both sex and fundamental frequency Hz decide the voice tone together, they had to be considered to match pairs of sex with Hz.

The creation of agents' voices went through several steps. First, the base voice was created through Google's text-to-speech technology. However, without modification with real voice of human, text-to-speech can be sound too machine-like. Thus, a female voice actor was hired, and she recorded voice acts for each agent. Each voice of agents was then modified and combined with the pre-made text-to-speech voice file. These sounds were later modified into different levels of fundamental frequency Hz by Sony VEGAS Pro 17. The voices can be categorized by female-like (183 Hz), male-like (133 Hz), and androgynous-like (154 Hz) voices. The subjects of the articles were translated from Korean.

Table 1. The subjects of the articles

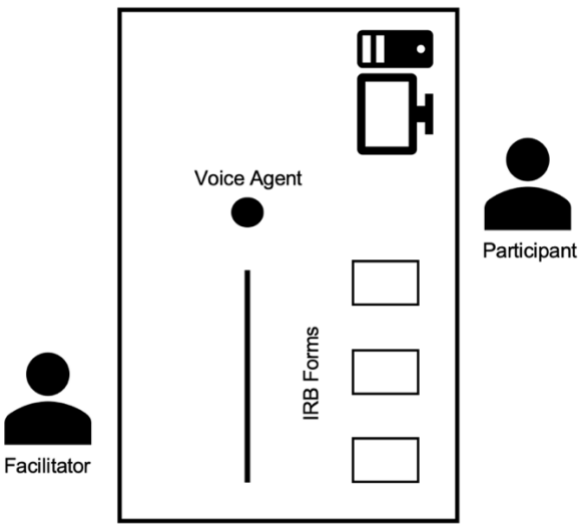
The subject of the Article
Regulation renewal regarding the information on clinical trial information registration and disclosure system
Levels of atmospheric carbon dioxide
A recent case of cholera infection

`Full texts of the articles are given in *Appendix 1*
`These are translated from Korean.

Experimental Setting

Since this study used Wizard of Oz methodology, the facilitator supposed to look after the participants' action. Thus, in a big table, a facilitator was seated at the right in front of the participants. However, from their sight, they cannot see the facilitator during the experiment. And a smart speaker was placed between the facilitator and the participant. The participant used a pre-setup desktop for answering the credibility scale. IRB forms and all the documentation regarding this study were presented like *Picture 1*. This way, the participants were allowed to read the documentation regarding this study at any time they wanted. Refer to *Picture 1* for the information regarding room setting.

Picture 1. Room Setting



3.2 Results and Discussion

Female Agent and Credible News Article

This experiment seeks to find out if there is a significant credibility difference in news articles depending on agent's gender. The experiment was conducted on adult males and females who were enrolled as students at Seoul National University for about 2 weeks from December 3, 2019, to December 13, 2019. A total of 45 people participated in the experiment. However, for the quality of data analysis, 42 data with no data errors were analyzed for the final analysis. Thus, the demographic results of the subjects were 21 males (50%) and 21 females (50%), and the age ranged from 20 to 29 years.

For the data analysis, R package was used to conduct One-way ANOVA. To present significance of this experiment, *Table 2* shows the details of statistical analysis. On Table 2, the *Tech Fam*. stands for self-reported familiarity in technology. The *News use* means preference of news access (text based or audio based). Both technology familiarity and use of news platform had no statistical significance. However, there were statistical significance between male($p<0.0334$) and androgynous($p<0.0154$) agents depending on the sex of the participant. Female participants gave the highest credibility score to news contents which were delivered by androgynous agents –the average score was 16.42, on the other hand, male participants rated news contents which were delivered by female agents as the most credible contents –the average score was 14.76.

Table 2. Results of analysis of variance (One-way ANOVA)

Source of Variance		SS	df	MS	F	p-value
Male Agent	Tech Fam.	2.4	1	2.432	0.23	0.634
	Sex	46.1	1	46.1	4.855	**0.0334***
	News use	27.6	1	27.647	2.777	0.103
Female Agent	Tech Fam.	23.0	1	23.0	2.14	0.151
	Sex	1.9	1	1.929	0.171	0.681
	News use	0.0	1	0.006	0.0	0.982
Androgynous Agent	Tech Fam.	17.58	1	17.581	2.453	0.125
	Sex	42.0	1	42.0	6.405	**0.0154***
	News use	16.79	1	16.793	2.336	0.134

`p<0.05
`(reject the null hypothesis at the 0.05 level of significance.)

Chapter 4

Semi-Structured Interview

In Chapter 3, I tried to answer to the research question of the existing effect of gender of voice agents in perceived news credibility. However, since the experiment cannot give us a full scope of what thought process users went through during this experiment, a semi-structured interview was conducted to capture participants' detailed thoughts. What factors do users concern and expect when they use voice agents as information providers? How the propensity of news consumption can be related to gender of voice agents? In this section, the possible explanations on these questions above will be addressed.

The message credibility which was used in this study was conceptualized and constructed by communication researchers, Alyssa Appelman and S. Shyam Sundar in 2016. Just like other types of scales, the score of credibility may present participants' overall preference or initial reactions but not their perception and mental process of giving more credits to the female-like agent. Moreover, *Experiment 1* is exploratory research based on simulation activity. Thus, this semi-structured interview was conducted to have a deeper

understanding of the previous *Experiment 1* and overcome the limitations in credibility scale—which scores cannot represent users' process of agent use. This semi-structured interview was held in Korean—but it was transcribed and analyzed in English by the researcher.

4.1 Semi-Structured Interview

Scores of the credibility scale cannot represent the logical process of participants in giving higher credibility to articles that were delivered by female agent. Therefore, for such a reason, this semi-structured interview session was conducted under 2 agendas. First, I aimed to see participants' information consumption propensity through voice agents in general. Second, I also wanted to find out participants' personal opinions on voice news agents. To achieve these two agendas, in this interview, participants were asked to answer and share their thoughts on each question. Open-ended questions were dominant because the intention of having this session was to discuss and share participants' ideas and mental process in suing voice agents as news deliverer. Most participants were opened to share their personal experiences and thoughts in general. In Chapter 5, based on the results of this interview, a guideline of users' mental process of using news voice agents with gender-specification.

Participants were given some instructions before they got into the actual interview. They were allowed to share their personal opinion at anytime during the interview. Participants were able to ask questions and the facilitator

could change directions of questions freely. Refer to *Table 3* on the next page to find details about the semi-structured interview questions. The questions were translated from Korean.

Table 3. Interview Questions

Question	Questions Related to Contents	Questions Related to Voice Agent
News Contents Message Information	*`Generally, which platform do you use to access or reach news and why?* *`What do you consider the most when you choose to read/listen/watch the news?* *`Let' s say someone hands in a piece of information to you. If you want to say ' I trust thins information' , what factor this the most important and clout?*	*`Please list from the most credible agent to the least credible agent. And explain why you think so.*
Agent	*`Tell me which article was easy to listen to and why.* *`In Contrast, tell me which article was hard to listen to and why.* *`In order for AI agents to become more effective information providers, what should be more developed and why?*	*`How often do you use your voice agents and why?* *`If you do not use voice agents, why don' t you use them?* *`Why do you think that other people use voice agents?* *`Please guess what people expect from using voice agents (The reasons can be anything like functional technical, and etc.)*

4.2 Results and Discussion

For the data analysis, only 42 out of 45 were analyzed—for the data quality, 3 of them had to be disregarded. In sum, more than half of participants showed strong preference and trust in female AI agent voice. No matter what news contents were given from the agents, people wanted to receive it in a very familiar environment and setting—this includes personas, voice, and format of contents.

People prefer to consume news in a very private way. Even though voice agents give useful search results, knowing that others can hear what they are hearing from the agents is a burden. And this private concern often blocks people from using similar service.

There were five big categories: news consumption, familiarity in technology, the exploratory propensity in using technology, the propensity of information consumption, and lastly gender preference on voice agent. From the interview, participants answered each question and the responses of each question were analyzed and group either yes or no, weak or strong, OR leader type or follower type. Participants had various concerns and expectations on each agenda.

Table 4. Themes of semi-structured interview (results)

	Group	Concerns	Expectations
News consumption (in general)	Text-based	`privacy `skimming (Time saving)	`clear sentences `skimable texts for time saving
	Audio-based	`multi-tasking (lesser con-centration)	`simple sentences
Familirarity in technology (familiarity on voice agents)	Yes	`sources of the articles in the experiment `sources of the agents from the experiment	`humna-like voice agent
	No	`sources of the articles in the experiment	`machine-like voice agent
Exploratory propensity in using technology (related to voice agents)	Weak	`sources of information which delivered from agents	`emotional aspects of agents `interacting with agents who can do non-verbal communication
	Strong	`lack of product choices in real world or market	`diverse persona and characteristics of voice agents
The propensity of information consumption (information consumption via voice agents)	Leader Follower	`algorithms of article selection	`clear delivery (linguistically) `simple sentences
Gender preference (on voice agents)	Yes	`commitment in specific gender at any subject	`definite persona of agents `choices of various agents depending on services or contents
	No		`hearing various voices of agents

Gender Preference - Familiarity in Female Agents

Taken together, participants prefer the female-like agent because they feel that female-like agents are the most familiar voice.

> "The biggest problem with current voice agents is that they sound all the same. If the content changes, I guess the voice and the delivery should be changed as well." (P10)

> "I liked hearing news from the female-like agent. It sounds more familiar to me and that is important—it is just a personal opinion." (P32)

News Consumption – Text-Based vs. Audio-Based

People who prefer to consume news content from mobile phones usually concern about time saving and expect clear sentences to understand quickly. Interestingly, people who care about timesaving in news consumption, think that watching TV news and listening to voice agents are very time-consuming. They argue that text-based news is a very efficient way of consuming news because you can skim.

> "To me, consuming news is just for the updates—nothing more. It has to be quick and simple. I do not want to spend too much time and pay attention for a long time. For this, mobile is the best way to approach because you can skim many articles at once." (P20)

> "I guess I use mobile phones all the time because I can see the news updates every second and minute. If I want to dig one issue that was on the web, I can jump up to another article that is related to that subject. It is easy and quick." (P04)

However, people who prefer audio-based news listed different concerns and expectations in news consumption. They prefer audio-based news because they'd like to multi-task while listening to news from agents, radio, or Youtube. Even if people consume news through video platforms, they often multi-task. People concerned about the length of articles because if the article is too long, they think that they could miss important aspects of the article.

Exploratory Propensity in Using Technology - Desires of Meeting Various Agents

However, besides these opinions, some say they want to see more various personas in agents who have a voice of 'well-known characters or celebrities.

> "I'd like to hear more diversified voices of voice agents. I feel like all agents have the same tone of voice, attitudes, and so on. I want Pengsoo voice agent! " (P27)

> "The voice sounds all the same whichever contents I listen to. That makes me kind of bored. I want it to be a more active and characterized figure because I think AI speakers are for entertainment." (P39)

The reason for seeking for various characteristics in AI agents is that people often get bored and tired of listening content in one tone. Some participants wanted to meet diverse agents because they are not afraid of investing their energy into adapting new technologies and agents who have different personas. We now know that the desire of meeting and interacting with diverse agents exists among general users of voice agents.

The Propensity of Information Consumption

Also, some participants argued that they do not want to use voice agents who present to be an active information provider. In other words, there were two types of propensity of information consumption through voice agents: leader and follower.

> "I feel uncomfortable when any types of agents pretend that they have the key to source and power. I want them to stand as an information giver who just delivers what it has been transferred into their database." (P07)

This type of reaction is quite close to what has been found in the previous researches on the level of intervention of the AI agents. Oh, Song, Choi, Kim, Lee, and Suh (2018) have found that participants of their study wanted AI agents to be assist-role-centered not a leader type. In this study, they conducted a drawing activity experiment to see how much and when people prefer to be helped in drawing from the AI agents. People are seen as wanting to get the right help from the agents only when they want it, and not taking further help or action from them if it seems unnecessary or over their boundaries. Even if an agent does not directly act as a leader to a user, the user does not want to see the agent act as an agent with free choices and wills. If we remind the reaction of this research, participants wanted a voice agent with a friendly persona or voice with just the right nuance of an assistant, not a perfect facilitator or carrier of information. Thus, when we design such services on information delivery by voice agents, the persona should be grounded with very familiar features. In addition, the agents must be an indication that it is a simple informant and should not intervene further or take actions that appear to be capable of more than messengers. Because if the user feels that the voice agent is managing and controlling the information or services that the user receives, the user might show a significant rejection.

Chapter 5

General Discussion

To sum up, this paper aims to answer the research question of possible credibility differences in news content by the gender of voice agents. The analysis of both experiments and semi-structured interviews only aimed at 42 participants who did not have any data errors. Female participants gave the highest credibility score to news contents which were delivered by androgynous agents, however, male participants rated news contents which were delivered by female agents as the most credible contents. In this section, to take a step further from the results of a semi-structured interview, I would like to suggest a mental model of users who use voice agents as informants.

Application of Thoughts of Real Users

Chris Duffey proposes a framework called 'SUPER' in his book called '*Superhuman Innovation: Transforming Business with Artificial Intelligence*' which was published in 2020. This framework includes five factors: speed, understanding, performance, experimentation, and results. The author claimed that these factors form the business innovation of artificial intelligence must be considered (Duffey, 2020). This book sharply indicates the vision of artificial intelligence in business. The proposed knowledge by Duffey is suggesting us a

few lessons. The author suggests that developing services based on basic human needs and desires is the key to AI business. At the heart of the discussion on AI is not the technology itself. It is about how technology can be used and where it can be applied. With this consideration, defining the role of humans and AI is also important. AI should be an assistant, colleague, or manager (Duffey, 2020).

In 2017, IKEA's innovation lab called 'Space10' released a result of their survey on what people want from AI. People who were involved in this survey reported that they would like to interact and meet gender-less persona other than a definite gendered persona of AI agents (Schwab, 2017). This stands that the users in the real-world are ready and expected to meet diversified persona of agents. Because the majority of millennials and generation Z reported that they need an expended gender option rather than a dichotomous concept in gender, the discussion on the diversity in persona towards gender is probably more wide-speared among the young generation, especially after the millennial generation (Parker, Graf & Igielnik, 2019). Even if people prefer and give more credits to female agents, it is still important to invest more efforts to let users to explore diverse choices by using their products or agents. Nevertheless, by far, it seems that people in the industry did not pay attention to the mental model of the real users. If we know what mental process that users go through during the use of voice agents, in terms of information consumption, it will be easier to design services and products.

The Mental Model of Voice Agent Users

If you are designing a product, you have to remind yourself that what users will do with your product. And this, of course, includes that you also have to fully understand what the goal can be achieved by using your product, and how will your users achieve the goal through the process during the use of your product. In sum, you have to know what users think through while using your product and what they expect from it in the end. To find out the process of user's mental process, you first need to think about how users process their thoughts. This mental model will later help you to improve the tactical aspects of work strategy and product or service design (Young, 2008; Jung, 2009).

In the earlier paragraph, I have discussed why we need to have such a mental model of users in the respect of information consumption. Here, I suggest a mental model that users go through during the use of voice agents as informants and this model possible allow us to have a constructive view of information consumption through voice agents. This only considers users who consume information, news, through agents. People consider different components when they use voice agents as news deliverers. In the following section, I will be giving the components that form the mental model of users; the components which form users' mental model in a situation when people use voice agents as informants will be addressed. From the results of semi-structured interview, approximate preference and tendency were addressed but this does not show mental process of users. In designing informants voice

agents, these are the questions that designers might ask themselves as well as users to ground its service. Each bold-fonted statement is corresponding to mental spaces of tasks and contents. As description of mental spaces, statements right following of mental spaces, represents contents. The statements with italic fonts are corresponding to task. In detail, in Young's mental model, task used aa a comprehensive term; task includes emotion, thinking, action, and so on. If tasks can be grouped, this became a column of tasks. In the end, tasks lead to contents; contents are behaviors or actions which based on tasks (Young, 2008; Jung, 2009). Refer to the *Table 2* for a full picture of the mental model.

Concerns During the Use. If people have these concerns below, people take a step further to verify the quality of information which was either delivered by voice agents or any other platforms which provide news articles.

Source of the news: People did a careful attention on the source of the news no matter which platform they use.

Accuracy of the news: Along with the source of the news, the accuracy was also important. Here, the accuracy means clear and definite tone of opinion delivery.

Neutral: People cared and concerned about biased news. They wanted neutral perspectives toward issues that were being addressed in the news.

Consistency of the presentation: If the consistency of the presentation breaks down, people would stop listening or reading news and re-search for alternative news to get proper information.

Factitious delivery: The factitious flow of news delivery blocks people to concentrate. This link to the natural way of delivering news like a news anchor—people claimed that most of voice agents deliver news like machines. As soon as people hear factitious delivery of news, they were thinking to switch its channel.

Recognition: Current voice agents do not recognize which users they are talking to. Even if a device belongs to person A, it still responds to person B.

Verbalness accuracy: People were concerned about the fact that they do not know what words can be recognized by voice agents. With this idea, people wanted voice agents to have a broader range of words recognition. Also, people thought that the current systems do not reflect real-life verbalness.

Privacy: People worried that others who are near them can also listen to what people request and voice agents say.

Expectations During the Use. If a voice agent meets with the expectations, people are willing to use the agent as the main informants and multitask.

Clear argument: The news should be very clear with their main argument and issue.

Presenting highly topical news of the day: Providing topical issue of the day might save user's time spending on news browsing.

Clear presentation of news: People wanted to listen to the news with a clear presentation—if the presentation is unclear, people must pay more energy to understand its content and to find the main arguments of the news. In this respect, people expect a clear presentation of news in order to easily understand the news without spending too much energy.

Precise setting for personal use: People expect and were excited to meet personalized voice agents; recognize one's voice accurate and so on.

Presenting news based on one's interest: Along with the *precise setting for personal use*, people also wanted voice agents to learn what topics the users

Leading to a broader perspective of the news: People want voice agents, or AI conversational agents, to be informative with broader scopes them; because people think agents have millions of databases of news.

Anchor-like delivery: In news delivery, people want agents to be formal anchors.

Providing follow-up news automatically: People want automatic suggestion of follow-up news related to the news that they just listened.

Format of the news: People want voice agents to provide news with a listener-friendly format.

The most viewed news of the day: People want AI agents to assist in catching up the most viewed news of the day.

Emphasizing important aspects of the news: People also want AI agents to emphasize important aspects of the news to understand the news intuitively.

Summary of topical newses: Some people did not want to listen to the whole context of the news; they want a brief summary of newly updated news of the day.

Gender-free persona: Some participants wished to meet gender-free voice agents; like voice of famous characters to feel entertainment aspects of the news.

Level of Credibility. With and without each factor below, the perceived credibility of news from the agent will either increase or decrease.

Artifactual voice: Participants showed decrease in credibility when the voice of voice agents feels too artificial.

Accessibility: If it is too hard to approach the news topics that people want to listen to, people presented a decrease in the credibility of voice agents as news deliverers.

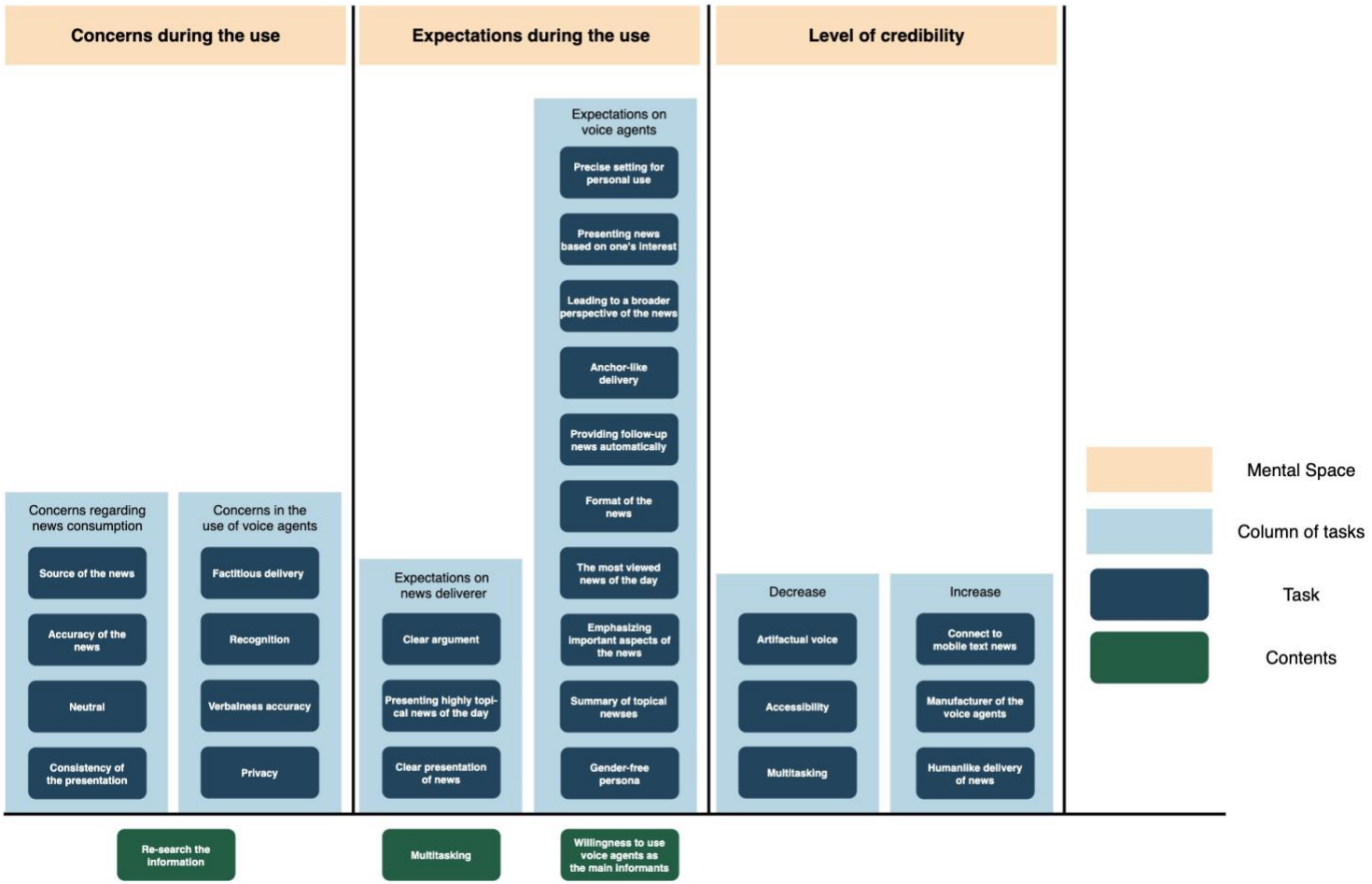
Multitasking: People showed a great decrease in credibility and likability toward voice agents if the agents disturb multitasking.

Connect to mobile text news: If the voice agents are able to be connected with various devices that people owned, people showed an increase in credibility (e.g. mobile phone).

Manufacturer of the voice agents: Some people explained that the credibility of news can also come from the brand royalty on the manufacturer of the voice agents.

Humanlike delivery of the news: If an agent has a human-like voice, people show a slight tendency of an increase in credibility (this was extracted from the comparison question of choosing a human-like voice versus machine-like voice).

Picture 2. A Mental Model of Consuming News Through Voice Agents



Limitations

Limitations

First, due to a technical issue, the variations of voice remain as the first limitation of this experiment. For instance, there might be a possibility who prefers an energetic androgynous voice over a female voice. In this respect, even if this study specifically focuses on the news credibility in the persona which was based on sexes, this research should be further investigated with the advanced technology with diversified voices of females and other genders. Second, in the experiment, the participants were limited to the age of 20s and registered students of Seoul National University. Since these people tend to have a similar lifestyle and education history, this work might have to be extended to the bigger population to verify its generalizability. For instance, Thirdly, the long-term experience of voice agents and interaction between user and newsagent (AI agents who provide news) was not addressed in this study. This study only addresses initial expressions and reactions toward newsagents and news articles. Even there is a little possibility that long-term use of voice agents as news messengers might have a different impression, further research is still needed.

Conclusion

Since the voice agents became popular information deliverers in our daily lives, the investigation on its credibility seems necessary. This study illuminates the credibility of news contents which delivered by different sexes. This exploratory study has taken a step further from previous approaches in this field. Previous studies on gender regarding voice agents have so far agreed with the consensus which voices of female agents are generally preferred over agent voices of other sexes. Where gender discussions are not limited to voice agents but treated in a broader sense, discussions on gender preferences and credibility by contents have not yet been agreed upon. However, this research confirmed that people give more credits to news that was delivered by female agent. Like Zdenek (2007) argued that agents with clear gender-related personas may strengthen the social model, there needs more explorations on the investigation of what can form a plausible variation of persona.

In designing credible informational services of voice agents, it is important to consider what mental process users actually go through during the use. Without considering users' mental models, the UX designers or researchers have to run through the same steps and questions everytime they try to look at the behaviors and thoughts of users'. By keep wondering what real users want to do with designers' products and what behavioral and thought processes involve achieving the goal, it becomes possible to make successful

products (Young, 2008; Jung, 2009). Thus, the suggested mental model in this paper will help to ground further researches and UX designs of voice agents and prevent repetitive verifications.

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Appendix 1

Subject: Regulation renewal regarding the information on clinical trail information registrationand disclosure system

환자와 보호자가 실제 활용할 수 있는 세부정보까지 확인할 수 있도록 하는 임상시험 정보 등록·공개 제도가 이달 말부터 본격 시행된다.

식품의약품안전처는 오는 26 일부터 임상시험 관련 대상 질환, 병원 연락처, 참여자 기준, 진행 현황 등을 환자나 보호자가 쉽게 확인할 수 있도록 '의약품안전나라' 홈페이지에서 제공한다고 24 일 밝혔다. 해당 홈페이지 내 임상시험 정보 메뉴에서 임상시험 정보공개를 선택해 검색하면 된다.

지금까지는 임상시험 제목과 실시 병원 등 단순 정보만 공개됐으나 앞으로는 △임상시험 제목 및 목적 △임상시험 실시 병원 △병원 전화번호 등 문의처 △임상시험 참여 기준 △진행 현황 △상세한 대상 질환 등 환자 또는 보호자가 실제 활용할 수 있는 세부정보까지 확인할 수 있게 된다.

세부정보 공개는 오는 26 일부터 승인되는 임상시험부터 적용된다. 제도 시행 전 승인된 임상시험의 경우 순차적으로 세부정보를 제공할 예정이다.

식약처는 "이번 정보 공개가 임상시험 참여를 원하는 환자들뿐만 아니라 연구자, 기업의 연구·개발에도 도움이 될 것으로 기대한다"고 밝혔다.

URL:
http://www.dt.co.kr/contents.html?article_no=2019102402109931102001

Subject: A recent case of cholera infection

올해 첫 해외유입 콜레라 환자가 발생했다. 보건당국은 콜레라 유행 지역을 여행할 때 감염되지 않도록 주의해달라고 당부했다.

질병관리본부는 지난달 29 일 오전 6 시 대한항공 비행기(KE482)를 타고 인도 델리에서 국내로 입국한 54 세 여성이 콜레라 환자로 확인됐다고 1 일 발표했다. 이 환자는 설사 증상을 호소해 검사를 했고 환자의 채변에서 콜레라 균이 나왔다.

환자 상태는 양호하다. 추가 감염을 막기 위해 격리하고 있다. 질병관리본부는 환자가 입국한 뒤 국내에 머물면서 접촉한 사람들에게 콜레라 증상이 나타나지 않는지 확인하고 있다.

질병관리본부는 같은 비행기를 탄 승객 중 심한 설사 증상을 호소하는 사람이 있다면 가까운 병원을 찾아 검사 받으라고 당부했다. 콜레라 환자를 진단하거나 치료한 병원은 관할 보건소에 신고해야 한다.

정은경 질병관리본부장은 "여행지가 검역감염병 오염지역이라면 입국할 때 건강상태 질문서를 작성해 검역관에게 제출해달라"며 "해외 여행할 때는 올바른 손씻기, 안전한 식생활 등 감염병예방수칙을 지켜달라"고 했다.

URL: https://www.hankyung.com/society/article/201911018392i

Subject: Levels of atmospheric carbon dioxide

대기 중 이산화탄소 농도가 지구에 인류가 탄생한 이후 가장 높은 수준을 기록했다고 CNN 이 12 일(현지시간) 보도했다.

이는 기상학자 에릭 홀로더스(Eric Holthaus)가 트위터를 통해 밝힌 것으로 그는 "지구의 대기가 415ppm 이 넘는 이산화탄소 수치를 보인 것은 인류 역사상 처음이다"고 트위터를 통해 밝혔다.

미국 하와이에 있는 마우나로아관측소 자료에 따르면, 지난 11 일 대기 중 이산화탄소 농도는 415.26ppm 을 기록했다. 이 수치는 호모 사피엔스의 진화 이전인 약 80 만 년 이후 가장 높은 수준이라고 CNN 은 전했다.

지구 역사상 이산화탄소 수치가 가장 높았던 시대는 지금으로부터 약 300 만 년 이었던 플라이오세 시대였다. 이 당시 지구의 온도는 지금보다 2~3 도 따뜻했고, 이산화탄소 농도는 310~400ppm 사이였던 것으로 알려져 있다.

그 당시 북극은 얼음이 아닌 나무로 덮여 있었으며, 북국의 여름 기온은 섭씨 15 도, 지구 해수면은 지금보다 25 미터 높았던 것으로 추정되고 있다.

대기 중 높은 이산화탄소 농도는 지구의 자연스러운 냉각 순환이 이뤄지지 못하게 하고 지표면에 열을 가둬두어 지구 온도를 상승시킨다.

이산화탄소와 다른 온실 가스의 배출로 인해 이미 지구의 기온이 1 도 상승했으며, 세계가 보다 즉각적인 조치를 취하지 않는다면 지구 온도는 더 상승할 가능성이 높다고 외신들은 전했다.

URL: http://dongascience.donga.com/news.php?idx=28749

국문 초록

음성 에이전트와 관련된 이전의 연구에서 비추어 볼 때, 음성 에이전트에 의해 전달되는 내용에 중점을 둔 논의들은 매우 제한적으로 이루어졌다. 음성 에이전트에 대한 논의가 에이전트와 사람들 사이의 일반적인 상호작용 즉, 이른바 스몰톡을 주로 다루고 있는데 이는 음성 에이전트 설계와 이 에이전트에 삽입되는 서비스를 설계하기에는 부족하다. 하여, 본 연구에서는 음성 에이전트의 가장 직관적인 측면이라 볼 수 있는 성별과 관련된 뉴스 컨텐츠에 대한 사람들의 신뢰도를 살펴보고자 한다. 더 나아가 반구조화 인터뷰를 통해 음성 에이전트를 정보 소비의 창구로서 사용하는 유저들의 멘탈 모델을 제시한다. 총 45 명의 서울대학교 학생들이 오즈의 마법사 방법과 반구조화 인터뷰에 참여하였다. 참여자들은 어떤 성별을 가진 음성 에이전트가 전달하는 뉴스에 가장 신뢰가 가는지에 대해 응답하였으며, 이후 뉴스 소비 성향에 대한 인터뷰에 참여했다.

주요어 : 뉴스, 멘탈 모델, 성별, 신뢰도, 음성 에이전트
학번 : 2018-29968