**Codebook for User Experience Thematic Analysis**

# Introduction

This codebook is designed for the thematic analysis of studies of user experience for AI in radiology. By following the PRISMA process, the systematic review identified 13 studies to be included for analysis. As described in the systematic review protocol, a thematic analysis was selected as the most appropriate and used a primarily deductive approach with inductive processes completed as needed. The Unified Theory of Acceptance and Use of Technology (UTAUT) was chosen as the conceptual framework for designing the codebook. The codebook was developed by team members through brainstorming, research, and group discussions. Since the thematic analysis was not strictly deductive, the codebook was modified and added to over several iterations to best reflect the data extracted from the included studies.

# Method

## Initial Generation

The conceptual framework chosen for the thematic analysis was the UTAUT model. It was selected because it was rigorously tested and developed from eight different models of acceptance. The thematic analysis aimed to identify factors impacting on the workflow, and use and acceptance of AI in radiology was anticipated to provide a strong foundation for these factors.

To develop initial codes, team members researched the UTAUT model and brainstormed sub-themes for each of the constructs in the UTAUT model. The article “User Acceptance of Information Technology: Toward a Unified View” by Venkatesh et al, was the primary source for defining codes because it discusses the development and testing of the UTAUT model, including which parts of the existing models make up each construct.

## First Iteration

During the individual coding process and team review modifications and additions to the codebook were identified. For effort expectancy, it was found that there was overlap between codes which made it challenging to classify data. To rectify this issue, EE2 and EE3 were renamed ‘learnability’ and ‘complexity’ and the examples were shuffled to best reflect the codes. The code FC2 was named ‘facilitating conditions’ which is the same name as the theme, so the team decided upon ‘support’ as the new name to better reflect its description and examples. Team members identified a range of data which did not fit into the existing codes, and these broadly related to the attitude of the participant. Therefore, the theme ‘personal attitude’ was created. The first three codes for this theme were clearly and easily defined as ‘acceptance’, ‘willingness’, and ‘trust’. The remaining data referred to concerns such as legal issues, cost and funding, safety, security, and risk in general. It was decided that each of these concerns are risks of using AI, so they were combined into a single code which was called ‘risk’.

# Codes

The codebook is divided into sections by the UTAUT model constructs which are used as the themes.

## Performance Expectancy

Performance Expectancy is defined as “the degree to which an individual believes that using the system will help him or her attain gains in job performance” (Venkatesh et al., 2003).

| Code mnemonic | Code name | Code Description | Examples |
| --- | --- | --- | --- |
| PE1 | Efficiency | The efficiency of the workflow of radiologists is affected by integrating an AI product in the workflow. | 1. Changes to the amount of time required to complete tasks. 2. Different amount of time spent on routine tasks. 3. Change to the amount of time in the workflow. 4. The quantity of work output has changed for the same amount of effort. |
| PE2 | Effectiveness | The effectiveness of work produced by radiologists in their workflow is affected by integrating an AI product into the workflow. | 1. Changes to the quality of the work output. 2. Changes to the accuracy of diagnoses. 3. The usefulness of the product. |
| PE3 | Extrinsic motivation | Integrating an AI product into the workflow achieves outcomes which are extrinsic motivators or demotivators for radiologists. | 1. Changes to working conditions. 2. Changes to pay. 3. Changes to job security. 4. Changes to chance of promotion. |

## Effort Expectancy

Effort expectancy is defined as the degree of ease associated with the use of the system (Venkatesh et al., 2003).

| Code mnemonic | Code name | Code Description | Examples |
| --- | --- | --- | --- |
| EE1 | Perceived ease of use | The degree to which a person believes that using a system would be free of effort. | 1. I would find the system easy to use 2. Overall, I believe that the system is easy to use |
| EE2 | Learnability | The degree to which a person believes that learning how to use the system will be easy or difficult. | 1. Easy to learn to use system 2. Easy to become skillful at using the system 3. It takes too long to learn how to use the system to make it worth the effort. 4. Learning to operate the system is easy for me. |
| EE3 | Complexity | The degree to which a system is perceived as relatively difficult to understand and use. | 1. Easy to get the system to do what I want it to do. 2. Interaction with the system would be clear and understandable 3. Find the system to be flexible to interact with 4. Working with the system is so complicated, it is difficult to understand what is going on. 5. Using the system involves too much time doing mechanical operations (e.g., data input). 6. Using the system takes too much time from my normal duties. |

## Social Influence

Social influence is defined as the degree to which an individual perceives that important others believe he or she should use the new system. (Venkatesh et al., 2003).

| Code mnemonic | Code name | Code Description | Examples |
| --- | --- | --- | --- |
| SI1 | Subjective Norm | The person's perception that most people who are important to him think he should or should not. Perform the behaviour in question. | 1. People who influence my behaviour think that I should use the system. 2. People who are important to me think that I should use the system. |
| SI2 | Social Factors | The individual's internalisation of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others,in specific social situations. | 1. I use the system because of the proportion of coworkers who use the system. 2. The senior management of this business has been helpful in the use of the system. 3. My supervisor is very supportive of the use of the system for my job. 4. The organisation has supported the use of the system |
| SI3 | Image | The degree to which use of an innovation is perceived to enhance one's image or status in one's social System | 1. People in my organisation who use the system have more prestige than those who do not. 2. People in my organisation who use the system have a high profile. 3. Having the system is a status of symbol in my organisation |

## Facilitating Conditions

Facilitating conditions are defined as the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system. (Venkatesh et al., 2003).

| Code mnemonic | Code name | Code Description | Examples |
| --- | --- | --- | --- |
| FC1 | Perceived Behavioural Control | Reflects perceptions of internal and external constraints on behaviour and encompasses self- efficacy, resource facili- tating conditions, and technology facilitating conditions. | 1. I have control over using the system. 2. I have the resources necessary to use the system. 3. I have the knowledge necessary to use the system. 4. Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the system. 5. The system is not compatible with other systems i use |
| FC2 | Support | Objective factors in the environment that observers agree make an act easy to do, including the provision of computer support. | 1. Guidance was available to me in the selection of the system. 2. Specialised instruction concerning the system was available to me. 3. A specific person (or group) is available for assistance with system difficulties |
| FC3 | Compatibility | The degree to which an innovation is perceived as being consistent with existing values, needs and experiences of potential adopters. | 1. Using the system is compatible with all aspects of my work. 2. I think that using the system fits well with the way I like to work. 3. Using the system fits into my work style. |

***Personal Attitude***

As the research advanced to the data extraction process, it is to the team’s recognition that the four initial factors adapted from the UTAUT model are not sufficient. The team discovered that a significant percentage of the data extracted points toward the subjective opinion of the participants because of the nature of these articles are evaluation user experience. Thus, a new factor ‘personal attitude’ is added after group discussion. This factor directly reflects the subjective attitude of the participants toward AI technology used in medical imaging from four aspects: acceptance, willingness, trust, and risk.

| Code mnemonic | Code name | Code Description | Examples |
| --- | --- | --- | --- |
| PA1 | Acceptance | The factor intentionally examines the personal level of acceptance of the participants. It reflects whether or not the participant welcomes AI as an innovative factor to the medical imaging industry as well as personal career development. | 1. Do you believe that AI should be accepted by the medical imaging community? 2. Personally, do you support the use of AI at work? 3. Do you feel comfortable cooperating with AI experts in research? 4. Do you accept AI changing your current clinical workflow? |
| PA2 | Willingness | The degree of the intention the participant holds on using AI in medical imaging. Also, it measures the perceived intention to trust the algorithm, the intention to learn about AI technology, and the intention to cooperate. | 1. I am willing to use AI to diagnose patients. 2. I am willing to cooperate with AI experts to improve AI products. 3. I am willing to trust the AI product I am using. 4. I am willing to learn more about AI and the implementation and integration between AI and medical imaging. |
| PA3 | Trust | The degree to which the participant has faith in the innovation. Mainly reflect the level of trust on the accuracy of AI in diagnoses. Some minor aspects relate to implementation and job security. | 1. I trust the result from the AI product to be accurate. 2. I trust the implementation of the system to be safe. 3. I trust the AI product will follow security procedures. 4. I trust that learning AI technology will be beneficial to my work in the future. 5. I am worried that AI will take my job in the upcoming years. 6. AI development will result in the unemployment of current doctors. |
| PA4 | Risk | The different hurdles AI will bring to the participant itself and the radiology community in general. The aspects evaluated include ethical issues, legal issues, funding, and safety. | 1. AI products are not ethnically examined enough by society. 2. AI products are not legally examined by society. 3. I do not think using AI products in medical imaging is safe. 4. I believe the funding for the implementation of the AI products in hospital is not sufficient. |

# References

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, *27*(3). <https://doi.org/10.2307/30036540>