

## INTRODUCTION

### Large Language Models (LLMs)

- Type of **Artificial Intelligence** (AI) that can interpret and generate human language.
- Trained with massive datasets, and utilizes deep learning to generate, translate, summarize, and more.
- Models used: GPT-4o & GPT-4o-mini.

### Inductive Thematic Analysis (TA) at the Semantic Level

- “A method for identifying, analyzing and reporting patterns within [qualitative] data” (Clarke & Braun, 2006, p. 79).
- **Inductive:** Identify themes without predefined codebook.
- **Semantic Level:** Explicit & surface-level themes.
- **Drawbacks:** Time-consuming, subjectiveness, inefficient.
- De Paoli (2023), Mathis et al. (2024), and Dai et al. (2023) suggest that LLMs can aid in producing valid thematic analysis.

## THE DATA

### Fast-Slow Warbler Qualitative Data (Schultz-Coulon et al., 2024)

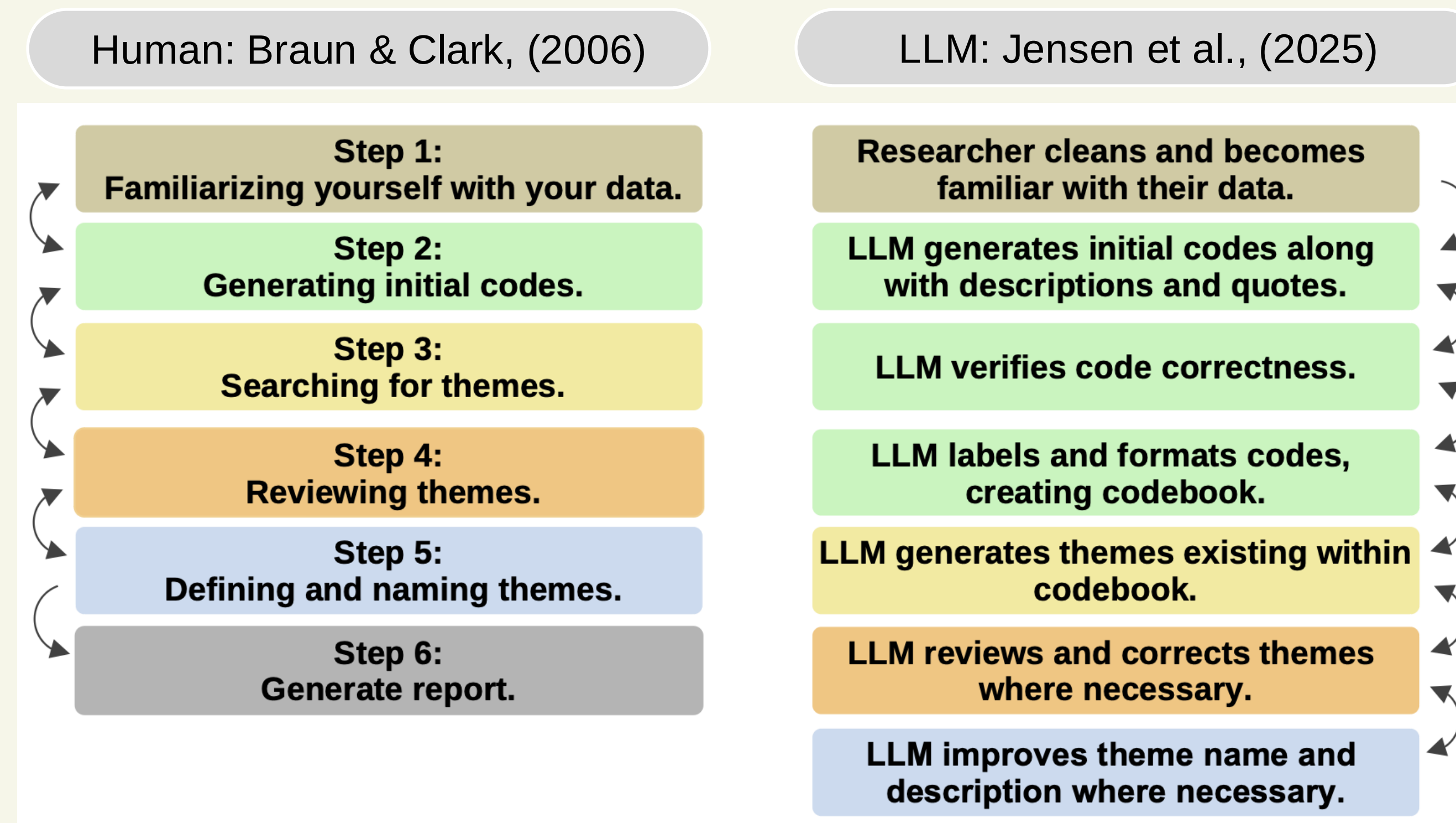
- Self-reported data describing participant strategies used to classify four different species of Warbler birds (n = 74).
- Data collected in two sessions; we utilized session one data.

## HOW LLMs WORK

- **Machine learning** aims to classify patterns within data.
- **LLMs:** Represent a subset of machine learning for text.
- **Training:** Models are trained on a massive dataset of texts.
- **Tokens/Probability:** Textual input is broken down into *tokens*. The model learns to predict the most likely token sequentially in a string.
- **Attention:** Transformer architecture is used, which assists in weighting input tokens (*attention*) by relevancy to help determine this next token.
- **Generation:** Outputs are generated sequentially using these probabilities, despite non-sequential attentional mechanisms.

## PROCEDURE

### Thematic Analysis Steps



### OpenAI Application Programming Interface (API)

- Gives the user direct access to OpenAI LLMs through python scripts (OpenAI, 2025).
- **Key:** Password required to access the API.
- **System Prompt:** The model's 'audience' and context.
- **User Prompt:** The model's requested task.
- **Parameters:** Model, temperature, “top\_p”.



### Prompt Engineering

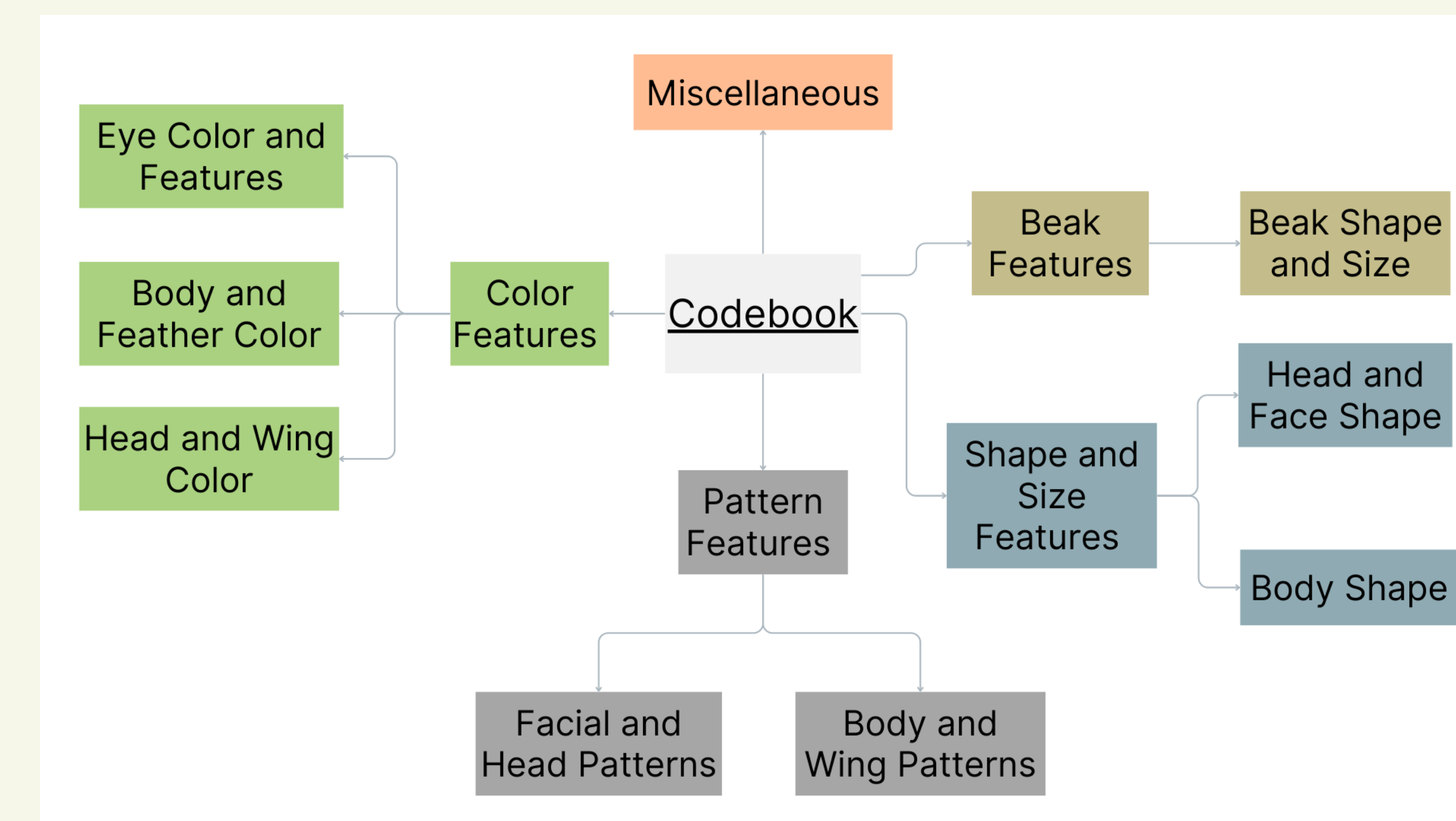
- **Prompt Engineering:** The process of writing effective instructions (prompts) to guide LLMs towards generating desired outputs.
- **Our Method:** Scripts were written, and the prompts were iteratively improved until outputs were deemed acceptable.
- An LLM may code a piece of text *differently each time* it is asked to even when *using the same prompts* and model settings (Abdurahman et al., 2025, p. 7).

### (Avoiding) Hallucinations & Embellishments

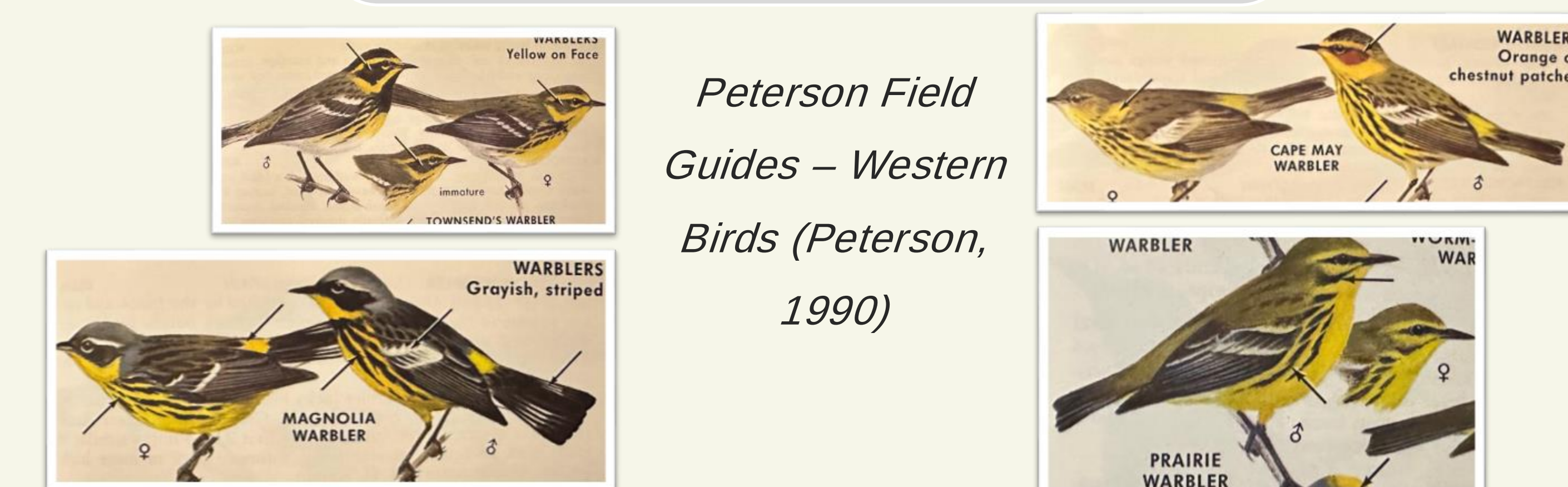
- **Hallucinations:** False information resulting from the token-prediction algorithm.
- **Embellishments:** Conversational text designed to improve structure and grammar of original input that is generated without permission from the user.

## RESULTS

### Final Themes (GPT-4o)



### LLM Themes vs. Bird Field Guide



## DISCUSSION

- LLMs are a useful tool for assisting researchers in TA.
- Our work supports previous study results that LLMs can detect context-dependent themes in human qualitative data.
- The LLM accurately identified themes from short-form data and is likely even more effective with rich data.
- The development of new models is ongoing, making them promising for future research.
  - Therefore, our steps may require further refinement.
- LLMs are imperfect, thus we suggest that researchers play a large role in guiding them during the analysis.



Scan the QR code for a Reference List, final Codebook and Prompt Timelines!