

AromaGen: Interactive Generation of Rich Olfactory Experiences with Multimodal Language Mdlers

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Introduction

Abstract

We present **AromaGen**, an AI-powered wearable system that generates rich olfactory experiences from free-form text, images, or speech using multimodal large language models (LLMs). Given a user description, AromaGen performs zero-shot generation to produce a ratio vector over **12 base odorants** dispensed by a neck-worn device. Through **human-in-the-loop iterative refinement**, users provide natural language feedback to adjust the composition until it matches their preferences. In a controlled study with **26 participants**, AromaGen matched or surpassed human-only mixing, achieving a median similarity to real food aroma of **8.0/10 vs. 5.5**, and reduced perceived artificiality.

Problem

Existing olfactory interfaces rely on:

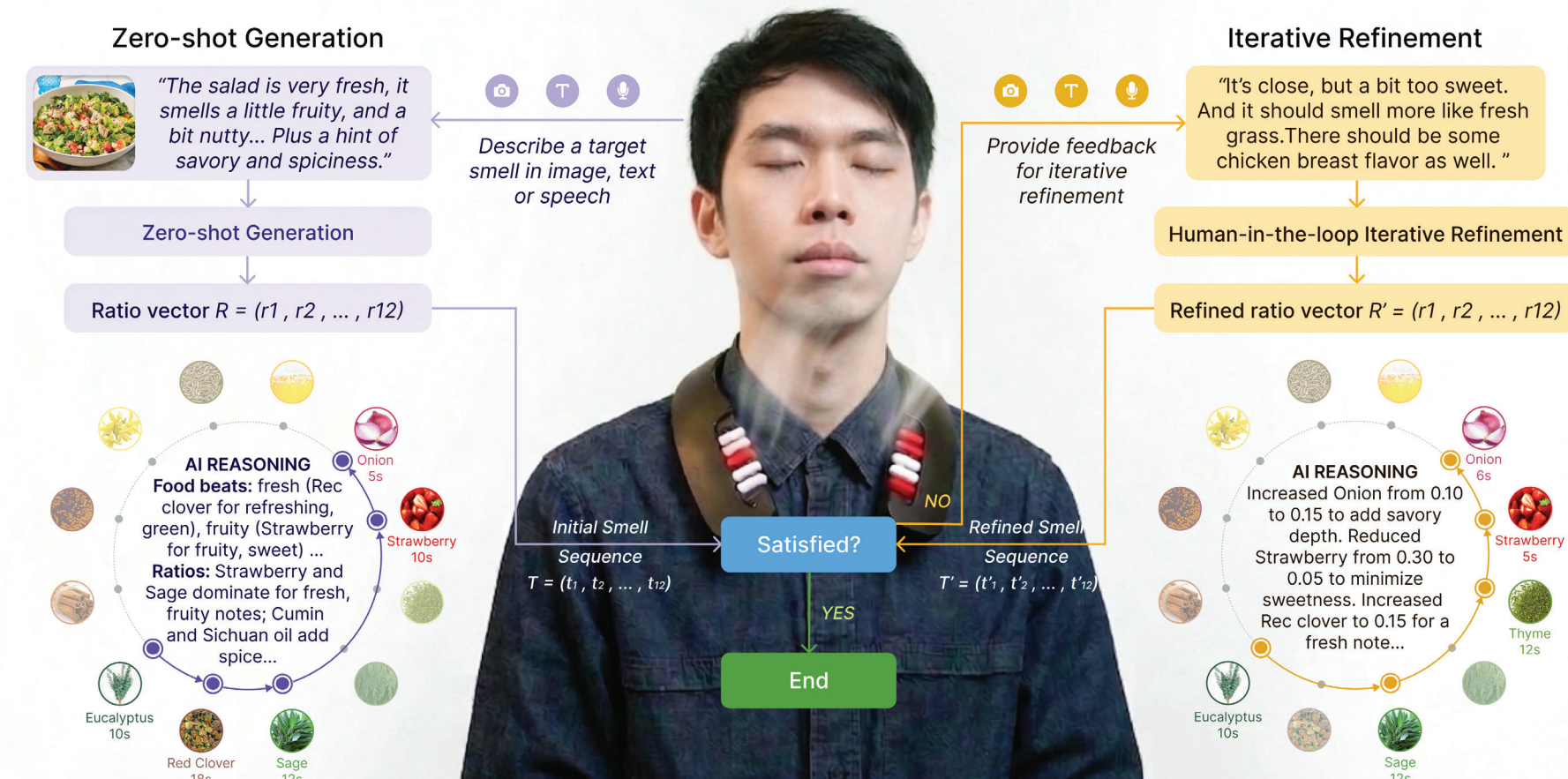
- Fixed scent cartridges
- Predefined generation patterns
- Sensor measurements
- Chemical / molecular specifications

→ **These limit flexibility, cost, and accessibility for everyday users.**

Key Contributions

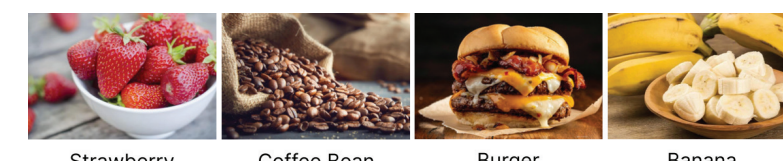
- ★ **Multimodal LLM-based aroma generation from text, image, or speech.**
- ★ **Wearable 12-channel neck-worn dispenser with 12 selected base odorants.**
- ★ **Human-in-the-loop iterative refinement via natural language feedback.**
- ★ **Controlled user study (N=26) demonstrating strong perceptual fidelity and reduced cognitive load.**

AromaGen at a Glance



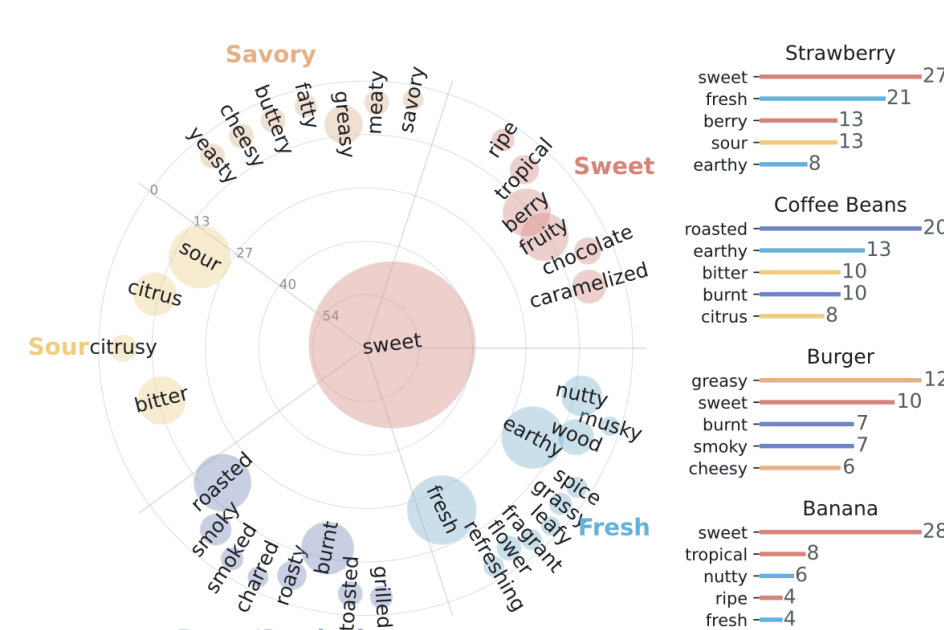
Methods

Formative Study: Olfactory Perception and Language



Tasks:

1. Aroma Description: describe each aroma in their own words.
2. Odorant Composition: decompose each aroma into constituent components and allocate 7 points to reflect perceived contribution
3. Synthetic Fidelity: smell each of four aromas (natural essential oils vs. real food) and rate perceptual similarity on a 7-point scale.



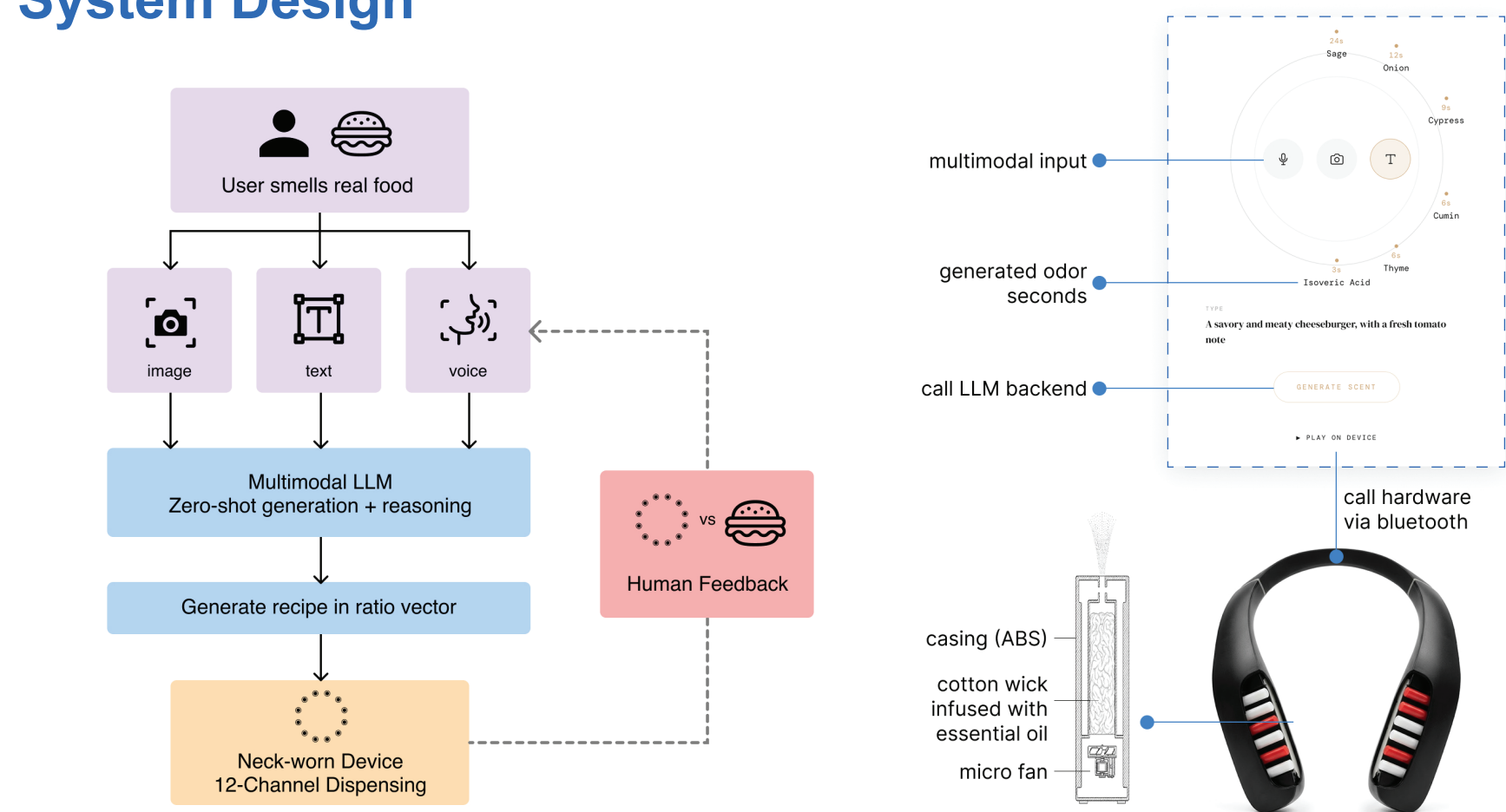
Design Implications

- ★ **LLM-based semantic-to-odorant mapping.**
- ★ **Base odorants and generation.**
- ★ **Iterative refinement.**

Aroma Space Design: 12 Base Odorants

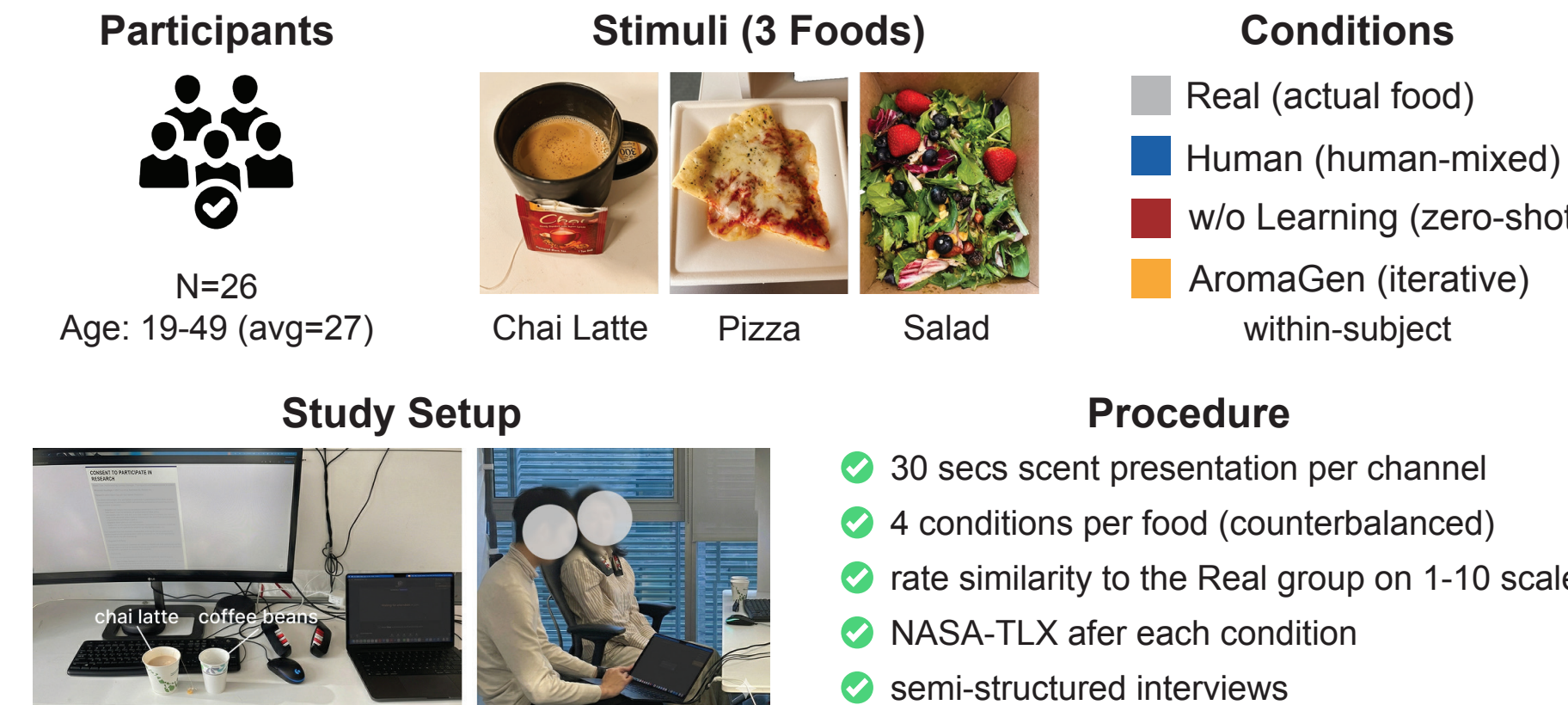


System Design



Experiments

User Study Overview

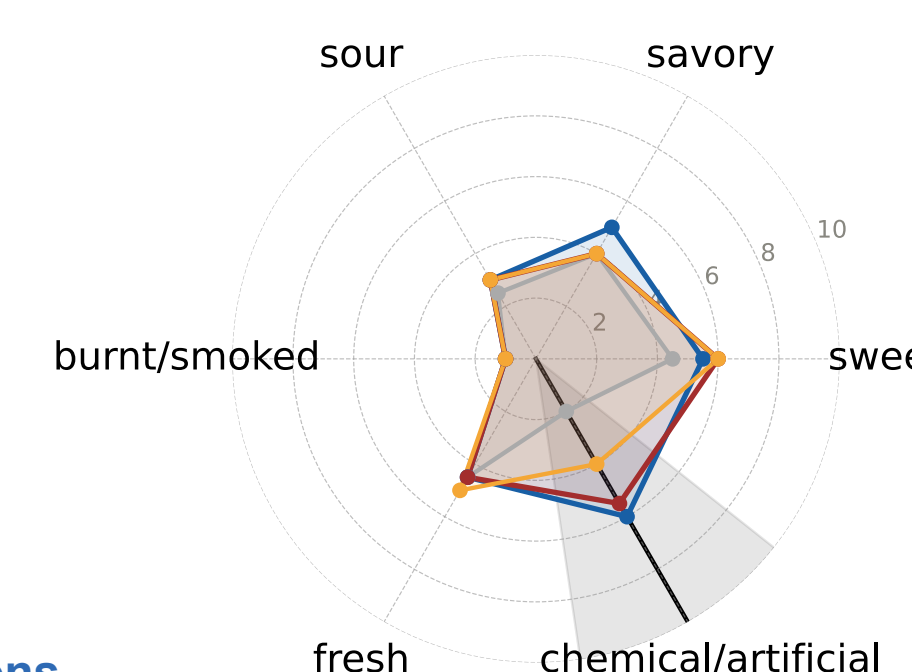


Results

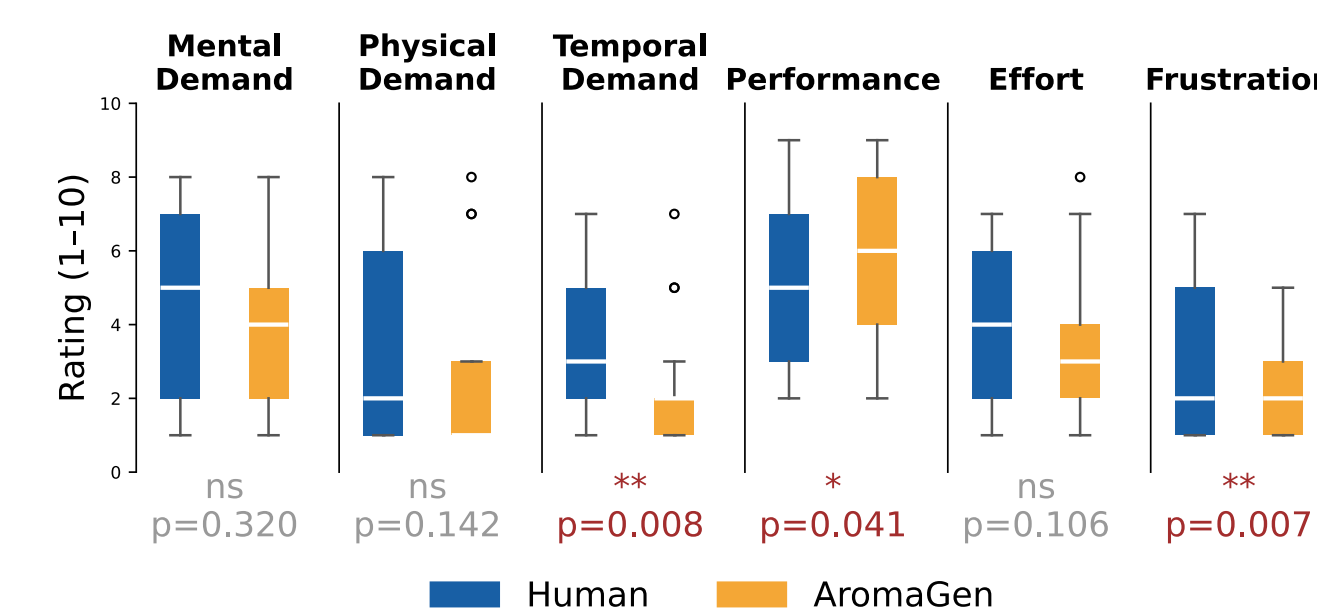
Semantic Distance to Condition Real (Lower is Better)

Condition	Human	w/o Learning	AromaGen
Chai Latte	5.39	5.20	3.24
Pizza	5.32	5.10	3.29
Salad	5.46	5.29	3.43
Average	5.39	5.20	3.32

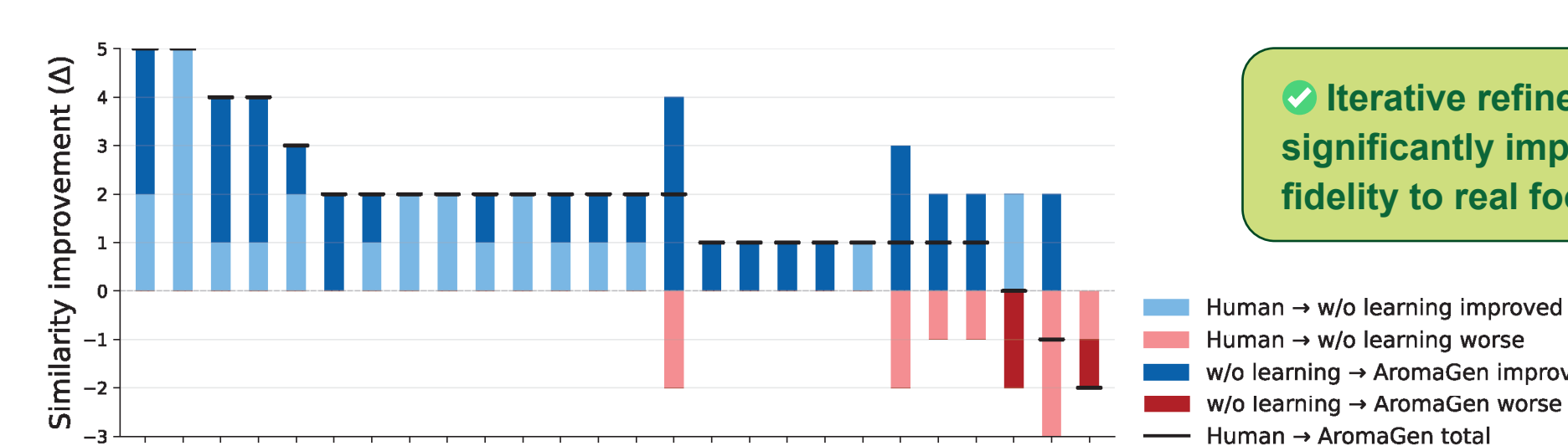
Descriptor Ratings (1-10)



NASA-TLX (Lower is Better)

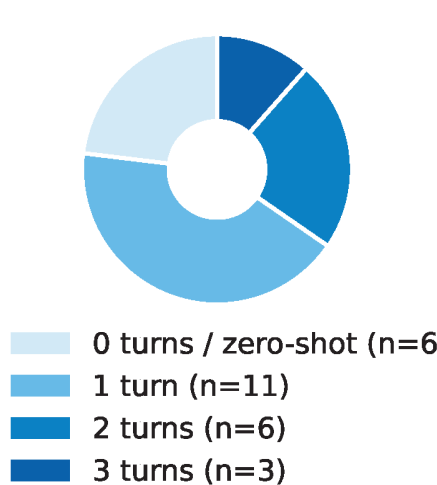


Per-Participant Similarity Improvement Across Conditions

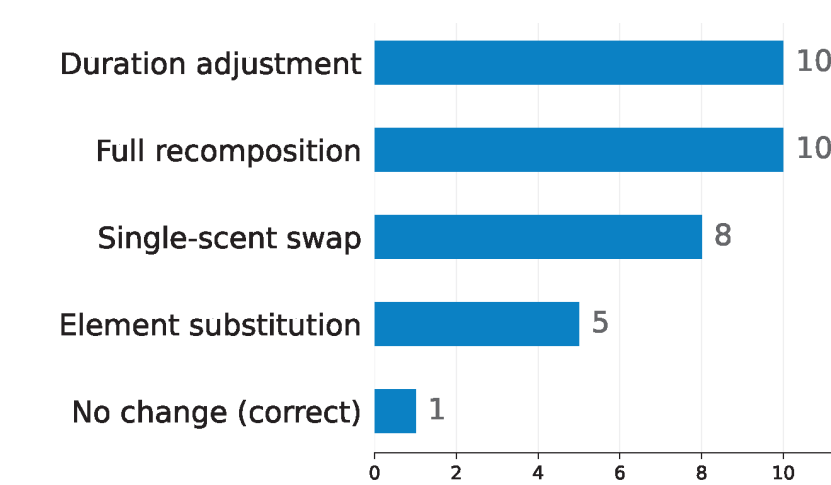


✓ **Iterative refinement significantly improved perceptual fidelity to real food aroma.**

Turns of Satisfaction



AI Adjustment Strategies



Contact

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Link to paper