Team submission for: Tomme Denney, Jingren Ma(Komi), Yunbing Han(Hannah)
Project Prep Assignment (Assignment #3)

1. Write no more than 500 words on the purpose of the project. What is unique about it? How are you including the biometric? (5 pts)

Project Purpose

Buddy Run reimagines running training by transforming abstract biometric data into an intuitive, emotionally resonant coaching experience. Unlike traditional fitness apps that simply display heart rate or pace numbers, Buddy Run creates a dynamic relationship between runners and their physiology through real-time cadence optimization and adaptive pacing guidance. The core purpose is to help runners of all levels, from beginners to experienced athletes, discover and maintain their individually optimal running cadence, reducing injury risk while improving performance efficiency.

What Makes It Unique

The prototype's uniqueness lies in three key innovations. First, it implements a personalized cadence discovery system grounded in sports science research. Buddy Run calculates individualized optimal cadence based on the user's height, weight, age, and physiological data from their initial baseline mile.

Second, Buddy Run employs adaptive tempo guidance that evolves with each run. The initial trial run establishes the user's natural cadence and physiological baseline. Subsequent runs are categorized into intensity tiers (Low Intensity Tier 1/2, High Intensity Tier 1/2), each prescribing progressively optimized cadence targets. Drawing from Heiderscheit et al.'s (2011) research showing that even 5-10% cadence increases reduce joint loading and injury risk, the app makes incremental adjustments over weeks—never exceeding the safe 5% progression threshold identified in biomechanics literature.

Third, the haptic and auditory feedback system replaces nagging voice commands with intuitive rhythmic cues. Instead of being told "speed up" or "slow down," users receive tempo vibrations or metronome beats matching their target cadence, with manual ±adjustment controls for real-time tweaking. This design respects the runner's agency while providing subtle, non-intrusive guidance.

Biometric Integration

Buddy Run integrates biometrics through live Whoop data streaming (updated every 5 seconds), capturing real-time heart rate and cadence during runs.

During runs, the app compares current cadence against the personalized target (calculated from height, weight, age, and baseline performance using formulas derived from Tanaka et al.'s HRmax equations and Cavanagh's stride optimization research). When deviation occurs, tempo cues adjust to guide the runner back to optimal rhythm.

Each completed run refines the user's physiological profile. Heart rate patterns inform intensity classifications, while cadence consistency data trains the recommendation engine to make increasingly precise suggestions. This creates a feedback loop where the app becomes more personalized with every mile.

By grounding design decisions in peer-reviewed biomechanics research while maintaining an accessible, game-like interface, Buddy Run bridges the gap between clinical exercise science and everyday fitness technology, making optimal running technique achievable for everyone.

2. Please share at least 3 references that helped guide you toward some of your design choices for this project and provide no more than 2 sentences describing what each contributed. (5pts)

Nacke, L. E., Kalyn, M., Lough, C., & Mandryk, R. L. (2010). Biofeedback game design: Using direct and indirect physiological control to enhance game interaction. *Proceedings of CHI 2011*.

- This paper's distinction between direct and indirect physiological control informed our decision to prioritize cadence as the primary feedback mechanism—a measure runners can directly influence—while using heart rate as a secondary, context-setting variable. Their finding that intuitive sensor-to-action mappings (like flexing a leg muscle to run faster) produced greater enjoyment reinforced our choice to deliver rhythmic haptic and audio tempo cues that feel like natural extensions of the running motion rather than external commands.

Mueller, F. F., et al. (2011). Jogging over a distance: Supporting a "jogging together" experience although being apart. *CHI '10*.

- Mueller's research demonstrated that audio-based pace awareness can create a compelling sense of co-presence between distant runners. This shaped Buddy Run's core concept of an AI running companion that provides socially motivated, supportive feedback. Their use of spatialized sound to communicate relative pace inspired our approach of using tempo cues to create an implicit "running alongside" relationship between the user and the app's guidance system.

Consolvo, S., McDonald, D. W., & Landay, J. A. (2009). "Theory-Driven Design Strategies for Technologies that Support Behavior Change in Everyday Life." CHI 2009.

- Consolvo's eight design strategies helped shape our approach to the AI buddy's personality and feedback style. Their emphasis on positive reinforcement (rewarding desired behavior without punishing lapses) informed our decision to frame cadence guidance as encouraging rather than corrective. Their "controllable" strategy—allowing users to modify tracked data—justified our inclusion of manual cadence adjustment controls, respecting runner autonomy while still providing algorithmic guidance.

3. Write a brief (about 500 words) of the planned methods for the project. What are you measuring and under what conditions? How many participants do you plan to engage. (5pts)

Planned Methods

This project is actively integrating HR biometrics with physical data for runner experience enhancement. At the current stage, we will recruit **3 experienced runners** aged 18-55 with no current injuries who possess the body awareness needed to provide meaningful feedback on biofeedback interventions and can articulate how these features influence their performance.

Each participant begins with a 5 min baseline calibration run at a self-selected comfortable pace. During this run, we collect physiological data—heart rate, cadence, and pace—via Whoop device (broadcasting every 5 seconds) without providing any adaptive feedback. This establishes individual baseline metrics that, combined with demographic information (age, height, weight), create a personalized physiological profile informing subsequent adaptive coaching. (Additional Stride length function is still experimenting)

Following baseline assessment, participants complete one intervention run testing of their choice from zone 1 to zone 5 of heart rate. Target cadence for each condition is algorithmically determined based on the participant's baseline performance and physical characteristics, following established running biomechanics research.

During intervention runs, participants receive two feedback modalities: haptic vibration patterns matching target cadence rhythm and audio tempo sounds synchronized to optimal cadence. Participants can manually adjust target cadence using plus/minus controls, allowing us to measure preference for autonomy versus algorithmic guidance. Primary measurements include cadence adherence (deviation from target in steps per minute), heart rate range and stability, and pacing consistency (calculated as standard deviation across run segments).

Immediately following each run, participants complete a brief survey assessing perceived exertion (RPE scale 1-10), feedback intrusiveness (5-point Likert scale), subjective pacing control, and preferences between haptic versus audio feedback. After completing all intervention runs, we conduct 30-45 minute semi-structured interviews exploring how cadence feedback influenced their running experience, whether they felt more connected to their body, perceived usefulness of manual adjustment controls, and suggestions for improving feedback modalities.

4. Is this a group or solo project? If group, who are the group members.

Yes. Tomme Denney, Jingren Ma(Komi), Yunbing Han(Hannah)