Designing a Real-Time Nutrition Tracking Device

In recent years, working out has exponentially grown in popularity. Owning a gym membership has become a must for people of all ages who want to improve their physical health and appearance. For some people, the gym is a way to build strength and resilience and for others, it's a pathway to achieving their ideal body or a way of managing stress. Countless people dedicate themselves to structured workout programs that promise to fulfill all their goals without actually achieving any progress. One major reason for this stagnation is a misaligned or inadequate diet. Having a good diet plays a critical role in fueling workouts, aiding recovery, and driving long-term results. Without proper nutrition, even the best-designed workout program can fall short, leaving individuals frustrated and unmotivated.

However, it is not an easy task to know when and what to eat. There are multiple existing apps that can track calorie and protein intake, but they all require users to manually input everything they eat. This process is time-consuming and leaves many people feeling overwhelmed. That is why our design team is interested in developing a product inspired by continuous glucose monitors used by people with diabetes. The idea would be to attach a sensor to the underside of the user's arm that would constantly read real-time values from their blood. These values would then be transferred to an app that would, accordingly, recommend when to eat or drink based on their exercise goals.

This device would be designed based on information from the research article *Nutrient Timing: The Means to Improved Exercise Performance, Recovery, and Training Adaptation*, authored by John L. Ivy, PhD, and Lisa M. Ferguson-Stegall, PhD, and published in *SAGE Journals* (2013) through the American College of Lifestyle Medicine. The article was found on Google Scholar and was chosen due to its scientific research that directly correlates to the development of our product. It discusses the importance of nutrient timing in enhancing workout performance and recovery. It breaks down optimal nutrient intake into three critical phases: the energy phase, the anabolic phase, and the adaptation phase. Each phase requires a different balance of carbohydrates, proteins, and other nutrients to maximize energy availability, reduce muscle breakdown, and enhance recovery. Our product aims to help users manage these phases by continuously monitoring key biomarkers, such as blood glucose and potentially other indicators of nutrient availability.

The energy phase, as outlined by Ivy and Ferguson-Stegall (2013), is critical for optimizing energy levels during workouts. It focuses on two key periods: pre-exercise and during exercise. In the 4-hour period leading up to exercise, consuming a meal rich in carbohydrates is recommended to maximize muscle glycogen stores. Research indicates that ingesting 150–200 grams of carbohydrates 2 to 4 hours before a workout can boost glycogen levels and enhance endurance, especially in workouts lasting over 90 minutes. Predicting when a user will work out based on blood readings alone would be challenging, but algorithmic predictions based on their data and history could make it possible to remind the user in advance. The device could then suggest the optimal time and amount of carbohydrate intake to maximize glycogen storage and prepare for a workout. During exercise, it could monitor glucose levels and prompt users to

consume a carbohydrate or protein beverage when levels start to dip, preventing premature fatigue.

The anabolic phase, according to Ivy and Ferguson-Stegall (2013), is the critical period immediately following exercise, where the focus shifts from fueling to recovery and muscle repair. This phase typically occurs 30 minutes to 2 hours after exercise when the body is at it's best state to absorb nutrients. During the anabolic window, the body has the highest capacity to take in glycogen, which is often depleted after an intense workout. Consuming carbohydrates soon after exercise accelerates energy restoration. Protein intake is also crucial during this phase for muscle repair and growth. It provides amino acids that support the rebuilding of muscle fibers damaged during exercise. Our product could support users in this phase by monitoring biomarkers related to muscle recovery and glycogen levels, then providing tailored recommendations for post-workout nutrition. Based on a user's real-time readings, the app could suggest the ideal time and quantity of carbohydrate and protein intake to maximize glycogen recovery and muscle repair, enabling faster recovery.

The last phase our device would consider is the adaptation phase. This phase occurs 4 to 6 hours after the anabolic window. It is essential for sustained muscle glycogen storage and protein synthesis. The muscle recovery process continues through regular carbohydrate and protein intake. This ensures that the body retains all the anabolic benefits initiated in the anabolic window. According to Ivy and Ferguson-Stegall's (2013) research, supplementing regularly with carbohydrates and proteins a few hours after exercise helps maintain elevated glycogen storage rates, supporting muscle recovery. Our device could assist users with this as well by recommending timed nutrient intake based on biomarkers indicating ongoing recovery needs.

Interview Process

To gain a better understanding of how the device should be designed, interviews were conducted. To maximize insights from the interviews, the format was kept open-ended, following the advice of Rogers, Sharp, and Preece (2023) in *Interaction Design: Beyond Human-Computer Interaction* (6th ed.), who state, "...if the goal is to gain impressions about people's reactions to a new design concept, then an informal, open-ended interview is often the best approach." To keep the interview on track, open-ended questions were balanced with some targeted questions.

These interviews' purpose was to understand what challenges people who regularly exercise could face with nutrient timing, diet tracking, and fitness goals, and how we could implement a solution to them in our device. Ideally also getting knowledge about their openness to a device offering real-time feedback. According to *The SAGE Handbook of Qualitative Research* (Adams, 2015), balancing open-ended questions with targeted questions provides depth. This interview structure was designed with Rogers et al. guidelines, focusing on keeping the questions neutral, avoiding compound questions and complex language.

The interviews were conducted with people who exercise regularly, as the product is targeted toward these individuals. The first question addressed the interviewee's background and fitness routine to understand their fitness level, goals, and habits. This is to set the stage for later questions about diet and nutrition.

1. Can you tell me about your current fitness routine?
   1.1 Has your current fitness routine changed from previous ones, and if so, why?
   1.2 What goals are you trying to achieve with exercising?

This question is meant to invite participants to describe their routine in their own words, which hopefully will lead to more giving responses. The sub-questions is to encourage them to reveal more about their commitment to health that could be useful for our product development.

The second question builds on this by introducing nutrition, which is central to the product's focus. The idea is to establish interviewees' view on nutrition regarding workout progress.

2. Do you consider nutrition part of working out and making gym progress?
   2.1 Do you implement this in your routine somehow?

This question explores the interviewee's knowledge about nutrition's role in fitness. Their response could help identify current practices and challenges regarding nutrition, which is critical to understand when developing our product. The sub-question is to clarify how the participants implement the connection between nutrition and fitness.

As the first two questions are broad and open, the next set becomes more specific. The focus shifts to the phases presented by Ivy and Ferguson-Stegall (2013), aiming to understand the interviewees' daily nutrition habits.

3. How do you approach eating before exercise?
   3.1 Have you noticed any differences in performance based on what or when you eat before?

This question gathers insights on the participant's pre-exercise nutrition strategy, which tells about their energy optimization. Self-reflection here could also reveal if they recognize the impact of nutrient timing on exercise performance. The aim is to understand if there is a need for personalized pre-exercise recommendations.

4. How do you approach eating after exercise?
   4.1 Have you noticed any differences in recovery based on what or when you eat?

This question dives into post-exercise nutrition habits that are "crucial for recovery and muscle repair" (Ivy & Ferguson-Stegall, 2013). By reflecting on their choices, participants reveal if they see a connection between nutrition and recovery. The purpose is again to understand if there is a need for real-time personalized post-exercise recommendations.

5. Are there specific points during your workouts or day when you feel low on energy?

This question identifies potential energy dips throughout the day, which could be targeted by timely reminders or alerts in the app, enhancing personalization (Rogers, Sharp, & Preece, 2023).

6. Do you currently use or have previously used any apps or tools to track your nutrition or exercise?
   6.1 If so, what do you like or dislike about them?
   6.1.2 How much time do you spend tracking your diet or nutrient intake, and how do you feel about the process?
   6.2 If not, why not?

This question helps identify valuable or frustrating features in current apps. The follow-ups reveal challenges or unmet needs, helping you design a more user-friendly product that stands out in the market.

7. How would you feel about having an app that knows when you need to eat or drink?
   7.1 How would you feel about attaching a device to your body?
   7.2 Does it change your opinion if the device monitors energy and nutrient levels in real-time?
   7.3 What kinds of recommendations would you find useful? For example, reminders for protein intake, hydration, or specific adjustments.

This question explores acceptance of wearable devices and real-time tracking, addressing user concerns about physical integration. The follow-up questions could reveal what users value in a monitoring device, which could help develop useful features.

8. Would there be any hesitations for you in using a device like this?

This question allows users to voice concerns about privacy, usability, or other aspects, providing critical insights into adoption barriers. By understanding these reservations, you can ensure the product's design aligns with user expectations and builds trust.

Interview Findings

The interview was conducted with one participant who had years of experience in fitness, but was still an amateur. We learned that the participant was aware of the role nutrition plays in fitness progress. He also had a general understanding of nutrient timing. He recognized the importance of eating before and after exercise. Apart from knowing the need for protein after a workout for muscle recovery, he didn't know much more of what to eat for optimal energy and recovery. For example, he was not aware of specifics, such as the recommendation by Ivy and Ferguson-Stegall that "intake of 150 to 200 g carbohydrate 2 to 4 hours before a long, intense exercise bout is a reasonable strategy." Information like this could greatly benefit his progress, which is to consider when developing our product. He told us that he knew that you should eat before exercising. However, he wasn't sure about how much and when. This is precisely where our product could provide significant value. Using real-time blood readings to assess glycogen

levels and recommend personalized carbohydrate intake for optimal energy could solve his struggle.

Additionally, the interviewee mentioned sometimes being low in energy during workouts and throughout the day, which he attributed to irregular eating habits. For example, he noted that his performance was noticeably weaker if he skipped breakfast before a workout before lunch. He told us that he doesn't plan meals around exercise and typically follows a regular eating schedule. He mentioned that his primary strategy for nutrition was simply to add protein-rich foods after workout. This insight further strengthens the possible need for a device that can not only remind users of ideal nutrient timing but also provide personalized recommendations based on actual physiological data, which would make it easier for users to align their nutrition with their fitness goals without having to study the subject.

Some of the interview's more direct questions toward the end resulted in valuable insights for our product's design. Although the participant had not used any nutrition tracking apps, he had experience with a running app that tracks key metrics like pace, distance, time, elevation, steps, and route, as well as the ability to compare his results with friends and earn achievements (like a crown for a personal best). These statistics gave him motivation to keep running regularly. This feedback can be used to include similar motivational features in our product to engage users. In our case the features of our app could be in addition to nutrient tracking, showing real-time biomarkers like blood glucose, blood lactate, and hydration levels, as well as relevant metrics such as estimated caloric burn, which could enhance the user experience. We could also implement features like nutrient timing recommendations, personalized alerts, and long-term trends to allow users to track their progress over time. Social comparisons and achievements could even further increase motivation, making the product both a practical tool and a source of encouragement.

Reflections on the Interview Guide and Process

The interview demonstrated that the product concept could have practical applicability. However, it also became clear that there is a need to revise certain questions. The last three questions in particular were overly specific, which limited the participant's ability to respond freely. This potentially led him towards answers he expected the interviewer wanted . For example, Question 7 did not give any insights, as it encouraged a positive response rather than prompting the participant to consider different factors. Cost and potential risks were not at all considered. In a real-world scenario, he would certainly weigh the pros and cons much more before making a commitment to use a health-related wearable.

In contrast, the first, more open-ended questions (Questions 1–6) provided more valuable insights. They allowed the participant to explore their fitness and nutrition routines without restriction. Open-ended questions were clearly the way to go, as they provided genuine, nuanced responses without leading to any answer.

Based on these findings, future interviews would benefit from having more open-ended questions that allow for a broader range of responses, rather than directly asking about comfort

with a wearable. Instead a question like this could focus on the factors the participant considers when adopting new health technologies. This approach could give more balanced and reflective answers, which would reveal both the appeal of the product and any potential hesitations.

Overall, this reflection confirms that an open-ended structure encourages participants to provide deeper insights and that minor adjustments to specific questions can help maintain the authenticity and depth of the responses.

References

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