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Article

Personalization of artificial intelligence driven fitness apps for senior citizens

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Abstract: The purpose of the study was to examine the role of personalization in motivating senior citizens to use AI driven fitness apps. Vroom's expectancy theory of motivation was applied to examine the motivation of senior citizens. The responses from participants were collected through structured interviews. The participants belonged to South Asian origin belonging to India, Bangladesh, Nepal and Bhutan. The authors adopted a content analysis approach where the gathered interview responses were coded in the context of elements of Vroom's theory. The findings of the study indicated that a highly personalized approach in the context of motivation, expectancy, instrumentality and valence will motivate senior citizens to use AI based fitness apps. The study contributes to the personalization of AI fitness apps for senior citizens.

Keywords: personalization; senior citizen; health; fitness

1. Introduction

User motivation can be greatly impacted by personalization in fitness apps. Ghanvatkar et al. (2019) underlined the significance of personalization, stressing the necessity of behaviour modification strategies in customized interventions as well as data-driven prediction tools. In order to increase motivation for physical exercise, recent research has looked into the use of artificial intelligence (AI) to personalize fitness apps (Zhu et al., 2021). The "personalization paradox," which refers to the possible conflict between user modeling and adaptation in personalized applications for behavior change, has been brought up as a worry with this technique (Zhu et al., 2021). Adaptive and personalized fitness apps are still being developed, with an emphasis on yoga, diet, and exercise, despite these obstacles (Dixit et al., 2021). Numerous studies have looked into the possibilities of fitness apps powered by AI. Both Alturki and Gay (2019) and Meng (2021) draw attention to the potential of these apps to encourage healthy behaviour changes and physical activity, with Alturki and Gay (2019) concentrating on the application of augmented and virtual reality technology. Chung et al. (2018) and Khaghani-Far et al. (2016) both stress upon how important it is that these apps offer pertinent and reliable information. They also emphasize how important it is that these apps be accessible and easy to use, especially for senior citizens. The difficulties in establishing digital wellness apps for senior citizens are also highlighted by Kari et al. (2020), including participant-related, technology-based, and physical activity-based difficulties. The necessity of age-

appropriate functionality and user-centered design in fitness apps for senior adults is highlighted by these studies.

Senior citizens are those in the age group of 60 years and above (Mittal and Patel, 2024). Studies on the elderly have brought attention to their particular requirements and difficulties. Zhang et al. (2023) highlight the value of lifelong learning for elders, especially when it comes to using information technologies. Numerous difficulties that senior citizens encounter when utilizing AI apps have been found through research. These include limits related to vision, motor skills, and cognition (Elguera Paez and Zapata Del Rio, 2019); they also involve issues with decision-making, privacy, and control (Shandilya and Fan, 2022). Nyrup et al. (2023) highlights the possibility of age-related bias in AI systems when introducing the idea of digital ageism. A possible remedy is presented by Qian et al. (2021), who talks about how AI and the Internet of Things might help the elderly with assisted living and health-care monitoring. The aggregate findings of these studies highlight how crucial it is to take particular wants and concerns of senior citizens into account when developing and utilizing AI apps.

Vroom's expectancy theory of motivation, which highlights how instrumentality, valence, and expectation influence behavior, can be used to analyze how apps are becoming more digital (Ziden and Joo, 2020). In assessing the digitalization of apps, Vroom's theory may be useful since it clarifies user satisfaction and motivation (Chopra, 2019). In the exploration of the assessment of user experience in augmented reality mobile applications, Davidavičienė et al. (2021) emphasizes the significance of Vroom's theory in providing clear objectives, simplicity, seamless functioning, creative information display, and interaction. Similar methodology for encouraging consumer engagement with branded mobile apps was presented by Stocchi et al. (2018). The existing research point to the potential value of using Vroom's theory to assess the digitization of apps, especially when it comes to determining user satisfaction and motivation.

While there is sufficient literature on AI driven fitness apps, personalization of the app catering to specific needs of senior citizens needs more attention. The study contributes to the existing literature in the area of healthcare development for senior citizens by identifying the motivation to use fitness app, efforts needed to use the app, personalization of the app and user satisfaction through Vroom's expectancy theory of motivation. Section 2 explains the materials and methods for carrying out the study, Section 3 provides the results and its interpretation and the remaining sections contribute to discussion, conclusion, limitations and contribution to future research direction.

2. Materials and methods

The purpose of the study is to gather new insights from senior citizens in the context of personalization of fitness app. This requires a qualitative approach to gathering data (Benlahcene and Ramdani, 2020). The acceptable approach to gather insights from qualitative data is content analysis (Emrouznejad et al., 2023). Content analysis is defined as a methodology to examine the written, spoken, or visual content of different types of communication. It entails methodically and impartially locating and measuring particular traits within a collection of texts or other communication

sources (Serafini and Reid, 2023). The researchers have further highlighted that various disciplines, including political science, psychology, sociology, and communication studies, use content analysis extensively. A variety of methodological viewpoints might inform the study approach for content analysis in digital app research. The selection of pertinent material for the content analysis can be studied in digital journalism literature provided by Banshal et al. (2022). Andronie et al. (2021) suggests incorporating user viewpoints into content analysis and highlights the significance of comprehending consumer behavior in the adoption of mobile commerce apps. Weiss and Strahringer (2021) provides a technique that can be modified for use in digital app research for the structured content analysis of smartphone apps. Since, content analysis is a widely accepted methodology for research on digital apps, the current study has adopted this approach, The different steps in content analysis approach are as follows:

Selection of participants and the content:

The participants for the study were senior citizens of India who were above the age of 60 years and using digital apps for health and fitness. The data of senior citizens was received from various forums of senior citizens that were active in the country. The senior citizens in India belonged to India, Bangladesh, Nepal and Bhutan who were settled in India. The researchers adopted a purposive sampling method since the objective was to understand the personalization of AI fitness apps and its usage. The fitness apps considered for study were ranked on the basis of maximum downloads. This data was provided by Google Play since there was no other agency who had done a structured survey on the ranking of fitness apps. The top five most downloaded apps were Noisefit, HealthifyMe, Boat Crest, Fitbit and JustFit. A structured questionnaire containing interview questions in the context of Vroom's expectancy theory was prepared using the scale items from (Yang and Koenigstorfer, 2021) so that unique insights on personalization of fitness app could be captured. The questionnaire was validated from experts in digital marketing and pre-tested on a set of participants to ensure that sufficient information was captured during the interview stage. The questions were designed in the context of motivation, expectancy, instrumentality and valence. The followings interview questions were designed for the study:

Motivation:

1) In what ways do AI functionalities within fitness applications enhance your drive and involvement in your exercise regimen?

2) How does the ability to personalize AI fitness applications affect your motivation?

Expectancy:

1) When utilizing AI fitness apps, did you encounter any difficulties or restrictions? What strategy did you use to conquer them?

2) Could you describe an instance in which the AI's recommendations did not suit your needs or preferences? What was your approach to this?

Instrumentality:

1) Which AI fitness app features are the easiest for users to navigate and use?

2) Is there a particular AI fitness app that you think has a user-friendly UI that you could share?

3) What role does AI play in personalized exercise regimens or fitness programs

that you have access to through apps?

4) Could you give an example of a situation where using an AI fitness app's personalized features helped you in your fitness journey?

5) Have you used wearable technology—such as fitness trackers or smartwatches—to interact with AI fitness apps? In what way did this improve your encounter?

6) In your opinion, how can wearables enhance the efficacy of AI-powered fitness applications?

Valence:

1) How precise do the AI-driven workout, nutrition, and fitness goal recommendations in these apps seem to be in your experience?

2) How did AI's recommendations contribute to your fitness results?

The participants were contacted through email and WhatsApp and after taking their permission, structured interviews were conducted through online medium between September 2023 and December 2023. 59% of the participants were males and 41% were females. 55% of the participants were in the age group of 60 years to 70 years and 45% were in the age group of 71 years to 80 years. 38% of the participants were in employment while 62% led a retired life and devoted to their family-oriented work. The interviews were conducted through online platform such as google meet, MS Teams and Zoom depending on the comfort level of the participants. The interviews were recorded and later transcribed for the purpose of analysis. Data analysis started immediately after the first interview was completed. A coding system was created where the principal categories were labeled as motivation, expectancy, instrumentality and valence since the purpose of the study was to evaluate the fitness apps in the context of Vroom's expectancy theory of motivation. The interview texts were examined to identify themes that best described the principal categories related to Vroom's expectancy theory of motivation. The same process continued for each interview. Every interview was examined for new insights and themes that best explained motivation, expectancy, instrumentality and valence. The themes that were constantly repeated in each interview were discarded. The process continued till no new insight was forthcoming from the participants and a saturation level was reached. This happened at the end of 45th participant. Hence a sample size of 45 was considered sufficient for the study. Two independent researchers were employed for coding to eliminate bias in the coding process and improve inter-coder reliability. Manual coding was preferred over software based coding since software is based on certain algorithms which may not provide correct interpretation of the text.

As per the university guidelines, ethical approval is important for clinical trials. Since, the current study involves survey based research, no approval is needed for the study as per the University ethical policy.

3. Results and interpretation

Interpretation:

Content analysis techniques, where the interview statements were subjected to systematic review in search for sub-themes and primary themes, identified key ideas that fell under a common overarching theme of motivation. For instance, the statement

"I really like the 30-day workout challenge which forces you to exercise consistently" was categorized under the sub-theme 'creating workout challenge', that summarizes a systematic motivational approach leading to long-term activity maintenance. This sub-theme was categorized under the main theme 'perseverance' as broadly encompassing an overall sense of long-term commitment. Similarly, the declaration in regards to 'user recommendation' was also connected with the main theme 'endorsement' where it explained the motivation strength of peer influence. The sub-theme 'stimulation for goal setting as well as fitness planning' was derived from users' appreciation of structured planning features in the application that falls under the main theme 'stimulation' that shows how motivation could be achieved through clear goal-setting. 'Social interaction' was identified as a motivating factor through the sub-theme 'social engagement', building the overarching theme of 'interactivity', illustrating how community dynamics can drive or fuel the desire of the user. The third inspiring theme is the inspirational presence of the coaches gathered with the sub-theme 'inspirational' towards the overarching theme of 'awakening', illustrating how personal motivation can be through external motivation. These themes taken together depict the ways in which elements of the app can bring about general motivation among users toward exercising.

Interpretation:

Interview statements fell under the common theme of expectancy, in relation to users' expectation that the app should be convenient and easy to use. Under the sub-theme convenience, the following statement was derived: "It's good to work at home rather than travel to the gym for workout.". This came under the umbrella theme 'comfort', because end-users expect a hassle-free workout experience. Similarly, the sub-theme 'easy navigation' stemmed from the fact that navigation of the application is easy to do and was connected to the umbrella theme 'effortless', whereby end-users would expect an uncomplicated user experience. Tracking progress easily was also classified under the sub-theme 'easy tracking', which was classified under the general theme 'monitoring', thereby indicating that the user must have an easy time following their exercise journey. A 'user-friendly' interface was also one of the most important sub-themes under the main theme 'compatible', indicating that a system should be user-friendly and adaptive. The convenience at which the application could be accessed through the Play Store led to the sub-theme 'easy availability', which was related to the main theme 'accessible', as users tend to expect there to be smooth availability of the application. The plans being easy to follow led to the last sub-theme 'simplicity', categorized under the main theme 'seamless', as the expectation is that the users would have an experience that is smooth and uncomplicated when relating to fitness plans. Together, the sub-themes and main themes indicate the manner in which easy access and convenient application usage expectations influence users' engagement with the app.

Interpretation:

Interview statements were coded and analyzed in order to identify the presence of sub-themes and overarching main themes: the application's instrumentality or performance capacities. Instrumentality, in this context, could be described as how effectively the app's functionalities and features are able to assist users toward the achievement of their fitness goals and motivating them toward further utilization.

Consequently, the sentence "I could set the goals and make short-term and long-term plans" illustrates the sub-theme of 'goal setting', which was related to the major theme of aspiration, demonstrating the ability of the app to help the users to come out with and work toward their fitness aspirations. Similarly, the 'multiple features and plans' provided through the use of this app were considered to be highly 'extensive', meaning the vast resources that the users have enhance the functional value of the app. The guidance provided through 'coaching' under the main theme of 'mentoring' was the result of the sub-theme, 'coaching and guidance'. Under the sub-theme of 'customer support', customer service was captured and associated with assistance. Features such as 'monitoring and feedback' were captured and tied to the 'review' of performance, illustrative of the facilitative role of the app in tracking progress and accountability for performance improvement generally. Other sub-themes that comprised 'flexible subscription, flexibility of training, and flexible plans' were put under one general theme, 'flexibility'. This showed the level of flexibility to suit the schedule and preferences of other users into the application. Providing tailored workout plans was categorized under the main theme as 'need personalization'. This theme was linked to the main theme under 'customization', thus strengthening the role in shaping fitness experiences according to users' needs. The sub-themes such as 'guidance and reminders', were looked at in relation to the 'prompts' of the super-ordinate theme that speaks to how the app constantly inspires users by keeping them on track, while 'precision' in functionality was associated with 'perfection' in the main theme so reflected how great the performance of the app would be with regards to delivering precise and effective features.

Inference:

Valence is the positive or negative value that users attribute to the outcome they obtain from the application, heavily influencing their motivation to continue applying it. An example of utterance is the state "The app allows a full change of habits and life" which was encapsulated in the sub-theme 'life and habit transformation' with the chief theme 'transition'. This is what gives sense to the app's promise of long-lasting lifestyle change, motivating users through this promise of long-term improvement. The case was similar with the statement referring to the app as offering an amazing experience. This statement was also connected with the sub-theme 'amazing experience' and fell in the realm of main theme 'memorable'. It pointed towards the positive emotional outcomes users associate with the app that would enhance motivation. The reliability of the app in functioning well was captured through the sub-theme 'reliability', put under the overarching theme 'trustworthy', which pointed out how the users' confidence in the ability of the app to succeed repeatedly creates motivation through assurance of success. Lastly, the capacity of the app to facilitate users on "a wonderful journey of self-healing" contributed to the sub-theme 'journey of self-healing', categorized under the overarching theme 'rejuvenation'. This theme illustrates the restorative and empowering outcomes that users derive from their stay in the application, which manifests in continued motivation to stay engaged with the app for personal growth and well-being. The analysis helped in developing the theoretical frame (refer **Figure1**).

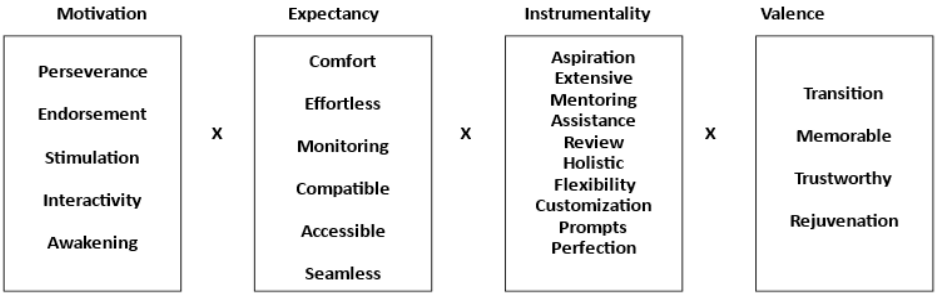

Figure 1. Vroom's expectancy theory of motivation for AI driven mobile app.

4. Discussion

(1) Motivation (refer **Table 1**)

Table 1. Identification of themes related to "motivation".

Interview statements	Participant number	Sub themes	Main themes
I really like the 30-day workout challenge, which forces you to exercise consistently.	12, 38, 40	creating workout challenge	perseverance
The selection of app is based on user recommendations	19, 22, 27, 29	user recommendations	endorsement
The app encourages goal setting and fitness planning	1, 33, 45	encouragement for Goal setting and fitness planning	stimulation
I could engage with users who had similar fitness goals	2, 8	social engagement	interactivity
The coaches are very inspiring	43, 45	inspirational	awakening

Motivation is frequently needed on the journey to achieve the fitness goals and achieving a healthy lifestyle. Different themes were identified under the main theme of motivation. Creating a "perseverance" for the users by organizing a "workout challenge" will motivate users to use the app. The findings compliment Ahmad et al. (2020) where the emphasis was on examining the willingness for usage of fitness apps. The "social engagement" of users helps in creation of an environment of "interaction" amongst themselves and keeps them interested in the newfound enthusiasm for well-being. The findings are in line with studies by Zhu et al. (2021) which concludes that social engagement boosts physical activity. The "encouragement for goal setting and fitness planning" act as a "stimulation" for the users to create an "awakening" in the journey of achieving the fitness goals. Similar results were found by Martschukat (2021). The AI driven fitness coaches play an important role in "inspiring" the users at every stage of the fitness journey. This is further augmented by existing "user recommendations" that act as an "endorsement" to encouraging usage of the apps. These findings match with the findings of Priya et al. (2024) and fill the void of existing research since the senior citizens have to be inspired with user recommendations to use the apps.

(2) Expectancy (refer **Table 2**)

Table 2. Identification of themes related to "expectancy".

Interview statements	Participant number	Sub themes	Main themes
It's good to work at home rather than travel to the gym for workout	17, 19, 22, 24, 25, 27	convenience	Comfort
The app is easy to navigate	15, 23	easy navigation	Effortless
Its easier to track the progress	5, 17, 27	easy tracking	Monitoring
The app should have a user friendly interface	18, 32	user friendly interface	Compatible
It's easily available in the playstore	24, 28, 35	easy availability	Accessible
The plans are easy to follow	14, 24, 25	simplicity	Seamless

Expectancy represents the efforts needed to use the AI driven fitness apps. Due to "easy availability" of the apps on various platforms, its "accessibility" facilitates easy download by different users with less efforts. The results compliment the findings by Yadav et al. (2022). The AI driven apps have made users "carry out their work at home rather than visiting the gymnasium" since it is more "convenient" to use the app. Since the fitness apps facilitate "easy navigation", built into their design, fitness apps are "seamless" in terms of their efforts to operate and have a "user friendly interface". These findings support the studies by other researchers (Cho et al., 2020). The features in the apps make "easy tracking" of the fitness regimen and users feel more at ease and in control of their progress as a result of smooth "monitoring" features that make tracking progress easy. Researchers (Chin et al., 2016) have explained that tracking feature is a major driver to use the fitness apps. The "simplicity" of the features in the app ensure "seamless" journey towards health and well-being. The results fill the gap in existing literature which points towards cognitive impairments and motor skills as a difficulty in using the fitness apps (Elguera Paez and Zapata Del Río, 2019).

(3) Instrumentality (refer **Table 3**)

Table 3. Identification of themes related to "instrumentality".

Interview statements	Participant number	Sub themes	Main themes
I could set the goals and make short term and long term plans	6, 17, 37	goal setting	Aspiration
The app has multiple features and multiple plans	2, 11, 13, 22	multiple features and plans	Extensive
Fitness goals are achieved through coaching and guidance	41, 42, 45	coaching and guidance	Mentoring
A good customer support is important	18, 28, 43	customer support	Assistance
The app facilitates monitoring and feedback	5, 15, 24, 33, 36	monitoring and feedback	Review

Table 3. (*Continued*).

Interview statements	Participant number	Sub themes	Main themes
The app is one stop solution for all fitness needs	7, 30, 39, 40	one stop solution	Holistic
We can pause the subscription when we don't want to use	29, 32, 35	flexible subscription	Flexibility
We can select our own personal trainer	23, 38	flexibility of training	Flexibility
It gives plans for beginners as well as advance workouts	8, 10, 27	flexible plans	Flexibility
The app can be tailored to my schedule and fitness need	31, 32, 44	need personalization	Customization
I love to be guided and reminded for workouts	14, 27, 35	guidance and reminders	Prompts
I like apps that are precise in functionality	16, 35	precision	Perfection

Instrumentality is associated with the performance of the AI driven app. Health and wellness may be approached "holistically" using fitness apps, which give consumers a "one-stop solution" for all of their fitness requirements. Studies by Sathya et al. (2024) provided similar results. AI-powered fitness apps perform better than expected, providing a wide range of features that support users' "goal setting" thereby aligning with the "aspirations" of the user objective towards fitness. These findings support the studies by Lee et al. (2024). The "multiple features and multiple plans" in the apps offer "extensive" options to the users to personalize their fitness plans. Similar results were achieved by Lee and Lin (2023). The apps provide "coaching and guidance" depending on the selected plan which provides a "mentoring" support to the users at every stage of their fitness journey to achieve their goals. These findings are in line with Dorgo et al. (2009). The apps make it easier to "monitor and provide feedback", allowing users to "review" their progress and gain insightful knowledge to improve their routines. Fieraru et al. (2021) gave similar results. Users can enjoy unmatched "flexibility" by pausing their membership whenever necessary, thanks to various subscription choices. Also, the "flexibility" of training includes the choice of a personal trainer and a variety of beginner-to-advanced exercise regimens. Additionally, the "customization" feature of the apps enables users to "personalize" their fitness journey according to their fitness requirements and schedule, making it an adaptable tool for individuals looking to enhance their physical health. These apps provide "prompts" which act as "reminders" to keep up the fitness program. Similar results were seen in Wang et al. (2021). Their flawless design makes sure that every function works to "precision", thereby improving the apps overall performance to achieve perfection. The results support the findings of de Moraes Lopes et al. (2020). The review of literature highlighted gaps in existing fitness apps such as unique requirements, security concerns and personalized feedback (Flores et al., 2021). They also raised concerns about dependability and quality of the apps (Anthony Berauk et

al., 2018). The AI driven fitness apps have resolved the concerns raised in the existing literature as is evident from the findings under instrumentality. The findings show that AI driven apps offer a more "personalized" approach that helps in boosting the fitness activity of the senior citizens. Kim (2021) has identified the need for personalization of fitness apps. This is in agreement with Ahmad et al. (2020) which highlights that a personalized approach increases the willingness to use the apps.

(4) Valence (refer **Table 4**)

Table 4. Identification of themes related to "valence".

Interview statements	Participant number	Sub themes	Main themes
The app allows a complete transformation of habits and life	1, 4, 18, 20, 21	life and habit transformation	Transition
The app gave me an amazing experience	25, 26, 45, 34	amazing experience	Memorable
The app is reliable as it gives good results	14, 44	reliability	Trustworthy
It's a wonderful journey of self healing	9, 12, 45	journey of self healing	Rejuvenation

The term "valence" describes how emphasis a user gives to a specific outcome or reward (Vroom's theory 1964 cited in Chopra, 2019). It expresses the extent to which a person wants a desirable outcome. AI fitness apps have benefits that go beyond simple physical training regimens and enable a total "life and habit transformation" leading to well-being. These results support the findings by Whelan and Clohessy (2021). Users of these programs see a tremendous "transition" in their lifestyles as they set out on a" journey of self-healing" resulting in "rejuvenation". These findings endorse the study by Stone (2024). According to the users, the apps offer an "amazing experience", allowing users to see noticeable gains in their well-being with each step becoming "memorable". Siebert et al. (2020) had come out with similar results in studies on customer experience journey. The "reliability" of these apps as a result of consistently good results ensure that they become "trustworthy" partners in the journey to achieve fitness goals. Literature on outcome of fitness apps is more focused on efficacy of fitness apps (Licorish et al., 2022). Efficacy is measured in terms of the gap between user expectations and features offered by the apps (Chung et al., 2018; Grundy, 2022). Little attention has been paid to the rewarding experience of mobile apps. The key findings with respect to AI apps related to valence have focused on health and fitness transformation. The results are in line with studies by Depper and Howe (2017).

5. Conclusion

The results give an understanding of how the app works as an effective motivator for the users in four dimensions: motivation, expectancy, instrumentality, and valence. Under motivation, users are motivated through structured challenges and goal setting which favor long-term engagement and a commitment to the fitness routine. The expectancy dimension reflected the fact that it is the ease with which the app will offer convenience and ease of access that will drive users to the required minimal effort

towards a perfect performance. Instrumentality-the features of the app, for instance, flexible times for work-out training that allows them to monitor their progress and individualized plans, complete with their fitness goals strengthen users' motivation. Finally, app results are under valence and reflect the experiences that users associate with the app, in this case, positive emotional and life-altering experiences. These include personal transformation, self-healing, and trust in what is being chosen really works. Together, the dimensions demonstrate that the app met the needs of the motivational value of its users in terms of functionality, easiness, and meaningful results, thereby creating longer user engagement and satisfaction.

Limitations and future research direction

The main drawback of conducting a study of this nature based on content analysis lies in having to depend completely on the subjectives regarding the interpretation made of interview statements. Although content analysis embodies a systematic procedure for quantifying data into a topic and categorizing them further at the sub-topic level, there is a tendency for the researcher to introduce bias when they identify and label those themes-from complex and ambiguous statements, in specific. Further, it may be limited to its generalizability to a wider population because of its sample size and context-specific nature. Potential future research will include larger, diverse samples, especially in the application of mixed-method approaches as validated by content analysis put together with quantitative techniques like surveys or psychometric tools for validating the themes and sub-themes discovered. Longitudinal designs allow one to study in terms of whether motivation and app usage change across time and, therefore, would offer much better insights regarding sustained engagement.

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