
Ecological Factors of Long-Term Family Physical Activity Tracking

Herman Saksono¹

hsaksono@ccs.neu.edu

Andrea G. Parker^{1,2}

a.parker@northeastern.edu

¹College of Computer and Information Science

²Bouvé College of Health Sciences

Northeastern University

Boston, MA, US

Abstract

Health research shows that family influences are critical to achieving a healthy lifestyle. In this position paper, we present ecological factors that influence physical activity (PA) self-tracking practices in a family setting: intrapersonal, interpersonal, and community factors. As we suggest the value of these factors for short-term (< 6 months) family PA tracking, we speculate the limitations and the evolving influence of these ecological factors during long-term family tracking.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

Physical activity (PA) can prevent and reduce the risk of chronic diseases associated with obesity. However, while family is an important source of support to achieve regular PA [8], families in low-SES neighborhoods face increased barriers to be active [1]. These barriers include economic stresses, limited resources, and crime concerns [1]. Therefore, PA promotion strategies should be targeted for the needs of families in low-SES neighborhoods [8]. With the increased accessibility of PA self-tracking applications (e.g., Fitbit, MyFitnessPal), individuals have greater access to tools for monitoring their fitness and achieve

Ecological Model of Health Behavior

Healthy behaviors are maximized when individuals are motivated to make healthful choices and their environment supports those choices [13]. The ecological model combines both individual and environmental factors of health behaviors [13]:

Intrapersonal: factors related to individuals' beliefs, attitudes, intention, knowledge, and skills [10].

Interpersonal: factors related to the influence of other people on an individual's behavior [6].

Community: factors related to the larger collective group that influence an individual's health behavior [13].

positive health behavior. While the efficacy of these tools is promising, many of these tools are not designed for families—a critical social environment where healthy behavior is nurtured [2,5]. Furthermore, many of these PA self-tracking tools are designed for short-term change which raises a question about their efficacy for long-term use. Understanding long-term PA tracking is critical given that PA tracking behavior evolves over time [9]. Moreover, individuals often abandon their self-tracking tools due to discomfort with the tracked data, changing life circumstances, saturation of learned insights, etc. [3].

In this position paper, we present our investigations on social PA self-tracking, more specifically, in low-SES family context. Guided by the lessons learned from our short-term 1-2 months evaluations, we will present the potential challenges that may emerge when designing social PA self-tracking for long-term use.

Ecological Influences of Family Self-Tracking

We conducted two in-depth qualitative PA tracking studies with families living in low-SES neighborhoods. In Study 1, we evaluated Spaceship Launch, a gamified PA tracking app for families [12]. The dashboard in the app was designed to encourage caregivers and their children to work together getting their step counts to meet the family's goal. We interviewed 15 caregivers to understand how collaborative game mechanics can engage families in PA tracking. Sixteen children (4-14 y.o.) participated in this study.

In Study 2, we conducted a two-month study to evaluate the use of consumer PA trackers for adults (Fitbit Alta) and children (UNICEF KidPower band) [11]. We interviewed 11 caregivers from nine families living

in predominantly low-SES neighborhoods. Unlike Study 1 where we provided a family PA tracking app, in Study 2, the families were asked to use the apps that were provided by the consumer PA trackers. Therefore, insights from Study 2 characterize family tracking practices when using consumer PA tracking apps. Nine children (6–11 y.o.) participated in this study. Currently we are conducting an extension of Study 2 with five additional families to get more insights into family relationships during PA tracking.

Findings from these two studies suggest three categories of caregivers-related factors that influence the impact of family PA tracking. These factors are caregiver's intrapersonal experiences, interpersonal-experiences with their children, as well as their relationships with their social-physical environment. Guided by the Ecological Model of Health Behavior [13], we will describe each of these factors and the challenges that may emerge during long-term tracking. While these factors reflect the perspectives of adult caregivers during family PA tracking, understanding their insights is critical because caregivers' supportive behaviors are significantly and positively correlated with their children's PA [5].

Intrapersonal Factors

In Study 2, we learned three emerging cognitive, emotional, and physiological experiences that arose within the caregivers' internal self while they were using PA tracking tools. These experiences are *attribution to self*, *surprising discoveries*, and *bodily experiences* [11]. Our data suggest that achieving PA tracking goal and attributing that achievement to one's ability can lead to positive emotional responses. We also suggest that a surprising discovery about one's

ability to meet PA tracking goals can motivate individuals to be more active. Finally, we suggest that caregivers often triangulate their PA trackers' readout with their in-body feelings, such as the feeling of fatigue, sweating, or becoming more fit.

Interpersonal Factors

In Study 1, we learned that caregivers value family interactions that emerge while reviewing PA tracking data [12]. We further suggest that these interactions were valued because they can heighten the feeling of connectedness with their children [12]. Guided by this finding we suggest that PA tracking tools for families should be designed to spark family interactions aimed to elevate the feeling of emotional connectedness. In the extension of Study 2, we also learned how caregivers' aspirations of their children influence how PA trackers are integrated into one's family. Indeed, some caregivers saw that the PA trackers directly fit into their families' health aspirations. However, other caregivers also discussed their non-health related goals (e.g., teaching the virtue of being responsible, being a good model) and how the PA trackers were used to help to achieve those goals.

Community and Physical Environmental Factors

Prior work suggests that PA is deterred by the perception of crime and safety in one's neighborhood [7]. In Study 2, we explored how the use of PA trackers in a family setting is influenced by the perception of crime. While safety concerns could make caregivers feel hesitant to be active outside with their children and thus restrict the impact of PA trackers, we also learned how social connections in a neighborhood can help caregivers to be more comfortable to be active outside [11]. This underscores how social-connections at a

community level can impact the efficacy of PA trackers in neighborhoods with high crime rate.

Collectively, these three categories simultaneously influence the efficacy of PA self-tracking in a family context. This suggests that family PA trackers should be designed to support the aforementioned factors.

Long-Term PA Tracking In a Family Setting

In this section, using insights from our short-term studies, we speculated the evolving influence of the ecological factors during long-term family PA tracking.

Learned Skills

The intrapersonal factors that emerge during family PA tracking in Study 2 (i.e., attribution style, surprising discoveries, bodily experiences) suggest that interventions can be designed specifically to address or leverage these well-defined factors. As an example, reattribution training can help individuals who experienced negative emotion during a failure to meet a PA goal [4]. Such training can shift one's perception about failure (i.e., changing the perception from "failure is due to a permanent inability" to "failure is a temporary setback of a stable progress") and facilitate positive emotional outcomes. Similarly, surprising discoveries about one's ability to meet their goals can elevate one's self-efficacy and encouraged them to challenge themselves to higher goals. Finally, bodily experience is a promising construct that can support the feeling of progress (i.e., by using the user's bodily feelings to show that they have made some progress).

While PA tracking tools can be designed to address specific factors toward short-term change, more work is needed to understand the impact of such interventions

once families incorporated regular PA into their lifestyle. We motivate researchers to seek the answers to this question: *how do these intrapersonal factors evolve during long-term tracking; and whether these factors stay relevant/become irrelevant over time?* Understanding this complexity will inform how self-tracking tools can transition alongside with the users' stages of change—perhaps by adapting the focus of the intervention; or by helping families to maintain the skills to continue to leverage their intrapersonal factors.

Evolving Relationships

The interpersonal factors that we discussed in Study 1 and Study 2 also show that PA tracking in a family setting is influenced by caregivers' aspirations for their children; as well as their psychological needs to be socially connected with their children. Furthermore, we argue that aligning the design of self-tracking tools with caregivers' relationships with their children can help families to be regularly active.

However, more insights are needed to understand how do these aspirations and desires evolve as children grew older [14] and at the same time life circumstances change [3]. This suggests that self-tracking tools for families should be adaptive to the changing relationships between caregivers and children. For example, *how do evolving caregivers-children relationships affect family self-tracking as children become more mature and more independent? As children start to seek friendships and peer relationships when they reach middle childhood (6-8 years old)—as well as romantic relationships during teenage age—, how do the lessening centrality of caregivers in their children's life can influence family self-tracking?*

Changing Community

In Study 2, we suggest that the depth of social connections between families and their neighbors are critical to a continued use of PA self-tracking tools, especially in low-SES context [11]. These social connections can heighten the feeling of comfort and safety to be physically active outside especially in neighborhoods where the crime rates are high. We motivate future work to design PA self-tracking tools that highlight these connections with an aim to help overcome the disempowering narratives of crime.

This finding suggests that self-tracking is also influenced by the social environment in which a family lives. In long-term tracking, the importance of social environment presents a question of whether and how self-tracking tools should help families to cope unfavorable changes in their community. For example, *how can such tools help families achieve their PA goals in the midst of environmental changes, such as neighbors being displaced (a change that could impact caregiver perceptions of how safe it is for their kids to be active outside), business being closed (which could impact access to PA facilities), and policy changes (such as cuts in parks and recreation budget that reduces PA opportunities)?*

Conclusion

Ecological factors (i.e., intrapersonal, interpersonal, and community) can positively influence short-term family physical activity (PA) tracking. However, during long-term tracking, relationships evolve and communities change. As such, more work is needed to understand how changes in these ecological factors influence long-term family PA tracking.

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