Promoting Short-Term Gains in Physical Exercise Through Digital Media Creation

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Abstract. Although regular physical exercise is associated with various health benefits, low rates of adherence remain as an intricate problem. In this paper, we propose a new emotional facilitator named productivity for increasing adherence to regular physical exercise by promoting short-term gains. We define how it would be utilized in the context of digital exertion games to encourage physical activity and maintain high level of intrinsic motivation. We discuss about potential application domains of productivity and introduce possible target user groups. We believe inclusion of design ideas disclosed in this paper will lead to more engaging experiences with higher adherence to physical exercise.

Keywords: Physical exercise adherence, Digital exergames, Exercise motivation, Emotional facilitators

1 Introduction

Physically active lifestyle has been consistently associated with various health benefits such as lower incidence of cardiovascular diseases or improved mental health [1, 2]. Most of these beneficial effects only manifest and persist as a result of regular physical exercise [3, 4]. Although most information is readily available, poor adherence rates to training programs remain as a frequently reported problem [5, 12]. As a result, significant decline in gained health benefits and high drop out rates in administered programs are observed within first six months [5].

Previous research in psychology consistently demonstrated the positive effects of emotional facilitators on regular practice of physical exercise [6]. These are grouped into four categories:

1. Perceived competence
2. Perceived social interaction
3. Novelty experience
4. Perceived physical exertion

These facilitators have been frequently employed by information scientists to design systems that would increase adherence rates to physical exercise [7–9]. Among all, *achievement* has been commonly utilized in exercise applications due to its strong connection with long-term goal oriented structure of physical exercise. For example, fitness trackers typically employ gamification metaphors such as filling empty bars to represent current progress; followed by rewards upon reaching predefined goals. Yet, it is well known that this concept does not produce satisfactory results in terms of inducing long-lasting improvements in user behaviour. Usually a significant decline in exercise motivation is observed when rewards are removed from the equation. Additionally, since short-term gains are difficult to observe or quantify, high drop-out rates in up to 50% of administered programs are observed within first six months [5].

In this paper, we prose a new emotional facilitator named productivity for increasing adherence to regular physical exercise through promotion of short-term gains in digital exertion games. We define how it would be used to encourage regular practice of physical exercise and support users in maintaining high levels of intrinsic motivation. We discuss about potential application domains of productivity and introduce possible target user groups such as elderly or developmentally challenged. We believe inclusion of ideas disclosed in this paper will result in engaging digital exertion game designs with higher adherence rates to physical exercise.

2 Productivity in Digital Exertion Games

Derived from to produce, productivity refers to state of generation, creation or enhancement. The fundamental difference between productivity and achievement is about the former being a long-term goal oriented approach whereas the latter is a short-term process to bring something into existence. Our ultimate goal with productivity is to make small changes and gains evident in physical exercise through digital content creation; such as musical compositions or simple drawings to represent exercise performance. Such content can be used multiple times to assess, compare or contrast previous performance with current results. We take construction and management game genres as basis where the creation and maintenance is favoured over final goals and achievements. Such games include SimCity, Sims or RollerCoaster Tycoon franchises.

In order to demonstrate the usage of productivity, we introduce potential application domains and propose possible target user groups depending on knowledge provided by sports professionals.

2.1 Music Composition through Physical Exercise

A brief review of literature on digital exertion games reveals two crucial criteria that must be taken into account while designing games for elderly. First, due to inevitable age-related decline of cognitive functions such as attention, information processing speed and memory retention, appropriate cognitive challenge

becomes highly important [11]. Second, physiological health and fine motor skills tend to show a significant variance between elderly users [11].

We propose a card matching game known as concentration to address both elements mentioned above. Simplified version of this game consists of four cards where one card is the target that needs to be matched with remaining three possible choices. In order to enhance memory retention, period of time that cards are shown to players would be adjusted based on individual's capabilities and personal exercise needs. This also would allow difficulty level adjustments to ensure flow for maximum amount of entertainment and pleasure.

Standard scenario starts with a user present and all cards facing down. When the game is initialized, a default sound loop starts to play until the end of game. Next, topmost card that we call the target is flipped and revealed for a certain amount of time. After predefined period is finished, the card is flipped back again. Following this step, the deck of three cards is revealed to user. The cards are flipped back again after a certain amount of time, similar to the target card. Finally, the system waits for input from the user for a certain period of time and deals new cards after it finishes.

For physical exercise, we propose squats and lateral arm raises during card selection process (Figure 1). Users can select a card by raising one of their arms until it forms a certain angle with their trunk or execute a squat motion for selecting the middle card. Through combination of these movements we aim for a simple yet effective exercise scenario; which is most suitable for elderly or developmentally challenged.

Fig. 1. Physical gestures are employed for card selection.

Productivity comes into action after each selection process has been completed. Proposed system includes various short sound loops for forming musical compositions to represent physical exercise performance. Successful task execution leads to introduction of additional music loops into the system which builds up to a more complete musical piece. Consecutive selection of correct card results in a complete song, corresponding to adequate performance which is the desirable outcome in most scenarios. Since song length is usually as short as ten to fifteen seconds, we additionally expect performance comparison between

different sets of exercise to be carried out effortlessly by simply listening to both compositions.

2.2 Drawing through Physical Exercise

Another scenario that we propose replaces the art medium from music to drawings. Similar as above, simple full body gestures would be used to administer adequate exercise routines. Productivity could be employed through sketching or revealing certain portions of a drawing with each successful task execution. Ultimately, this would lead to a drawing that would be used for performance comparison, building motivation or and sharing among friends or loved ones.

3 Discussion

Short-term Goals

Our main focus in this paper is about promoting short-term gains during physical exercise to maintain a high-level of intrinsic motivation. Commercially available products such as smart watches or activity trackers place their main focus on end goals to ensure physically active users. Such approach fails at building a sufficient level of intrinsic motivation which in turn leads to commitment issues and high drop out rates.

Although our idea of productivity to promote short-term gains solely revolves around digital content creation, other forms of media, material or concepts would also be suitable for application. Ultimately, we believe as long as people find meaning and become aware of their progress, intrinsic motivation could be built in short-term to promote regular physical exercise.

Long-term Goals

Even though our focus is on short-term goals, the importance of long-term goals is also undeniable. We propose productivity to promote short-term gains in regular physical exercise, but designers could promote long-term goals through intelligent designs too. For example, day-by-day musical composition creation could mean less when each piece of music is unrelated. On the other hand, combining each musical composition created on a daily basis could form a longer and meaningful song to represent long-term performance of users.

Additionally, a band or orchestra approach could be utilized to boost long-term intrinsic motivation through productivity and perceived social interaction. Promoting collective creation would lead to a higher sense of belongingness and improved adherence rates to physical exercise classrooms.

Reaching Users

It is obvious that different user groups have different preferences when it comes to physical exercise. The approach we introduce in this paper must be tailored to each user group according to their specific needs. Although we only talked about two user groups, it could easily be extended to others such as professional athletes, people involved in recreational sports or children. These groups can further be divided into sub-groups depending on age, profession or social background. We believe receiving the support of industrial design professionals would be an appropriate action for achieving our future goals in this subject.

A Variety of Sports

Although current scenario focuses on a small set of target user groups, we believe our approach can be applied to a variety of sports. For example, professional cycling is a repetitive sport where athletes pedal five to six thousand times in an our. This data can be simplified into a shorter digital content and can be used by athletes to perform brief performance assessments on their own data. A one hour long session can be shortened into a few seconds long sonic waves to represent their performance; such as high pitch representing the common occurrence of an unwanted movement.

4 Future Work

In this paper, we do not strictly relate our idea with a specific user group. Since we believe different users might have different needs, it is apparent that our idea requires formal testing with different users. As our first and most important future work, we are planning to have long-term experiments; preferably with elderly participants.

Considering our approach depends on content creation, providing necessary tools and materials is utmost importance. It is obvious to us that the creatable content would have a great impact on both intrinsic motivation development and adherence rate. We aim to investigate this branch of our approach in the near future too.

Pilot tests we did with multiple participants also confirmed the importance of perceived social interaction especially in elderly groups. Few participants mentioned that it is not just more enjoyable but also easier to engage in gameplay when multiple users are present. We believe this might be caused by social structure of Japan where group work is more favoured over individual work. Nevertheless, we plan to address this issue in the near future with addition of multiplayer modes to our next generation design concepts. Currently we are hoping to build on top of our music based approach and bring multiple individuals together to exercise in a band or orchestra context. Through each participant controlling an individual instrument, groups of people can create digital content in a collective manner.

5 Conclusion

In this paper, we proposed an emotional facilitator named productivity for increasing adherence to physical exercise through digital exertion games. We introduced its place in categorization schema of emotional facilitators in physical exercise and demonstrated how it can be utilized in the context of digital exertion games. Future directions that we are interested in include qualitative and quantitative user studies and introduction of additional design concepts to support multiple game modes and various target user groups. We believe our efforts will contribute to advances in building intrinsic motivation and increasing adherence rates to regular physical exercise.

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