MangoMirror

Encouraging positive behavior change in health and fitness through glanceable feedback

ABSTRACT

We introduce Mango Mirror, a smart mirror designed to help users achieve their health and fitness goals by displaying personal data that functions as glanceable feedback. With this feedback, users gain valuable insight into their existing habits and behaviors with little effort or deliberate investigation as the feedback is incorporated into a common and recurring daily routine.

In addition to saving users time and energy from having to manage multiple apps and trackers, Mango Mirror encourages positive behavior change and self-awareness by combining multiple feedback mechanisms with robust personal data.

INTRODUCTION

Global health and wellness reports routinely find that consumers genuinely want to make healthier choices [8,12]. According to a recent survey conducted by market research company YouGov, 37 percent of American respondents planned to set New Year's resolutions for 2018 to get more exercise. 37 percent also reported that they planned to set goals to eat healthier and 24 percent wished to focus on other aspects of self-care [13]. In Canada too, 33 percent claim that improving personal fitness and nutrition is their top resolution [11]. So we know that most people are well-intentioned when it comes to their health. However, we also know that achieving health and fitness goals is far from easy.

Increasingly, people are adopting methods and technologies from self-tracking to make meeting their personal goals more manageable and easier to measure. Further, self-tracking is often thought to play a role in increasing motivation to work toward goals and maintaining desired behaviors. For examples of this, consider common approaches like tracking money spent to decrease total spending, logging time wasted on social media to increase productivity, or counting steps per day to increase physical activity. The assumption in these cases is that self-monitoring leads to self-knowledge, a better understanding of existing habits, and ultimately changes in behavior. One step beyond technology products that

are designed merely to track user behavior are products designed to encourage certain behaviors. By incorporating findings from behavioral science, including established goal setting strategies into so called persuasive technologies, existing products have successfully influenced behavior change in users, particularly in the area of physical activity and exercise [2,3].

The notion that self-tracking tools can be effective aids to goal achievement hinges on two important points within existing theories of goal setting and task motivation as they relate to activity trackers: the first is that people require summary feedback in order to understand their current status relative to the goals they are trying to achieve, the second is that personal data, aggregated, tracked, and displayed on glanceable interfaces can function as effective mechanisms of summary feedback.

In this paper, we present Mango Mirror, a smart mirror that displays the user's health, fitness, nutrition, and sleep data along with her schedule and reminders, plus news, weather, traffic, daily quotes and more. Unlike existing products in the self-tracking space, which often track individual behaviors and require the user to deliberately analyze the data collected, Mango Mirror brings the data to the user by presenting abstract, easily consumable information in a location the user visits routinely. By enhancing daily routine with key health and activity data in this way, Mango Mirror promotes goal-oriented decision making throughout the day for users.

This paper is structured as follows: We begin with a discussion of Goal Setting Theory and the decades of empirical research that have established feedback mechanisms as important moderators for effective goal setting. Then, we explore existing research on glanceable feedback as a form of persuasive technology. Finally, we consider how feedback mechanisms and what we call glanceable persuasion are incorporated into Mango Mirror's design to effectively assist users in reaching their health and fitness goals.

GOAL SETTING THEORY AND FEEDBACK

Mango Mirror's primary goal is to motivate positive behavior change for users that will help them meet their health and fitness goals. In this respect, product design was heavily influenced by existing findings from behavioral science and from Goal Setting Theory in particular. Psychologists Edwin Locke and Gary Latham spent decades conducting empirical research into goal setting and human motivation aiming to understand how people respond to different types of goals and, by extension, how goals might be set to motivate behavior.

Core findings from Goal Setting Theory that are most relevant to the topics of this paper include that 1) goals are most likely to be achieved when they are specific and challenging (though not too challenging), and 2) clear goals and appropriate feedback motivate behavior change—goals have an energizing function, working toward a goal is itself a source of motivation [9].

Particularly relevant in Goal Setting Theory is the idea of feedback as an important moderator for effective goal setting and motivation. According to Locke and Latham [9]: "For goals to be effective, people need summary feedback that reveals progress in relation to their goals. If they do not know how they are doing, it is difficult or impossible for them to adjust the level or direction of their effort or to adjust their performance strategies to match what the goal requires."

This feedback can come in a variety of types and forms. For example, feedback can come from bosses, coaches, or managers. It can come from the goal-setter herself if she chooses to check-in on her own to evaluate how her goal setting and performance is going. Increasingly, individuals have turned to using apps and trackers to create mechanisms of feedback. An important caveat in all three examples of feedback types, and especially in the latter two, is the implicit assumption that the goal-setter possesses the motivation to engage in meaningful reflection of her personal data when confronted with feedback of these types.

GLANCEABLE INTERFACES AS PERSUASIVE TECHNOLOGIES

Much has changed in consumer technology since since Locke and Lahman's work in the late twentieth century, While the underlying theory about feedback as a moderator for effective goal setting is uncontroversial, it may be worth considering how activity trackers and self-tracking apps fit here. Enabled by technological advances in data science and storage, individuals have access to more data about themselves now than they've ever had before.

Naturally, consumer technology products will need to employ designs that can take advantage of the value to be found in such large collections of data while effectively synthesizing it and bringing it to the user in a way that is beneficial and helps to achieve a desired end.

Existing research on activity trackers as tools for supporting goal achievement suggests that users may not actually be engaging with feedback in an optimal way. According to a group of researchers from Portugal's Madeira Interactive Technologies Institute [5]: "Our recent work has shown that many activity tracker users lack the interest, skills, or motivation to reflect extensively on data about past behaviors. In fact, more than 70% of the usage of our activity tracker related to *glances*—brief, 5-second sessions where users check their current activity levels with no further interaction." As the authors of the paper point out, the newest challenge to generating meaningful feedback requires leveraging these brief sessions, or glances, to optimize impact toward behavior change.

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This type of feedback is often referred to as glanceable feedback. Glanceable feedback presented via a glanceable product interface, offers a way to create real-time personal awareness to the user [3]. Glanceable feedback must consist of easily consumable information. Product designers in particular have noted the role that abstraction can play in making feedback information easily consumable in a single glance [6].

The overall importance of glanceable feedback in behavior change apps and tools has been acknowledged by a growing body of existing research [2,3,5]. Further, glanceable feedback possesses certain beneficial qualities over types of feedback that are more extensive or more deliberately consumed. For example, glanceable feedback requires minimal attention from the user and very little energy to be processed.

It can work in the background so to speak, and doesn't require the user's full attention--in some cases, it may even be able to be processed more or less subconsciously. It has also been suggested that frequently monitoring behavior in the way that glanceable feedback facilitates may lead to early correction of undesired behaviors, halting them before they develop into more permeating habits that are difficult to break and likely to hamper effective goal setting and motivation.

One of the most significant features of glanceable feedback may be its versatility of implementation. By embedding glanceable feedback into frequently occurring activities (like glancing at a watch, checking smartphone notifications, or looking in a mirror) feedback information can be brought to the user automatically, presented precisely in the locations where he is most likely to gaze. This routine interaction with feedback positively affects self-regulation and promotes behavior change.

Glanceable feedback has been shown to be particularly useful when applied to behaviors related to health and fitness. Existing research provides a collection of examples of glanceable feedback interfaces being used to effectively encourage physical activity, enhance exercise performance, or increase long-term commitment to fitness and other health goals among users. UbiFit, a combined smartphone application and fitness device that uses a stylized display to encourage behavior change has been found to increase individuals' commitment to physical exercise [1]. The running and exercise app, TripleBeat, uses a glanceable interface to improve the likelihood of goal achievement [3]. Finally, WaterJewel, a wearable bracelet designed to remind its wearer to stay hydrated throughout the day was found to promote healthy drinking behavior better than standard mobile apps that did not incorporate glanceable feedback in any way [4].

These apps and devices appear to be only the beginning of using glanceable feedback to improve the efficacy of physical activity trackers. We envision optimally designed glanceable feedback interfaces as a highly promising avenue for using smartphone apps, personal data tracking, and wearable devices as means to goal achievement. We aim to build on current understanding and existing technologies to advance the use of glanceable feedback as a mechanism to promote positive and effective goal setting strategies.

PRODUCT INTERFACE DESIGN

Effective glanceable feedback works well with and adapts to the limitations of time and attention it faces. A very brief window of time for presenting feedback means that information must, first and foremost, be easily consumable. Glanceable visuals, then, "enable quick and easy visual information uptake" [10]. This means that not only does any information presented need to be clear and brief, it must also be easy to capture and interpret even when attention is divided among multiple, unrelated tasks.

As many researchers have found, abstraction can be very helpful here [6]. Graphic representations may better convey strong messages with a single glance compared to numerical data. Better yet, stylized representations that easily convey progress toward goals without any reference to numerical data at all often receive some of the strongest responses from users in terms of successful behavior change. For example, stars or smiley face icons to indicate that a goal has been achieved or that the user is progressing toward it at the appropriate pace, or a simple shape that fills in as the user completes the pre-established quota for a daily goal or milestone [6].

In their seminal investigation of the design space for glanceable feedback, Gouveia et al. [6] offer a general outline of what makes feedback glanceable and how it should be integrated into product design to achieve desired effects: "We argue that glanceable feedback for behavior change should be abstract, integrate with existing activities, support comparisons to targets and norms, be actionable, and have the capacity to lead to checking habits and act as a proxy to further engagement." These researchers also found that subtle differences emerge in how users interact with glanceable feedback devices based on the exact design concept chosen—this highlights the level of precision required to design glanceable interfaces that work at accomplishing what they intend to.

MANGO MIRROR AND GLANCEABLE PERSUASION + FEEDBACK

Mango Mirror is the first product of its type. While smartwatches and smartphones have incorporated glanceable feedback into their interfaces, they still rely on minimal interaction from the user. Mango Mirror embeds important personal information about a user's health status and goals into a reliably occurring activity. If the average person looks in the mirror 8 times per day [7], there is ample opportunity to leverage this time for self-improvement.

The longest periods of time spent in front of the Mango Mirror would likely be in the morning while getting ready for the day and in the evening while getting ready for bed. Not only are these reliably occurring interactions with Mango Mirror, they also catch the user at a particularly personal time, when she is most likely alone and focused on self-care.

The fact that Mango Mirror is a literal mirror also makes the product uniquely persuasive. The presentation of personal information coupled with the visual of the user's own reflection is a powerful

combination. In an abstract way, a user's reflection may function as an additional form of feedback, particularly if her goals relate to health and fitness. For example, noticing a tired reflection looking back at her, side-by-side with her display of tracked sleep data—showing less than 8 hours of sleep—may remind a user to prioritize sleep in her personal care. Conversely, feeling pleased with the reflection staring back upon a quick glance in the mirror, displayed adjacent to personal data showing that she's hit all of her exercise and nutrition goals, can go a long way in validating a user's sense of pride and self-satisfaction, motivating her to continue practicing positive habits.

By incorporating glanceable feedback into a user's daily routine, Mango Mirror makes self-reflection and goal-setting daily activities without requiring that users alter their existing schedules or make tradeoffs with their other activities and obligations.

Finally, Mango Mirror's clean, minimal interface displays only the most pertinent information, allowing users to avoid navigating multiple smartphone apps to collect a potentially unmanageable amount of data combined in a way that lacks clarity or powerful abstraction.

BENEFITS OF MANGO MIRROR

Mango Mirror offers users a better conception of their overall health than is possible with a collection of smartphone apps or self-tracking devices. By bringing all personal data to a single location and embedding its presentation into an existing daily routine, Mango Mirror saves users the time and energy they would otherwise spend deliberately reviewing the same data. Further, it spares them the challenge of having to create a new habit to check each app or data source individually—as if establishing a new habit isn't exactly where most of the difficulty is when it comes to any type of behavior change. By incorporating glanceable feedback into a user's daily routine, Mango Mirror makes self-reflection and goal-

setting daily activities without requiring that users alter their existing schedules or make tradeoffs with their other activities and obligations.

Daily self-reflection, even if very brief, promotes increased personal awareness and self-knowledge making users more likely to engage in deeper reflective analysis of their behavior and how it aligns with their longer-term goals and values.

Mango Mirror's unique ability to combine the user's reflection with glanceable data feedback creates a truly innovative component when compared to existing persuasive technologies.

CONCLUSION

Mango Mirror is a smart mirror that displays the user's health, fitness, nutrition, and sleep data along with her schedule and reminders, plus news, weather, traffic, daily quotes and more. Through a discussion of existing research from behavior science, human motivation, and product design, we have outlined the ways in which its innovative design reflects well-established insights about goal setting and motivation and incorporates cutting-edge features that leverage the persuasive power of glanceable feedback to support behavior change.

REFERENCES

1. Consolvo, S., Klasnja, P., Mcdonald, D. W., Avrahami, D., Froehlich, J., Legrand, L., . . . Landay, J. A. (2008). Flowers or a robot army?: Encouraging awareness and activity with personal, mobile displays. In *Proceedings of the 10th International Conference on Ubiquitous Computing*. New York, NY: ACM.

2. Consolvo, S., Klasnja, P., Mcdonald, D. W., & Landay, J. A. (2009). Goal-setting considerations for persuasive technologies that encourage physical activity. In *Proceedings of the 4th International Conference on Persuasive Technology*. New York, NY: ACM.

3. de Oliveira, R. & Oliver, N. (2008). TripleBeat: Enhancing exercise performance with persuasion. In *Proceedings of the 10th International Conference on Human Computer Interaction with Mobile Devices and Services*. New York, NY: ACM.

4. Fortmann, J., Cobus, V., Heuten, W., & Boll, S. (2014). WaterJewel: Design and evaluation of a bracelet to promote a better drinking behaviour. In *Proceedings of Mobile and Ubiquitous Multimedia*, 58-67.

5. Gouveia, R., Pereira, F., Cabana, A., Munson, S., & Karapanos, E. (2015). You have 5 seconds: Designing glanceable feedback for physical activity trackers. In *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing and the Proceedings of the 2015 ACM International Symposium on Wearable Computers*. New York, NY: ACM.

6. Gouveia, R., Pereira, F., Karapanos, E., Munson, S., & Hassenzahl, M. (2016). Exploring the design space of glanceable feedback for physical activity trackers. In *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp '16)*. New York, NY: ACM.

7. Gray, E. (2012, May 14). Most women look in the mirror 8 times a day, survey shows. *HuffPost*. Retrieved from https://www.huffingtonpost.com/2012/05/14/women-workplace-look-in-mirror-8-times-a-day-survey_n_1515316.html

8. Kantar Health. (2016). *The global health and wellness report: Findings from the national health and wellness survey (NHWS)*. Retrieved from http://www.kantarhealth.com/docs/ebooks/2016-global-health-and-wellness-report.pdf

9. Locke, E.A., & Latham, G.P. (2002). Building a practically useful theory of goal setting and task motivation. *American Psychologist, 7*(9), 705-717.

10. Matthews, T., Blais, D., Shick, A., Mankoff, J., Forlizzi, J., Rohrbach, S., & Klatzky, R. (2006). Evaluating glanceable visuals for multitasking. Technical Report EECS-2006-173. UC Berkeley.

11. Simpson, S. (2017, January 9). One in three Canadians (33%) say improving personal fitness and nutrition is top New Year's resolution. *Ipsos*. Retrieved from https://www.ipsos.com/en-ca/news-polls/one-three-canadians-improving-personal-fitness-and-nutrition-top-new-years-resolution

12. The Nielsen Company. (2015). *Global health and wellness report*. Retrieved from https://www.nielsen.com/content/dam/nielsenglobal/eu/nielseninsights/pdfs/Nielsen%20Global%20Health%20and%20Wellness%20Report%20-%20January%202015.pdf

13. YouGov. (2017). *New year survey*. Retrieved from http://d25d2506sfb94s.cloudfront.net/cumulus_uploads/document/366cvmcg44/New%20Year%20Survey,%20December%208%2011,%202017.pdf