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The Promise of Digital Technology Augmented Behavioral Treatment of Obesity

STOTLAND Stephen

Montreal Comprehensive Weight Management Program, Montreal, Quebec, Canada
sstotland@montrealcomprehensive.ca

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Abstract: Digital technology is being applied to augment or replace standard behavioral treatments for obesity. This is motivated by the need for efficient and scalable treatment methods to meet the demands of obesity care. We discuss the challenges of behavioral treatment and the potential for digital technology not only to create efficiency, but to augment current practices.

Keywords: Obesity, Behavioral Treatment, Digital Programs for Obesity, Psychology of Weight Control

1.0 The challenge of obesity treatment

By changing their patterns of behavior, individuals can influence many aspects of their own health and well-being (Loef & Walach, 2012; Nguyen et al., 2024). However, people often fail to take such beneficial actions, and if they do, they often do not persist. The reasons for less-than-optimal self-care are certainly complex, requiring bio-psycho-social frameworks of understanding.

Behavioral treatment of obesity is a very hopeful endeavor, which rests on the belief that a person can exert influence over his/her environment and him/herself, despite the countervailing forces (biological and social-environmental) supporting the status quo. When theory meets reality, however, we find that things are often not as straightforward as hoped for. Hence, the 60-year history of behavioral treatment of obesity seems, frustratingly, not to have made much progress or to have lived up to its initial promise (Wadden, Tronieri & Butryn, 2020). To be fair, the challenges have grown, as society has moved towards a greater reliance on ultra processed, high calorie food and more sedentary lifestyles. The person wanting to take control of his/her weight is battling these powerful forces.

In the present paper, I focus on the psychological dimension of weight management, specifically the role of attitudes and emotions in the process of behavior therapy for obesity. I will argue that there is a gap between our basic knowledge of the importance of these factors, and their translation into treatment applications. I will

conclude by proposing that digital technologies may be helpful in creating a more effective behavioral approach.

2.0 The psychology of obesity and weight management

The development of overweight and obesity follows a dynamic path, with periods of weight gain, stability, and weight loss (Howe, Firestone, Tilling & Lawlor, 2015). The majority of overweight people have a pattern of periodically trying to lose weight, but ultimately regaining what they have lost. From a psychological point of view, the question is what initiates these shifts and cycles from gaining to stability to losing. Models of the stages of behavior change describe the process in broad terms, indicating that for voluntary behavior change to occur it must be preceded by a decision to take action, which itself is preceded by a decision-making process in which the person contemplates the costs and benefits of the potential course of action (O'Connell & Velicer, 1988; Prochaska et al., 1994). Although not a fully conscious and rational process, the shift from contemplation to action is characterized by a feeling of hopefulness and the expectation of benefit (Andres, Saldana & Beeken, 2015; Polivy & Herman, 2002).

As the person enters the action phase of behavior change, they are engaged in a process of modifying their choices and behavior, and hopefully building new habits (Gardner et al., 2021). The person trying to lose weight makes numerous decisions on an ongoing basis about what and how much to eat, when, and how, and similar decisions about their physical activity (Wansink & Sobel, 2007). They initiate these actions and then observe the results, making adjustments. While doing all of this, there is a continuous stream of self-referential thinking ("Is this the right plan? Am I doing well? Am I losing enough weight? Is this worth the effort I'm making? Maybe I'm not meant to lose weight. Maybe it's my genes. Maybe I need medication or surgery) and related feelings (excitement, pride, anxiety, guilt, frustration, discouragement), which moderate the link between intentions and behavior (Aulbach et al., 2023; Stotland, Larocque & Sadikaj, 2012). These internal experiences are ever changing and hard to communicate, to assess, or to intervene in (Forman et al., 2017; Goldstein et al., 2021), but effectively managing them appears critical to a successful outcome (Teixeira et al., 2015).

In standard behavior therapy, the motivational impact of thoughts and feelings are addressed through educational components (teaching people about the links between thoughts, feelings, and actions) and practical exercises (keeping journals about emotional eating, practicing cognitive techniques to enhance positive interpretations of events and outcomes, making small goals to increase the likelihood of goal achievement and the feeling of accomplishment). It is unclear how effective current methods are in helping people understand and manage the attitudinal and emotional dimensions of the behavior change process. Little is known about how well these kinds of lessons about self-regulation are learned and utilized when they are needed (see Goldstein et al., 2021; Stubbs et al., 2021).

Current behavioral treatment of obesity focuses mostly on eating and exercise, emphasizing the importance of continuous monitoring of those behaviors (Wadden, Tonieri & Butryn, 2020), while the cognitive and emotional dimensions are given less attention. The self-monitoring of eating and exercise behavior is often considered the core intervention (Burke et al., 2022; Patel, Wakayama & Bennett, 2021). This narrow focus is partly a function of limited resources and the pursuit of efficiency and scalability, but it is also partly due to the view that more extensive work on motivation and emotions is not necessary, given that the majority of obese people are psychologically normal. Unfortunately, this conclusion rests on the faulty premise that a generally healthy person will exhibit optimal psychological functioning even in areas of life they are struggling with. Hence, the obese individual, even one who is generally happy and well adjusted, is vulnerable to dysfunctional mindsets and emotional responses in relation to weight management (Friedman & Brownell, 1995; Puhl, 2023; Steptoe & Frank, 2023; Stotland, Larocque & Sadikaj, 2012).

While early work in the area seemed to indicate that focusing on modifying eating and exercise behavior directly could produce adequate outcomes (Stuart, 1967; Penick, Fillion, Fox & Stunkard, 1971), the voluminous literature over the past 5 decades has shown that there is a great deal of variability in short- and long-term outcomes, that the average person does not achieve a clinically significant weight loss, and tends to regain the lost weight over the next couple of years (Wadden, Tonieri & Butryn, 2020). Despite these less than satisfying results, experts still universally regard behavior change interventions as foundational to multidisciplinary obesity care (for e.g., the Canadian Adult Obesity Clinical Guidelines, 2020), which highlights the need for a more effective behavioral model and treatment methods. We appear to be at a crossroads, where behavioral approaches may become less and less relevant as medical interventions (pharmacotherapy and surgery) take prominence based on their more impressive outcomes (Wadden et al., 2023), or we will find ways to reinvigorate the behavioral model by devising new methods to address the psychological dimension of behavior change.

Before moving to possible solutions, let's take another moment to look back. We can see clearly what the behavior therapy process looks like in Stuart's landmark 1967 paper. The process starts with observation, to identify the target behaviors and the circumstances in which they occur, and only then devising a strategy to interrupt or to replace the problematic habit. Further observation gauges the impact of the strategy, proceeding systematically to the identification and modification of other habits until the behavioral profile (what we would call the "lifestyle") has been transformed, and the weight loss goals achieved. Along the way, the therapist ensures that the client understands the rationale for each step and actively collaborates in the treatment design, encouraging feelings of autonomy and competence and a positive working relationship. When the process looks like this the results are likely to be good, but we need to acknowledge that it is quite labor intensive and requires a fairly high level of clinical expertise.

For many reasons, which we will not review here, the field moved away from this individualized approach, and has looked for ways to standardize and reduce the intensity of the process, always with the stated goal of efficiency (Forman et al., 2023). The logical conclusion of this is the advent of completely automated digital programs that deliver educational content in small packages, teaching people about nutrition, exercise and strategies for goal setting, self-monitoring and stress reduction. The individual makes use of this good advice on his/her own. This self-directed, automated approach is helpful in a minority of cases, those who engage with it and are able to stick to it (Thomas et al., 2022). Thus, for a few people, there may be no need for therapists or coaches, at least in the short term.

It is true that behavior therapy, being based on explicit rationales explaining the problem and providing a step-by-step guide to changing it, lends itself well to a self-directed approach. The methods are easy to understand and, theoretically, can be employed oneself. Unfortunately, what is left out is that people often do not act in their own best interests, do not learn the things they set out to learn or employ new knowledge consistently, do not see their own blind spots, react emotionally rather than rationally, and in general often do need teachers, coaches and therapists to get past these challenges inherent in human nature.

The limitations of current behavioral approaches to obesity appear to be operational rather than theoretical. We have compelling models of many of the processes motivating people to take action, to persist, or to fall off the plan and drift towards relapse and weight regain (Forman et al., 2017; Jansen, Roefs & Houben, 2015; Stubbs et al., 2021; Teixeira et al., 2015). The practical question is how to translate these insights into treatment methods that incorporate them. It is here that digital technology may hold great promise. In fact, it may be no exaggeration to suggest that behavioral treatment cannot succeed in providing widely effective treatment without the integration of digital technology. Not merely a means of reducing costs and increasing access, digital technology has the potential to transform the treatment model and create a more effective approach than what can be provided by health care professionals alone, even by multidisciplinary teams working in what are considered gold standard programs (e.g. the Look Ahead study; Zhang et al., 2021). The goal is to use professional resources as needed, while saving time and money, empowering people, and reducing the burden of obesity.

3.0. Current status of digital technology in obesity treatment

Digital tools that have been included in obesity treatment research include connected devices (smart scales), wearables (activity monitors), apps (food/nutrition journals), online education (learning exercises), messaging, telehealth, machine learning, and AI conversational chatbots. This large and rapidly expanding literature examines these tools, alone and in combination, with and without additional clinical intervention (for reviews, see Chew, 2022; Hinchliffe, Capehorn, Bewick & Feenie, 2022; Irvin, Madden, Marshall & Vince, 2023; Price, Santos & Amador Bueno, 2022; Oh, Zhang, Fang & Fukuoka, 2021).

Apps for monitoring eating and connected devices (primarily activity monitoring watches and smart scales) have been widely adopted by consumers and are becoming ubiquitous features of behavioral obesity treatment programs. When used alone, studies show a pattern of initial effectiveness and rapid drop off in usage, and a negligible impact on weight. In combination with standard behavior therapy provided by clinicians, the digital tools appear to offer some added value, particularly in increasing adherence to self-monitoring, although this effect may be time limited. More comprehensive projects have created completely automated behavioral programs, which include apps, devices, online educational content and, in a few cases, AI generated messaging and feedback and just-in-time interventions.

As mentioned earlier, online programs utilizing digital tools were initially proposed as a means of creating efficiency and cost-effectiveness, assuming adequate efficacy could be demonstrated. With these programs becoming well established (e.g. Thomas et al., 2022), the development of very large datasets tracking client interactions with the system

over extended periods of time allows for new kinds of analyses that were not possible before (Lee et al., 2023; Forman et al., 2023; Goldstein et al., 2021). Data collected by devices can now reliably measure body weight, physical activity, sleep, and even eating behavior (Chou et al., 2024), without relying on patient self-report, thus reducing the burden of self-monitoring. Patients' attention can instead be directed towards reflecting on their progress, planning new strategies and problem-solving. Those processes can perhaps be supported by conversational AI coaches (Noh et al., 2023).

What remains more challenging to measure is the psychological experience of the individual, which traditionally has been assessed with self-report questionnaires on a periodic basis, and this limits the effectiveness of digital programs. It has been impossible to assess states of mind and emotion on an ongoing basis. One method of attempting to do so is known as Ecological Momentary Assessment, which prompts the person with a series of questions on a semi-random basis. For example, the person may be prompted 5 times per day and asked how they are feeling, how hungry they are, whether or not their diet is going well today, if they are feeling confident, etc. (e.g. Forman et al, 2017). This approach gets closer to the real-time and ever-changing experience of the individual and has the potential to inform just-in-time interventions (Wang & Miller, 2020) targeting risk for behavioral lapses from the program (see Goldstein et al., 2021). This is an interesting and emerging approach, but quite demanding for the individual, and it is not clear how feasible it is for wide scale or long-term use.

What has not yet been tried in the domain of digital weight management is the use of affective computing, which includes techniques such as sentiment analysis and sensor-based assessment of affective states (Alslaity & Orji, 2024; Cai, Li & Li, 2023; Qian, Hu, Yamamoto & Schuller, 2023). Providing a passively collected metric of stress and negative affect would empower digital programs to provide a new kind of feedback and real-time tracking of the individual's risk state, without requiring the person to stop what they're doing, pull out an app and manually record how they're feeling.

To conclude, let's imagine an optimal scenario. Behavioral obesity treatment provided by a multidisciplinary team (e.g., dietitian, kinesiologist, psychologist) is augmented by an AI coach (chatbot), which can (1) gather information (e.g., weight status, food consumption, and physical activity) through conversations with the person, and input from devices (e.g., activity trackers and mobile apps); (2) integrate the information to provide useful feedback, and to inform predictive models of weight loss (is the person on track or losing more slowly than predicted? are there contextual factors predicting lapses?); and (3) offer real-time adaptive recommendations (e.g., help with decision-making), provide feedback (e.g., trends in weight, eating, activity), and emotional support through empathic and motivating conversations. Not only would the chatbot provide a bridge between meetings with the health care professionals, but it would also offer access to educational opportunities (for both patients and professionals), facilitate data collection, analysis and feedback, and perhaps most importantly, enhance awareness of the ongoing experience of the individual as they progress through this long-term process. The burden of bringing awareness to moment-by-moment and day-by-day shifts in attitudes and feelings will be lowered, and the professional team will benefit by being able to focus on what matters, for this patient, at this time.

With the amount of current research exploring the integration of digital technology and artificial intelligence in obesity treatment, the optimal scenario just described may not be far off. This is an area of study worth exploring.

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