Behavior Change Techniques in Top-Ranked Mobile Apps for Physical Activity

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Background: Mobile applications (apps) have potential for helping people increase their physical activity, but little is known about the behavior change techniques marketed in these apps.

Purpose: The aim of this study was to characterize the behavior change techniques represented in online descriptions of top-ranked apps for physical activity.

Methods: Top-ranked apps (n=167) were identified on August 28, 2013, and coded using the Coventry, Aberdeen and London–Revised (CALO-RE) taxonomy of behavior change techniques during the following month. Analyses were conducted during 2013.

Results: Most descriptions of apps incorporated fewer than four behavior change techniques. The most common techniques involved providing instruction on how to perform exercises, modeling how to perform exercises, providing feedback on performance, goal-setting for physical activity, and planning social support/change. A latent class analysis revealed the existence of two types of apps, educational and motivational, based on their configurations of behavior change techniques.

Conclusions: Behavior change techniques are not widely marketed in contemporary physical activity apps. Based on the available descriptions and functions of the observed techniques in contemporary health behavior theories, people may need multiple apps to initiate and maintain behavior change. This audit provides a starting point for scientists, developers, clinicians, and consumers to evaluate and enhance apps in this market.
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Introduction

Mobile health (mHealth) leverages technology, such as smartphones, to monitor and improve public health. Approximately one in five smartphone users utilize at least one software application (app) to support their health-related goals, and 38% of health app users have downloaded an app for physical activity.[1] These apps tend not to be grounded explicitly in theories of health behavior, and the vast majority of commercial apps have not been evaluated using scientific methods.[2,3] Deconstructing this market may be useful for understanding why mHealth approaches have yet to realize their potential, particularly in the physical activity domain.

General parameters of physical activity apps, such as cost, acceptability, and theoretical representation, have been examined.[2,4] Others have reported on formative data, the process used to develop apps for research, or the acceptability and feasibility of using apps for behavior change.[5–8] The extent to which the techniques incorporated in physical activity apps have been examined has been to evaluate their fidelity with recommendations for weight loss and obesity prevention.[9,10] Characterizing the behavior change techniques in these apps would illuminate the landscape at the border of technology and behavior change, and could be valuable for both scientists and developers working in the mHealth domain, as well as physicians and other practitioners who currently have little information on which to base any app recommendations for patients who seek low-cost interventions to increase their physical activity. The present study examined how behavior change techniques are used to market top-ranked physical activity apps for the most common mobile operating systems.

Methods

The top-ranked "health and fitness" apps as of August 28, 2013, were identified on the two major online marketplaces: Apple iTunes (iPhone operating system [iOS]) and Google Play (Android). Apps were drawn from the top 50 paid and top 50

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free lists in the "health and fitness" category for each operating system (resulting in four lists totaling 200 apps). Descriptions of each app were located online, reviewed, and coded independently by two trained coders using the Coventry, Aberdeen, and London–Refined (CALO-RE) taxonomy.[11]

Results

Of the 200 screened health and fitness apps, 167 (84%) involved physical activity (Android, 38 free and 37 paid; iOS, 43 free and 49 paid). The mean cost for paid apps was $1.97 (SD=1.96) and did not differ across operating systems ($p>0.05$).

Table 1 summarizes the frequencies of behavior change techniques marketed in apps. App descriptions had between one and 13 behavior change techniques (mean=4.2, SD=2.4, median=4). The most commonly observed techniques were as follows: providing instruction on how to perform behavior, modeling/demonstrating the behavior, providing feedback on performance, goal-setting for behavior, planning social support/change, information about others' approval, and goal-setting for outcome (all >24%). Other techniques observed, albeit less frequently, included prompt review of behavioral goals, facilitating social comparison, setting graded tasks, prompting review of outcome goals, providing information on where and when to perform the behavior, prompting self-monitoring of behavior, and prompting self-monitoring of behavioral outcomes (all <20%). Other behavior change techniques were rare (<8%).

Some behavior change techniques were more common in paid than free apps, including providing feedback on performance ($\phi=0.37$, $p<0.01$); planning social support/change ($\phi=0.26$, $p<0.01$); setting graded tasks ($\phi=0.24$, $p<0.01$); and providing information on where and when to perform the behavior ($\phi=0.22$, $p<0.01$). One technique, teaching to use prompts/cues, was more common in free than paid apps ($\phi=-0.27$, $p<0.01$).

A series of latent class models were estimated with one to five classes (rare techniques were excluded). Fit comparisons suggested a two-class model. The first latent class comprised 54% of the coded apps and represented apps focused on physical activity motivation, with an emphasis on social- and self-regulation of physical activity. Descriptions of these apps were characterized by the presence of techniques that provide feedback on performance ($\rho=0.77$, 95%

Table 1. Prevalence of behavior change techniques in top-ranked physical activity apps in the "health and fitness" category

Behavior change technique	*n*	Proportion
Provide instruction on how to perform behavior	111	0.66
Model/demonstrate the behavior	88	0.53
Provide feedback on performance	83	0.50
Goal setting—behavior	63	0.38
Plan social support/change	61	0.37
Information about others' approval	46	0.28
Goal setting—outcome	40	0.24
Prompt review of behavioral goals	31	0.19
Facilitate social comparison	25	0.15
Prompt review of outcome goals	22	0.13
Set graded tasks	22	0.13
Provide information on where and when to perform the behavior	18	0.11
Prompt self-monitoring of behavior	17	0.10
Prompt self-monitoring of behavioral outcomes	16	0.10
Teach to use prompts/cues	11	0.07
Prompt rewards contingent on effort or progress toward behavior	10	0.06
Provide rewards contingent on successful behavior	10	0.06
Action planning	6	0.04
Information on consequences of behavior to the individual	6	0.04
Prompting focus on past success	5	0.03
Information on consequences of behavior in general	4	0.02
Stimulate anticipation of future rewards	4	0.02
Environmental restructuring	2	0.01
Normative information about others' behavior	1	0.01
Relapse prevention/coping planning	1	0.01
Shaping	1	0.01

Note: Techniques not observed in any apps included agreeing to a behavioral contract, barrier identification/problem solving, fear arousal, general communication skills training, motivational interviewing, prompting anticipated regret, prompting practice, prompting self-talk, prompting use of imagery, prompting generalization of target behavior, prompting identification as role model/position advocate, stress management/emotional control training, time management, and use of follow-up prompts.

CI=0.68, 0.86) and plan social support/change (ρ=0.62, 95% CI=0.51, 0.72), as well as the absence of all other behavior change techniques (except for goal-setting for behavior, ρ=0.58, 95% CI=0.47, 0.68). The second latent class comprised 46% of the coded apps and represented apps focused on physical activity education. Descriptions of these apps were characterized by the presence of providing instruction on how to perform the behavior (ρ=1.00, 95% CI=0.98, 1.00) and modeling/demonstrating the behavior (ρ=0.95, 95% CI=0.90, 1.00), as well as the absence of all other behavior change techniques.

Discussion

A review of documentation for top-ranked physical activity apps established that apps (1) emphasized a limited number of behavior change techniques and (2) could be separated into educational and motivational types. Others have reviewed apps for fidelity with evidence-based recommendations for obesity prevention or weight loss, but this study was the first to audit an array of behavior change techniques marketed in physical activity apps.[9,10]

The most common behavior change techniques in physical activity apps were educational and emphasized providing information or demonstrations of specific physical activities. Knowledge about how to practice a desired health behavior is a necessary precursor to behavior change because it contributes to task self-efficacy, which facilitates the formation of intentions to be physically active.[12,13] Forming intentions is rarely sufficient for changing behavior, and further motivational support is often needed for people to implement their intentions.[14–16] Surprisingly, the most well-established technique for bridging the intention–behavior gap, action planning, was relatively rare in descriptions of the top-ranked physical activity apps.[17,18] People seeking an app to increase physical activity should consider their needs carefully and may need more than one app to modify behavior.

With respect to study limitations, apps were selected based on proprietary and confidential ranking algorithms, which may have differed for the two operating systems. Apps were coded based on their online documentation instead of downloaded versions. Techniques that were not described or not included in the coding taxonomy will not be represented in these results. These data reflect the prevalence of specific behavior change techniques marketed in apps, and readers should not assume that techniques were implemented similarly across apps, that they are necessarily efficacious for increasing physical activity, or that findings about techniques delivered in person will generalize across modes of delivery. The usability of apps was not considered. This area is evolving rapidly; thus, it will be important to update these findings periodically.[19] Finally, strong conclusions about the efficacy of apps for promoting physical activity cannot be drawn from these data.

In summary, a limited number of behavior change techniques are marketed in contemporary physical activity apps. These marketing materials are important because they identify the intended use of an app, which informs whether the U.S. Food and Drug Administration exercises its discretionary authority to regulate apps as mobile medical devices.[20] They also create the first impression of an app for many users and likely influence decisions to download the app. Given the current status of mHealth and the differential rates of innovation for research, technology, and theory, it may be challenging to develop a large evidence base for individual apps (at least using conventional methods); therefore, taxonomies of behavior change techniques provide a useful and inexpensive lens through which apps can be viewed and evaluated by scientists and clinicians.[3,21,22] This information, and related advances in sensing and modeling, will be instrumental for developing apps optimized to modify lifestyle health behaviors and reduce the burden of non-communicable diseases in the 21st century.[23,24]

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