Promoting Behavior Change from Alcohol Use through Mobile Technology: The Future of Ecological Momentary Assessment

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Abstract

Background—Interactive and mobile technologies (i.e., smartphones such as Blackberries, iPhones, and palm-top computers) show promise as an efficacious and cost-effective means of communicating health-behavior risks, improving public health outcomes, and accelerating behavior change (Abroms and Maibach, 2008). The present study was conducted as a "needs assessment" to examine the current available mobile smartphone applications (e.g., apps) that utilize principles of ecological momentary assessment (EMA) -- daily *self-monitoring* or near real-time self-assessment of alcohol use behavior -- to promote positive behavior change, alcohol harm reduction, psycho-education about alcohol use, or abstinence from alcohol.

Methods—Data were collected and analyzed from iTunes for Apple iPhone©. An inventory assessed the number of available apps that directly addressed alcohol use and consumption, alcohol treatment, or recovery, and whether these apps incorporated empirically-based components of alcohol treatment.

Results—Findings showed that few apps addressed alcohol use behavior change or recovery. Aside from tracking drinking consumption, a minority utilized empirically-based components of alcohol treatment. Some apps claimed they could serve as an intervention, however no empirical evidence was provided.

Conclusions—More studies are needed to examine the efficacy of mobile technology in alcohol intervention studies. The large gap between availability of mobile apps and their use in alcohol treatment programs indicate several important future directions for research.

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Keywords

Ecological momentary assessment; alcohol; intervention; cellular phones; behavior change; cell phones

Introduction

Daily data collection via mobile technology and other media-related outlets – such as cellular telephones, hand-held palmtops, blackberries, and web-based protocols – can increase ecological validity by measuring cognitive, behavioral, and affective phenomena as they occur in natural settings and in, or near real-time (Hufford et al., 2002).[1] These types of designs offer many advantages over paper-and-pencil methods of assessment (Shiffman, 2000). First, they involve repeated sampling of behavior over numerous time points and allow for the ability to capture less frequent and rare events. Second, daily process methods minimize recall biases inherent in retrospective designs by allowing for the "time-stamped" study of micro-processes as they unfold over time (Shiffman, 2000). That is, behavior can be recorded where there is a clear "beginning" and "end," and can be verified as occurring at a particular point in time, relative to another behavior. Third, daily process methods provide powerful temporal sequencing of antecedents and consequences of a particular behavior and thus allow researchers to meet the logical and rigorous methodological requirements for establishing mediation of factors that contribute to drinking (Huebner and Tonigan, 2007; Kazdin and Nock, 2003).

The use of mobile technology has been predicted to triple by the year 2013 (Solutions Research Group, 2008). Technological advances in behavioral assessment with mobile technology have already had a major effect on healthcare delivery and access, primarily because they are time and cost-effective, and are widely available. For example, text messaging is one type of media-related intervention currently being used by medical providers to deliver reminders or recommendations to patients, such as to take medication and attend appointments. Mobile technology may also be the "new frontier" for intervention research with the 85% of problem drinkers who never come into contact with professional help (NIAAA, 2008; Tucker, 2003; Willenbring, 2007); and thus has the potential to transform how we deliver alcohol interventions and promote behavior change from harmful alcohol use.

The large gap between alcohol treatment needs and services received represents a significant public health problem: untreated AUDs are associated with high rates of drunk driving, domestic violence, arrest and incarceration, major disease (e.g., diabetes, cardiac disorders), economic burden, and employment problems (NIAAA, 2008). Further, some research suggests that the process of behavior change begins before one enters treatment or seeks help for their alcohol problem (Epstein et al., 2005; Tucker, 2001; Tucker, 2003; Willenbring, 2010), yet to our knowledge, no efficacious intervention programs have been designed to use mobile technology to stimulate or help sustain positive behavior change for drinkers who do not connect with support services. Thus, we believe it is important for clinical researchers to begin to make the shift from ecological momentary assessment – identifying behavior as it occurs "in the moment" – to what Heron and Smyth (2010) coined

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[1]Daily data collection methodology or daily process approaches are associated with several terms in the research literature: ecological momentary assessment (EMA), experience sampling, and real-time or event-level assessment. We use these terms interchangeably. For more detail on definitions of these terms, please see Neal, D. J., Corbin, W. R., DelBoca, F. K., Parks, K. A., Collins, R. L., Fromme, K., Muraven, M., King, L. P., Pardi, A. M., & Vetter, C. J. (2006). Capturing the moment: Innovative approaches to daily alcohol assessment. *Alcoholism: Clinical and Experimental Research, 30,* 282–291.

as "ecological momentary intervention" (EMI) - intervening on behavior as it occurs "in the moment", by utilizing mobile technologies.

Interventions using real-time mobile technology have previously demonstrated efficacy to improve health outcomes in a number of domains (Abroms and Maibach, 2008; Heron and Smyth, 2010; Krishna et al., 2009), including sexual health and risk behavior (Levine et al., 2008; Ybarra and Bull, 2007), smoking cessation (Brendryen and Kraft, 2008; Rodgers et al., 2005), anxiety (Cuijpers et al., 2009), exercise and weight management (Patrick et al., 2009; Sherwood et al., 2006), and diabetes (Giménez-Pérez et al., 2002). Despite its adoption in other health-related fields, however, limitations of EMI research remain in the area of alcohol treatment and prevention. First, there is little to no connection between research and practice in adopting EMI. One reason for this may be that both practitioners and researchers view computerized interventions as expensive, time-intensive, and overly-complex (Conner et al., 2009). Second, few randomized clinical trials (RCTs) have been published using real-time mobile technology intervention procedures as either adjuncts of or comparisons to currently effective AUD treatments with community-based problem drinking populations. Heron and Smyth (2010) recently published a review article of mobile technology-based interventions for improving health behaviors. Of the 27 studies reviewed, only one focused on alcohol use, and this was in a college student sample. Lastly, there is little connection between EMA, which has proliferated in alcohol assessment and intervention research, to *specifically tailored* EMI. That is, to our knowledge no studies have taken EMA data on predictors of alcohol use behavior (e.g., drinking in response to negative mood) (Armeli et al., 2007) and adapted these data to create a mobile technology program that could be used as a clinical intervention or tool.

Despite the cost-effectiveness and utility of mobile applications (apps) as potential tools to reduce problematic drinking, very little information has been gathered about the prevalence and different types of apps that currently exist for alcohol harm reduction, treatment, and recovery. The present study was conducted as a "needs assessment" and systematic exploration of the current available iPhone apps on Apple iTunes© that promote positive behavior change in the areas of alcohol harm reduction, psycho-education about alcohol use, self-help support, or abstinence from alcohol 2. We then conducted a qualitative analysis to examine whether components of "best practices" for AUD treatments were being used in this technology platform. We hope findings from this study will increase the empirical, knowledge-base about mobile technology as it applies to drinking.

We sought to answer the following questions: 1) How many mobile technology apps related to alcohol use behavior are available on the iTunes© platform? 2) Do any of these apps use empirically-based principles of alcohol treatment? 3) Is there evidence to support the efficacy of these apps for alcohol use behavior change? We applied the public health concept of the "needs assessment" to identify gaps in the proliferation of mobile technologies vis a vis application of these technologies to advance alcohol behavior change and intervention programs. Our goal is to provide recommendations for advances and opportunities for intervention research with non-treatment seeking groups of problem drinkers using mobile technology and other media-outlets and stimulate discussion in the field about how to use apps in future research.

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[2]We recognize that mobile technology refers to a large variety of technical solutions that may be used on a hand-held platform or smartphone (telephone communication, text messaging, internet browsing). Our interest in examining "apps" as a potential tool for alcohol use recovery was because these programs, relative to other technical solutions, the allow the user to enter information in "real-time" and receive immediate feedback, are flexible and data driven, can be customizable (personal data can be saved), and are highly cost-and time-efficient (Ceruzzi PE (2000) *A History of Modern Computing.* Cambridge, MA: The MIT Press.)

Materials and Methods

The needs assessment proceeded in three steps: an inventory of the number of apps that were related to alcohol use on the iTunes© platform. Categorization of apps based on thematic similarities and distinct elements was conducted and a review and critique of those apps that utilized empirically-based principles of alcohol treatments (see below for definition of empirically-based).

Assessment and Inventory

We first took an inventory of the applications available on iTunes© by assessing the number of apps that directly addressed alcohol use behavior, alcohol treatment, recovery, abstinence, or harm-reduction. We used the following search terms on the iTunes© website: *alcohol, drinking, recovery, abstinence, harm reduction, moderation, blood alcohol, alcoholics anonymous, self-help, 12-step, recovery, and cognitive therapy*.[3] We chose the iTunes© platform because it is the most popular and outranks other platforms (Android©, Blackberry, and Nokia) in terms of the number of apps available (Business Wire, 2010), by nearly 3 to 1. Further, because iTunes© was developed first, there exists substantial overlap among the platforms; such that many, if not most of the apps found on other platforms are also available on iTunes©.

Coding and Categorization

The next step in our needs assessment was to code and categorize apps based on overlapping and distinct themes and elements (Lesparence, in press). Apps that did not address drinking or alcohol use (such as apps that focused on recovery from depression or anxiety), were not included. For the qualitative analysis, coding proceeded as an iterative process whereby entries were made by two independent coders into an excel spreadsheet. Entries included the app name, a summary of the app description, whether there were alternate versions of the app (e.g. free versions with advertisements, "light" versions used to promote the full version), the search term used to identify the app (to code for duplicates and apps that fall into multiple categories), and the category or categories in iTunes© where the app could be found. Summaries of elements of each app were coded line by line, which were then classified into categories based on common themes. This procedure was repeated as themes emerged until the data were placed into exclusive categories. This process resulted in two primary categories: those that "facilitated" alcohol use and those that aimed to "intervene." Classification was mutually exclusive. For ease of interpretation, duplicate apps were counted only once, and apps in foreign languages were not included. All codes were reviewed by a third coder (the first author) and discrepant codes were resolved.

Critique and Review of Empirically-Based Principles

Finally, we sub-coded the intervention-oriented apps based on whether they used evidence-based principles or components of empirically-supported treatments for alcohol use disorders. Our criteria for coding evidence-based principles (EBPs) were taken from Nathan and Gorman (2007) and a review of the current available literature on what is effective for treating alcohol use disorders from the website of the National Institute on Alcohol Abuse and Alcoholism (NIAAA) and from Division 50 of the American Psychological Association "Portal for Evidence-Based Practice in Addictions." The EBPs used in the current study were *motivational enhancement* (weighing the pros and cons of alcohol use; feedback on alcohol use), *coping/self-control training* (identifying and dealing with triggers, coping with

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[3]We did not examine podcasts as part of our needs assessments because these downloadable programs do not require the user to enter information in "real-time". A podcast is a downloadable audio or video digital file that can be viewed or listened to, such as song, pre-recorded video, lecture, etc.

urges, self monitoring), *social skills training* and/or *social support* (Self-help group support, twelve-step facilitation, (Alcoholics Anonymous, couples and family treatment, community reinforcement), and *cognitive therapy* (identifying cognitive distortions and restructuring irrational thoughts, relapse prevention). Our goal was to evaluate which apps adhered to these principles, and if so, what aspects of the EBPs they incorporated.

Results

Out of approximately 350,000 apps in the iTunes© store, we found 767 (0.2% of the total number of apps) that were related to alcohol use behavior. Apps were listed in the following 17 categories: "Books" (n= 21), "Business" (n = 3), "Education" (n = 14), "Entertainment" (n = 193), "Finance" (n = 1), "Games" (n = 94), "Healthcare and Fitness (n = 56), "Lifestyle" (n = 236), "Medical" (n = 19), "Navigation" (n = 7), "Photography" (n = 2), "Productivity" (n = 7), "Reference" (n = 27), "Social Networking" (n = 12), "Sports" (n = 1), "Travel" (n = 6), and "Utilities" (n = 58). 4

Alcohol Facilitating Categories

Our content analysis showed that, 545 out of the 767 apps (71%) were coded as "facilitating" alcohol use. We found five sub-categories for the "facilitating" apps that corresponded to *Entertainment*, *Making Drinks*, *Buying/Ordering/Locating Alcohol*, *Providing Information*, and *Organization/Management*. In the *Entertainment* (n = 290) sub-category, apps were comprised of drinking games, trivia games (e.g., *How drunk are you?*), coordination testers, and "fake" BAC calculators by asking the user to "blow here." Apps that focused on *Making Drinks* (n= 86) provided information on recipes and television shows on how to make alcoholic beverages. Apps related to B*uying/Ordering/Locating Alcohol* (n = 75) allowed the individual to find nearby bars, "happy-hours", pubs, and events in bars. *Information* (n = 85) related apps allowed the individual to download beer and wine guides, alcohol and beverage laws, how to make "mixers" and other alcoholic drinks, and purported cures for hangovers. Finally, *Organization/Management* (n = 9) apps catalogued favorite wines and beers and where they could be purchased. Figure 1 presents the number of facilitating apps broken down by each sub-category.

Alcohol Intervening Categories

We coded 222 apps (29%) that "intervened" on alcohol use (e.g., related to self-monitoring or providing some form of intervention or harm reduction); and 202 of those apps (90%) utilized some empirically-based principles of alcohol treatments that fell in the areas of *motivational counseling/feedback*, *coping/self-control training*, and *social support* (primarily in the area of 12-step facilitation). Specifically, 45 focused on some form of *motivational counseling/feedback:* about half of these apps were feedback-oriented (n = 19), such as showing how much money would be saved from not buying alcohol or how many calories are in different types of alcoholic beverages; while the other 26 provided psycho-education about alcohol addiction for "lay people." One hundred and twenty two apps focused on what we defined as *coping/self-control training*, primarily through BAC assessment and self-monitoring apps, such as keeping track of one's sobriety date on their phone (n = 104). Within the *coping/self-control* category, we also found 3 apps that focused on reducing cravings for alcohol by providing a downloadable relaxation exercise and 15 apps that focused on harm-reduction, such as providing contact information for a taxi company, or friend, to give the user a ride home after drinking. In the area of *social support*, 19 apps were related to 12-step facilitation or AA, such as programming the phone to dial

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[4]Due to substantial growth in the number of applications since this review was completed these estimates may no longer reflect the current number of alcohol-related apps on iTunes©. Our search began on January 11, 2011 and concluded February 7, 2011.

one's sponsor with one touch, setting reminders to call a sponsor, or providing location and scheduling information for the nearest AA or 12-Step meeting. Because alcohol beverage control and enforcement is also considered an effective policy intervention at the population-level (Wagenaar et al., 2001), we coded an additional "policy" category that included apps addressing alcohol and beverage laws. We found 10 apps that gave information on alcohol and beverage laws in different US states, information about field sobriety tests, and information for police officers and lay-persons regarding nearby DUI check-points.

There were 26 additional "intervening" apps categorized as "other/miscellaneous" because they did not align with EBPs. These provided information about affirmations and hypnotic procedures for controlling alcohol use. Examples of these apps included being able to download hypnotherapist recordings on controlling drinking, biblical encouragement, subliminal techniques for the reduction of alcohol use, and "affirmation spells" to stop drinking. When entering in the search terms "cognitive therapy," we did not find any apps that addressed cognitive therapy or relapse prevention for alcohol use. This term yielded 8 "irrelevant" apps, which addressed issues such as anxiety and depression, but did not directly deal with drinking or alcohol use reduction. See Figure 2 for alcohol-related "intervening" apps broken down by EBP category.

Discussion

The purpose of this study was to present data on future directions of EMI (Heron and Smyth, 2010) research via a qualitative review of smartphone apps for drinking behavior. Our aim with this needs assessment was to provide information, and areas for future growth, about current applications of mobile technology to help people recover from, or reduce problematic alcohol use.

First, we found over 700 applications on the iTunes© platform that were related to facilitating or intervening on alcohol use behavior. However, almost three quarters focused on facilitating alcohol consumption through drinking games and entertainment, rather than intervening on it; and only one third of the apps were categorized as intervention-oriented. Among those apps, three of the four principles of effective AUD treatments were represented, and roughly 10% of the intervening apps could not be categorized as empirically-based or potentially effective.

Of the apps that did use EBPs, about half applied self-monitoring techniques. While this is often a useful "front-end" behavioral technique when one first begins treatment, self-monitoring constitutes a very small portion of an effective AUD treatment and is best utilized in conjunction with other "best practices", such as weighing pros and cons of behaviors, understanding triggers that lead to drinking, and avoiding high-risk situations (Gorman and Nathan, 2007). Roughly 20% of the intervening apps focused on motivational enhancement; these included 19 that provided some form of feedback about drinking and 26 that provided psycho-education about alcohol. Another 8% of the intervening apps focused on 12-step facilitation or self-help support, 7% on harm reduction, and finally 2% focused on policy-related principles. There were no data to support the efficacy of any of the apps as venues for reducing or abstaining from problematic alcohol use. While several apps were found to represent empirically based principles, and some even claimed to help reduce drinking, no review data was presented on the iTunes© platform to support whether these apps have been empirically tested[5].

We conclude from these findings that, despite the widespread use of mobile technology and smartphones in our daily lives, the field of alcohol studies has yet to move into this domain

as a method of preventing or treating alcohol problems. We are therefore arguing for the inclusion of ecological momentary *intervention* (Heron and Smyth, 2010), as well as ecological momentary *assessment* in alcohol treatment research. Findings from the current study highlight gaps and weaknesses in the current uses of EMI in this area: While the Apple iTunes© app store has apps related to reducing or quitting drinking, very few used components or principles recommended as effective for recovery from problematic alcohol use or for facilitating harm reduction. Our results also suggest there is a large window for growth in these areas. For example, developing brief interventions using mobile technology may make evidence-based interventions more widely available to individuals. Further, treatment "add-ons," and stepped-care programs using mobile technology may aid in the generalization of skills learned in treatment to clients' daily lives. While media-related interventions, such as cellular phone assessment, can influence people and have equal if not greater potential to promote positive changes in health behaviors than individual-level interventions (Abroms and Maibach, 2008), these have been less well investigated in alcohol treatment studies.

In light of these findings, we provide five recommendations for research with mobile technology to better understand and treat problem drinking. Our goal is to stimulate discussion within the field and to encourage investigators to develop new ways of assessing the relative efficacy and cost-effectiveness of these technology solutions as interventions. First, apps could be created that provide normative-based feedback to an individual about his or her alcohol consumption and problems through a simple computer program, or could link someone to a 12-step or AA "quit line." iPhone© users already have access to effective products and services to help them quit smoking, which may serve as models for alcohol-related intervention apps. For example, the affordable *My QuitLine* app connects users to the National Cancer Institute's tobacco quit-line service and allows them to speak directly to a coach or receive advice via a text message sent directly to their mobile phone (National Tobacco Cessation Collaborative, 2009). Second, an app could provide a resource or referral "clearinghouse," connecting treatment-seekers to psychologists, psychiatrists, medical professionals, counselors, and other health professionals who provide treatment for alcohol use problems. Third, in conjunction with cognitive-behavioral treatment, an app could include "mobile" skills training tied to current mood or craving states. For example, the user may enter a problem or mood state as the "input" and receive a solution or skill to practice as an "output". Fourth, apps could be applied as an after-care and relapse-prevention tool, in addition to the standard recommended practice of attending AA meetings. A cell phone could be utilized as a mobile assessment and self-monitoring tool, and could subsequently connect an individual to his/her sponsor or therapist to receive additional booster sessions. In this vein, new research endeavors should develop and test apps that are evidence-based through RCTs – examining their efficacy as either "stand-alone" treatments or as adjuncts to currently effective intervention programs. Finally, we recommend that a "technology task force" be developed at NIAAA to provide psycho-educational material and treatment information through apps, as well as to verify and help disseminate apps that are empirically-based.

Limitations

Several limitations to this study should be discussed. First, findings might have been more valid and reliable if more than just two independent coders had been included. However all codes were reviewed and assessed by a third individual (the first author), and discrepant

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[5]Based on our review of Psychinfo, PsychArticles, Medline, and Pubmed (using the search terms "mobile technology, "apps", "application", "iTunes", "Android", and "mobile telephone") no published data currently exists on the efficacy of apps related to alcohol consumption, drinking, recovery, or treatment.

codes were discussed. Second, our search examined only the iTunes© platform and did not include comparisons across other platforms, such as Google for Android and Blackberry. However, because the majority of apps found on Android and other platforms overlap substantially with those on iTunes, we felt that focusing our search to iTunes did not necessarily restrict our assessment, but conversely, provided us with the greatest breadth of apps available. It may be noteworthy to assess, in a future study, degree of discrepancy in the number and type of apps available for alcohol use behavior across a number of different mobile technology platforms. A third restriction of this study is that we used a mutually exclusive coding system to determine our categories. For example, some of the BAC-related apps could be considered "facilitating" in that they could be used for entertainment, while also considered "intervening" in that they could be used for self-monitoring of one's alcohol consumption.

Future Directions

It is important to understand the pitfalls and uses of these emerging technologies to improve the efficacy, feasibility, cost-effectiveness, and overall reach of our alcohol treatments and to develop more precise ways of measuring behavior change. While mobile apps are accessed by many individuals, we still need to identify "for whom" and under what conditions mobile technology is most effective at reducing harmful alcohol use (Heron and Smyth, 2010). For example, real-time data collection via mobile technology may be a particularly useful venue with which treatment providers can communicate to populations/patients that do not typically present in a formal treatment setting, those who are younger, and who possess a high degree of technology literacy. Indeed, because a primary barrier to seeking help among problem drinkers is the belief that one can control drinking on their own and that no help is needed (Grella et al., 2009), it will also be useful to employ dissemination strategies and pro-active approaches to motivate these individuals to use apps and to choose ones that are evidence-based. This study is the first to our knowledge to assess whether alcohol-related, and empirically-based apps exist. An important next step will be to increase interest in, and motivation to adopt these forms of technology among an identified target audience.

Conclusion

More and more individuals spend a significant amount of time online and using technology for communication purposes. As a result, there is a compelling need for the alcohol treatment field to remain up-to-date with the ever changing and advancing outlets of interactive media as they relate to alcohol help-seeking and behavior change. Such technological advancements may serve to bring alcohol interventions to individuals who might otherwise not have access to, or interest in seeking treatment, and may facilitate and improve efficacy of treatment programs for those already working with providers.

Acknowledgments

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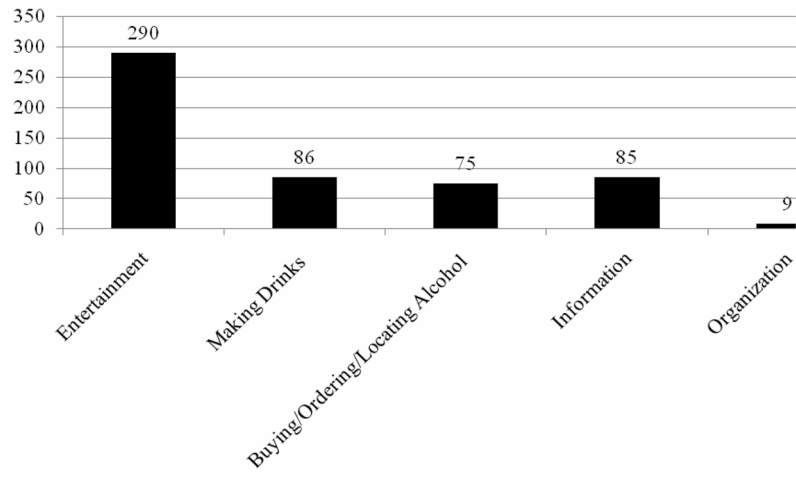
Figure 1.
Number of alcohol-related apps on iTunes© that "facilitate" alcohol use displayed in coded sub-categories.
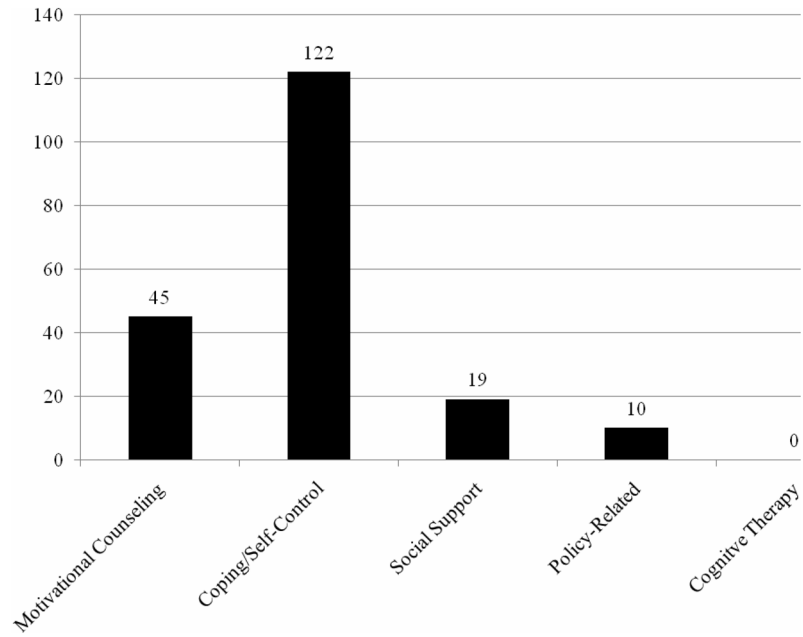
Figure 2.
Number of alcohol-related apps on iTunes© that "intervene" on alcohol use corresponding to empirically-based practices.