

Running head: Mobile Telephones in Clinical Psychology

The Use of Mobile Telephones as Adjuncts to Cognitive Behavioral Psychotherapy.

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Abstract

Despite the rapid proliferation of technological adjuncts in cognitive behavior therapy, much of this development appears to have occurred on an *ad hoc* basis and in many cases has resulted in applications that are beyond the resources of most practicing clinicians. We delineate the specific areas in which CBT can be augmented through use of technology and outline the characteristics of an ideal therapy augmentor. Mobile telephones are identified as a low-cost and accessible device whose use has been largely untapped to date. The existing literature on use of the mobile phone is reviewed, and potential areas for its application in CBT are examined. We conclude with clinical guidelines for its use and the recommendation that use of mobile phones in CBT is a promising avenue for both clinical practice and research.

KEYWORDS: Cognitive Behavior Therapy, Mobile Telephones, Cellular Telephones, Homework Adherence, Ecological Momentary Assessment.

The Use of Mobile Telephones as Adjuncts to Cognitive Behavioral Psychotherapy.

Cognitive behavioral therapy (CBT) has gained increasing prominence as a compelling evidence-base has grown for its efficacy and effectiveness (Butler, Chapman, Forman, & Beck, 2006; Westbrook & Kirk, 2005). At the same time, there has been an increasing interest in the use of technological aids to assist with delivery of CBT (Andersson & Carlbring, 2003; Marks, Kenwright, McDonough, Whittaker, & Mataix-Cols, 2004). In this paper, we examine the specific ways in which existing limitations of CBT need to be remedied and discuss ways in which standard approaches may be enhanced. We then delineate the characteristics of an ideal therapy augmentor, and highlight the use of mobile phones as an overlooked addition to standard therapy regimes.

Challenges in Using CBT

Despite the effectiveness of CBT in treatment of many psychological conditions, there are many individuals for whom CBT proves less than optimally effective. For example, conditions such as depression and substance use problems (Segal, Williams, & Teasdale, 2001; Connors & Maisto, 2006) are known to have high relapse rates, while many individuals successfully treated for anxiety and depressive disorders have significant residual symptoms (e.g., Goodman, Price, Rasmussen, Delgado, Heninger, & Charney, 1989). It would appear that despite the existence of effective treatments, there is considerable room for refinement.

The skillful application of CBT presents numerous challenges to the psychotherapist. These include generalization of treatment effects, difficulties with collection of assessment data, and problems with homework adherence. A common challenge that CBT therapists are required to manage is the translation of therapy successes into in vivo situations. Skills learned in the therapist's office are taught

under optimal learning conditions, where the patient is supported to help him or her feel as safe and comfortable as possible. In the office, the patient also has the benefit of additional input from the therapist, if required. When the patient is called on to apply therapeutic strategies under conditions of high emotion outside of the therapeutic environment, there may be considerable difficulty in implementing these skills.

Many individuals undergoing cognitive behavioral interventions fail to return accurate, useful monitoring data to their therapists. This failure may occur either because they have not recorded the data, or even more problematically, have faked completion of monitoring records for a variety of reasons (Collins, Kashdan, & Gollnisch, 2003). The accuracy of monitoring data can also be compromised by a patient's recall if it is done retrospectively.

Shiffman & Stone (1998) also point out that pen-and-paper reporting makes collection of base-rate data difficult. For example, it may be difficult for an individual to collect a random sample of non-anxious behavior and mood state using pen-and-paper questionnaires. Without this adequate baseline data, the effectiveness of any intervention is difficult to ascertain. In addition, the use of pen-and-paper monitoring during CBT effectively limits the amount of data that can be collected. While asking a patient to monitor their mood once or twice per day may be a reasonable expectation, requiring more frequent monitoring is too onerous a task for all but the most committed patients.

Homework is a core element of cognitive and behavioral interventions, allowing the patient to rehearse skills that they have learned during sessions with the therapist. Adherence to homework tasks is known to be associated with improved outcome in CBT (Burns & Auerbach, 1992; Kazantzis, Deane, & Ronan, 2000;

Neimeyer & Feixas, 1990). Use of technology to provide simple, structured prompts for homework completion may considerably aid some clients, particularly those who may already be experiencing difficulties in negotiating the demands of their everyday lives without the additional burden of therapy related tasks.

Technical Applications in Cognitive Behavior Therapy

In response to the difficulties outlined previously, there is a growing level of research interest in the use of novel devices and technologies in the delivery of cognitive behavioral interventions. Components such as internet delivery and augmentation, CD-ROM/DVD-ROM delivery (e.g., Whitfield, Hinchelwood, Pashley, Campsie, & Williams, 2006), and handheld PC use have been reported in the literature (e.g., Anderson, Jacobs, & Rothbaum, 2004).

Challenges in Existing Applications

Despite the promise that has been shown in previous research into technical applications within CBT, an examination of the literature leaves the impression that much of the innovation has been driven by the availability of new devices, rather than careful consideration of the therapeutic role such devices may play. Importantly, some newly developed technologies appear prohibitively expensive for routine clinical practice, while other technology such as virtual reality is simply not readily useable in locations outside clinical research facilities. We suggest, therefore, that an important step is to delineate the features of an ideal device suitable for augmenting existing therapy approaches. Such devices may augment therapy either by enhancing therapeutic outcome, or by increasing therapeutic efficiency. Therapeutic outcome may be enhanced through increasing the ‘dose’ of the active therapy components (e.g. more frequent exposure treatments). Alternatively, efficiency may be improved by

allowing similar therapeutic outcomes to be achieved with reduced therapist time and involvement.

Mobile Telephones

The mobile telephone has several attributes which make it a strong candidate for a device to assist in therapy. These are summarised in Table 1. An ideal treatment augmentation/delivery device would be small and light enough to be carried by the individual undergoing treatment. Furthermore, the individual must be willing to carry the device with them, a prospect which is more likely if the device is either completely unobtrusive or unlikely to draw attention to the user. The cost of purchase and maintenance of the ideal device would be low, allowing individuals on low incomes to afford to use it. To enable a device to be used in treatment by the largest number of people requires that the device be as ubiquitous as possible.

Requiring an individual to power-up a device with each use faces the same problem as requiring the individual to remember pen-and-paper monitoring. The mobile phone can be *always on* and capable of spontaneously prompting patients without their activation. In addition, mobile phones are capable of constant communication, and so are *always connected*.

An ideal therapy augmentation device would have a clearly readable screen, as well as the ability to alert/remind the patient through audio cues. The user must be able to input data easily into the device for information gathering and monitoring purposes. There are several advantages to this *Ecological Momentary Assessment* (EMA) methodology, such as the realtime nature of the responses, tagging of each entry with a date/time signature, compliance tracking, and reducing missed assessment items (Shiffman & Stone, 1998). This EMA approach has been used in

realtime assessment of numerous conditions and holds considerable promise (Collins et al., 2003).

No single device is likely to suit the broad range of requirements for every patient that presents to a clinic. As such, a level of software customizability must be part of any ideal device. The device must be capable of running software programs written by the therapist or an associated programmer, and importantly new versions of the software must be able to be easily installed. When all of these characteristics are considered, it is readily apparent that the mobile phone may hold promise as a therapy augmentation device which has been largely overlooked.

Mobile telephones are commonplace, small and inexpensive. Display technology has improved dramatically, with recent models having the ability to display moving video in full colour, in addition to the usual voice channel. Many units incorporate advanced audio technology allowing the playback of additional high-quality audio formats such as MP3. Most handsets now incorporate some degree of programmability (e.g., with a Java Virtual Machine), and battery life that allows their use over several days before recharging.

With mobile phones now a common part of the everyday life of most individuals in developed societies, there are only a small number of people for whom mobile phone use would be prohibitively intimidating (Gee, Coventry, & Burkenhead, 2005). Preliminary evidence indicates that some patients may even find communication using a mobile phone easier than face-to-face communication (Honkalampi, Tanskanen, Hintikka, Haatainen, & Viinamäki, 2001).

Previous Clinical Applications of Mobile Telephones

Mobile phones are widely used in everyday life and increasingly being utilized in medical research and practice. For example, mobile telephony has been used for

monitoring of hypertension (Halifax et al., 2007), ECG monitoring (Iwamoto et al., 2007), and transmission of radiological images (Kim, Yoo, Park & Kim, 2007).

However, the use of mobile/cellular telephones has received remarkably little attention in the psychological literature. Table 2 presents a summary of previous psychological research using mobile phone technology. Articles for the review were obtained via a PubMed search using the term “(CELL OR CELLULAR OR MOBILE) AND (PHONE OR TELEPHONE) AND (PSYCHOL* OR PSYCHIAT* OR PSYCHOTHER*)”, and then an examination of the reference lists of the articles retrieved. We chose to limit our review to articles using mobile telephone technology rather than older superseded systems such as pagers.

The earliest published clinical application of mobile phones in behavior therapy is the report of two single-case studies by Flynn, Taylor, & Pollard in 1992. Both individuals described in this report were treated for driving phobia using in vivo exposure, which included a series of driving expeditions in which the mobile phone could be used to communicate with the therapist. The availability of the phone was phased out over a period of six weeks. While both cases showed improvement in their phobia as measured by driving distances, the second case repeatedly relapsed when the phone was withdrawn. This early study highlights the need to carefully view the use of mobile phones as adjuncts in therapy, in light of their ability to operate counter-therapeutically as safety signals.

In 2001, Wade and Troy reported on five individual case studies where a mobile phone was used as a prosthetic memory aid by individuals with significant memory problems. In each case a predetermined set of computerised reminder calls was constructed for each individual. At selected times, the user would be called by a central computer and a recorded message would be delivered. The software also

allowed for some 'high priority' calls to be diverted to a caregiver if the user failed to answer. All five cases improved on a range of behavioral outcome measures such as medication adherence, carrying out planned exercise, self-care and hygiene tasks. These authors highlighted several additional advantages of mobile phones such as their usability by vision impaired or dyslexic individuals, as well as their acceptability and inconspicuousness when used in public.

The ability of mobile phones to gather ecological momentary assessment data has been tested in the measurement of alcohol consumption in a group of university students. Collins et al. (2003) reported a comparison between ten students asked to monitor their drinking using traditional pen-and-paper monitoring, and a group of ten students who used a mobile phone to directly enter responses into a central computerised telephony system. The authors highlighted several advantages of mobile phone monitoring, including immediate entry of data into a centralised database for analysis, ability to assess compliance with monitoring, and early identification and correction of errors in data entry.

Calls to mobile phones were used to gather ecological momentary assessment data of mood from 21 children/adolescents, 16 of whom had current affective disorders, by Axelson et al. (2003). In this study, each participant was provided with a phone that could receive calls only. A total of 60 calls were made at a rate of up to 12 times over a 66 hour period to participants, in which they were asked to report their current activity, current environment (including the presence of others), current mood, current media use (e.g., television, music), anticipated positive future activities, and recent significant events. By the end of the eight week intervention period, a total of 17 of the 21 participants entering the study had provided complete datasets, and only 4 had dropped out. The authors highlight the strengths of their ecological momentary

assessment methods and the utility of the mobile phone in implementing them in a paediatric sample.

One of the most impressive uses of mobile phone technology is the smoking cessation program for university students by Obermayer, Riley, Asif, & Jean-Mary (2004). In an uncontrolled study, a group of 46 cigarette smokers were recruited into a combined internet and SMS treatment program to assist them in the lead up to, and immediately following their quit-date. In this program, a series of tailored SMS messages were sent to each participant, customised on the basis of their responses to an internet-based questionnaire. The messages contained coping statements, suggestions of activities to manage risk, and encouraging statements such as the number of abstinent days. The authors reported that of the 27 individuals who completed the treatment 10 had quit smoking, and that for those who continued to smoke, there was a significant drop in their level of reported nicotine dependence. The authors concluded that “Text messaging using wireless cellular phones holds substantial promise as a treatment delivery method for a range of health-behavior interventions.” (p78).

Kim, Yoo, & Shim (2005) reported on the use of Short Message Service over mobile phone as a method of managing blood sugar levels for 42 individuals with Type II diabetes. The intervention was centred around an internet site that patients would contact to report their daily blood monitoring results. Information was transferred to a database either via an internet connection, or a mobile telephone. Once a participant had reported their current measurements, they were sent a message via internet and mobile phone, containing recommendations for the patient to assist with their care. Kim et al. found that the phone/internet-based intervention not only resulted in an improvement in patient-care satisfaction, but also succeeded in bringing

about a significant reduction in the two primary measures of successful diabetes management. Although this study did not utilise a control group, it provides preliminary evidence for the utility of mobile telephones in the management of health conditions such as diabetes.

Gee et al. (2005) used a mobile phone to track the mood and gambling behavior of a group of 17 male gamblers. Participants were given a mobile phone with a pre-paid limit, and asked to call a computerised answering system to report when they had an urge to gamble, or had just completed a gambling episode. All but one participant reported being comfortable with the use of the mobile phone. The authors reported that the mobile phone presented a viable alternative to pen-and-paper monitoring, allowing near-realtime monitoring of anxiety before, during and after gambling.

The Gee et al. (2005) research highlights two important lessons from the use of mobile phones in behavioral/mood monitoring. Firstly, the authors report that data was lost for two participants in the study due to a computer crash. This highlights the need to ensure adequate data security and backup. Secondly, Gee et al. indicate that several erroneous responses were recorded either by participants or the computer software. One advantage of computerised systems – their ability to check the validity of responses, does not appear to have been fully utilized by these researchers.

This review of the applications of mobile telecommunication technology in clinical psychology suggests that there is considerable room for further research. Such research could both usefully compare standard treatments with those delivered with the augmentation of mobile telephone technology, as well as examine the possibilities of using mobile phones as a stand alone means of intervention. Initial

research, however appears promising, and clearly demonstrates that additional research is warranted.

Future Clinical Applications of Mobile Telephones

Recognition of the fact that mobile telephones have many of the characteristics of the ideal therapy augmentation device, paves the way for several potentially fruitful avenues of research and clinical application.

Direct Telephone Contact

Mobile telephone technology provides an opportunity for the therapist and patient to expand the methods they use to communicate. When the therapist is mobile, they can contact their patients from almost anywhere. When the patient is mobile, they can contact their therapist from their current location, which could include during homework tasks such as in vivo exposure. We see innovations such as brief ‘reporting-in’ calls before or during exposure tasks as a novel and highly practical use of mobile telecommunication technology.

While it has long been recognised that telephone counselling may operate as an effective intervention (Leach & Christensen, 2006), it has been less clearly acknowledged that mobile phones provide enhanced opportunity for the completion of therapy tasks. For example, in their small-sample study of individuals with driving phobia, the mobile telephone was effectively utilised in assisting participants to complete in vivo exposure exercises during which they were either in contact with their therapist, or carried a mobile telephone that would make such contact possible (Flynn et al., 1992).

Video calls in particular may enhance communication with the therapist, providing an extra channel of visual communication. This may be particularly important for those in rural or remote areas, who may benefit from ‘seeing’ their

therapist. Although the guidelines for patient contact would need to be clearly defined to avoid therapist overload, evidence that such contact is beneficial suggests the need to consider this as a means of enhancing therapeutic outcome. For example, it is known that having a contactable treating health professional leads patients to perceive their health practitioner as more supportive (Chin, Adams, Khoury, & Kurakowski, 2005). The potential value of this is highlighted by the body of research emphasising the importance of the therapeutic alliance in determining psychotherapy outcome (e.g., Wampold, 2001).

Short Message Service

Short Messaging Services (SMS) and the richer Multimedia Messaging Service (MMS) have become a widely used communication method, rivalling mobile voice telephony in popularity, particularly among the young. Using this technology, the mobile telephone user can send short text messages to another subscriber, at low cost, with near-immediate delivery.

SMS technology can feasibly be used in many ways to augment existing therapy protocols, and assist in assessment. Messages can be sent at agreed times to prompt homework completion, or reporting of monitoring data, for example. SMS may be particularly useful at times when direct phone or face-to-face contact is not appropriate or feasible, but there remains a need for information to be exchanged. SMS messages can either be sent at the time of writing, or can be programmed by the therapist for delivery at a predetermined date and time, enhancing their utility further. It is also possible for patients to initiate the SMS contact with the therapist. These messages can either be read immediately, or stored electronically for later retrieval and action by the therapist. There is also now software available to enable a PC to

operate as an SMS receiver and storage device, thus further enhancing the possibilities of efficient data collection, security, and storage without adding to therapist burden.

Audio, Video and Photograph Recording

Many mobile telephones are now equipped with cameras that can record photographs as well as full-motion video. Increasingly sophisticated colour LCD screens also allow for the display of such images and video. The ability to record and review these images has several potential therapeutic applications, particularly for exposure-based interventions. For example, a patient who is spider phobic may use their telephone to record video or pictures of a spider used in the therapy session, and then use these images for later homework exposure exercises. By carrying their telephone (and the images) with them, the patient can make use of any free time to engage in more frequent exposure. Patients may also record their exposure achievements (e.g., taking a photograph from inside a shopping centre), and review these later with their therapist.

Java Programmability

As mobile telephones have increased in complexity and processing power, the range of applications they are able to run has also expanded. Modern computer programming languages such as Java are designed to allow applications to be readily translated (or 'ported') to different platforms, including mobile telephones. Such programmability allows mobile telephones to run simple programs that may comprise one component of an intervention.

For example, there exist a number of interventions with demonstrated efficacy which have been developed for a single PDA-based operating system (e.g., Newman *et al.*, 1999; Przeworski & Newman, 2004). While use of this system does not impair their effectiveness, it makes dissemination of the interventions more difficult and only

open to those with devices running the same operating system software. PDAs are also generally more expensive than simple mobile phone, and more vulnerable to user-damage. Using the Java Virtual Machine, the same software program can be run on multiple different devices, without the need for expensive and time-consuming 'application porting.'

Bluetooth

Bluetooth is a short-range, wireless communication protocol designed to allow transfer of information between electronic devices, personal computers and computer peripherals. Among other applications, Bluetooth technology provides the ability to rapidly download or print information from the device without the need for a direct physical connection. For example, a therapist can also easily transfer information and software to the device. Patient monitoring data could also be easily downloaded to the therapist's computer at the time of the next consultation.

Internet Enabled Mobile Phones

Although there are difficulties with screen size and input methods, many mobile telephones are now capable of rudimentary internet access. Specific protocols such as WAP and iMode have attempted to provide online content in a format that is suitable for display by mobile telephone.

The internet now provides an enormous array of useful information, and is increasingly used to deliver therapeutic interventions. For example, one of the authors (LC) is currently running an internet-based treatment for problem gambling, which enables individuals experiencing this disorder to receive help in the relative anonymity of their own homes. Using a mobile telephone, a website such as this could be accessed in vivo, from within the gambling venue itself.

Suitable Clients

Some clients may be more suited to mobile telephone augmentation than others. Clients who are unable to attend frequent therapy sessions due to limited income, or living in remote areas, may benefit. Individuals for whom a cellular telephone is already a routinely used device would seem particularly suited. Clients for whom repeated homework tasks are indicated (e.g. regular exposure treatments) may also be particularly suited. Similarly, those clients who require reminding or prompting to undertake homework tasks may benefit.

Research Applications for Mobile Phones

Clearly mobile phones have considerable application for routine clinical tasks. The advantages of the mobile phone in therapeutic instruction and efficient data collection are multiplied when dealing with a large number of patients, as in research trials. The use of the mobile phone also may help reduce the common problem of missing data within research datasets, and potentially broaden the available pool from which participants are recruited. Treatment outcome studies are notoriously expensive to implement, and mobile phones usage may offer several ways of reducing this expense. For example, patients can directly enter data into the database, but more importantly the number of therapist hours required per participant is likely to be reduced.

Challenges in Mobile Telephone Use

Although there is considerable potential in the use of mobile phones, there remain a number of issues/areas which require additional consideration. The skill-set required to program today's mobile telephones is outside the expertise of most practicing clinicians. Furthermore, while there are some universal elements to all mobile telephone devices (e.g., audio alarms), there are numerous providers who supply models with different features and operating systems. Given the rapid rate of

technological development and dissemination, such problems are likely to reduce in impact in the foreseeable future.

Despite dramatic falls in prices of mobile telephone equipment over the last ten years, it may still present challenges to individuals on a limited budget. For example, in the series of five case studies presented by Wade & Troy (2001), one dropped out of treatment due to concerns over increasing telephone expenses. One option is to cover the costs of telephone calls made during the course of contact although this then raises the potential for misuse. However, the use of phone/charge cards (e.g., Gee et al., 2005) provides an elegant solution to cap costs.

Although mobile telephone coverage across the globe has also steadily improved, there remain areas which are still poorly serviced, or may have other environmental barriers to network access. The rapid expansion in mobile phone network coverage, however, means that such issues are likely to be a temporary hurdle in increasing application of mobile technology.

Mobile telephones are also embraced with varying enthusiasm by different age groups. Some age groups may simply not have access to, or the ability to use, mobile phones. For example, the eldest participant from the study of mobile phone monitoring of gambling and mood withdrew due to being uncomfortable with mobile phone use (Gee et al., 2005). Training of each patient in the use of the mobile phone for assessment and treatment augmentation can take a considerable amount of time (Wade & Troy, 2001; Collins et al., 2003) and there is potential for data insecurity or loss (e.g., Gee et al., 2005). Wade & Troy (2001) suggest that having the patient incorporate the phone into their regular daily routine, carrying it on their person at all times, is essential to its effective and secure use. Sensitive monitoring of the patient's response to the mobile phone is therefore an essential component of any application.

A significant concern related to mobile telephone use is information security. Security requirements are dependent on the way in which the mobile telephone is employed. In situations where the mobile telephone is being used primarily as a communication tool (e.g., voice, SMS), the inherent security in the digital mobile telephone network is adequate. Where the mobile phone is used to record information, this should be recorded in such a format as to prevent access by a third party. This may be done by programmers through data encryption routines, or by users through the use of a personal shorthand or coding system.

Finally, it is important to remain alert for clinical situations in which use of the mobile phone may be counter-therapeutic. For example, the clinician treating anxiety disorders needs to be acutely aware of the operation of safety signals which may impede successful progress through an exposure program. The early report by Flynn et al. (1992) demonstrated that for one patient, relinquishing their mobile phone contact can precipitate relapse into avoidance. In this situation, it may be important to recognize that the mobile phone can be seen as an extension of the therapeutic encounter, and in turn plan a more graded approach to reduction of mobile phone usage in more dependent patients.

We have several specific recommendations for professional psychologists looking to employ mobile telephones in their practice. Examples of the use of mobile telephones in clinical practice are shown in Table 3. Firstly, it must be recognised that many clients will have an existing handset, and so the therapist must choose between providing a device, or working with whatever technology the client has. If the therapist elects to provide a device, they should choose a device that presents the best balance of required features (without unnecessary extras) and cost. Therapists should compare potential purchases against the criteria discussed in this article (see

Table 1). If providing a device for the use of clients, beware of the potential for theft or loss. Consider using the device in both assessment and treatment roles, and ensure that the use of the device does not compromise client safety (e.g., through using a handset while driving). Ensure that the aim is eventually to relinquish the device, rather than for the client to become device-dependent. Therapists should inform clients about data security and ensure that adequate action has been taken to protect personal information. Therapists should ensure that any digital data maintained is appropriately secure. Finally, therapists should recognise the challenge in learning to program mobile telephones, and ensure that they undertake adequate training or enlist the support of a suitably qualified programmer.

Conclusions

In conclusion, we believe that there is considerable room for improvement in current monitoring and intervention methods. Despite the mobile phone possessing several attributes that would make it suitable, there has been surprisingly little research involving its use in clinical applications. We present this paper as a discussion of the potential future role for mobile phones, and in the hope that it will encourage future researchers and clinicians to consider integration of the technology within their work.

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Table 1

Mobile Phone Characteristics

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- Portable (Small and light)
 - Acceptable
 - Low initial cost
 - Low maintenance cost
 - Societal penetration / Ubiquity
 - Always on
 - Always connected
 - Programmability
 - Audio and video output
 - Keypad and audio input
 - User-friendliness / Ease of use
-

Table 2

Previous psychological research using mobile telephone technology.

Study	Sample	Method	Results
Axleson et al. (2003)	$N = 21$ Adolescents	Used telephone calls to mobile phones to gather ecological momentary assessment of mood, activity, environment and events.	Low dropout rate, and comprehensive randomly-sampled data cited by authors as evidence of strengths of mobile phone use in ecological momentary assessment.
Collins, et al. (2003)	$N = 20$ Social drinkers	Compared pen-and-paper monitoring with electronic assessment using mobile phones.	Both monitoring methods equivalent, but with some advantages to electronic methods such as ease of data gathering and collation.
Flynn, et al. (1992)	$2 \times N = 1$ 2 Case studies	Mobile phones provided as contact for people with driving phobia during solo driving trips.	Improvement in both cases, but cautions that mobile phones can operate as safety signals.
Gee et al. (2005)	$N = 17$ Problem Gamblers	Mobile phones used to gather data on problem gambling and associated variables.	Problem gambling associated with increased subjective arousal. Assessment method evaluated as effective.
Kim, et al. (2005)	$N = 42$ Diabetic patients	Patients contacted nurses via internet or mobile phone to report blood-sugar. Return SMS/email with management suggestions returned.	Increase in patient care satisfaction. Significant improvement in diabetes management, based on two common measures of successful diabetes management.
Obermayer et al. (2004)	$N = 46$ Regular smokers	Uncontrolled treatment program using SMS messaging to assist with smoking cessation.	Mobile phones deemed effective as method of assisting with smoking cessation programs.
Wade & Troy (2001)	$5 \times N = 1$ 5 Case studies	Five brain-injured individuals where a mobile phone served as a memory aid.	Improvement for participants on medication adherence, self-care, exercise. One patient dropout due to phone expense.

Table 3

Mobile telephones ability to address challenges to CBT

Challenge	Role of Mobile Phone	Example
Assessment data and monitoring	Collection of data in realtime or near-realtime.	Entry of mood ratings during or after behavioural activation tasks.
	Transfer of data to therapist.	SMS report of 'food diary' information transmitted back to therapist for client with eating disorder.
	Accurate baseline records.	Device prompts for the client for mood ratings at random/pre-programmed times.
Homework adherence.	Homework prompting.	Prompting the client to carry out negotiated homework tasks at agreed time.
	Storage of homework assignments.	Recording of homework assignments for later use by clients.
Treatment generalization	Assistance with implementing therapy tasks between sessions.	Storage of photographic and audio exposure stimuli on mobile phone for review (e.g. in client with emetophobia).
	Between-session contact.	Contacting therapist during homework exposure tasks.
	Emergency contact during tasks.	Contacting therapist if necessary in emergency.