How technology supporting daily habits could help women remember oral contraception

Katarzyna Stawarz and Anna L. Cox
University College London
Gower Street, London WC1E 6BT
k.stawarz@cs.ucl.ac.uk, anna.cox@ucl.ac.uk

Non-adherence to oral contraception regimens can have serious consequences: oral contraception misuse or discontinuation is often caused by forgetfulness, and results in over 1 million unwanted pregnancies in the US each year. Due to its simplicity and habitual nature, taking the Pill can be easily incorporated into a daily routine. However, technology-based interventions aimed at improving adherence only focus on just-in-time reminders and taking the Pill at a specified time; the routine aspect of the task is neglected. We argue that technology that facilitates the creation of sustainable habits and supports women when their routine changes could reduce forgetfulness and would be more effective at reducing non-adherence than existing reminder-based solutions.

Habits. Technology. Forgetfulness. Oral contraception.

1. INTRODUCTION

The contraceptive pill (the Pill) is one of the most popular and easily available contraception methods in the UK (Robinson, 2012). With just one pill to take each day, its regimen is simple and easy to follow. However, its effectiveness depends heavily on regular use (Matter & Meier, 2008), which makes women responsible for the quality of their own protection against unwanted pregnancies. Since remembering to take the Pill every day can be easily disrupted, this protection can fail.

Each year, approximately 20% of 3.5 million unwanted pregnancies reported in the US are caused by medication non-adherence (Rosenberg & Waugh, 1999). That figure has not changed much in the past 15 years and irregular use and discontinuation are still the main causes of oral contraception non-adherence (Black et al., 2010, Smith & Oakley, 2010). Nearly a half of women who conceived whilst using the Pill as their main method of contraception reported memory issues: they did not remember to take it every day; took it at irregular times; forgot to pack the pills when travelling; or did not remember to order refills on time (Jones et al., 2002).

Despite the prevalence of forgetfulness, adherence interventions appear to only focus on intentional non-adherence and educating women about the risks of irregular use (Halpern et al., 2011). However, even women who understand the need to take the Pill every day and the consequences of forgetting, still make this error.

Interventions aimed at reducing forgetfulness are few and far between, and tend to focus on just-in-time reminders alerting women to take the Pill at a specified time. Such reminders often require an immediate action after the alert goes off so that the action is not forgotten (Cramer, 1991). This seems to disregard the fact that oral contraception regimens can become habitual tasks that could easily be incorporated into a daily routine. In this paper, we demonstrate the weaknesses in existing technologies that aim to support Pill taking, and argue that by taking advantage of the habitual nature of the Pill regimen by facilitating the creation of daily routines, technology could be more effective than just-in-time reminders.

2. TAKING THE PILL

There are two main oral contraception regimens that depend on the type of the pill: a combined hormone pill and a single hormone pill (Robinson, 2012). A combined pill needs to be taken every day at the same time for 21 days followed by seven pill-free days before a new pack can be started. Women can take this pill up to 12 hours late without compromising its effectiveness. A single hormone progestogen-only pill does not require any breaks: it has to be taken every day, ideally within a 3-hour window if it is to remain effective. Even though this regimen is stricter, its continuous nature and the

lack of breaks make it easier to remember than the combined pill (Aubeny et al., 2004).

Remembering to take the Pill therefore relies on prospective memory, i.e. a set of cognitive processes responsible for completing actions at some point in the future (Ellis, 1996). There are two main types of prospective memory tasks: time-based tasks that need to be completed at a specified time (e.g. take medication at 9am) or after a set period of time has elapsed (e.g. take antibiotics every 8 hours); and event-based tasks, where the task is linked to an existing event, e.g. taking the Pill with breakfast. Depending on individual circumstances, an oral contraception regimen can be classified as either of these tasks. However, event-based tasks are more effective in preventing forgetfulness: they are easier to remember and the presence of a routine guides the behaviour and provides more contextual cues, increasing the adherence to a medical treatment (Park & Kidder, 1996), e.g. the act of eating breakfast serves as a cue to take the Pill

2.1 Study 1: Remembering strategies

To better understand how technology could support women who take the Pill, first we needed to learn how women usually try to remember it. Therefore, we conducted an online survey that explored women's strategies for remembering their Pill, how often they forgot, and to what extent they rely on technology. The survey resulted in 971 complete responses. 76% of respondents were women aged 18-25 years old – an age group that is most likely to experience an unwanted pregnancy as a result of an oral contraception failure (Rasch, 2002). Women in this group are also likely to download smartphone apps, as 66% of 16-24 year olds in the UK own a smartphone (Ofcom, 2012).

The preliminary results confirm that women do indeed forget to take their Pill: nearly a half of respondents admitted completely missing the Pill at least once during the month preceding the survey, and during the same period, three quarters took it later than they should. 61% of women taking the Pill said that it was part of their daily routine and 52% said they simply "tried to remember" (there was a 50% overlap between these two groups). Therefore, it does not come as a surprise that the most common causes of forgetting were changes in the daily routine, being busy or distracted, and general forgetfulness. Yet, women who relied on their routine forgot less often: in the routine group 41% of women (N=589) completely forgot the Pill at least once in the past month and 69% were late, compared to 56% and 86% respectively amongst those that did not mention daily routines (N=382).

Interestingly, only 25% of women mentioned using some sort of technology, predominantly their phone's alarm clock, as a reminder. Only 5% (N=45) used medication reminder apps and among them only eight used dedicated smartphone contraception reminder apps. In addition, nearly a quarter of women who used technology to support their memory also said that the pill taking was a part of their routine, which suggests that technology might have been used as a backup reminder.

Our initial findings show that women rely mainly on routines and this strategy increases their adherence. They also tend not to use technology to support this task. In the next section we explain why it is rational to rely on routines to support medication regimens.

3. ROUTINES AND MEDICATION TAKING

One of the reasons that women may favour using routines to support their Pill taking behaviour may be due to the habitual nature of the oral contraception regimen. The regimens for both the combined and single hormone Pill can be thought of as habitual tasks: they need to be taken regularly and within a particular period of time, leading to a gradual learning of patterns of behaviour and associations between the task and the environment (Wood & Neal, 2007). As the frequency of repetitions of the task strengthens the association between the goal and the action (Aarts & Dijksternuis, 2000), the pill taking behaviour becomes automatic and relevant cues or the environment can trigger it without requiring conscious thought.

3.1 Benefits of a routine

The importance of habits and patterned behaviour in medication taking is emphasised in the Medication Adherence Model (Johnson, 2002). Johnson argues that good habits are established by the development of a routine and the use of reminders. As timing (e.g. breakfast time) and the location (e.g. kitchen) are key elements of a routine, each one is unique for each individual and reflects their lifestyle and daily activities which, in return, makes it more memorable, meaningful and reliable (Johnson, 2002). However, while routines make repetitive tasks easier, they can turn them into automatic behaviour that can be completed mindlessly, which may be dangerous when the task requires deliberation (Reach, 2005).

3.2 Dangers of a routine

While the 'automaticity' of a habit can be characterised by its efficiency, it also brings a lack of awareness, un-intentionality and often uncontrollability to the behaviour (Bargh, 1994). Even though habits are useful for reducing cognitive load and supporting everyday routines such us remembering daily medication, the automaticity of actions and the lack of thinking required when performing habit-

ual tasks can have negative consequences (Reach, 2005): routines can "override" planned actions, leading to action slips (Heckhausen & Beckmann, 1989; Reason, 1990), especially omission and repetition errors (Einstein et al., 1998).

Technology has the potential to support daily routines and minimise their risks. In the next section we explore current digital technologies that aim to support medication regimens.

4. MOBILE REMINDERS

4.1 Forgetfulness and mobile reminders

Current adherence interventions aimed at reducing forgetfulness tend to focus on providing just-in-time reminders. For example, Hou et al. (2010) evaluated the impact of text-message reminders on adherence to oral contraception during a randomised controlled trial with 82 women. For three months, text messages reminding women to take their Pill were sent once a day at a time chosen by the participant before the trial. The results showed that, despite the daily reminders, the intervention did not improve the adherence compared to the control group. Hou et al. also discovered that women who ended the trial with an excellent adherence record had felt at the beginning of the study that they would not need text-message reminders, which suggests that they either already used their own reminders or relied on a daily routine.

As 92% of adults in the UK own a mobile phone and 39% own a smartphone (Ofcom, 2012), text-message reminders are a reasonable choice of a reminder technology. However, they may not be flexible enough to support the Pill regimen in the context of a busy everyday life. Therefore, using smartphone apps may be a better solution, as they offer more control over the reminders, provide more complex functionality and are already being used to support remembering.

Recently, Dayer et al. (2013) have reviewed over 160 medication adherence apps available to smartphone users. Despite the fact that the effectiveness of the apps has not been formally evaluated yet, they concluded that smartphone apps can help with medication regimens and could be recommended by pharmacists to support the treatment. However, their study focused primarily on apps addressing intentional non-adherence. Therefore, a similar review of medication reminder apps was needed to understand what functionality they offer, how they support remembering, to what extent they support daily routines, and how useful and reliable users find them.

4.2 Study 2: Functionality review of mobile reminder apps

We have reviewed 229 medication reminder apps (including 25 dedicated Pill reminders) available for iPhone and Android smartphones and have discovered that even though the apps often offer features that can make remembering the Pill easier, such as customisable reminder alerts or time zone support, they focus primarily on just-in-time reminders and require immediate action as postponing the reminder is often not possible. The apps are designed to encourage women to rely on the app's reminder rather than to try to remember their Pill themselves, even though the apps are not always reliable. The analysis of customer reviews highlighted users' frustration that sometimes reminders do not work, other apps can interfere with the alerts, or software updates can break the app. All this can result in missed reminders and missed pills.

These results suggest that the existing technologies are not fit for purpose, as they do not support women in developing sustainable routines that enable them to take the Pill regularly. This may explain the low adoption rate of existing smartphone apps that we identified in Study 1.

5. CONCLUSIONS

Due to their portability and increasing popularity, mobile technologies, and smartphones in particular, have the potential to support daily routines and prevent dangers of automatic behaviour. Yet, despite the fact that habit formation is supported in apps designed to change behaviour, e.g. promoting physical activity by providing regular feedback (Rabin & Bock, 2011), existing medication reminder apps focus primarily on just-in-time reminders and do not provide any functionality supporting the creation of sustainable habits.

Based on the premise that oral contraception regimens are habitual tasks and incorporating pill taking into a daily routine reduces forgetfulness, we argue that technology facilitating the creation of reliable routines or supporting the existing ones would be the most effective in reducing oral contraception non-adherence. However, if that technology is to successfully support daily routines, it must also take their dangers into the account and provide failsafe mechanisms for situations where the routine is disrupted or where the automaticity of the behaviour makes it unclear whether the Pill has already been taken. We believe that mobile devices have the potential to become that technology and that they could successfully support the creation of sustainable habits and provide additional reminders when needed.

6. REFERENCES

Aarts, H., & Dijksterhuis, A. (2000). Habits as knowledge structures: Automaticity in Goal-Directed Behaviour. *Journal of Personality and Social Psychology*, 78, 1, 53–63

Aubeny, E., Buhler, M., Colau, J., Vicaut, E., Zadikian, M., & Childs, M. (2004). The Coraliance study: non-compliant behavior. Results after a 6-month follow-up of patients on oral contraceptives, *The European Journal of Contraception and Reproductive Health Care*, 9, 4, 267–277

Bargh, J. A. (1994). The four horsemen of automaticity: awareness, intention, efficiency, and control in social cognition. In R. S. Wyer & T. K. Srull (Eds.), *Handbook of social cognition: Vol I Basic processes* (pp. 1–40). Lawrence Erlbaum Associates.

Black, K., Gupta, S., Rassi, A., & Kubba, A., (2010). Why do women experience untimed pregnancies? A review of contraceptive failure rates, *Best Practice & research. Clinical obstetrics & gynaecology,* 24, 4, 443-55

Cramer, J. A. (1991), Overview of Methods to Measure and Enhance Patient Compliance. In J. A. Cramer & B. Spilker (Eds.), *Patient Compliance in Medical Practice and Clinical Trials* (pp. 3-10). Raven Press

Dayer, L., Heldenbrand, S., Anderson, P., Gubbins, P., Bradley, M. (2013). Smartphone medication adherence apps: Potential benefits to patients and providers, *Journal of the American Pharmacists Association*, 53, 2, 172–181

Einstein, G. O., McDaniel, M. A., Smith, R. E., & Shaw, P. (1998). Habitual Prospective Memory and Aging: Remembering Intentions and Forgetting Actions, *Psychological Science*, 9, 4, 284–288

Ellis, J. (1996). Prospective memory or the realization of delayed intentions: A conceptual framework for research. In M. Brandimonte, G. O. Einstein, & M. A. McDaniel (Eds.), *Prospective memory: Theory and applications* (pp. 1–22). Lawrence Erlbaum Associates.

Halpern, V., Lopez, LM, Grimes, DA, Gallo, MF (2011). Strategies to improve adherence and acceptability of hormonal methods of contraception, *Cochrane database of systematic reviews (Online),* CD004317

Heckhausen, H., & Beckmann, J. (1989). Intentional Action and Action Slips. *Psychological Review*, 97, 1, 36–48

Hou, M., Hurwitz, S., Kavanagh, E., Fortin, J., Goldberg, A. (2010) Using Daily Text-Message Reminders to Improve Adherence With Oral Contraceptives: A Randomized Controlled Trial, *Obstetrics & Gynecology*, 116, 3, 633–640

Johnson, M. J. (2002). The Medication Adherence Model: A Guide for Assessing Medication Taking, *Research and Theory for Nursing Practice*, 16, 3, 179–192

Jones, R. K., Darroch, J. E., & Henshaw, S. K. (2002). Contraceptive Use Among U.S. Women Having Abortions in 2000-2001, *Perspectives on Sexual and Reproductive Health*, 34, 6, 294–303

Matter, S. & Meier, B. (2008). Prospective memory affects satisfaction with the contraceptive pill, *Contraception*, 78, 2, 120–124

Ofcom (2012). *Communications Market Report 2012*, http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr12/CMR_UK_2012.pdf

Park, D. C., & Kidder, D. P. (1996). Prospective memory and medication adherence. In M. Brandi-monte, G. O. Einstein, & M. A. McDaniel (Eds.), *Prospective memory: Theory and applications* (pp. 369–390). Lawrence Erlbaum Associates.

Rabin, C. & Bock, B. (2011), Desired Features of Smartphone Applications Promoting Physical Activity, *Telemedicine and e-Health*, 17, 10, 801–803

Rasch, V. (2002), Contraceptive failure–results from a study conducted among women with accepted and unaccepted pregnancies in Denmark, *Contraception*, 66, 2, 109–116

Reach, G. (2005). Role of habit in adherence to medical treatment, *Diabetic Medicine*, 22, 4, 415–420

Reason, J. (1990). *Human Error*. Cambridge University Press.

Robinson, G. (2012). Oral contraception for women: a brief overview, *Nurse Prescribing*, 10, 3, 122-125

Rosenberg, M., & Waugh, M. S. (1999). Causes and consequences of oral contraceptive non-compliance, *American Journal of Obstetrics and Gynecology*, 180, 2 (Pt 2), 276–279

Smith, J. & Oakley, D. (2010). Why Do Women Miss Oral Contraceptive Pills? An Analysis of Women's Self-Described Reasons for Missed Pills, *Journal of Midwifery & Women's Health*, 50, 5, 380–385

Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. *Psychological review*, 114, 4, 843–63