The Dose Makes the Poison: Theoretical Considerations and Challenges of Health-Related POPC

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1. Introduction

A century ago, the main causes of death were infectious diseases. Today, most individuals die of chronic degenerative diseases, mainly caused by unhealthy lifestyles such as an unbalanced diet or physical inactivity (Centers for Disease Control and Prevention, 2015). Not surprisingly, health behavior change and maintenance have been proposed as one of the major challenges of this century (Benjamin, 2014). In the past, health or fitness coaching was a privilege for the few well off enough to afford it. Today's mobile health technology, *mHealth*, promises easily accessible and individually customizable health and fitness coaching for everyone. mHealth possibilities range from text message reminders to fitness apps for use on mobile phones or tablets, up to real-time user-generated data from wearable sensors (Miyamoto, Henderson, Young, Pande, & Han, 2016). Compared to illness-related topics – such as diseases, medicines, and pharmaceuticals – fitness, exercise, diet and nutrition are of major interest for young people, also indicated by their health information seeking behavior on the Internet (Escoffery et al., 2005). Social media offer numerous health-related platforms that can serve as ongoing motivators for healthy behaviors through social reinforcement, support, inspiration, or information (Vaterlaus, Patten, Roche, & Young, 2015). For example, social media and the Internet are used as health information sources, to receive and provide information about what one is eating, restaurant reviews, recipes, or pictures of food (McKinley & Wright, 2014).

The popularity of using technology, social network sites, and other online and electronic media such as mobile apps or smartwatches for health-related activities has risen dramatically (Kim, Park, & Eysenbach, 2012). In 2012, already one third of the cell phone and half of the smartphone owners in the U.S. used their devices for health purposes (Fox & Duggan, 2012). In 2015, more than 100,000 health apps were available (Research2Guidance, 2015); other estimates have counted up to 400,000 applications (Kramer, 2015). Health apps can support quitting harmful behaviors, enhance health-promoting behaviors, or monitor risk factors of chronic illness. Health-promoting behaviors such as physical activity or balanced nutrition are common goals of health applications (Kim, 2014).

Importantly, many such health-promoting behaviors occur often and repeatedly across the day, for example eating or walking. Other behaviors are boosted by social comparisons, including publicly showcasing the achievement of one's exercise goals. Thus, efficient monitoring of health behaviors and use of social networks and mHealth applications to support changes in lifestyle behaviors often require being permanently online and permanently connected (POPC; Vorderer & Kohring, 2013; Vorderer et al., 2015). Being POPC describes both, a permanence in communication—as an overt behavior of persistently using online media—and a psychological state of permanent communicative vigilance (Vorderer, Krömer, & Schneider, 2016). That is to say, a person can be permanently connected by actually engaging in an online social activity as well as by thinking about online activities, such as incoming messages or updates on activities of social partners while not currently interacting online. Thus, being POPC or a "POPC mindset" (Klimmt, Hefner, Reinecke, Rieger, & Vorderer, this volume) does not only entail actual behaviors such as monitoring what is going on online or quickly responding to messages and events, but also entails salience of online contents during offline times.

In this chapter, we aim at exploring the link between effective—i.e., health promoting—usages of mHealth tools and being POPC. While most of our theoretical arguments and examples in this chapter refer to mHealth tools, often smartphone applications, we believe that they also apply to other forms of health-related media, including social networks, blogs, or online channels for health-related topics.

2. Health-Related POPC

Self-monitoring or self-tracking—i.e., recording of a person's behaviors, feelings, and thoughts—is a central tool in behavioral psychology, medicine, and health provision serving both behavioral assessment and treatment

functions (Korotitsch & Nelson-Gray, 1999). Mobile applications provide an easily accessible, permanently available, and economic opportunity to track individual data on health and fitness, which has become quite popular (Choe, Lee, Lee, Pratt, & Kientz, 2014). In 2012, about every fifth smartphone owner had at least one health app installed – preferably an exercise, diet, or weight app (Fox & Duggan, 2012). In Germany, 11 to 17 percent of the population currently uses apps and services for fitness, tracking and self-monitoring, with a higher proportion among young people (Albrecht, Höhn, & van Jan, 2016; BMJV [The Federal Ministry of Justice and Consumer Protection], 2016). However, the health apps market is described as chaotic, fragmented, and confusing (Research2Guidance, 2015). Profound basic research on users and determinants of use is lacking. Most current research on the topic was conducted by commercial market companies and not designed for scientific purposes.

If and how mHealth technologies are used depends on user characteristics and motivations. Overall, health-related self-tracking is common particularly among young people up to 35 years. The potential of mHealth devices to sustainably support health behavior changes is high for those who are either already motivated to improve their health, are regular mobile technology or tracking device users, or both. For most people, increasing their motivation to start using mHealth tools represents the main challenge (Patel, Asch, & Volpp, 2015). Thus, apps and wearables facilitate, but cannot directly drive or trigger health behavior changes. To make use of mHealth technology for health promotion, at least two preconditions need to be met (Patel et al. 2015): (1) People need to be motivated to acquire such a device *and* actually use it. Among those who own an activity tracker, more than half do not engage in long-term use, one third stops using it during the first six months after acquisition (Ledger & McCaffrey, 2014). (2) Long-term engagement in mHealth use such as activity tracking requires the formation of new behavioral habits, strong motivation, and experience of success and progress towards defined goals (Ledger & McCaffrey, 2014). Therefore, information should be tailored to individual profiles and has to be fed back to the user in an understandable and motivating way (Patel et al., 2015).

mHealth technology allows constant tracking of health indicators and behaviors as well as monitoring of activities within one's health-related social network, for example, exercise performance of fitness buddies. A POPC mindset with its facets salience and monitoring of online content (e.g., data on health indicators of oneself and others) as well as reactibility to messages and content (e.g., social support concerning exercise performance) is not only a prerequisite but potentially also increases adherence to mHealth. Whether a POPC mindset for health-related purposes leads to long-term health behavior change and successive health improvement, likely depends on a number of factors we discuss below.

3. Modeling the Relationship of POPC, Use and Effects of mHealth Devices

A precondition to being POPC for health-related purposes is using mHealth technology. In the following section, we will summarize conceptual models of determinants of using mHealth technology and discuss how being POPC and mHealth interact for changing health-promoting behaviors in the long term.

Determinants of using mHealth devices

The (intention to) use mHealth applications is often explored based on the Technology Acceptance Model (TAM; Davis, Bagozzi, & Warshaw, 1989), and the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh, Morris, Davis, & Davis, 2003). The UTAUT is an extension of the TAM that also integrates factors focusing on human and social change processes (Legris, Ingham, & Collerette, 2003). In both models the user's perception of technological devices, corresponding expectations, and attitudes towards technology and its context are major determinants of the intention and actual usage of technology. As an alternative, Wirth, von Pape, and Karnowski (2008) proposed the Mobile Phone Appropriation Model that predicts the adoption of new technology, particularly smartphones, which are central to the mHealth context. The model has started to be used in the field of health behavior change (e.g., Stehr, Rossmann, & Karnowski, 2016). Sun and colleagues provided a comprehensive integration of technology acceptance models and health behavior theories, adding psychological factors such as subjective norm and self-efficacy (Sun, Wang, Guo, & Peng, 2013). Generally, one of the conceptual challenges in the context of mHealth is adjusting existing models to the specific aspects and determinants of using technology for *health*-promoting purposes. In one of the first studies,

Yoganathan and Kajanan (2014) have tested predictors of the adoption of fitness app use. Next to predictors of technology acceptance, psychological factors, such as intrinsic motivation for physical activity, were particularly important.

Taken together, the individual decision to use and adopt mHealth technology is not an automatic consequence of providing health apps or wearables – even if they are offered for free. The first important step to facilitate mHealth use is reaching potential users and motivating them not only to buy or install a tool, but also to use it in a specific, health-promoting way. In the next section, we describe how being POPC could facilitate the long-term adoption of mHealth devices and, in turn, affect health-related outcomes.

Effective use of mHealth devices: The role of being POPC

Over the last years, several theoretically relevant aspects of health-promoting technologies have been discussed, including the scarcity or even lack of evidence-based behavior change techniques used in mHealth tools (e.g., Azar et al, 2013; Breton, Fuemmeler, & Abroms, 2011) or the use of helpful features to make mHealth persuasive (e.g., Fogg, 2009). In our view, POPC could promote long-term health behavior change by making the following three evidence-based strategies more effective: (1) the duration of using an mHealth tool, (2) the potential for real-time monitoring of activities and the interactive character facilitating immediate feedback or reinforcement, and (3) the connectedness to other users for social support or social comparison.

Duration. Despite many theoretical and practical advances in health behavior change interventions, long-term changes in health behaviors such as physical activity or balanced nutrition remain a big challenge. A number of studies in behavioral weight loss have suggested that longer treatment duration increases intervention success (e.g., Levy et al., 2010; Perri, et al., 2001). mHealth technology offers a cost-effective solution, because it can be used for very long periods of time without significant additional costs. Importantly, a POPC mindset (including salience and monitoring of as well as reactibility to online content) could facilitate long-term adherence to weight loss interventions. The effects of a POPC mindset have not been investigated in the context of duration or adherence to health behavior interventions. Technological solutions, particularly mHealth, have been rarely examined in randomized controlled trials targeting health outcomes such as long-term weight control (Gilmartin & Murphy, 2015). Several systematic reviews concluded that these studies have important limitations and underlying mechanisms have not been studied (Mateo et al., 2015; Allen, Stephens, & Patel, 2014). In sum, to date few randomized controlled trials targeting long-term health behavior change have taken advantage of the potential of mHealth solutions for longer duration of interventions. The potential facilitating role of a POPC mindset is yet unexplored.

Real-time monitoring and interaction. A second important feature of mHealth technology with implications for POPC is the interactive character of mHealth applications (Noar & Harrington, 2012) and the potential of real-time monitoring. Real-time monitoring of activities has been facilitated and in some cases was made possible only through the latest technological developments. Today's smartphones integrate measures of step count and distance walked, calorie consumption, heart rate and much more, often requiring only a few clicks. Two major advantages of real-time monitoring include eliminating common memory biases for (health) behaviors (e.g., Shiffman et al., 1997) and teaching individuals to make better, more accurate estimates of their health behavior (Rosenthal, McCormick, Guzman, Villamaory, & Orellano, 2003). Based on real-time monitoring users can receive immediate feedback on their performance, which is an evidence-based, effective technique for behavior change (Michie et al., 2013). The interactive character of mHealth devices, that is, enabling information exchange between user, the app, and other users, offers immediate feedback on one's performance. Such feedback is extremely rewarding and reinforcing (Hattie & Timperley, 2007), helps self-regulation (e.g., Ilies & Judge, 2005), and most likely triggers high levels of being POPC. At the same time high levels of monitoring of and reactibility to online content make performance-related feedback immediately available and could increase its effectiveness. Importantly, a recent analysis of over 3,000 paid health apps showed that while reinforcement is one of the key psychological factors to drive behavior change, only about 6 percent of paid apps were reinforcing (Becker et al., 2014) and thus made use of one major advantage of mHealth.

Social support and social comparison. Being part of a social network comprised of users with similar goals using the same mHealth technology is a third important aspect in the context of POPC and mHealth. Social support by

other users, for example through praise for achievements or cheering and encouragement in the face of failure, as well as social comparison and competition are important elements of many mHealth tools. Feeling connected with others is a central human need and a prerequisite for intrinsic motivation, which in turn is the basis of long-term behavior change (Ryan & Deci, 2000; Teixeira et al., 2010). Social control is associated with engaging in more healthy behaviors (e.g., Lewis & Rook, 1999). Social comparison can be very motivating (particularly, when performing better than one's reference group; e.g., Deci, 1971), and for the same reasons can be demotivating (when performing worse than one's reference group). Importantly, knowing that relevant others are monitoring one's health behaviors, commenting on (non-)performance, and attempting to outperform one's achievements likely increases the desire to be POPC. More frequently monitoring comments and behaviors of others in a social network allows reacting and using these social mHealth features to their full potential. At the same time, not all social support is beneficial (Berkman, Glass, Brissette, & Seeman, 2000) and of induced stressors, social stressors are arguably the most stressful (e.g., Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003). Consequently, monitoring one's social network—also for health related purposes—might be the strongest motivator for being POPC (cf. Vorderer et al., 2016).

POPC, mHealth, and their potential for health promotion

As we described above, central features and advances of mHealth technology are likely more effective the more often users are online and feel connected. Importantly, based on evolutionary theory on enhancement, predictions can be deduced about when POPC likely enhances the benefits of mHealth technology, social networks, or other health-related Internet sources such as blogs, Instagram, or YouTube channels for engaging in healthy behaviors and when it diminishes them. Every performance enhancement is associated with tradeoffs, with a vast majority of studies suggesting an inverted U-shaped performance function (Hills & Hertwig, 2011). That is, too little or too much performance enhancement can have undesirable side effects. For example, both, lower and considerably higher than recommended levels of physical activity are associated with lower well-being compared to medium levels (e.g., Merglen, Flatz, Bélanger, Michaud, & Suris, 2014). Concerning the use of social media, young adults reported perceiving both, advantages and disadvantages for their health behaviors (Vaterlaus et al., 2015). For example, social media could be a motivator for exercise, for example through social support, and at the same time a barrier due to intense screen-based media use leading to more sedentary time (Finne, Bucksch, Lampert, & Kolip, 2013). It is likely that the engagement in health-related POPC is related to its effectiveness for enhancing health promotion. Generally, very high levels of health-related POPC behavior potentially lead to conflicts with other health-related behaviors, because POPC takes up time planned for other activities. Also, being in a POPC mindset could additionally lead to stress and distraction from socially engaging with physically present others or procrastination of important but long-term goal behaviors, such as studying or physical exercise, with potential negative consequences for health and well-being (for a discussion of POPC and goal conflicts also see van Koningsbruggen, Hartmann, & Du, this volume). Therefore, we propose an inverted U-shaped relation between POPC behavior for health-promoting purposes and mental and physical health and well-being (Figure 23.1).

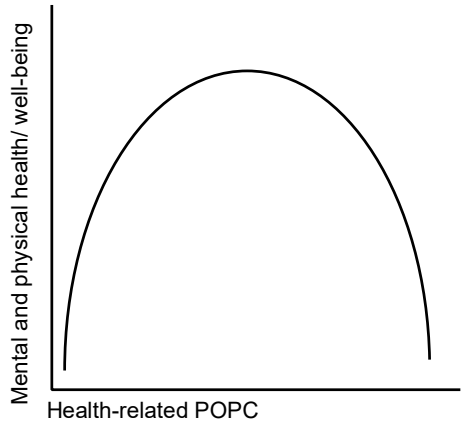

Figure 23.1: Relation between the individual's engagement in being POPC for health-related purposes and health promotion

Additionally, individual differences in the effectiveness of health promotion through being POPC can be assumed. Studies on cognitive enhancement showed that primarily individuals with lower baseline capabilities improved after drug treatment, while effects on individuals of normal or above-average cognitive ability showed negligible improvements or even decrements in performance (de Jongh, Bolt, Schermer, & Olivier, 2008). Similar patterns could be hypothesized for health behaviors: Physically very active persons might show a smaller relative benefit of a health-related POPC mindset than less active individuals.

4. Conclusions, Implications, and Future Perspectives

In this chapter we have described different forms and determinants of mHealth use and how it relates to behaviors triggered by a POPC mindset. We argue that a POPC mindset could increase effectiveness of health promotion through mHealth and other electronic media devices. In our view, at least two main conclusions can be drawn based on the state of the current research reviewed above:

First, effective use of mHealth technology and other online media for health promotion is determined by at least two different factors: (A) affinity to information and communication technology (as prerequisite for being POPC), and (B) motivation for a healthy lifestyle. People in Group A can build on their technology interest and could profit from triggers towards healthy lifestyles. People in Group B are already looking for tools to improve health behaviors and would benefit from technology that can support them to achieve these goals. Mobile online media such as mHealth tools or social networks show great promise to support users in achieving healthy lifestyles and thus promise to be an important part of the big challenge to improve health in the long term (Noar & Harrington, 2012).

Second, as we outlined in this chapter, an *adequate dose* of being POPC could be an important prerequisite for using mHealth and other social media tools to their full potential and, thus, more effectively. Such effective use could be associated with higher levels of mental and physical health and well-being (see also Figure 1). Importantly, mHealth and other mobile media tools provide answers to previous challenges such as longer duration of health behavior change interventions, real-time monitoring that can replace cumbersome analogue tracking and biased memories of health activities, immediate rewarding feedback, and social connectedness with others in the same situation or with similar goals. These functions hold the promise to make a healthier lifestyle more accessible and sustainable. At the same time, the relation between being POPC—both as a determinant of technology adoption and a consequence of (mobile) technology use—and the effectiveness of mHealth use has not been explored yet. It is likely that a POPC mindset affects the different ingredients of effective behavior change differently: An increase in the duration of health behavior change based on mobile technology is probably the result of an even share of the POPC mindset dimension of salience, monitoring, and reactivity to online content. For receiving performance feedback on health behaviors, monitoring could be the most important POPC facet, whereas both particularly high levels of reactivity and monitoring might be central to receive social support from others. As none of these relationships have been tested yet, however, these assumptions remain hypothetical. The general lack of theoretical delineations and empirical evidence of the effects of a POPC mindset in the context of health purposes is somewhat surprising, given the profound impact of technological advances and related POPC behavior on everyday life, communication, and well-being of individuals in our modern society (Becker et al., 2014).

Many open questions remain. As discussed above, for example, the right level of being POPC seems to be crucial for successful mHealth. However, what that means in everyday life, remains largely unclear. According to previous research, too much use of online media is associated with lower physical activity (Bélanger, Akre, Berchtold, & Michaud, 2011)— but can this also be transferred to health-related use of (mobile) online media such as mHealth? Future research needs to address how being POPC and effective health promotion work together most effectively. To further explore this relationship empirically and theoretically, we finally want to emphasize another challenge that an integrated, process-oriented theoretical model of health-related POPC faces: Instead of focusing on single sequences of uses and effects, chains or cascades of multiple and interacting determinants of use and effects should be taken into account (see also Schneider, Reich, & Reinecke, this volume). Considering the interplay between determinants could help explain why mHealth supports only some

people in improving health sustainably while others use devices only for a short period of time but do not benefit in the long run. Thus, a longitudinal perspective of both theoretical and empirical delineations of health-related POPC is essential in future research.

Being POPC is probably highly intertwined with the (effective) use of health-related mobile media and likely follows the same pattern as many other behaviors: the dose makes the poison. More research is profoundly needed to better understand how POPC, as one important facet of our modern and media-saturated world, influences health promotion and well-being. The current state of research suggests that the importance of mobile online media such as mHealth is increasing both for medical applications as well as for a healthy lifestyle. A POPC mindset and online media tools could be an important part of the puzzle to understand one of the major challenges of this century, health behavior change and maintenance.

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