THE EFFECT OF HEALTHCARE SERVICE PROVIDERS' ENTREPRENEURIAL TRAITS ON THEIR USE OF MHEALTH TECHNOLOGICAL INNOVATIONS

NAME: DYLAN KOENES

STUDENT NUMBER: 921209453060

STUDY PROGRAMME: BACHELOR HEALTH AND SOCIETY

SUPERVISOR: HERMAN KOK

DATE: JULY 5TH 2016

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Foreword

This thesis is written in order to complete the bachelor Health and Society at the Wageningen University. The bachelor programme covers how health-related behaviour and outcomes are the result of the organisation of the healthcare system as well as individuals' interactions. The subject of this thesis is within the scope of this bachelor's field because there is a distinct focus on healthcare professionals, and how their behaviour can impact healthcare quality, accessibility and affordability.
Entrepreneurship came to my attention when I was doing my minor titled Innovation and Entrepreneurship at the Wageningen University. During this minor, there was a focus on how business success can be achieved using entrepreneurial principles. Many healthcare organisations such as hospitals can be compared to businesses in the sense that they want to provide high quality services (healthcare) to as many customers (patients) in the most profitable way (low costs) possible. This is what made me decide to combine the subjects of healthcare and entrepreneurship for my thesis.

In the process of writing this thesis, my supervisor Herman Kok was of great help. His critical eye has tremendously increased the quality of this literature review and for this, I want to state my thanks.

Abstract

For at least three decades, the adoption of new technology has been a theme for researchers. Technological innovations are used in the healthcare sector to improve the quality-, increase the availability- and decrease costs of care. Lately, a new type of healthcare related technological innovation has been gaining popularity: mHealth technology. mHealth technology covers a broad range of devices and software which are easily transported and can be used in various locations. Not all healthcare service professionals however, are willing to adopt mHealth innovations. Several entrepreneurial traits are linked to taking risks, recognising opportunities and successfully implementing innovations. This thesis reviews if entrepreneurship theories can be applied to healthcare service professionals.

1 Introduction

1.1 Problem statement

Since the late 1980's the adoption of, among others, Information Technology (IT) has been an area of interest for researchers (e.g. Davis, 1989). In healthcare, such technology is used to create a high quality, efficient and more cost-effective system (Halford, Lotherington, Obstfelder, & Dyb, 2010). The next step in using technology to improve healthcare is already underway.

Mobile health (mHealth) technologies have the potential to greatly impact healthcare, health research and outcomes (Nilsen, Kumar, Shar, Varoquiers, … & Atienza, 2012). mHealth technology comes in a large variety and encompasses, among others, devices used by professionals (e.g. mobile radiology monitors) (Böckmann, 2016) as well as wearables and smartphone applications to track blood pressure (Goldberg & Levy, 2016) or even a smart bottle to track fluid intake (Bear, Shumpert, Shaporev & Reukov, 2016). A lot of new opportunities offered by mobile technology remain unexplored however, according to a literature review by Fiordelli, Diviani and Schulz (2013). This despite the multiple challenges faced by the healthcare industry.

Life expectancy in Europe is increasing (Eurostat, 2016). This ageing of the population is, among other problems, accompanied by rising healthcare costs (Walker, 1999). The ageing society is not the only issue healthcare systems face. For example, obesity and severe obesity in the United States are estimated to increase 33% and 130% respectively by 2030, putting additional financial strain on the healthcare system (Finkelstein, Khavjou, Thompson, Trogdon, … & Dietz, 2012). Another challenge healthcare systems face is the increase in burden of disease originating from non-communicable diseases (Murray & Lopez, 2013). Due to the ubiquity of mobile devices and wide range of applications (Sloninsky & Mechael, 2008), mHealth technology may aid in tackling these challenges.

However, the adoption of mHealth then faces the challenges of healthcare being a complex system, with many actors and stakeholders that may influence whether or not innovations such as mHealth technologies are implemented (Omachonu & Einspruch, 2010). In order to innovate, different interests must be considered. Service providers and financers may be influenced by the opportunity for profit, governments have quality demands and customers want their needs met affordably. In general, actors are a part of at least one of the following dimensions: *financing*, *service provision* and *regulating* (Wendt, Frisina & Rothgang, 2009), an addition to these dimensions is the patient or consumer, the one who receives care. Innovation in the healthcare sector could originate from, or be resisted by, any actor in this complex system. This may present a barrier to technological progress. Healthcare service providers (HSPs) (e.g. hospitals, general practitioners, physical therapists) have direct relations with all other actors (Wendt et al., 2009), which could mean innovative HSPs may influence any part of the healthcare system. Not only their central position in the healthcare system makes HSPs crucial to the innovation process. As with information technology implementation in the healthcare sector, the success of mHealth technology is largely dependent on the acceptance by HSPs (Gagnon, Desmartis, Labrecque, Car, … & Légaré, 2012). The relationships they build with patients make HSPs crucial for the implementation, since mHealth is consumer-centered and consumer-driven (Akter & Ray, 2010).

Having entrepreneurial qualities such as open-mindedness, long-term vision and intuition can help overcome difficulties by proposing innovative solutions (Marcati, Guido & Peluso, 2008). Entrepreneurship can be a driver for innovation and change (Spinelli & Adams, 2012). Many definitions for the concept of entrepreneurship exist. According to Spinelli and Adams (2012) "entrepreneurship is a way of thinking, reasoning, and acting that is opportunity obsessed, holistic in approach, and leadership balanced for the purpose of value creation and capture". Spinelli and Adams (2012) also name several desirable traits entrepreneurs can possess, among them an obsession with opportunity and willingness to take risks. A literature review by Anderson, de Drew and Nijstad (2004) names several personality traits that influence innovation. Among these traits are tolerance for ambiguity, openness to experience, self-confidence, independence and pro-activity. This is of interest because, as Spinelli and Adams (2012) show in a literature overview, these traits are also associated with entrepreneurship. In non-healthcare sectors, the link between entrepreneurial traits and propensity to innovate has already been established (e.g. Alam, 2011; Avlonitis & Salavou, 2007).

It should be noted that while the term entrepreneurship is mostly associated with starting a new business, it can exist within large organisations. Most often this is called *intrapreneurship* or *corporate entrepreneurship (Antoncic & Hisrich, 2001; Antoncic & Hisrich, 2003)*. Entrepreneurial Orientation (EO) is a term that can be used to describe these forms of entrepreneurship within organisations and points out how they differ from the commonly used definition of an entrepreneur being a new entry to a market (Covin & Miller, 2014).

1.2 Research aim

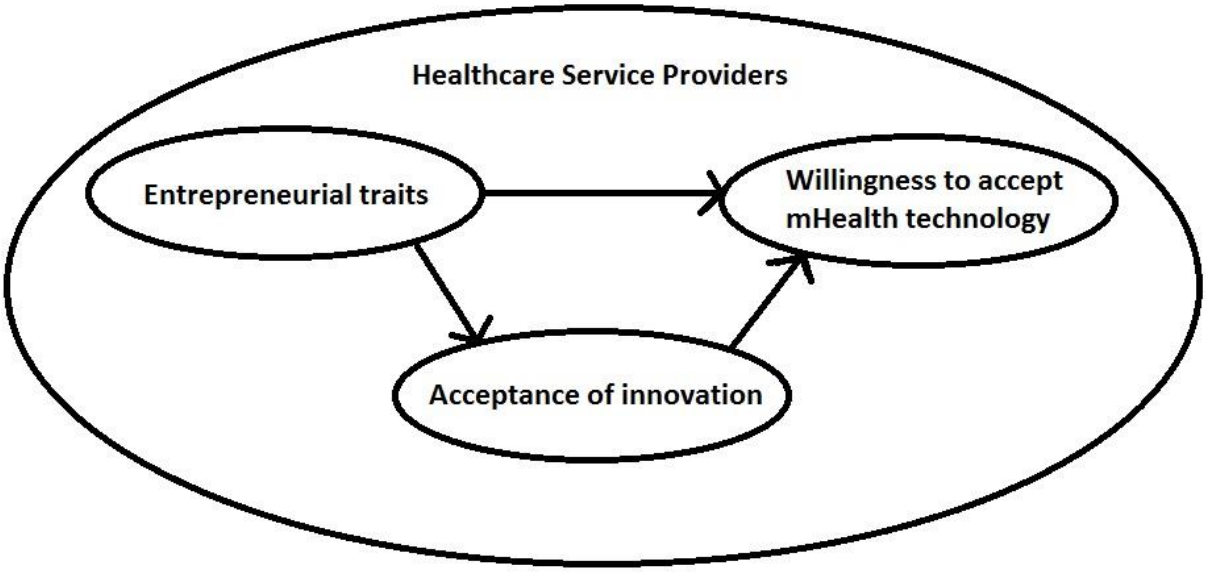
The aim of this research is to determine the effect of entrepreneurial traits among HSPs on the willingness to adopt mobile technological innovations in healthcare service provision. It is expected that because of the traits that constitute an entrepreneur, these individuals are more likely to accept innovations, leading to a higher adoption rate of mHealth technology. The entrepreneurial propensity to see opportunities where others do not may directly lead to a higher adoption rate, while other factors such as willingness to take risks and open-mindedness can lead to a general acceptance of innovation. The hypothesised relationship is displayed in figure 1. The model depicts that entrepreneurial traits a HSP may possess can directly influence the willingness to accept mHealth technology and lead to a more general acceptance of innovation which will then in turn influence mHealth technology adoption.

The research question of this narrative literature review is: How do entrepreneurial traits among healthcare service providers impact their willingness to adopt mHealth technological innovations? Subquestions are:

1. What are entrepreneurial traits?
2. What affects the adoption of innovations?
3. What are mHealth technology innovations?

This paper will begin by exploring trait theory and specifically entrepreneurial traits, adoption of innovation and mHealth technologies. In the discussion section that follows, the expected relationships between these concepts, as portrayed in figure 1, are addressed.

Figure 1. Conceptual relational model of entrepreneurial traits, acceptance of innovation and willingness to adopt mHealth technologies.



1.3 Methods

This research is fully based on a literature study. Literature was found using the Scopus and Google Scholar search engines. Keywords used were: health, care, healthcare, system, service, provider, stakeholder, adoption, innovation, innovator, mHealth, mobile, technology, technological, devices, entrepreneurship, traits, and combinations of these.

Relevancy to this research was determined by reading article titles. Articles with promising titles were further screened for relevance by reading the abstract or summary. Both 'chronological' and 'cited by' rankings were used independent from each other in order to present the most recent and most important findings.

Recency (articles from 2000 and later) was a deciding factor for selecting literature, but older articles were used when established principles were discussed or when it was the most recent literature concerning a particular subject. The snowballing technique was used when articles had useful references to other findings.

2 Literature review

2.1 Entrepreneurial traits

Personality traits are useful predictors for entrepreneurial success (Leutner, Ahmetoglu, Akhtar & Chamorra-Premuzic, 2013). However, as Brandstätter (2011) notes, people's understanding of what a trait is varies. Traits can be seen as descriptions of a person's mean level of states across events (e.g. Fleeson, 2001) or as complex, genetically co-determined psycho-physiological structures that cause mental or behavioural processes (e.g. John, Naumann & Soto, 2008). The measures of traits are based on descriptions of how people think, feel, etc. but it is assumed they are the manifestation of real internal causes (Brandstätter, 2011). Pivotal research was done by Tupes and Christal (1961), introducing the Five Factor Model (FFM). The five factors the FFM describes are: Openness to experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism.

McCrae and John (1992) extensively reviewed the different explanations various authors use for these factors. They found that neuroticism is the least controversial factor among researchers, interpreted as a person's tendency to experience distress. Extraversion is slightly more difficult to define, as it is often described as having warmth, positive energy, but also dominance. Also, a high score for extraversion does not automatically mean a low score for neuroticism. Agreeableness is characterized by altruism, nurturance, caring and emotional support. It is the opposite of hostility and an antagonistic attitude. Adjectives describing conscientiousness are: achievement oriented, diligence and being organized. It is also described as being prudent, holding impulsiveness in check. Scoring high on conscientiousness can also mean directing a lot of energy towards a particular goal. The greatest deal of controversy concerns openness to experience. Different adjectives are used to describe openness to experience in different languages. Most commonly, it is understood as a measure of intellect but broader terms such as aesthetic sensitivity, need for variety and unconventional values are also associated with openness to experience.

These factors are also called Big Five and designated with the acronym OCEAN (Brandstätter, 2011). FFM does not give an exhaustive description of personality, but serves to provide a certain level of trait description (McCrae & John, 1992). The Big Five profile that seems to characterise entrepreneurs scores high on extraversion and openness to experience, lower on agreeableness, while scores for neuroticism and conscientiousness were not significantly related to entrepreneurs (Caliendo, Fossen & Kritikos, 2011).

Opportunity recognition is a central entrepreneurial trait (George, Parida, Lahti & Wincent, 2016). Generally speaking, there are two schools of thought on opportunity recognition: that of Schumpeter (1934) and of Kirzner (1979). Schumpeter (1934) claims opportunities are central to value creation and are already present but need to be discovered in order to make use of them. Kirzner (1979) however, claims opportunities do not exist in their final form, but must be invented. The literature agrees on the fact that opportunity recognition can lead to value creation through diverse processes. The question that drives opportunity research is why, when and how and some individual are able to recognise opportunities where others cannot (George et al., 2016).

Through a systematic literature review of 180 articles, George et al. (2016) have found opportunity recognition to be dependent on six factors: systematic search, alertness, social capital, prior knowledge, personality and environmental conditions.

In their systematic review, George et al. (2016) found that prior knowledge mainly influences opportunity recognition in two ways. For one, knowledge obtained through personal or professional experiences can be a resource in recognising unmet needs or conditions in the market. Secondly, prior knowledge is seen as a cognitive resource, which may or may not need to be combined with information from other sources.

George et al. (2016) found the personality attributes regarding opportunity recognition that are most discussed in literature are self-efficacy, creativity, the propensity to take risks, need for achievement, need for independence, and locus of control.

Environmental conditions that influence opportunity recognition can be physical (e.g. the availability of technology), socio-political (e.g. regulations and capital available) and cultural (Shane & Venkataraman, 2000; Tominc & Rebernik, 2007). The literature says information on these conditions is important because it helps entrepreneurs to successfully exploit opportunities (Shane & Venkataraman, 2000).

Alertness is defined as the capacity to possess keen insights into identifying entrepreneurial opportunities, and works even without actively searching for them (George et al., 2016). Gaglio and Katz (2001) argue that alertness is a measure of the complex and adaptive mental frameworks about change, industries and social environments with which entrepreneurs can view situations from other (unconventional) perspectives than those low in alertness.

Systematic searching, actively looking for opportunities, helps entrepreneurs recognise opportunities (Fiet, Piskounov & Patel, 2005) and can provide the entrepreneur with knowledge that can be crucial to exploit those opportunities (George et al., 2016). Some argue systematic searching is the opposite on the spectrum of alertness, while Murphy (2011) says they are two separate dimensions. Murphy (2011) claims varying between high or low levels of searching, combined with high or low levels of alertness can lead to different kinds of opportunities.

According to George et al. (2016), the literature sees social capital as a positive influence on opportunity recognition. Having diverse contacts can increase pattern recognition and peripheral vision which helps spotting opportunities (Baron & Markman, 2000; Tang, 2010). Social capital also offers access to scarce resources, allowing entrepreneurs to exploit opportunities (Fuentes, Arroyo, Bojica & Pérez, 2010).

Marques, Ferreira, Ferreira and Lages (2013) found characterising psychological, cognitive and motivational entrepreneurial traits in a sample of 367 health care professionals. Results show healthcare professional entrepreneurs exhibit a similar profile to other entrepreneurs.

Marques et al. (2013) found the traits associated with entrepreneurship through a review of literature about entrepreneurs in general. They then performed a survey about these traits among healthcare professionals and after statistical analysis they found the traits mentioned in table 1. to be associated with entrepreneurship in healthcare professionals.

Psychological factors related to entrepreneurship have been receiving attention from scholars since McClelland's research in 1961. Since then, various authors have found psychological characteristics that seem to be associated with entrepreneurship. These characteristics are part of behavioural theory (also known as behaviourism), which posits that human behaviour can be (in part) explained by an individual's personal qualities, without interference of internal processes (Bargh & Ferguson, 2000).

Conversely, the cognitive traits that are related to entrepreneurship mentioned by Marques et al. (2013) are assumed to be the result of internal processes (Bargh & Ferguson, 2000). A main difference between cognitive and psychological traits is that psychological traits are non-modifiable, while cognitive traits can be altered through conscious effort (Gartner, Shaver, Gatewood & Katz, 1994).

Entrepreneurial motivation is difficult to analyse, because it lacks objectivity and varies across cultures and individuals (Farmer, Yao & Kung-McIntyre, 2011). Acting entrepreneurially means assuming risks and taking on responsibilities (McClelland, 1961). The need for self-recognition, desire to influence social status or sheer necessity are factors that explain entrepreneurs' willingness to take on those risks and responsibilities (Marques et al., 2013).

Table 1. Traits associated with entrepreneurial healthcare professionals.

Dimensions	Traits
Cognitive	Alertness to external business opportunities
	Professional and personal self-realization
	Accurateness/Effective problem solving rigor
	Optimism/perception of success
	Influence of the affective state
Psychological	Creativity/innovation
	Self-esteem/self-confidence
	Self-control
	Autonomy
Motivational	Self-recognition
	Necessity/family influence
	Social status

Adapted from Marques, C. S., Ferreira, J. J., Ferreira, F. A., & Lages, M. F. (2013). Entrepreneurial orientation and motivation to start up a business: evidence from the health service industry. *International Entrepreneurship and Management Journal*, *9*(1), 77-94.

Conclusion

There are multiple ways to analyse the entrepreneurial profile. While Caliendo et al. (2011) used the FFM which is applicable to a range of situations, but only gives a general representation of personality, George et al. (2016) arguably went for the opposite strategy, zooming in on a single entrepreneurial trait. Marques et al. (2013) chose to take the middle road and analysed all known traits associated with entrepreneurship. Marques et al. (2013) have shown that HSPs have a profile similar to other entrepreneurs, allowing the use of general entrepreneurship theories in the healthcare sector.

2.2 Acceptance of innovation

After reviewing a multitude of definitions, Page (2014) found that healthcare professionals unanimously agree that in order for a product or process to be classed as an innovation it must have a positive impact on the patient or the healthcare professional. Varkey, Horne and Bennet (2008) use a more elaborate definition that is in accordance with that of Page (2014): innovation is the successful implementation of a novel idea in a way that creates compelling value for some or all of the stakeholders.

The success of technological innovations is largely dependent on the acceptance by its intended users (Sitorus, Govindaraju, Wiratmadja & Sudirman, 2015). Even though an innovation may bring benefits to users, it often takes years for it to be accepted (Rogers, 2003).

In order to explain user acceptance of technology, the Technology Acceptance Model (TAM) was developed by Davis (1989). Core concepts are Perceived Usefulness (PU) and Perceived Ease of Use (PEoU), respectively: to what degree users think a technology can improve their task performance and how much effort using this technology will take. Later versions of the TAM also include a measure of the subjective norm (i.e. a measure of the influence of the social environment). In 2003, Venkatesh, Morris, Hall, Davis, Davis and Walton combined the TAM with seven other prominent theories to create the Unified Theory of Acceptance and Use of Technology (UTAUT). This model aims to better explain technology acceptance

The UTAUT uses four main constructs: performance expectancy, effort expectancy, social influence and facilitating conditions. The UTAUT expects that these constructs determine behavioural intention, which is assumed to be the only determinant for use behaviour (Venkatesh, 2003). Where the UTAUT was created with the professional environment in mind, its expansion, the UTAUT2 was developed for consumers as end users (Sitorus et al., 2015). The UTAUT2 takes into account hedonic motivation, price-value and habit. The underlying assumptions are that consumers adopt new technology for pleasure, want the best value for money, but are also influenced by their habits when considering the adoption of new technology.

From a survey among physicians, Morton and Wiedenbeck (2009) found that PU explained 73% of the variance in physicians' acceptance of Electronic Health Records (EHRs). Gagnon, Ghandour, Talla, Simonyan, … and Rousseau (2014) have made an effort to expand the Technology Acceptance Model (TAM) to increase its predictive power for healthcare professionals. They conclude it is important to account for age and gender in order to promote technology use. Gagnon et al. (2014) found the intention to use EHRs was mostly dependent on PU for physicians under 50 years old while female physicians were more influenced by the social environment.

In a systematic literature review concerning the adoption of mHealth by healthcare professionals over the period of 2000 to 2014 by Gagnon, Ngangue, Payne-Gagnon and Desmartis (2016), 179 elements that hindered or facilitated mHealth technology adoption were reported. These elements were categorised as related to mHealth characteristics, individual factors, external factors (human environment) and external factors (organisational environment). Most HSPs perceive mHealth as time saving, but they have their concerns on it disturbing their workflow (Gagnon et al., 2016). Gagnon et al. (2016) describe an existing fear HSPs have when using smartphones as mHealth technology. HSPs think smartphone use could be disruptive during patient visits or gets mistaken by others as checking text messages or e-mails. HSPs describe workplace readiness and management support for mHealth, as organisational factors influencing their mHealth adoption (Gagnon et al., 2016). Of particular interest to this current study are the individual characteristics that are related to entrepreneurship. Gagnon et al. (2016) found that awareness, familiarity with mHealth or with technology in general, risk perception, autonomy, self-efficacy and experience can either increase or decrease the likelihood of HSPs using mHealth.

Besides the HSP side of accepting innovation, it is also important to consider the patient side since mHealth is consumer-centred and consumer-driven (Akter & Ray, 2010). One model that tries to explain consumer adoption is the Diffusion of Innovation (DOI) model by Rogers (2003). The DOI model categorises technology adopters into five categories, depending on how fast they adopt: innovators, early adopters, early majority, late majority and laggards. Rogers (2003) identified five characteristics of innovation that help explain the differences in adoption rates. The first is the relative advantage an innovation has over preceding technologies or methods. The second factor is compatibility with the individual, the innovation should fit in with existing values, past experiences and needs of potential adopters. Complexity is the third factor, easy to use innovations are adopted sooner. Potential adopters want to be able to experiment with innovations before they adopt, trialability is the fourth factor influencing adoption rates. The last factor Rogers (2003) describes is observability: the effects of an innovation should be observable and communicable to others.

Through a 29-month long case study of an electronic way of making doctor's appointments, Zhang, Yu, Yan and Spil (2015) determined several factors hindering patients' acceptance of this innovation. They found that insufficient communication, lack of added value, patient preference incompatibility and patient characteristics (such as low internet literacy and lack of access to computers) contributed to a low adoption rate (from 1,5% at 3 months to 4% at 29 months after implementation). Zhang et al. (2015) recommend that healthcare providers address these issues before introducing more complex electronic healthcare programmes.

Conclusion

An innovation, by definition, creates value for some or all stakeholders (Varkey et al., 2008). This notion is important because perceived value is a deciding factor in accepting and using technological innovations (Morton and Wiedenbeck, 2009). Though HSP characteristics can facilitate or impede mHealth technology adoption, there are many other factors (e.g. external environment, patient acceptance and technological features) influencing the acceptance of mHealth.

2.3 Mobile Health Technology

Technological devices are becoming ubiquitous, less expensive, smaller and more wearable (Heinzelmann, Lugn, Kvedar, 2005) and advancements in hardware and telecommunications infrastructure will assist the growth of mobile technology in healthcare (Standing & Standing, 2008).

Mobile health, in literature referred to as mHealth, is a rapidly growing field which provides opportunities for disease prevention, enhancing diagnoses, educating patients, increasing access to healthcare, reducing healthcare costs, improving treatment and the advancement of evidence-based treatment (Doswell, Braxter, Dabbs, Nilsen & Klem, 2013).

Mobile technology refers to a technological device which can easily be transported and used at differing locations to access or update information (Standing et al., 2008). In the healthcare sector, it can be used for administrative or clinical purposes and used groups including doctors, nurses, administrators and patients (Standing et al., 2008). A more specific description is given by Kumar, Nilsen, Abernethy, Atienza, … and Swendeman (2013) who use "wireless devices and sensors (including mobile phones) that are intended to be worn, carried, or accessed by the person during normal daily activities" as a definition of mobile technology. mHealth technology in this paper is defined as a mobile technological device or software application used for the purpose of improving health and healthcare service provision.

Practical applications of mHealth technology, are for example monitoring and providing feedback on weight loss (Burke, Styn, Sereika, Conroy, … & Ewing, 2012), delivering behavioural healthcare for mental health (Luxton, McCann, Bush, Mishkind & Reger, 2011) and diabetes management (Sieverdes, Treiber & Jenkins, 2013). Himes and Weitzman (2016) describe mHealth's utility for asthma and COPD (Chronic Obstructive Pulmonary Disease) patients. Inhalers can be equipped with sensors, measuring medication usage and environmental variables (air quality, pollen etc.), allowing for increasingly detailed patient profiles (Himes et al., 2016). Krebs and Duncan (2015) found that nearly 36% of smartphone or tablet owners used mHealth apps. However, users mostly tracked physical activity, food intake and weight-loss. Less than 10% of mHealth app-users made appointments or stayed in contact with a healthcare professional using their smartphone.

In 2012, the estimated number of health-related apps for mobile devices worldwide at over 40.000 (Boulos, Brewer, Karimkhani, Buller & Dellavalle, 2014). This includes apps intended for medical professionals as well as for consumers. These apps have a wide range of purposes. Apps for HSPs are most often intended to act as a knowledge base, for study purposes or for use with specialised equipment (Boulos et al., 2014). Apps for consumers are more diverse, some help manage a particular disease (such as diabetes mellitus) while others aid in smoking cessation. By far the most apps are aimed at weight loss or exercise (Boulos et al., 2014). Apps can provide goal specific information (e.g. diet, exercise, disease self-management), disease assessments and let users track their diet and exercise. Apps intended to change health behavior (e.g. smoking cessation or quitting alcohol) can provide motivation and aim to prevent relapses.

Boulos et al. (2014) describe concerns by multiple authors regarding the accuracy and reliability of health-related apps. Many apps lack the involvement of a medical professional, undermining the apps' trustworthiness. An indication of how apps can be dangerous for consumers is given by Ferrero, Morrel and Burkhart (2013) who tested an app that aims to identify skin cancer by analysing user-made images. Using clinical images of

melanomas Ferrero et al. (2013) discovered the app recognised only 10,8% of the images correctly as high-risk melanomas.

Several countries are working on legislation and certifications for health-related apps. The Federal Drug Administration (FDA) has drawn up guidelines for apps working in conjunction with FDA approved equipment in 2011 (US FDA, 2011). According to Boulos et al. (2014), in Europe the only app certified to be compliant with European legislature is ONCOassist, an app providing oncologists with prognostic tools and calculations. The British National Health Service (NHS) tries to deal with the issue of reliability by creating its own 'app store' in which every health-related app is vetted (Read, 2012).

The limitations for mHealth technology lie with the possible lack of advanced technical skills of individuals (e.g. elderly) leading to reduced patient engagement (Martin, 2012). This lack of technical skills may lead to patients being unable or unwilling to use mHealth technology. It can also be difficult to realise the full potential of mHealth technology in vulnerable populations. Especially in rural and underserved communities, fewer people have a smartphone they could use as an mHealth device (Martin, 2012)

Conclusion

The exact definition of mHealth technology varies throughout the literature. Some definitions cover all devices that are designed to be mobile and can be used in a health-promoting way (Doswell et al., 2013), others describe only specialised medical equipment while some also include software in the definition (Krebs & Duncan, 2015). This paper uses a broad definition that covers all devices and software used to promote health.

mHealth technology has a wide array of applications, which, together with the sheer number of software apps, makes it difficult to regulate. As of yet, most health-related app users track their own activities, while only few use apps to stay in contact with their HSP (Krebs & Duncan, 2015).

3 Discussion and conclusion

3.1 Discussion

This review set out to establish how entrepreneurship influences the acceptance of innovations in general and mHealth in particular. In order to do this, the concepts of entrepreneurial traits, acceptance of innovation and mHealth technologies were described.

The literature does not agree on the definition of traits (Brandstätter, 2011) and offers multiple points of view regarding entrepreneurial traits (e.g. Caliendo et al., 2011; George et al., 2016; Leutner et al., 2013). The Five Factor Model (FFM) claims entrepreneurs score high on extraversion and openness to experience but lower than average on agreeableness (Caliendo et al., 2011). George et al. (2016) describe opportunity recognition as a crucial entrepreneurial trait and determined the six factors influencing this: systematic search, alertness, social capital, prior knowledge, personality and environmental conditions. Marques et al. (2013) categorised 11 entrepreneurial traits belonging to Healthcare Service Providers (HSPs) into cognitive, psychological and motivational traits.

The studies by Caliendo et al. (2011), George et al. (2016) and Marques et al. (2013) have some striking similarities and may supplement each other for a more complete entrepreneurial profile. Extraversion as described by the FFM can help an entrepreneur create social capital, which according to George et al. (2016) will aid in finding and exploiting opportunities. Part of extraversion is also having a high self-esteem, which Marques et al. (2013) found to be related to entrepreneurship. While Caliendo et al. (2011) did not find a significant relationship between conscientiousness and entrepreneurship, the systematic search factor George et al. (2016) found could be used to substitute this FFM-concept. Conscientiousness is understood as being diligent and goal oriented, which is applicable to a systematic search. Marques et al. (2013) also finds a component of conscientiousness that related to entrepreneurship: effective problem-solving rigor. Both Marques et al. (2013) and George et al. (2016) find that alertness is an important entrepreneurial trait, strengthening the evidence.

A lot of models exist that try to explain acceptance of innovation (Sitorus, 2015). What is made clear in these models is that there are many factors influencing acceptance, such as environmental conditions, user characteristics and the technology itself (e.g. Davis, 1989; Venkatesh et al., 2003). What Morton and Wiedenbeck (2009) and Page (2014) have confirmed is that HSPs have similar ideas about accepting innovations as other users, allowing the careful use of general technology adoption strategies and models in the healthcare context.

Technology should (appear to) be easy to use, be useful and must have a positive impact on the patient or HSP, only then will the innovation be widely accepted (Rogers, 2003; Page, 2014). Since HSPs fear that their social environment will confuse mHealth use with private smartphone use (Gagnon et al., 2016), knowledge about mHealth technology should be spread among patients and HSPs' co-workers.

mHealth technology can be used in various situations and provides several benefits to both patients and HSPs (e.g. Doswell et al., 2013; Himes et al., 2016). While there is already an impressive amount of health-related technology, it is not officially regulated well (Boulos et al., 2014). Notably smartphone apps should be used with caution by consumers because they can be unreliable and inaccurate (Ferrero et al., 2013). HSPs should critically

appraise mHealth before they adopt it to ensure patients get correct information and quality care.

3.2 Conclusion

Combining the concepts of entrepreneurship, acceptance of innovation and mHealth technology, it becomes clear that there is evidence of entrepreneurial traits being positively related to the acceptance of technology (Gagnon et al., 2016). Authors such as Morton and Wiedenbeck (2009) and Page (2014) found that HSPs with their own business display a similar set of traits as other entrepreneurs. This opens up the possibility to use theories and models that are related to entrepreneurship in general in the context of the healthcare system. This may lead to increased rates of mHealth technology adoption.

Because of the potential that mHealth technology has for improving healthcare access, quality and affordability (Doswell et al. 2013) it is appropriate to encourage its adoption among HSPs. mHealth technology lets HSPs monitor patients more closely and time-efficiently leading to an improved quality of care (Sieverdes et al., 2013; Himes et al., 2016). However, before a particular mHealth technology is adopted on a large scale, it should pass a rigorous quality control. This effort should be made by regulatory bodies such as the Federal Drug Administration and the National Health Services in order to create a methodical approach.

While mHealth technology adoption is dependent on more than just user characteristics, it is important to encourage HSPs' entrepreneurial traits to maximise mHealth adoption rates. The other factors influencing technology adoption are related to the technology itself and the social environment (Gagnon et al., 2016). Some entrepreneurial traits are fixed (e.g. the five factors described by Tupes and Christal in 1961) while others are modifiable (such as prior knowledge, self-esteem and locus of control). Developing the modifiable traits during HSPs' education or during their career through training could have a positive impact on mHealth technology adoption.

Important to consider is the fact that mHealth technology, other than most technologies, has to cater to two kinds of users. For example, an mHealth device monitoring a patient's vitals has to be non-intrusive for the patient, but provide accurate and on-demand data to a physician. Developers of mHealth technology and software need to consider these two groups of users in the design process or risk rejection by either group.

3.3 Limitations and future research

Limitations of this literature review are that it is not performed systematically. As a consequence, not all theories and models are discussed in this review. mHealth technology is a relatively young field for research and not many authors have linked entrepreneurship and mHealth technology adoption.

Further research should be done on how to foster HSPs' entrepreneurial traits. A lot of research surrounding entrepreneurship and education already exists. This can be used as a stepping stone for research focussed on HSPs. Once the influence of traits becomes abundantly clear, this information should be integrated into a larger model that also accounts for environmental and technological conditions.

Literature

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