ANDREAS ALEXIOU

Management of Emerging Technologies and the Learning Organization

Lessons from the Cloud and Serious Games Technology

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Management of Emerging Technologies and the Learning Organization:

Lessons from the Cloud and Serious Games Technology

Management van Opkomende Technologieën en de lerende organisatie:

Lessen uit de Cloud en Serious Games Technologie

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Andreas Alexiou,
born in Larisa, Greece.

Erasmus University Rotterdam

Doctoral Committee

Promotors:	Prof.dr. S. J. Magala
	Prof.dr. M.C. Schippers
	Prof.dr. I. Oshri
Other members:	Prof.dr. L.C.P.M. Meijs
	Prof.dr. E. van Heck
	Prof.dr. D. Assimakopoulos

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Andreas Alexiou
Amsterdam, July 2016

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Chapter 1

General Introduction

1.1 Motivation and contribution

The thesis you are holding aims to shed light on different aspects of the phenomenon of emerging technologies and their implications for modern organizations. Emerging technologies are leading-edge innovations that are often considered as harbingers of change for firms operating within the affected industries. The management of emerging technologies is a multifaceted challenge that includes the management of the innovation process, the implementation of the new technologies and the management of change as it accrues from the adoption of the new technology by the organization and its environment. As a result, emerging technologies are often found at the epicenter of scholarly attention and the organization and management studies literatures have already made important contributions towards our understanding of these technological innovations and their impact on the firms' competitive positions.

The introduction of a new technology in a complex organization oftentimes disrupts existing organizational routines and relationships, resulting in an implementation process that relies less on the features of the technology itself but rather on the complex interaction between the technology and the adopting organization (Edmondson, 2003). The importance of non-technical factors in enhancing the adaptability of firms in events of discontinuous change, like the introduction of an emerging technology, has been amply stressed by

organizational scholars (see Lewin, Massini, & Peeters, 2011; Teece, 2015; Volberda, Foss, & Lyles, 2010). Learning capabilities in particular have been identified as a factor that not only enhances the ability of organizations to successfully forecast new technological trends (Cohen & Levinthal, 1994) but also contribute towards the successful adoption (Woiceshyn, 2000) and implementation of emerging technologies (Edmondson, 2003).

This thesis takes learning as a starting point to investigate its associations with successful emerging technology adoption as well as the act of adaptation to discontinuous change as captured by the phenomenon of organizational resilience. The first part of the thesis explores the micro-foundations of absorptive capacity as a driver for successful technology adoption as well as the behavioral, strategic and operational antecedents of organizational resilience. The second part explores the potential of a promising emerging technology, i.e. Serious Games, to enhance learning and training in an organizational setting. Serious Games have evolved vastly over traditional business simulations and other early game-based learning applications. They arguably provide with excellent opportunities for learning and training, however, the challenges embedded in the design and adoption of such solutions are immense. Following an integrative approach, the last two chapters of this thesis will highlight the interplay between design elements and human emotion and cognition and outline the potential advantages of game-based learning applications for organizations.

In the sections that follow I introduce the two parts of the thesis and the interrelated chapters that comprise them. Part I takes a macro-level view on the role of learning in supporting successful technological adoption and management of exogenous change while part II takes a micro-level view in exploring the potential of Serious Games technology in supporting learning and personal development in the context of work organizations. All

chapters included in this thesis offer vital new insights in the areas of emerging technologies management, dynamic capabilities and educational technology, which will be outlined in the parts that follow. I will conclude this chapter by presenting the research aim and outline of the following four chapters in this thesis.

1.2 Part I: Learning as the basis for emerging technology identification, adoption and management of disruptive change.

Through the eyes of Schumpeter, the capitalist economy is a system that is constantly under change which is discontinuous, and is characterized by qualitative revolutions that destroy existing equilibria and create new ones. These episodes of *creative destruction* are the result of the innovation process which "incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (Schumpeter, 1950, p. 83).

Given that technological progress many times constitutes the spearhead of such industry-wide revolutions, emerging technologies tend to be perceived as harbingers of change. Emerging technologies, such as nanotechnology, virtual worlds, 5G cellular communications and others can be defined as "science-based innovations that have the potential to create a new industry or transform an existing one" (Day & Schoemaker, 2000, p.2). While the introduction of such technologies has important implications for both incumbent and new entrant firms, it is incumbent firms that tend to have more difficulties adapting (Edmondson, Winslow, Bohmer, & Pisano, 2003). Existing literature has highlighted the phenomenon of declining performance of incumbent firms when a radical technological innovation is introduced (e.g. Christensen, 1997; Cooper & Schendel, 1976; Henderson & Clark, 1990; Sull, Tedlow, & Rosenbloom, 1997; Tripsas & Gavetti, 2000;

Tushman & Anderson, 1986). This is primarily due to factors such as forces of inertia within incumbent firms, embeddedness of the incumbent in an industrial network that underestimates the value of the emerging technology, as well as the differential economic incentives that new entrants and established firms face (Hill & Rothaermel, 2003).

The first part of the thesis focuses in two main challenges firms face when confronted with the introduction of emerging technologies: the problem of identification and the problem of adaptation and change. The problem of identification is at its core a learning-centric problem. Firms need to make informed strategic decisions based on whether they consider a new technology to form the basis for a radical technological innovation. For the lack of "precognition", they are forced to invest in accumulating basic know-how related to emerging technologies (Hill & Rothaermel, 2003) coupled with investments in applied research and product development (Buderi, 2000) in order to enhance their ability to timely identify and capitalize on emerging technologies. A learning capability that stands out in the literature when it comes to successfully forecasting and adopting emerging technologies is that of a*bsorptive capacity,* defined as the ability of a firm to recognize, assimilate, and apply valuable external information towards meaningful ends (Cohen & Levinthal, 1994; Cohen & Levinthal, 1990; Edmondson, 2003). Absorptive capacity enables firms to reinforce, complement and refocus their knowledge base (Lane, Koka, & Pathak, 2006) in an effort to successfully forecast technological trends and, most importantly, offers organizations the strategic flexibility to adapt and evolve in highly volatile environments (Zahra & George, 2002). While the study of absorptive capacity in relation to radical technological change is not a novel idea, we are still lacking a thorough understanding of the role of structural characteristics of firms in developing absorptive capacity (Volberda et al., 2010).

Additionally, we are missing the psychological underpinnings of absorptive capacity, embedded in the organizational members' feelings and relationships. As in the case of individual level learning, cognition and emotions in organizations play a crucial role in the learning process as they can provide the motivational underpinnings for a sustained learning effort (Leroy & Ramanantsoa, 1997; Scherer & Tran, 2003). Chapter 2 adopts a Positive Organizational Behavior lens and investigates the mediating role of productive organizational energy (POE) in the positive relationship of organizational structure and absorptive capacity. POE captures the "shared experience and demonstration of positive affect, cognitive arousal, and agentic behavior among unit members" (Cole, Bruch, & Vogel, 2012: p.447) and offers a fresh insight in the micro-foundations of absorptive capacity. Moreover, it presents evidence on the positive role of absorptive capacity in the successful implementation of new technologies.

The problem of adaptation and change is rooted in the need of organizations to develop the required capabilities in order to manage the inevitable change that an emerging technology will stimulate both for a firm's internal processes and relations as well as for the architecture of the wider industry. Such radical change is often greeted with rigidities and inertia on behalf of incumbent firms due to established highly structured routines that organizations employ during stability periods (Nelson & Winter, 1982; Simon, 1955), simplified routines around their core functions or competencies (Miller, 1993) as well as due to common reflexive responses towards threat, such as restriction in information processing, restriction of control and conservation of resources (Staw, Sandelands, & Dutton, 1981).

Existing literature on mindfulness (Weick, Sutcliffe, & Obstfeld, 1999), organizational attention (Ocasio, 1997), sense-making (Weick, 1988, 1993) and crisis management

(Starbuck, 2009) highlight a wide array of factors that strengthen an organization's ability to cope with disruptive change. Such factors include, social resources (Powley, 2009), vulnerability reduction (Haimes, 1998), leadership (Harland, Harrison, Jones, & Reiter-Palmon, 2005; Luthans & Avolio, 2003), dynamic structures (Volberda, 1996) and organizational learning (Hendry, 1996; Ill & Orr, 1998). Learning in particular is strongly related to *resilience*, the capacity of organizations to adapt to disruptive events (Kayes, 2015). Organizational resilience can be defined as a meta-capability that incorporates those capabilities required for an organization to recover and capitalize on environmental change (Alexiou, 2015). Such a capability is expected to relate to the capacity of firms to manage radical technological change, therefore it is deemed necessary to explore not only the components of organizational resilience but also the micro and macro-level factors that shape it. Unfortunately, despite the recent popularity and relevance of the concept, scholarly literature remains fragmented and the construct inadequately theorized (Sutcliffe & Vogus, 2003). To an extent, this is due to the multidimensionality of the construct and its meta-nature. The second chapter of the first part of the thesis answers the call for the reconciliation of disperse extant literatures on the nature of organizational resilience, and the investigation of its antecedents and outcomes. I conceptualize resilience as *the capacity of an organization to a) be mindfully aware of its environment, b) absorb the negative impact of disruption and c) positively adjust and capitalize on adversity*. Moreover, I argue that the resilience capability gets enacted in three distinct phases (incubation phase, impact phase, enhanced equilibrium phase) where every time a different set of organizational capabilities gets activated.

1.3 Part II: The role of emerging technologies in facilitating learning and knowledge exchange in organizations.

The ability of an organization to learn is considered fundamental for sustaining a competitive advantage (De Geus, 1988; Stata, 1989). While organizational learning represents both an organizational process and outcome (Dodgson, 1993), it has a strong social component (Herbert, 1991) and it is rooted in the learning of the organizational members (Argote & Miron-Spektor, 2011; Kim, 1993). It is therefore particularly interesting to investigate emerging technologies that engage individuals in learning activities and interpersonal interaction (Kohler, Matzler, & Füller, 2009), encouraging learning in an organizational setting.

Unfortunately, our understanding of the role of information and communication technology in supporting learning in organizations remains limited (Argote & Miron-Spektor, 2011; Edmondson, Bohmer, & Pisano, 2001) and that holds especially true for emerging technologies such as Serious Games and Virtual Worlds. Such technologies emerged from the digital games industry and due to their association with the act of play are oftentimes underestimated in their ability to act as valuable organizational tools. This misconception, however, is gradually disintegrating and we can currently identify a multitude of applications of gaming technology in areas as diverse as medicine (Arvanitis, 2006; Rosser et al., 2007), operation of city systems (Gann, Dodgson, & Bhardwaj, 2011) or military (Squire, 2006). March (1976, 1999, 2006) has in fact discussed the virtues of such playful technologies for modern organizations, stressing their complementarity to the efficiency-oriented "technologies of rationality", their ability to stimulate the exploration of "[…] alternative ideas of possible purposes and alternative concepts" (March, 1976 p.77),

as well as their ability to counteract constrains in organizational learning and change (Dodgson, Gann, & Phillips, 2013).

Departing from March's idea that the reconciliation of technologies of "foolishness" and "rationality" can facilitate organizational learning, the chapters in this second part of the thesis zoom into one such technology, Serious Games, and through an integrative approach, they build on theories of game design, learning, motivation and personality in order to investigate the potential of the technology to act as a vehicle for learning and training in an organizational setting.

Our understanding of the design elements that define the effectiveness of these applications is still at a nascent stage, and so is our understanding of the interplay between design elements, user characteristics and desired outcomes. In the case of Serious Games such outcomes involve primarily technology acceptance and user learning. Technology acceptance is an important predictor of technology effectiveness (Mathieson, 1991) and is therefore interrelated to any desired learning outcomes. Both the technology acceptance model (TAM) and the theory of planned behavior (TPB) suggest that the effectiveness of a newly introduced information system in an organization doesn't depend solely on its technological merits but also on the decisions of people to use them (Nickerson, 1981). According to the TAM and the TPB the factors that influence the acceptance of technology are the perceived ease of use and usefulness of the technology, subjective norms (shaped by normative beliefs and motivation to comply) and the perceived behavioral control (shaped by control beliefs and perceived facilitation) (Ajzen & Madden, 1986; Ajzen, 1985; Davis, 1989). These factors, as with any novel technological system, need to also be considered when designing and introducing Serious Games in an organizational setting.

Serious Games, however, possess a secondary quality, typically absent from most information systems that organizations deploy to support their operations: *playfulness*. In order to serve their purpose of facilitating learning through creativity, imaginative involvement, exploration and play, serious games need to be designed around core values of traditional game design that focus on user engagement and enjoyment (Alexiou, Schippers, & Oshri, 2012). Such requirements include a focus on narrative, aesthetics and mechanics that streamline the gameplay experience, balance the level of challenge and evoke the deep engagement of the user.

Finally, it is worth noting that despite the wide appeal of gaming technology, digital games are not a panacea for user engagement and motivation as is evident from their less than universal acceptance. That could be due to individual characteristics of users, such as their need for escapism, imaginative involvement or creativity, as well as due to how they perceive conflict, competition and challenge, elements that are usually core to traditional game design. For this reason, it is required to expand our investigation of effective Serious Games design towards incorporating the role of individual differences in technology acceptance and learning effectiveness. All the above highlight the need for an integrative approach to researching the role of such technologies in supporting learning in organizations. The chapters that comprise part II of the thesis contribute both conceptually as well as empirically to our limited existing knowledge of the intricacies of Serious Games design and their applications.

1.4 Research Aim

The overall aim of the thesis is to investigate the relationship between learning and the management of emerging technologies. In this setting, the dissertation is concerned not only

with the role of organizational learning in successfully adopting emerging technologies but also with the potential of "playful" emerging technologies to facilitate learning in an organizational setting. Provided that learning is rooted in individual level experiences and effort and embedded in the organization as a whole, the thesis adopts both a macro and micro level view when investigating the implications of learning for emerging technologies adoption and vice versa.

The main thesis aims can be summarized as follows:

1. Increase our understanding of the role of organizational learning and its psychological and behavioral underpinnings as enablers of emerging technology adoption and adaptation to change.
2. Identify and investigate the role of technological and non-technological factors in shaping the learning effectiveness of Serious Games via enhanced user engagement and motivation.

As such the thesis seeks to make a number of contributions. First, it contributes to the literature of emerging technologies management by verifying the important role of absorptive capacity as an antecedent of successful emerging technology adoption. Second, it contributes to the limited volume of work that explores the relationship between organizational structure and absorptive capacity (Volberda et al., 2010). Third, it answers the call for further integration of the study of psychological phenomena like human emotions into strategy research (Huy, 2012) by identifying the mediating role of the emergent phenomenon of POE between organizational structure and absorptive capacity. Forth, it contributes to our limited understanding of the construct of organizational resilience by conceptualizing it as a meta-capability that gets enacted over three distinct phases. At the

same time, it offers a new working definition for the construct and identifies its core underpinnings. Fifth, it explores the potential of "playful" virtual technologies in facilitating learning/training in organizations and provides with an integrative framework that maps out the role of important technical and user-related factors in facilitating learning. Finally, it empirically validates the positive role of hedonic game elements like narrative and aesthetics in sustaining user engagement and enhancing the learning experience. The role of these elements, crucial for sustaining the "playful" nature of these applications, has been unfortunately neglected by previous research.

1.5 Outline of the dissertation

Chapter 2 of this thesis enhances our understanding of the relationship between absorptive capacity and the successful adoption of emerging technologies, by looking not only at their direct relationship but also at the factors that shape and enable it. This study was conducted among firms challenged by the emerging technology of Cloud computing and investigated the role of structural characteristics (i.e. centralization of decision making and formalization) in enhancing the absorptive capacity of the incumbent firms by influencing the emotional and cognitive states and perceptions of their organizational members. The construct of productive organizational energy was used as a proxy to capture the "shared experience and demonstration of positive affect, cognitive arousal, and agentic behavior among unit members" (Cole, Bruch, & Vogel, 2012: p.447). The study revealed the negative indirect effect of centralization and the positive indirect effect of formalization on absorptive capacity via organizational energy that acts as a mediator for the aforementioned relationships. Moreover, the strong relationship between absorptive capacity and technology adoption was also verified.

Chapter 3 further explores the disruptive effect of emerging technologies for incumbent firms and investigates the role of organizational resilience in enhancing the capability of firms to react and capitalize on disruptive change. Chapter 3 departs from the traditional definition of organizational resilience as the capacity to bounce back from adversity by conceptualizing it as a meta-capability that allows an organization to not only bounce back but also capitalize on adversity. This valuable meta-capability derives from a group of distinct capabilities that get enacted during the three major phases of an organization's response to radical change, namely, *incubation phase*, *impact phase* and, lastly, *enhanced equilibrium phase*. Overall, this chapter contributes to the growing literature of organizational resilience by providing with a fresh definition of the construct, highlighting its relevance to the emerging technologies management literature, outlining the disruption cycle and the different organizational capabilities that get enacted in each phase, and enhancing our understanding of the human-related, operational and strategic underpinnings of the antecedents of organizational resilience.

Chapter 4 provides a novel integrative conceptualization of the role of game elements and user characteristics in supporting positive learning outcomes in the context of Serious Games. It poses that 3 groups of game elements, namely, narrative, aesthetics and game mechanics, are responsible for the motivation and engagement of users. Since the learning outcomes of such experiences are heavily dependent on the motivation of users, balancing the design choices so that the learning experience remains playful while pedagogical, requires a very deep understanding of the effect of the game elements discussed earlier on user perceptions and feelings. Finally, this chapter takes a step further to argue that much of the perceived experience in such playful learning environments is not solely dependent on

their technological or design merits but also on the dispositions of the players. For example, people that display a higher need for cognition or sensation seeking behavior, would react differently to a novel, intense, complex and cognitively demanding game environment compared to those that display lower levels of these traits. The paper discusses the different opportunities and challenges that spring from the blending of gaming technology and learning both from a constructivist learning approach, as well as a practical standpoint and provides with 11 proposition that will guide future research on the topic.

Drawing on the conceptual work of Chapter 4, Chapter 5 empirically investigates the nature of the relationship between narrative, aesthetics, player engagement and perceived learning by analyzing survey data from 133 users that participated in a carefully designed gaming session. This study successfully contributes to the limited existing empirical evidence linking specific game elements to user engagement. In particular, it empirically validates the important role of narrative in facilitating user engagement, reinforcing the view that digital games can provide with a fulfilling narrativist experience that complements the ludic experience of gameplay. Similarly, audiovisual elements in the game, further enhance user engagement justifying the continuous growth in investment of the gaming industry in increasing the fidelity and realism of their game engines. Lastly, this study explores whether certain effects in the model tend to be stronger for experienced gamers compared to non-gamers. Contrary to expectations, previous gaming experience doesn't moderate the perceptions of players regarding the perceived learning achieved in the gaming session. The above, constitutes encouraging evidence in that the learning effectiveness of such applications is not heavily dependent on the predisposition of users towards digital game technology.

1.6 Declaration of contribution

In this section, I declare my contribution to the different chapters of this dissertation and also acknowledge the contribution of other parties where relevant.

Chapter 1: This chapter is the product of the personal work of the author. General feedback by the supervisors has been considered during its development as with the rest of the chapters of this thesis.

Chapter 2: The majority of the work in this chapter has been done independently by the author of this dissertation. Dr. Saeed Khanagha assisted the author with the data collection and promotor prof.dr. Schippers provided with useful feedback throughout the development of this paper. The formulation of the research questions, the literature review, data analysis, interpretation of results and writing of this paper is the work of the author. This paper is under review at leading management journal. The author of this dissertation is the first author of the paper and Dr. Khanagha and prof.dr. Schippers the two co-authors.

Chapter 3: The majority of the work in this chapter has been done independently by the author of this dissertation. The author developed the theoretical framework, did the literature review and wrote this conceptual paper. Feedback on earlier stages of this paper were provided by promotors prof.dr. Oshri and prof.dr. Schippers. The paper has been published as a single author chapter in *Managing Emerging Technologies for Socio-Economic Impact*. Assimakopoulos, D., Oshri, I., Pandza, K. (Eds.), Edward Elgar, Cheltenham, UK.

Chapter 4: The majority of the work in this chapter has been done independently by the author of this dissertation. The author developed the theoretical framework, did the literature review, developed the propositions and wrote this conceptual paper. Promotors prof.dr.

Oshri and prof.dr. Schippers provided feedback on different stages of the paper. This paper is under review at an information systems journal. The author of this dissertation is the first author and the two promotors, prof.dr. Oshri and prof.dr. Schippers are co-authors.

Chapter 5: The majority of the work in this chapter has been done independently by the author of this dissertation. The author collaborated with Anthony Doerga, MSc. in the collection of the data. The formulation of the research questions, the literature review, data analysis, interpretation of results and writing of this paper is the work of the author. Promotors prof.dr. Oshri and prof.dr. Schippers provided feedback on different stages of the paper. This paper is currently under review at an information systems journal. The author of this dissertation is the first author with the two promotors, prof.dr. Oshri and prof.dr Schippers, and Anthony Doerga, being co-authors.

Part I

Chapter 2

Productive Organizational Energy Mediates the Impact of Organizational Structure on Absorptive Capacity.

Abstract

The ability of an organization to cope with radical technological change is regarded to be heavily dependent on its ability to absorb and apply knowledge from its environment. This study investigates the role of organizational structure in driving absorptive capacity and uncovers the role of the emergent phenomenon of organizational energy as the enabler of this relationship. A field study was conducted among firms that are challenged by the disruptive nature of Cloud computing. Our results show that structural conditions influence the degree of mobilization of an organization's affective, cognitive and behavioral resources, which in turn influence the effectiveness of learning processes related to the absorption and exchange of knowledge within the organization. Furthermore, they reveal the positive relationship between the enactment of absorptive capacity and the successful adoption of Cloud technology for incumbent firms. The findings contribute to our understanding of the microfoundations of absorptive capacity and how positive organizational phenomena facilitate effective adoption and implementation of emerging technologies.

2.1 Introduction

Rapid technological change constitutes a powerful competitive force that bears significant strategic implications for organizations (Adner, 2002; Day, Schoemaker, & Gunther, 2004; Hamilton, 1985). Schumpeter (1934) described such technological change as a force of "creative destruction" which can erode or reinforce the competitive advantage of all firms involved in the affected industries. Predicting and managing the implications of such change has been found to be related to the ability of organizations to absorb and utilize knowledge from their environment, i.e. their absorptive capacity (Grant, 1996; Lane et al., 2006; Zander & Kogut, 1995).

Recent empirical research has shed light on the antecedents of absorptive capacity by constructively synthesizing theories of learning, managerial cognition, the knowledge-based view of the firm and dynamic capabilities (for a review see Volberda, Foss, & Lyles, 2010). Consequently, extant studies have revealed a breadth of contributing factors, traced at different levels of analysis, such as managerial, inter-organizational, intra-organizational or environmental. At the intra-organizational level, organizational structure has been identified as a key factor that has a major influence on absorptive capacity (Van den Bosch, Volberda, & Boer, 1999). By organizational structure, we refer to the "formal allocation of work roles and the administrative mechanisms to control and integrate work activities including those who cross formal organizational boundaries" (Child, 1972: p.2). Unfortunately, despite the theoretical weight put on organizational structure in relation to supporting absorptive capacity, empirical evidence remains limited (Volberda et al., 2010) and agreement on the nature of the relationship between structural attributes and organizational capabilities is

lacking (Jansen, Van den Bosch, & Volberda, 2006; Zmud, 1982). Moreover, empirical research is yet to enquire the underlying mechanisms that drive this relationship.

By adopting a positive organizational scholarship (POS) lens (Cameron & Caza, 2004; Cameron, Dutton, & Quinn, 2003; Luthans & Youssef, 2007; Luthans & Church, 2002), the current study aims to reveal some important factors that facilitate the relationship between key aspects of organizational structure (i.e. degree of centralization and formalization,) and absorptive capacity. Prior research has shown the positive relationship between positive emotions, motivation, engagement and learning in an organizational context (e.g. Chadwick & Raver, 2012; Fineman, 1997; Osterloh & Frey, 2000; Scherer & Tran, 2003). Building on these insights, we propose the construct of productive organizational energy (POE) as a mediator between organizational structure on the one hand and absorptive capacity on the other. POE captures the "shared experience and demonstration of positive affect, cognitive arousal, and agentic behavior among unit members" (Cole, Bruch, & Vogel, 2012: p.447). We argue that POE is malleable and is influenced by organizational factors such as degrees of autonomy and participation in the decision-making process. As a result, the emergent phenomenon of productive energy enhances the learning capability of the organization by stimulating learning behaviors, knowledge exchange and proactivity.

Two organizational structures that have been shown to influence organizational behaviors that relate to learning, innovation and knowledge management are centralization and formalization (Hirst, Van Knippenberg, Chen, & Sacramento, 2011; Jarvenpaa & Staples, 2000; Lubit, 2001; Zmud, 1982). Absorptive capacity, a form of organizational learning related to the generation of new knowledge internally (Cohen & Levinthal, 1989; Lewin, Massini, & Peeters, 2011) as well as the absorption of knowledge generated

externally (Lane & Lubatkin, 1998; Zahra & George, 2002), would be expected to be influenced by the same structural factors. In this paper, we theorize and empirically test productive organizational energy (POE) as an important link between structure and absorptive capacity. POE, is a construct grounded in the realm of positive organizational behavior (Luthans & Youssef, 2007) and has been associated with knowledge creation and exchange (Cross, Linder, & Parker, 2007). Energized individuals have a significant impact on what units and networks as a whole learn over time, while energizing relationships were found to be a consistent determinant of knowledge exchange (Cross, Baker, & Parker, 2003). In fact, the energy network is an important predictor of information-seeking relationships, as people are more likely to seek out information and learn from individuals that are considered highly and positively energized (Cross, Linder, & Parker, 2007). In this sense, POE is a very useful construct that helps us ground the development of organizational capabilities on micro-psychological phenomena that manifest collectively through mechanisms of social interaction following a broaden-and-build paradigm (Fredrickson, 2003).

In the current paper we propose a research model that explores the relationships between two key variables underlying organizational structure –centralization and formalization- and the multidimensional construct of absorptive capacity, which includes the three processes of recognition, assimilation, and application of captured knowledge (Cohen & Levinthal, 1990; Lane et al., 2006). Specifically, we propose that POE will mediate the relationship between organizational structure and absorptive capacity. Finally, we examine whether absorptive capacity has a beneficial role in the successful implementation of a new technology.

The study makes several important contributions to the literature. By combining the literature on absorptive capacity with insights from organizational behavior and particularly the construct of organizational energy, we add to existing knowledge on the effects of structural characteristics of firms on learning capabilities and particularly knowledge absorption and application. At the same time, this study is one of the first to empirically investigate the role of the emergent phenomenon of POE as an enabler of dynamic capabilities, such as absorptive capacity. Moreover, contrary to the majority of studies investigating absorptive capacity in the context of large organizations, we focus on small and medium-sized firms that depend heavily on external sources for new knowledge acquisition but typically lack formal R&D departments due to limited internal resources. While the survival of such firms is also dependent on their ability to recognize and utilize external knowledge, relevant literature has remained relatively limited in this area (Zahra, Sapienza, & Davidsson, 2006). Additionally, the nature of organizational energy as an emergent collective phenomenon rooted in interpersonal employee interactions renders it difficult to be monitored and measured in a way that takes into consideration the divisional and multilayered organizational structure of large firms. To this regard, smaller organizations provide a more fertile ground to measure the collective energetic activation of organizational members.

2.2 Theoretical Background and Hypotheses

2.2.1 Introducing the main research variables: Organizational Structure, Productive Organizational Energy and Absorptive Capacity.

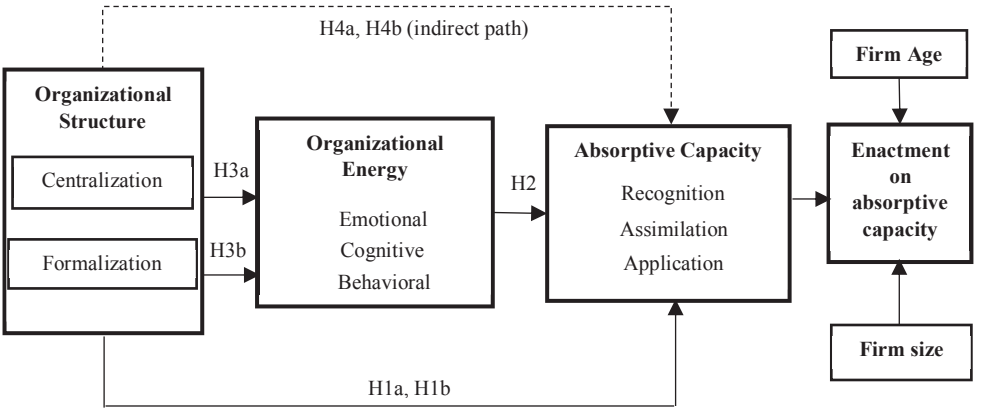
Our theoretical model is built around the premise that key characteristics of the work environment influence the level of energetic activation of unit members, i.e. their level of

positive affect, constructive thinking regarding work-related problems and investment of physical resources to benefit the organization (Cole et al., 2012). In particular, we focus on the degree to which individuals participate in the decision making process and the degree of job standardization. We posit that via mechanisms such as emotional and cognitive contagion (Barsade, 2002; Gibson, 2001) and behavioral integration (Bandura, 2001), the collective manifestation of productive energy can enable desirable organizational capabilities such as absorptive capacity. In other words, productive organizational energy mediates the influence of organizational structure on absorptive capacity. Absorptive capacity in its turn is a key capability for successfully adopting emerging technologies. Following the above, the theoretical model developed and tested in this study involves 4 sets of factors: (1) the organizational structure (as captured via the constructs of centralization and formalization), (2) POE (encompassing the affective, cognitive and behavioral activation of work members), (3) absorptive capacity (comprised of the three processes of recognition, assimilation and application of knowledge), and (4) the enactment of absorptive capacity as an important organizational outcome (Figure 2.1).

Successful companies possess the capacity to deal effectively with evolutionary changes in their markets, what is often referred to as *sustainable innovation* (Christensen, 1997). The main challenge for most firms however, is coping with *disruptive innovation*, which has the potential to reshape a market or industry. The extent to which firms can defend against or capitalize on radical change is heavily dependent on whether they have in place the required capabilities to do so (Christensen & Overdorf, 2000). Especially in contexts of radical technological change, absorptive capacity has been found to be of particular importance to the survival of firms (Lichtenthaler, 2009), as it allows them to reinforce, complement and

refocus their knowledge base (Lane et al., 2006), enabling them to forecast technological trends and take advantage of emerging opportunities ahead of their rivals (Cohen & Levinthal, 1994).

Figure 2.1
Theoretical Model



In the rich literature on absorptive capacity a multitude of inter- and intra-organizational variables are discussed that can act as antecedents and enablers of absorptive capacity (Jansen, Bosch, & Volberda, 2005; Volberda et al., 2010). In this study we are concerned with the intra-organizational domain, where organizational structure has been identified as an important, yet under-researched antecedent, particularly when considering the psychological and behavioral underpinnings of this relationship. Since our objective is neither to delineate all the relationships underlying organizational structure and absorptive capacity nor to identify new ones we focus on two major structural characteristics of firms that are considered central in the literature: centralization and formalization.

We thus argue that the standardization of jobs and centralization of decision making has psychological and behavioral implications for work members (Berger & Cummings, 1979;

Kohn & Schooler, 1973; Oldham & Hackman, 1981; Porter & Lawler, 1965). Such conditions can have a potentially beneficial or detrimental effect on the motivation of individuals as well as on the quality of interpersonal social interaction (i.e. communication, coordination and trust) which is vital for supporting learning and knowledge management behaviors within the organization (Bartol & Srivastava, 2002; Hoegl, Parboteeah, & Munson, 2003; Janz, Colquitt, & Noe, 1997; Nahapiet & Ghoshal, 1998).

Productive organizational energy, represents an invisible but powerful force that can be observed mainly by its effect (Bruch & Ghoshal, 2003). It represents an emergent construct that manifests at the organizational level through the mechanisms of social interaction (Klein, Dansereau, & Hall, 1994; Morgeson & Hofmann, 1999) and affective contagion (Hatfield, Cacioppo, & Rapson, 1994; Park, Spitzmuller, & DeShon, 2013). Drawing on the original conceptualization by Bruch & Ghoshal (2003) we treat POE as a second order construct that captures the interplay between the organization's cognitive, emotional and physical states. As such, it helps us evaluate the psychological and behavioral impact of organizational structure on work members.

Building on the original definition provided by Cohen and Levinthal (1990), we define absorptive capacity as the ability of a firm to recognize the value of new knowledge, assimilate it and apply it. We consider these processes as inherent to the cycle of knowledge absorption. Therefore, we treat absorptive capacity as a second order construct and expect its dimensions to be highly correlated. Moreover following the example of Schleimer and Pedersen (2013), we distinguish between a firm's ability to absorb knowledge and the enactment on this ability. In our case, the enactment on absorptive capacity refers to whether

a firm managed to utilize the newly acquired knowledge in order to successfully adopt the Cloud computing technology in their processes.

2.2.2 Hypotheses

The role of organizational structure in supporting absorptive capacity. The knowledge based view of the firm and the theory of dynamic capabilities suggest that organizational structure plays a catalytic role in the capacity of firms to create and absorb knowledge from their environment as it influences the structure of communication, cross-function interfaces, the transfer of knowledge among and within units and the development of networks of internal and external relationships (Van den Bosch, Volberda, & de Boer, 1999). An organization's structure is in essence responsible for how multiple knowledge-related tasks such as assimilating, integrating and utilizing knowledge, are effectively carried out (Loasby, 1976).

Centralization reflects the locus of authority and the extent to which decision-making is dispersed in an organization (Damanpour, 1991). A less centralized structure can reduce knowledge disparities between managers and subordinates (Adler & Borys, 1996), and inspire employee motivation, loyalty, and creativity (Manz & Sims, 1995; Parker, Bindl, & Strauss, 2010). Allowing individuals the freedom to combine thought and action and group members to interact and create new perspectives, enhances the ability of organizations to generate as well as retrieve and apply existing knowledge (Nonaka, 1988; Nonaka, Toyama, & Konno, 2000). At the same time, a decentralized structure typically results in broader communication channels, improving therefore the accurate and timely flow of information as well as the quality and quantity of ideas and knowledge that may be shared (Sheremata, 2000). Including a greater number of individuals in the process of decision-making and

strategic reflection, can consequently enable the organization to harvest on a wider variety of ideas, enhancing knowledge creation and utilization.

We expect that the degree of centralization would influence absorptive capacity at all steps of the process. In particular, a decentralized structure can enhance the ability of the organization to tap into and synthesize new sources of knowledge, for instance, by accessing improved environmental information from employees who know that this would be valued by their employers (Baum & Wally, 2003). Similarly, it can enhance the flow of existing information and knowledge within the organization, facilitating the application of this knowledge towards beneficial outcomes (Pertusa-Ortega, Zaragoza-Sáez, & Claver-Cortés, 2010; Tsai & Ghoshal, 1998). We therefore propose:

H1a. There is a negative relationship between centralization and the firm's absorptive capacity.

Formalization refers to the degree to which working relationships are prescribed by formal rules, procedures and policies (Fredrickson, 1986). Formalization has been previously theorized to have both a negative and a positive relationship to absorptive capacity. Traditionally, formalization has been argued to have a negative impact on learning in organizations (Goh & Richards, 1997; March & Simon, 1958; Weick, 1979), however there is evidence that formalization can also facilitate knowledge creation and utilization (Organ & Greene, 1981; Podsakoff, Williams, & Todor, 1986; Sine, Mitsuhashi, & Kirsch, 2006). The perception of formalization as the antithesis of flexibility has deep roots in social theory and writings on bureaucracy (Feldman & Pentland, 2003). In this sense, formalization is perceived as a tool for organizing expertise and exercising control that inevitably kills tacit knowledge (Lam, 2000) and creates a closed environment that reduces creative input

and reciprocal knowledge interaction, limiting therefore the capacity for acquiring and assimilating external knowledge (Jansen, Bosch, & Volberda, 2005; Vega-Jurado, Gutiérrez-Gracia, & Fernández-de-Lucio, 2008).

However, much like routines, formalization can also have a dynamic aspect. Unlike coercive formalization mechanisms that can inhibit creativity, innovation and information exchange, enabling standardization and formalization facilitates the opposite (Fiedler & Welpe, 2010). More specifically, it can facilitate the codifying of best practices and enhance the inter-functional transfer of explicit and codified knowledge, reduce ambiguity, and improve cooperation and collaboration among organizational staff as a whole (Pertusa-Ortega et al., 2010). At the same time, formalization can ease access to existing information, improve coordination, provide with efficient communication paths as well as better causal understanding of sets of tasks within units (Adler & Borys, 1996; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). Given the above, we expect the positive contributions of formalization to be more pronounced in environments characterized by uncertainty, complexity and interdependence (Juillerat, 2010). Considering the context of this study where organizations are called to sail in uncharted waters, we argue that there would be a net positive effect of formalization on absorptive capacity. We advance the second hypothesis:

H1b. There is a positive relationship between formalization and the firm's absorptive capacity.

The role of productive organizational energy in the development of absorptive capacity. Etzioni (1968) expressed energy as a form of a psychic and social resource. Under this view, human beings are members of a social system and can be activated through reflected-upon

experiences in order to commit themselves to a transcendental mission of bringing about societal change (De, 1979). Ingalls (1976), in a similar vein, defines energy as "the level of psychic and physical force that we have available to bring to bear on accomplishing any task or on developing any relationship we choose". Ingalls's theory was that any deviation from a behavior that is based on effective interpersonal relations and tolerance of ambiguity, results in a non-optimal energy solution. In other words, when an individual faces a lack of task objectivity and certainty in his or her work, the resulted conflict, interpersonal misunderstanding, generation of mistrust or organizational power struggle, requires energy expenditure in order to rebalance the system.

More recently, organizational psychology, has contributed significantly towards linking human energy to important organizational outcomes through an array of theories with implicit or explicit energetic implications, such as the theories of employee burnout, engagement, emotional dissonance, thriving, and human flourishing (for a review see Quinn, Spreitzer, & Fu Lam, 2012; Schippers & Hogenes, 2011). At the same time, the collective phenomenon of organizational energy has recently attracted scholarly interest and was found to have a substantial and predictable effect on organizational performance (Bruch & Ghoshal, 2003, 2004) and innovation through learning (Cross et al., 2007). Organizational learning, in particular, has been implicitly linked to the energetic activation of work members (e.g Cross et al., 2003) due to its rooting in the affective and cognitive domain. Unfortunately, there has been very limited research on explicitly revealing the nature of this relationship.

The link between energy and learning becomes clearer when we consider the combined role of emotions, cognition and behavior in the process of learning (More, 1974; Shipton &

Sillince, 2012). Emotions influence important phases of learning such as readiness to learn, search for and processing of new information and disposition to reproduce information and knowledge (Scherer & Tran, 2003). Negative emotions such as anxiety, inadequacy or dependency can hinder learning while the opposite holds true for hope, excitement or curiosity (Antonacopoulou & Gabriel, 2006). Similarly, the activation of intellectual processes such as the acquisition, distribution and interpretation of information is at the base of both individual and organizational learning (Huber, 1991). Finally, the directive and stimulating properties of motivation generate arousal and instigative behaviors characterized by persistence and purpose (Brophy, 1983; Dweck, 1986). It is obvious from the above that energized individuals characterized by positive emotions, cognitive engagement and agentic behavior share qualities that are conducive to learning.

In a similar fashion we would expect organizational energy to be related to absorptive capacity. Productive energy performs the same theoretical function across different levels of analysis with the difference being that it emerges at higher levels of analysis via mutual dependence and interindividual interaction instead of psychological or biological processes (Cole et al., 2012). A firm's absorptive capacity on the other hand, is more than the sum of the absorptive capacities of its employees. Besides the process of acquisition and assimilation of information that occurs at the individual level, it also demands the organization's ability to exploit it (Cohen & Levinthal, 1990). This step involves the transfer of knowledge across and within sub-units and is heavily dependent on the structure of communication as well as the character and distribution of expertise in the organization (Cohen & Levinthal, 1990). Energized individuals have been found to act as hubs for information exchange due to their open, committed and positive stance (Cross et al., 2003).

As a result, we can expect improved internal communication, stronger informal networks and relational contracts, and an enhanced culture of trust, all of which contribute towards the absorptive capacity of the organization (Argote, Mcevily, & Reagans, 2003; Swift & Hwang, 2013; Volberda et al., 2010). In line with the arguments above, it follows that:

H2. There is a positive relationship between productive organizational energy and the firm's absorptive capacity.

According to Bruch and Ghoshal's research (2003), organizations differ significantly in both the intensity and quality of their energy. More specifically, they differ in "the level of activity, the amount of interaction, the extent of alertness and the extent of emotional excitement" (p.46). We can trace some of this variance on contextual factors like organizational structure and climate (Cross et al., 2007; Fritz, Lam, & Spreitzer, 2011; Quinn, Spreitzer, & Fu Lam, 2012). For example, organizational culture and management style (i.e. lack of participation and effective consultation, poor communication, politics, a major restructuring, ambiguous work environments and individual cultural incongruence) are related to negative emotional states and stress, directly influencing the energy levels of individuals (Cooper & Cartwright, 1994; Danna & Griffin, 1999). On the other hand, higher autonomy, delegation of authority and involvement in the decision making process have been linked with higher levels of performance (Liden, Wayne, & Sparrowe, 2000; Spreitzer, 1997), organizational commitment (Avolio, Zhu, Koh, & Bhatia, 2004; Spector, 1986) and informal learning (Kukenberger, Mathieu, & Ruddy, 2012). Moreover, such empowerment satisfies the need of individuals to enhance their self-esteem and self-worth as well as retain and increase their sense of self-consistency and self-expression, concepts that begin to enrich traditional motivational theories (Shamir, 1991) and are expected to have a positive

influence on the energy levels of individuals. Furthermore, especially in highly volatile environments, formalization can act as a protective factor against ambiguity that is typically accompanied by negative emotions (Meyerson, 1990), high stress levels (Cooper & Cartwright, 1994; Glowinkowski & Cooper, 1986), work alienation (Michaels & Cron, 1988) and energy depletion (Maslach & Jackson, 1981). We thus propose:

H3a. There is a negative relationship between centralization and a firm's productive organizational energy.

H3b. There is a positive relationship between formalization and a firm's productive organizational energy.

Positive collective energy enables organizations to accelerate and enhance the sharing of information and knowledge among work members but also between the organization and its environment. On one hand, decentralization promotes employee involvement, facilitates the required openness that encourages debate, reflection and questioning of existing practices, empowers employees, satisfies their need for autonomy, and sparks their creativity. In turn, the above conditions positively energize individuals in multiple levels. People characterized as energizers by their colleagues have a striking impact on the learning capacity of individuals and networks since they operate as hubs of knowledge – they are more likely to be sought after as sources of knowledge and it is easier to access knowledge themselves- (Cross et al., 2003). On the other hand, formalization introduces a degree of clarity and efficiency that streamlines the exchange of information, and minimizes the energy expenditure associated with ambiguity, role conflict, interpersonal misunderstandings, or mistrust. Thus, we hypothesize:

H4a. Productive organizational energy mediates the relationship between centralization and absorptive capacity.

H4b. Productive organizational energy mediates the relationship between formalization and absorptive capacity.

While not included in our original hypotheses, our model includes a path from absorptive capacity of firms to the enactment of this ability as captured by the degree of success in implementing a new technology in their operations. The reason behind this extra step is that even though a firm might have in place the mechanisms that allows it to recognize the value, assimilate, and apply the captured knowledge, it doesn't necessarily mean that they will be enacted and contribute towards a successful implementation process. While this relationship does not have a central role in our conceptual framework, we deem that it is useful to explore.

Method

2.2.3 Setting & Data Collection

The hypotheses were tested in a sample of 111 firms in five industries (Automotive, Telecommunications, Hospital & Healthcare, Insurance and Banking, and Retail) that, according to industry analysts, are most heavily affected by disruptive consequences of Cloud computing. We defined our sample carefully in order to ensure a high level of validity and reliability from the data. First, we chose to focus on small and medium sized companies since for large organizations several of our key independent and mediator variables would tend to be heterogeneous. For example, the level of centralization in a large organization can differ between units due to, for instance, the leadership style of the middle manager

responsible for that unit. Second, we pursued the involvement of senior managers (CEO or member of the top management team) in the survey. This ensured a reliable evaluation of the absorptive capacity of the involved firms as well as of other variables in this study.

Our population was identified through collaboration with a major professional community of Cloud computing in the Netherlands and it involves the largest world-wide community of firms that were challenged by the disruptive effect of Cloud computing. The community numbers thousands of members, but our industry and size requirements results in a total of 1194 candidate organizations. Among this group, a total of 201 firms were open to participate in an external research project out of which 111 completed the survey after one reminder. The percentage of respondents who finished the survey in relation to all of the respondents who started the survey was 55.2 %. All companies were contacted by e-mail, and follow-up phone calls were done after one week to ensure a reasonable response rate. Participants included only members of the top-management teams or manager/directors who are directly responsible for the Cloud services.

In order to increase the reliability of our measurement, we asked the participants to introduce a second respondent. In response to our request, 65 respondents agreed to introduce a second respondent. We considered a time-lag of six-months with the original measurement, and contacted second respondents via email in order to answer the questions concerning absorptive capacity and successful adoption of the Cloud computing. After a reminder, 61 responses (54.9% of the population) were collected and this second measurement did not show any significant difference ($p > 0.05$) when compared with the original responses.

Prior to its distribution, the survey was pre-tested by several Cloud computing experts to ensure the validity and clarity of the questions. To encourage participation and provide some benefits to the respondents, an executive summary of the survey results was offered to all the participants. We compared the company attributes (number of employees, sales revenue, and years in business) for respondents and non-respondents and found no significant differences ($p > 0.05$).

2.2.4 Measures

Unless indicated otherwise, we used a five-point Likert scale ranging from 1 = "totally disagree" to 5 = "totally agree" for our measures. The Cronbach's alpha for all scales included in the analysis can be found in the diagonal of Table 2.2.

Absorptive Capacity. In order to measure absorptive capacity, we used a nine item adapted scale from Schleimer & Pedersen (2013). In their study they conceptualize absorptive capacity as having three dimensions: value recognition, assimilation, and application. Example items for the three dimensions include "We recognized the potential of Cloud technology to create value for the organization", "We understood how the components of the Cloud system fitted together to make it work in our market", "We were able to monitor the performance of Cloud solutions and corrected problems as they surfaced". These three dimensions form the ability of a firm to recognize, assimilate and apply knowledge successfully, something that the authors distinguish from the enactment of this ability.

Organizational Structure. Centralization in the context of our study reflects the concentration of authority and power in a firm (Baum & Wally, 2003) which would work

against higher employee autonomy and informal communication channels (Finlay, Martin, Roman, & Blum, 1995). Formalization, on the other hand reflects the "the extent to which rules, procedures, instructions, and communications are written" within an organization (Pugh, Hickson, Hinings, & Turner, 1968, p.75). In order to capture the degree of centralization of decision making and job standardization on the development of the absorptive capacity capability, we adopted the three item scales used in the study of Jansen, Van Den Bosch, & Volberda (2006). Example items include: "There can be little action taken in the organization until senior management approves a decision" and "Whatever situation arises, written procedures are available for dealing with it".

Productive Organizational Energy. POE was measured by using a ten item adapted version of Cole, Bruch and Vogel (2012) "productive energy at work" questionnaire. The three-dimensional construct captures the emergent phenomenon of energy at work. The affective dimension of the scale captures the positive feelings and emotional arousal that work members experience in their work environment. The cognitive dimension refers to the shared intellectual processes that result in persistent and constructive thinking when it comes to solving work related challenges. Finally, the behavioral dimension reflects the enactment of joined efforts by the work members to benefit the organization. Example items are: "people in the organization are mentally alert", "people in the organization often work extremely long hours without complaining" and "people in the organization feel enthusiastic in their job".

Enactment of absorptive capacity. Following the example of Schleimer & Pedersen (2013), we distinguish between possessing the ability to absorb knowledge from the environment and enacting this ability in order to successfully implement the cloud

computing project. We measured the degree of successful implementation of cloud computing by adapting the three item scale originally developed by Schleimer & Pedersen (2013) to measure the degree of success in implementing a marketing strategy in subsidiary firms of multinational corporations to the context of our study. Example items are: "We have integrated Cloud successfully into our organizational routines", "The process of implementing Cloud has been a success for our organization".

Control variables. We controlled for the size of the firm, as it may have an impact on the available resources and its flexibility on acquiring and assimilating external knowledge. In the same way, a unit's age could play a role in its ability to acquire and exploit knowledge (Jansen et al., 2005). Therefore, age was also controlled for and measured by the number of years since its founding.

2.3 Measurement Model

We deployed structural equation modeling as our analytical approach since the technique allows us to simultaneously link latent variables associated with concepts of theory to indicators used to present these concepts and at the same time estimate the relationships among these latent variables as proposed by the theory (Williams, Vandenberg, & Edwards, 2009). It is recommended that, when using SEM, the measurement model is assessed independently prior to the assessment of the structural model (Anderson & Gerbing, 1988; Hancock & Mueller, 2001). In relation to the measurement model, we evaluated the convergent validity (i.e. the degree of association between measures of a construct) and discriminant validity (i.e. the degree to which measures of constructs are distinct) of all constructs included in our analysis. To evaluate convergent validity, the Average Variance Extracted (AVE) of every construct was compared against its correlation with the other

constructs. Convergent validity was confirmed for all cases as their AVE scores were consistently lower than each construct's correlation with other constructs (Gefen, Straub, & Boudreau, 2000). Discriminant validity was also established since the Maximum Shared Variance (MSV) and the Average Shared Squared Variance (ASV) were both lower than the Average Variance Extracted (AVE) for all the constructs (Hair, Black, Babin, & Anderson, 2010). The results can be seen in Table 2.1.

Table 2.1
Convergent and Discriminant validities assessment

	AVE	MSV	ASV
Formalization	.66	.12	.04
Centralization	.51	.15	.07
Productive Organizational Energy	.80	.36	.19
Absorptive Capacity: Recognition	.57	.42	.24
Absorptive Capacity: Assimilation	.77	.71	.35
Absorptive Capacity: Application	.76	.54	.27
Enactment on Absorptive Capacity	.72	.71	.31

AVE: Average Variance Extracted, MSV: Maximum Shared Variance, ASV: Average Shared Variance

2.4 Results

Structural Model

The next step in the analytical process was to form the structural model by specifying the causal relationships as suggested by the hypotheses. Table 2.2 presents the descriptive statistics and correlations amongst all variables. The control variables (firm age, firm size) are also included in this table. As expected the correlations among the three dimensions of energy (affective, cognitive, behavioral) and the among the three dimensions of absorptive capacity (recognition, assimilation, and application) are high. The structural model including the variables centralization, formalization, POE, absorptive capacity, implementation

success, firm age and firm size fit well to the data (CMIN/DF = 1.43, CFI = .98, PCLOSE = .28 and RMSEA = .06).

Hypotheses 1a and 1b that link the two organizational structure variables to absorptive capacity were supported. Centralization was found to have a negative and significant direct effect on absorptive capacity (β = -.25, p <. 05), while the effect of formalization was significant and positive (β = .35, p < .005). Hypothesis 2 proposes that POE has a positive effect on absorptive capacity. Consistently with our prediction, POE was found to have a strong positive effect on absorptive capacity (β = .51, p < .001). Hypotheses 3a and 3b predicted that there is a positive relationship between organizational structure and POE. Our results support both hypotheses 3a and 3b since centralization has a strong negative effect (β = -.39, p < .005) on POE while formalization has a strong positive effect (β = .38, p < .005). Finally, as expected, absorptive capacity proved an important predictor of implementation success (β = .89, p < .001). Figure 2.2 depicts the results of the SEM.

Hypotheses 5a and 5b, predict that POE mediates the relationship between the two organizational structure variables and absorptive capacity. We tested the proposed model with the use of bootstrapping. Using AMOS 22 we resampled 1000 times and obtained the estimates and the confident intervals for the indirect effects. Analysis resulted in a significant, negative, indirect effect of centralization on absorptive capacity (β = -.20, 95% CL: -.44 ~ -.02, p < .01) through POE. Similarly, formalization was found to have a positive, significant indirect effect on absorptive capacity (β = .19, 95% CL: .03 ~ 0.42, p < .01) when POE is included in the model. As a result, both hypotheses were accepted.

Table 2.2

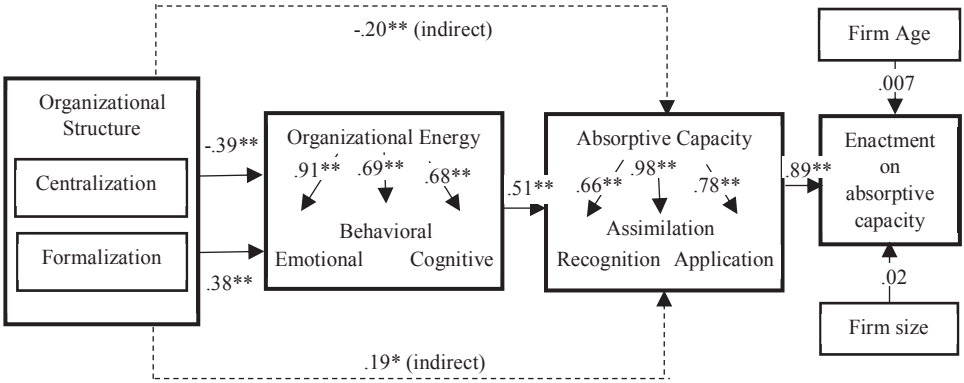
Descriptive Statistics of Variables.

(The diagonal incorporates the Cronbach's alpha for the scales.)

			Correlations										
	M	*SD*	1	2	3	4	5	6	7	8	9	10	11
1. AC_Recognition	2.87	0.67	**.78**										
2. AC_Assimilation	3.45	0.71	.65**	**.90**									
3. AC_Application	3.60	0.79	.70**	.77**	**.85**								
4. POE_Cognitive	3.44	0.85	.36**	.40**	.31**	**.77**							
5. POE_Emotional	2.81	0.86	.33**	.50**	.29**	.62**	**.96**						
6. POE_Behavioral	1.74	0.48	.33**	.44**	.36**	.88**	.63**	**.84**					
7. Centralization	2.55	0.66	-.17	-.09	.06	-.14	-.22*	-.10	**.76**				
8. Formalization	2.89	0.90	.06	.26**	.14	.08	.21*	.09	.44**	**.85**			
9. Enactment	3.67	0.79	.60**	.87**	.73**	.34**	.42**	.39**	-.12	.15	**.87**		
10. Firm Age	13.0	20.94	.09	.02	.07	.11	.05	.02	.10	.16	.04	-	
11. Firm Size	1.85	0.83	.07	.03	.10	.09	.04	.06	.12	.27**	.06	.42*	-

* $p < 0.05$ level.
** $p < 0.01$ level.

Figure 2.2[a, b]
SEM Results



[a] *p < .05, **p < .01, ***p < .001
[b] *Fit indices*: x^2 = 51.6 (36), CMIN/DF = 1.43, CFI = .98, PCLOSE = .28 RMSEA = .06

2.5 Discussion

The construct of absorptive capacity has received extensive attention from strategy scholars during the past two decades, following the establishment of knowledge as a key resource for developing and sustaining competitive advantage through innovation (Geroski, Machin, & Van Reenen, 1993; Grant, 1996; Hall, 2000; McEvily & Chakravarthy, 2002). Still to this day, however, absorptive capacity remains an elusive construct when it comes to various dimensions of its nature (Volberda et al., 2010), as well as to factors that enable and shape it (Lane et al., 2006; Matusik & Heeley, 2005; Zahra & George, 2002). Our study contributes to our understanding of this organizational phenomenon by illuminating the enablers and mediators of this relationship, notably organizational structure and POE.

Theoretical Contributions

First, our study contributes to the limited volume of work that explores the role of organizational structure on absorptive capacity (Volberda et al., 2010). While some previous studies provided mixed results regarding the role of centralization and formalization in facilitating absorptive capacity, our study revealed some noteworthy effects of the two variables. Formalization, contrary to many studies that have previously suggested a detrimental effect on learning related organizational processes, was found to have a positive relationship with absorptive capacity. This interesting result, highlights the beneficial effects of formalization in contexts that are defined by ambiguity and uncertainty as the one that was the focus of this study. Centralization, on the other hand, consistent with previous studies was found to have a negative relationship to absorptive capacity which highlights the variable effect of decision making structures on the learning processes involved (Fiol & Lyles, 1985).

Second, this study introduces a unique lens in exploring the affective, cognitive and behavioral dynamics that emerge within a firm as a result of oftentimes endogenous characteristics. Such dynamics, influence not only the individual capacity of work members to learn but most importantly enable a more effective flow of information and knowledge exchange at an organizational level by reinforcing relational ties and stimulating creative or innovative behaviors. Simultaneously, our findings suggest that the latent construct of productive organizational energy mediates the impact of the structural characteristics of firms on absorptive capacity, emphasizing further the anthropocentric foundations of dynamic capabilities, such as absorptive capacity. Psychological phenomena like human emotions are rarely integrated into strategy research (Huy, 2012), however they are

invaluable if we are to explain the psychological or social mechanisms underlying the mental processes that affect organizational outcomes (Powell, Lovallo, & Fox, 2011). Such phenomena act as enablers of many organizational capabilities linking them to internal or external conditions.

Third, our study contributes to the emerging field of positive organizational scholarship. Grounded in the field of positive psychology, POS provides macro-level scholars with a conceptual framework for organizing and integrating their research on elevating organizational processes and outcomes and the factors that shape them in the organizational context in which they take place (Cameron & Caza, 2004; Luthans & Youssef, 2007). As Pfeffer (2016) stresses in a recent essay, there is a need to reinstate in organizational studies employee well-being and happiness as important outcomes and gradually reduce our fixation on performance and profit as our dependent variables. This study takes this idea one step further to explore how positive employee states are not only important in their own right but are also tied to desirable organizational outcomes. The role of POE as a facilitator of absorptive capacity provides us with encouraging evidence towards this direction.

Fourth, while most studies on absorptive capacity so far have focused primarily on large R&D intensive companies (Spithoven, Clarysse, & Knockaert, 2010), our study was conducted among small and medium firms which oftentimes lack formal R&D departments and due to limited internal resources (Gupta, Smith, & Shalley, 2006) tend to depend heavily on external sources for new knowledge acquisition. While absorptive capacity and dynamic capabilities in general are critical for the survival of new ventures and SMEs, there is a surprisingly limited volume of existing work done in this context (Zahra et al., 2006). This study contributes to this limited existing body of literature by highlighting the implications

of absorptive capacity for the success of small and medium firms to integrate and reap the benefits of emerging technologies.

Managerial Implications.

The introduction and management of disruptive technologies is a challenging process, characterized by high uncertainty and complexity (Bucher, Birkenmeier, Brodbeck, & Escher, 2003; Day & Schoemaker, 2000a). Supporting existing claims (Brown, Chervany, & Reinicke, 2007; Gomez & Vargas, 2009) our findings suggest that absorptive capacity influences the successful integration of a new technology in the firm, provided that the three processes of absorptive capacity are realized i.e. recognizing the technology's value, perceiving the relatedness of the technology to the internal body of knowledge and processes in the firm, and adapting the technology to the needs of the firm. It is also important for managers to consider that having the capacity to explore and exploit technology related knowledge from their environment doesn't necessarily mean that the consequent implementation of the technology will be successful. Assessing separately the existence of the capability and the enactment of the capability allows managers to better understand possible causes of successes or failures of technology integration.

Additionally, this study provides managers with new insights on how to use organizational mechanisms to successfully facilitate knowledge processes. Expanding decision making rights while reducing ambiguity through a layer of formal rules and procedures frees important cognitive and emotional resources and strengthens the relational ties among organization members, further contributing towards a climate conductive of synergy, knowledge exchange, and trust. This in turn enhances the absorptive capacity of the firm since it reinforces the processes of learning and knowledge management that are

inherent to its core. Balancing the effects of decentralization and formalization might prove challenging, especially when taking into consideration that different cultures might perceive such conditions differently (Kirca & Hult, 2009). However, detecting changes in the energetic activation of work members could be a viable way to monitor the effect of policy or process changes on work members.

Limitations and Directions for Future Research

The current research is not without limitations. First, the conceptualization of absorptive capacity as a second order factor, doesn't allow us to explore the relationship between the different processes of absorptive capacity and how they influence organizational outcomes. For example, if recognition, assimilation and application form a learning "cycle", we could expect that earlier steps directly predict later and indirectly predict the desired organizational outcomes.

Second, we focused on small and medium firms operating within industries that were challenged by the technology of Cloud computing. While absorptive capacity is arguably a critical capability for firms operating under such conditions, it might be reasonable to expect variations in the manifestation of absorptive capacity across industries, an effect that our model does not capture. Moreover, cultural and leadership dimensions across firms are expected to play a significant role in shaping organizational energy, and consequently absorptive capacity. Similarly, we focused on two out of the four main structural characteristics of firms oftentimes encountered in the literature. Existing studies have identified integration and complexity as fundamental elements in control and coordination with important implications for organizational outcomes (Lee & Grover, 1999; Liao, Chuang, & To, 2011).

Future research can further explore the complex relationship of formalization and organizational learning and uncover the conditions under which it can be beneficially implemented. Environments that allow for higher autonomy in self-regulation might be more conducive of an enabling perception of formalization, and further support the rudiments of absorptive capacity (Juillerat, 2010). The self-determination theory for example (Deci & Ryan, 1985; Ryan & Deci, 2000) can be a useful framework for exploring the interdependence between intrinsic motivation and perceptions of formalization in the context of organizational learning (Juillerat, 2010). Furthermore, future studies can look into the mechanisms that enable the emergence of productive organizational energy, explore its volatility overtime and discover strategies for nurturing it. Social network theory can help mapping out the energy network in terms of information and knowledge flows as well as the contagious nature of emotions and ideas. Additionally, longitudinal studies can uncover how different conditions, incidents and managerial decisions shape it overtime. Finally, future research could look at the role of organizational work load in relation to organizational energy (Schippers & Hogenes, 2011; cf. Schippers, West, & Dawson, 2015).

2.6 Conclusion

In conclusion, our study offers a number of novel empirical findings regarding the drivers and enablers of absorptive capacity in the context of managing emerging technologies. It also provides a new angle to explore organizational phenomena that relate to dynamic capabilities by bringing forward the role of emergent psychological phenomena grounded in the cognitive and emotional evaluations of organizational members. Specifically, we find that the degree of centralization and formalization shapes the energetic activation of unit members which is a solid predictor of the ability of an organization to

absorb and exploit information from its environment. The revealed mediating role of productive organizational energy opens up a window for the exploration of positive organizational phenomena as facilitators of dynamic capabilities. It is our hope that this study's findings will stimulate further exploration of the linkages between positive individual and organizational phenomena and key strategic outcomes for organizations.

Chapter 3

Taming the Waves of Adversity: Exploring the Multidimensional Construct of Organizational Resilience.

Abstract

Ever increasingly so, organizations find themselves facing episodes of disruptive and unexpected change. In order to survive and thrive in such highly dynamic environments they need to develop the capacity for capitalizing on adversity by turning challenge into opportunity. Such a capacity is explored through the construct of organizational resilience. This paper conceptualizes organizational resilience as a meta-capability resulting from a group of distinct capabilities enacted during the three major phases of the organization's response to disruption, and synthesizes a working definition of organizational resilience. In addition, I explore the construct's dimensions and outcomes as well as the human-related, operational and strategic underpinnings of its antecedents.

3.1 Introduction

Life is bound to transition and transformation. Day becomes night, death becomes birth, the caterpillar becomes the butterfly. However, alongside linear, gradual, and typically predicted change, organizations -ever increasingly so- find themselves facing episodes of disruptive change, usually originating from sources that managers "don't know that they don't know". Rapid economic, technological, social and political changes weave a web of

effects that generate epistemological –imperfection of knowledge- and ontological –natural variation- uncertainty (Walker et al., 2003) which guarantees that "accidents" and big failures will occur probably more frequently than managers would like to admit (Starbuck, 2009). However, it is not possible for organizations to plan for every disaster that could conceivably affect them (Mitroff & Alpaslan, 2003). What is of the essence in such cases is that organizations have developed the capability to react and overcome adversity by the means of buffering the damage, creatively adapting and, and ultimately, capitalizing on the new reality once it manifests. Such a capacity is reflected in the construct of organizational resilience.

Organization theory has examined the maladaptive or pathological cycles of behavior in response to adversity both at an individual as well as collective level (Staw et al., 1981) and argued on how radical unanticipated change leads to response rigidities by restricting information processing – e.g. by narrowing the field of attention- and constricting control – e.g. centralization of authority, increased formalization. However, while there exist cases of organizations that have successfully dealt with exogenous shocks (e.g. a shooting and standoff in a business school, Powley, 2009) or survive ongoing strain in dynamic environments (e.g. the interesting case of criminal organizations, Ayling, 2009), there is limited theory on the mechanism that enables organizations to escape a deterministic fate and thrive upon adversity.

Despite the recent popularity of the concept of resilience among practitioners' discussions and literature, scholarly literature remains fragmented and the construct inadequately theorized (Sutcliffe & Vogus, 2003). I believe that the elusiveness of the concept to a great extend lies in its multidimensionality and meta-nature. Resilience is an

emergent capacity that lies at the intersection of active and passive capabilities of organizations, across organizational levels of analysis. As a second-order capability, or what Collis (1994) labels a meta-capability, resilience has to do not only with possessing particular resources or capabilities in order to cope with unexpected change but also have the ability to learn, generate and deploy them when needed.

In this paper I identify three phases in the circle of disruption: a) incubation phase, b) impact phase and c) enhanced equilibrium phase. Three corresponding sets of capabilities get enacted during these phases in order to secure a resilient response to adversity. These capabilities provide a roadmap for exploring the construct of resilience and are by no means exhaustive. They are the product of literature synthesis from fields as diverse as psychology, ecology and organization theory, and aim at highlighting how diverse and multidimensional is the phenomenon of resilience. To be more specific, the first phase represents the period of time when the threat has not yet materialized, however the mindful awareness of organization members and the attention capability of the management can allow for sensing early ripples and anomalies in the environment that could moderate the surprise factor and even allow for a timely response. During the second phase where the disruption is fully manifested, attention sets in the buffering of damage and preventing disintegration at different levels. Every threat has an immediate negative impact on individuals, such as psychological stress, anxiety and negative emotions. It also erodes group cohesiveness and cripples the formal structures and communication channels of the organization. At this stage, relational resources, transformational leadership and structural flexibility can minimize the impact of such effects. Finally, during the last phase, the organization needs to reach a new enhanced state of equilibrium, past the point of simple recovery. Capitalizing on adversity

is the quintessence of resilience and requires the ability to learn from crisis and innovate at a strategic level.

3.2 Resilience: A Conceptual Medley

The construct of resilience has a rich history in fields outside organization and management studies. Organizational resilience builds on and expands existing literature in the areas of ecology, sociology and psychology in order to bear on a simple but important challenge that modern organizations face. This part will attempt to flesh out the dimensions and properties of organizational resilience by synthesizing literature primarily of two major scientific fields that dominate the resilience discussion in relevance to organizations: psychology and ecology.

3.2.1 Ecological resilience

Traditional environmental science viewed the behavior of natural systems in terms of stability near an equilibrium state with the primary focus set on the system's resistance to disturbance and the speed of return to the single global equilibrium (a definition that springs from traditions of engineering). However Holling (1973), illustrated that even undisturbed natural systems could be in fact in a transient state and that the existence of multiple stability domains in those systems was actually possible. He illustrated how instabilities can force a system into another regime of behavior and define functionally different states, without however the movement between states to undermine the structure and diversity of the system. Ecological resilience is therefore defined as the magnitude of disturbance that a system can absorb before it redefines its structure and changes stable states (Gunderson, 2000). Holling redirected the emphasis away from maintaining efficiency of function,

towards maintaining existence of function and high variability had altogether become an attribute for existence, adaptability and learning (Folke, 2006).

The adaptive capacity of resilience was gradually brought forward and the dynamic adaptive interplay between sustainability and development with change became more explicit (Folke, 2006). Recent research in social-ecological systems incorporated the properties of adaptation, self-organization and learning alongside the ability to resist adversity. Along these terms, Carpenter et al. (2001) defined resilience as: a) the amount of disturbance a system can undergo and still remain within the same domain of attraction, b) the degree to which the system is capable of self-organization, and c) the degree to which the system can build the capacity to learn and adapt.

It is particularly interesting for our analysis the departure from a more mechanistic view of resilience that has at its epicenter the return to pre-disruption equilibrium to the idea that multiple different equilibrium states exist for a system and transformation through adaptation is a viable strategy for retaining existence of function. The role of learning in the process of adaptation and re-configuration is also particularly relevant to organizations.

3.2.2 Human resilience

Resilience in the field of developmental psychopathology made its first appearance by providing an important construct to examine why some at-risk children exposed to negative life events are in fact better able to succeed in their life (Masten et al., 1999). Within this literature resilience is defined as "a class of phenomena characterized by patterns of positive adaptation in the context of significant adversity or risk" (Masten & Reed, 2002: p.74). Positive adaptation accounts for the atypical process inherent to resilience that predicts

positive outcomes and growth (benefit) out of circumstances that typically lead to maladjustment (loss).

Early researchers considered resilience a trait; a unique and static characteristic of individuals. But soon empirical evidence demonstrated that factors external to the child (e.g. characteristics of their families and wider social environment) could also be contributing to resilience, resulting in the departure from phenomenological descriptions of resilient qualities of individuals, towards a dynamic process of resilience: a disruptive and re-integrative process of acquiring the desired resilient qualities (Richardson, 2002); fluctuating rather that fixed over time (Luthar, 2006); "dependent upon interactions between individuals and contextual variables" (Metzl, 2009: p.113).

A review of the literature reveals a set of antecedents that dominate the discussion on psychological resilience. These factors are typically related to a) how individuals make sense of the situation, b) creative competence, c) the role of values, and d) the role of social relationships. Sense-making in the case of resilience has to do primarily with finding meaning and purpose (e.g. Coutu, 2002; Fine, 1991; Luthar, 2006); creative competence reflects the skills of improvisation and ingenuity that allow for finding solutions and surviving with whatever means are available at the time; values play the role of an anchor or reference point that an individual holds on to in order to cope with the overwhelming effect of dramatic change; social relationships through compassion and solidarity create a net of support that helps people get back on their feet, make sense of the new reality and assist their psychological development.

The discussion on psychological resilience brings forward the element of positive adaptation instead of mere survival and the dynamic nature of resilience as a capability that

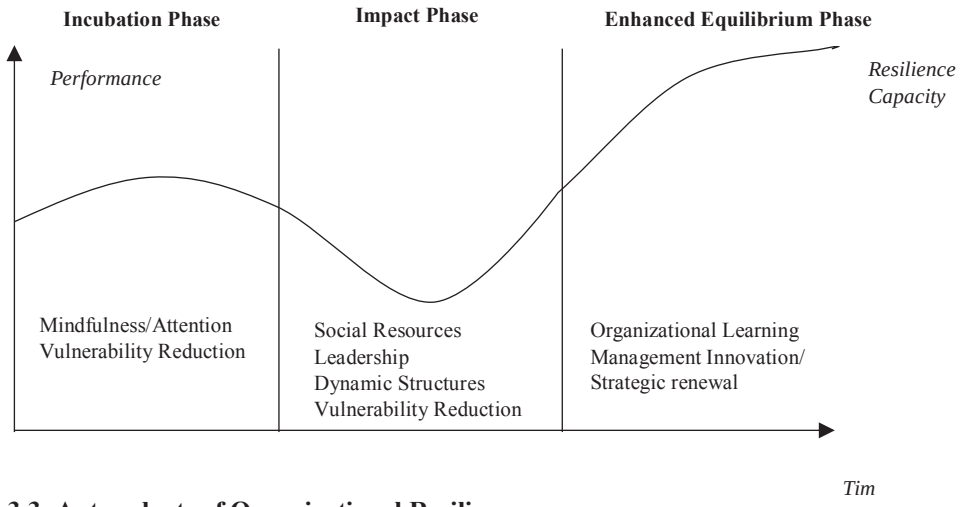
can be developed and enhanced over time by manipulating its internal variables through interaction with the environment. Organizations as human systems can benefit from some of the same protective factors that shield resilient individuals –e.g. creativity, social resources, and sense-making- and can learn to shape and enhance such qualities over time.

3.2.3 Organizational resilience

Resilience, recently introduced to organization studies, is often defined as a capacity to cope with unanticipated dangers and bounce-back (e.g. Wildavsky, 1988). Based on the previous discussion we consider the adoption of a wider definition of organizational resilience –one that includes the dynamic nature of resilience and the capacity to sense and capitalize on the opportunities that change offers in order to further develop. We define organizational resilience as *the dynamic capacity of an organization to a) be mindfully aware of its environment, b) absorb the negative impact of disruption and c) positively adjust and capitalize on adversity.* In the next part I will elaborate on some core antecedents of these three dimensions of resilience (see Figure 3.1).

The first dimension represents the relatively passive phase that takes place before the disruption materializes and includes the capabilities for sensing change and threats, and developing an integrative approach to risk management. The second dimension corresponds to the second phase of resilience activation that takes place once the disruption occurs and portrays the ability of an organization to buffer the initial damage and shock primarily through liquid/dynamic structures and by utilizing the strong interpersonal relationships among its members. The last phase portrays the ability of an organization to capitalize on adversity and grow. During this period, the organization needs to be able to learn from crisis, and allow for innovation at different levels (management, strategy, business processes).

Figure 3.1
The phases of the disruption cycle and the capabilities that invoke a resilient response.



3.3 Antecedents of Organizational Resilience

3.3.1 Incubation Phase

While it goes without saying that some rare, dramatic events (e.g. a terrorist attack) organizations are almost impossible to anticipate, when it comes to disruptions in the business cycle, for instance as a result of the dynamism of the environment (e.g. technological innovation), it is often the case that early signals do herald the upcoming events. Unfortunately, organizations often lack the ability to sense and interpret such signals and there are many reasons for that. One typical example is the case of technological disruption challenging some deeply held beliefs within a firm, resulting in an identity crisis (Tripsas, 1997).

Organizational awareness is a capability that assumes the role of a protective factor against unexpected change when active during times of equilibrium. Recent research highlights the critical role of managerial attention (e.g. Maula, Keil, & Zahra, 2013) and the

interrelation between processes of perception and cognition (Weick & Sutcliffe, 2006) in coping with exogenous disruption or unanticipated events. Empirical evidence has illustrated how top managers can shape a firm's strategy and handle disruptive events by "[…] interpreting changes in the external environment and formulating (or at least orchestrating the formulation of) appropriate and timely responses" (Maula et al., 2013: p.15). Attention can be better understood as a variety of interconnected processes with their roots lying deep in the cognitive dimension of human behavior. As such, it has been used in organization literature to describe different but interrelated mechanisms, processes, and outcomes that Ocasio (2010) effectively groups in three ideal types: a) attentional perspective: referring to the top-down cognitive structures that generate heightened awareness as response to specific stimuli and responses, b) attentional engagement: referring to the process of intentional, prolonged and concentrated allocation of cognitive resources into a selected set of environmental stimuli, and c) executive attention and vigilance: referring to the highly important to decision making abilities of being able to switch from and resume focus between different stimuli, and fixing the attention on one particular stimulus.

All three types of attention are highly interconnected and vital to decision making, strategic action, adaptation and change (Maula et al., 2013; Ocasio, 1997). Attentional engagement in particular can be considered an important indicator of resilience as it signifies the "quality" of organizational attention (Ocasio, 2010). It entails the mindful processing of information which reflects high attentiveness to context and the capacity to respond to unanticipated cues or signals (Levinthal & Rerup, 2006). Internal and external situation monitoring and reporting routines (Seville, 2008) that enhance the situational awareness of the organization, as well as IT infrastructure that enriches action repertoires and engages

actors in “more extensive search processes, increased collaboration, and more careful contemplation of issues and alternative courses of action” (Valorinta, 2009: p.991) are expected to further enhance the collective mindfulness of organizations.

Overall, mindfulness in the context of organizational resilience involves the passive element of awareness but also the active element of reflection, the combination of which enhances insight and the process of interpreting events constructively while experiencing a situation openly and holistically (Bishop et al., 2004; Brown & Ryan, 2003;Weick et al., 1999). Its role in developing a capacity for resilience is critical in the way that it a) fosters the capability of discovering and managing unexpected events (Weick et al., 1999) and b) enhances the capacity of learning from crisis (Levinthal & Rerup, 2006).

Embedded in the managerial efforts to sense and predict upcoming turbulence exists a strategic focus on vulnerability reduction through active assessment, monitoring and treatment of risk. Such risk management approaches can never wholly develop a capacity for resilience however the positive effect of proactive vulnerability reduction to the overall robustness of a system cannot be ignored. Vulnerability analysis includes a set of processes that are embedded in the operation of an organization and determine which areas and threats should be considered part of a catastrophic risk analysis by using frequency data or on the basis of expert judgments, scenarios and subjective probabilities (Haimes, 1998). One very important aspect of such an approach is the realization of the interconnectedness of risks and the continuous, proactive and systematic process of understanding, managing and communicating risk across organizational boundaries.

3.3.2 Impact Phase

When equilibrium gets punctuated by disruption, focus gets shifted towards overcoming the rigidities that arise and reversing the disintegrating effect that it conjures. A threat situation can have a detrimental effect on different levels like individual psychology, team cohesiveness and organizational processes (Staw et al., 1981). Social resources, leadership and structural flexibility represent the most important organizational reflexes during a period of impact.

One of the detrimental effects that adversity has on people is the activation of negative emotions like psychological stress and anxiety. Emotions are tightly interweaved with cognition and motivation (Lazarus, 1991), are a determinant of human behavior and relationships, and play an important role in the process of adaptation and change (Huy, 1999, 2002). Research in psychology has shown how negative emotions narrow individuals' scope of attention (Easterbrook, 1959) and thought-action repertoires (Fredrickson & Branigan, 2005), and call forth specific action tendencies (e.g. flight, resignation). Managing negative emotions and enabling principles like solidarity and compassion is extremely important for avoiding maladaptive adjustments to change (Avey, Wernsing, & Luthans, 2008; Dutton, Worline, Frost, & Lilius, 2006)

Initial empirical evidence shows that during a crisis, resilience is activated through the people's ability to alter social structure, extend compassion and act in ways that foster caring and supportive relationships, and enlarging information inputs by drawing on their social capital (e.g. Powley, 2009). Literature in developmental psychology, adult coping and posttraumatic growth (Tedeschi & Calhoun, 2004) have consistently illustrated that social

support and strong human relationships can contribute to the positive adjustment of individuals after exposure to adversity.

The role of leadership during this process, while largely overlooked (F. Luthans & Avolio, 2003), appears to be important (Harland, et al., 2005). Leaders can influence people and direct action by engaging in symbolic actions or creating powerful symbols that can influence people at a cognitive and emotional level (Dutton et al., 2006). At the same time they should have the ability to convert crisis into a developmental challenge (Bass, 1990), assist the meaning-making process of organization members as well as provide "intellectual stimulation to promote subordinates' thoughtful, creative, adaptive solutions to stressful conditions, rather than hasty, defensive maladaptive ones" (p. 690). As resources and time can be limited during times of crisis, the ability to improvise a solution without proper or obvious tools is a core element of resilience (Coutu, 2002). While individuals with such capabilities (bricoleurs) can be found among the ranks of every organization, it is important that they are granted expanded decision-making authority and access to resources in order to assume such a role (Mallak, 1998). Therefore appropriate improvisation established through tools, rules, and routines augments contingent structuring mechanisms, leading to increased responsiveness and contributing to overall resilience (Bigley & Roberts, 2001).

The same degree of flexibility and responsiveness however must be also displayed at an organizational level primarily through dynamism in terms of structure and the strategic use of information systems. Structural flexibility is dependent "[…] on the management's capabilities to adapt the organization structure, and its decision and communication processes, to suit changing conditions in an evolutionary way" (Volberda, 1996: p.362). Examples of internal structural flexibility include changes in organizational responsibilities,

alterations in control systems, existence of virtual role systems etc. (Volberda, 1996; Weick, 1993). Enterprise systems on the other hand, while often considered the backbones of modern organizations, can become a double-edged sword when it comes to flexibility. Their mission is to facilitate the seamless integration and exchange of data between the various departments of an organization however if not managed properly they can introduce rigidities and decreased flexibility due to increased control: a response to power differentials introduced by the centrality of the configuration and the concentration of power at the hands of selected individuals (Ignatiadis & Nandhakumar, 2006).

3.3.3 Enhanced Equilibrium Phase

Once the new reality starts to crystalize the organization enters a new phase of equilibrium where in the case of positive adaptation it signifies a phase of opportunity and growth. In order to turn the disruption into opportunity however the organization needs to be capable of integrating the lessons learned and innovating on a strategic level. The quintessence of resilience is not the mere ability to survive but rather transform through change, and grow through learning. Learning from crisis is a fundamental dimension of resilience, however, evidence shows that organizations hardly ever do so (Smith & Elliott, 2007). In order to capitalize on the newly formed reality, organizations need the ability to learn from their own failures, and hopefully, the failures of others. Many things can go wrong in this process. First, an organization could deny that it failed victim of an internal vulnerability by seeing the failure as having idiosyncratic and largely exogenous causes (Starbuck, 2009). Denial inhibits renewal and according to Hamel and Välikangas (2003) managers can counteract this by collecting firsthand information and experiences on the sites that first confront change and making sure that units that possess the required mindfulness

to interpret events are not censored. Second, an organization could engage in first order learning by evaluating and reconsidering some of its processes and practices, although the danger of failing to question the true nature of the problem and engage in deeper cultural or strategy change always lingers (Smith & Elliott, 2007).

The second step in this phase is the realization that strategy eventually decays. This is an important prerequisite for capitalizing on the newly formed reality and sustaining competitive advantage. Through rapid resource re-deployment and strategic variety organizations can accommodate for radical change in their environments (Hamel & Välikangas, 2003). Strategic flexibility reflects a set of capabilities related to the reconfiguration of the organization's goal, vision and mission and interpretation of the environment that is necessary when the organization faces disruptive or unfamiliar changes that have far-reaching consequences and require timely response (Volberda, 1996). The lack of previous experience of similar circumstances however might involve a holistic reconfiguration or renewal of plans, strategies, resources or products. New values and norms are necessary for the phase of renewal and as past experience may not be relevant, the ability to innovate at a managerial level would allow the organization to introduce new practices, processes, or structures that would further organizational goals (Birkinshaw, Hamel, & Mol, 2008).

3.4 Conclusion

Organization scholars have recently picked up on the extensive literature on ecological, sociological, and human resilience as well as related psychological phenomena like hardiness (Kobasa, Maddi, & Kahn, 1982) or invulnerability (Anthony, 1987) that reflect the ability of certain individuals to positively adjust and survive trauma, in an attempt to

explain how organizations cope with potential threats and what distinguishes organizations who survive such adverse circumstances from those who fail (Sutcliffe & Vogus, 2003). Organizational resilience represents a broaden-and-build approach to managing radical change instead of a deterministic and in essence mechanistic view of organizational survival in response to disruption.

Creativity and improvisation (e.g. Bigley & Roberts, 2001; Lengnick-Hall, Beck, & Lengnick-Hall, 2011; Mallak, 1998), sense-making (e.g. Coutu, 2002; Jacelon, 1997; Weick, 1993), strong values (Coutu, 2002; Sutcliffe & Vogus, 2003) and organizational assets like knowledge managements systems and clear communication channels are some of the factors that have been identified to foster organizational resilience. However as Zellars, Justice, and Beck (2011: p.1) observe in a recent review of the literature, "[…] much remains unknown about the ability to build resilience capacity at work". Given the dearth of empirical research in this area (Vogus & Sutcliffe, 2007) literature remains fragmented and many mechanisms behind the capacity for resilience remain unexplored. I argue that it is helpful to deem organization resilience as a meta-capability, a capacity that involves the nurturing and management of distinct first-order capabilities. Consequently, this paper attempted to provide with a working definition and flesh-out the construct's dimensions and outcomes as well as the human-related, operational and strategic underpinnings of its antecedents.

Resilient organizations are not a mere collection of resilient individuals (Ill & Orr, 1998). Future research should look in more detail how resilience is embedded in individual level knowledge, skills and abilities, how it is enabled by organizational routines and processes and how it gets reinforced by social interaction and human relationships. A major challenge in particular is drawing the link between individual and organizational level resilience

(Youssef, 2004; Zellars et al., 2011). The role of networks among organizational members as well as the relationships of the wider ecosystem in building a capacity for resilience is another fruitful area for research. Given the ever-increasing dynamism of the business environment within most industries –let alone organizations operating in traditionally dynamic environments like that of emerging technologies- and the countless contingencies that our modern socio-economic reality forces on firms, it is imperative that we understand how can organizations positively adjust under conditions of radical change and disruption and emerge stronger and wiser. By answering this, future research will be able to contribute towards meeting one of the most pressing needs of modern organizations.

Part II

Chapter 4

Towards an Integrative Model of Digital-Game Based Learning.

Abstract

The primary aim of this paper is to identify and theoretically validate the relationships between core game elements and mechanics, and user motivation, engagement and learning in the context of digital game-based learning environments. By means of eleven propositions we formalize the role of narrative, aesthetics and core game mechanics in facilitating higher learning outcomes through a motivation-engagement loop. At the same time, we outline the moderating role of player traits and personality in shaping the outcomes of the human-computer interaction in terms of learning effectiveness and technology acceptance. Finally, the paper discusses the different opportunities and challenges that spring from the blending of gaming technology and learning both from a theoretical as well as a practical standpoint.

4.1 Introduction

We are currently experiencing an increasing virtualization and rather unexpected *ludification*[1] of the way we communicate, collaborate, learn, consume and entertain ourselves. The relationship between play and learning, in particular, is one that has been explored both by evolutionary (for a review see Bjorklund & Pellegrini, 2010) and

[1] The introduction of game elements in non-game applications (from the Latin ludus = game).

developmental psychology (e.g. Jean Piaget, 1962; Vygotsky, 1978), as well as by recent studies in neuroscience (e.g. Pellis & Pellis, 2013). This significant body of literature has emphasized the positive influence of several dimensions of play on the development of important cognitive, emotional an social competences (Earp, Ott, Popescu, Romero, & Usart, 2014; Granic, Lobel, & Engels, 2014; Qian & Clark, 2016) elevating the act of play from the status of a mere pastime activity. Despite the above encouraging evidence however, educational digital games haven't yet managed to achieve the widespread acceptance of their entertainment counterparts and oftentimes are approached by scholars and educators with skepticism (Miller, Lehman, & Koedinger, 1999).

Recent developments in gaming technology, reinvigorated the discussion regarding the potential of digital games as vehicles for learning. Serious Games and instances of gamification have taken the world by storm the past few years (Takahashi, 2013), offering a more game-like educational experience and blurred the line between learning and entertainment even more. Unfortunately, we are still missing many pieces of the puzzle, and primarily a comprehensive overview and evaluation of popular game elements and mechanics that could be ported into educational applications in order to enhance user engagement and facilitate learning. There has been sporadic studies in the past that discussed certain dimensions of digital games and their importance in the gaming experience by looking at the motivational outcomes of gameplay (e.g. Cairns, Cox, Day, Martin, & Perryman, 2013; Erhel & Jamet, 2013; Nacke, Grimshaw, & Lindley, 2010; Qin, Rau, & Salvendy, 2010) and suggesting different angles of studying digital games, such as narratives (e.g. Lee, Park, & Jin, 2006), rule-systems (e.g. Juul, 2005), or aesthetics (e.g. Smuts, 2005). Nevertheless, we miss an integrative approach that would consider the complex nature of

the interaction between humans and computers in the context of game-based learning. On the one hand game design elements and qualities stimulate certain emotional, cognitive and behavioral responses in players but at the same time certain player dispositions moderate the strength of these effects and drive user behaviors. The theoretical framework presented in this paper stresses the importance of all the distinct game dimensions in the learning process, theoretically establishes the connection of all these elements to learning outcomes and introduces some key personality traits that could be moderating the aforementioned effects (see figure 4.1). The main aim of this paper is to guide future empirical research in the emerging area of digital game based learning.

In particular, we argue that: a) specific game rules and mechanics facilitate the development of cognitive skills such as neural processing and efficiency, spatial skills, enhanced mental rotation abilities, problem solving skills and creativity (Granic et al., 2014), b) narrative elements provide with excellent platforms for thought experiments and simulations of "models of behavior" (Simons, 2007), and c) game aesthetics provide with the necessary fidelity and realism that brings the other two aforementioned game layers to life, while enhancing skill and knowledge transfer to offline settings.

All game elements, however, have a dual role. Besides supporting learning, they stimulate user engagement and enhance the motivational pull of the instruction tool. Narrative elements enhance the emotional engagement of users via empathy and identification with in-game characters, game mechanics regulate the levels of challenge in the game contributing therefore to the cognitive engagement of users, and graphical fidelity assists user control which is an important element of player engagement (Whitton, 2010).

In addition, we recognize the importance of individual differences in accepting and utilizing this technology. In this paper we focus our attention to personality dispositions, given that the satisfaction of the different playing and learning styles can be to a certain extent accommodated by design choices via expanding the available strategies and approaches for completing the game or by offering multiple assessment criteria. Personality, on the other hand, reflects a higher level of (in)compatibility with the medium, one that is more persistent and harder for design to accommodate. In particular, we will focus in the role of goal orientation, openness to experience, conscientiousness, sensation seeking and need for cognition as we would expect them to be highly important for the translation of the gameplay experience into valuable learning outcomes, as well as for the acceptance of such a novel technology.

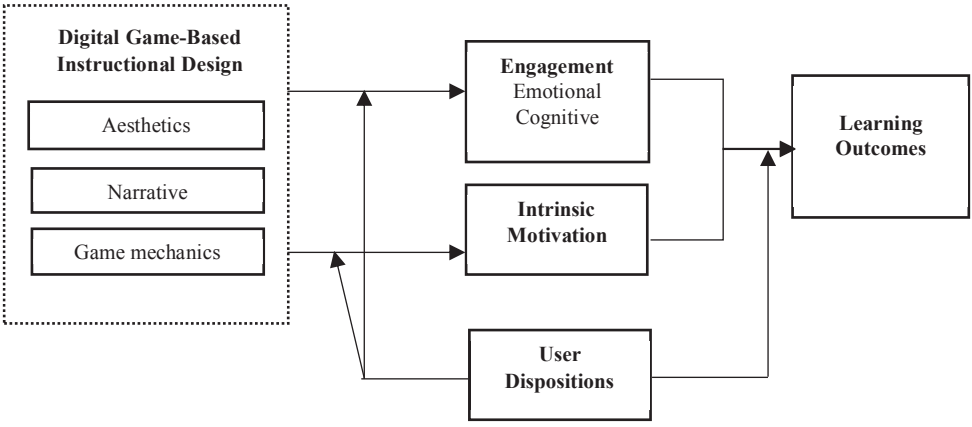
The first part of the paper outlines the major elements and mechanics of digital games and how they can stimulate the engagement and intrinsic motivation of players by drawing on motivational theories, theories of play and popular digital game design principles. The second part explores the moderating role of individual player dispositions and their implications for learning outcomes and user acceptance as they both relate to the successful adoption of this technology. The final section discusses the compatibility of digital game applications with existing pedagogical approaches, especially with the constructivist approach of instruction. Additionally, we discuss the core design challenges in developing such tools and their potential as learning vehicles in work organizations.

4.2 Game Elements and Engagement

User engagement is one of the most prominent qualities of digital games, to the extent that a considerable body of literature studies player behaviors that border with that of

pathological addiction (Gentile, 2009). While the possible "dark side" of gaming is not in the scope of this article, we cannot but acknowledge the power of engagement and explore the elements that could stimulate it and direct it towards beneficial outcomes.

Figure 4.1
A conceptual model linking instructional design with intrinsic motivation, user engagement and individual dispositions.



These elements are nested within the three main layers of every digital game: the game system (rules, mechanics), the layer of narrative (theme, story, characters) and a layer of aesthetics (audiovisual elements, fidelity, aesthetic choices). Game elements nested in these three layers are responsible for the cognitive and emotional engagement of the user. When it comes to learning applications, cognitive engagement refers primarily to the focus of attention, while emotional engagement stresses the role of emotions and feelings in supporting the desired cognitive processes. Unfortunately, the role of emotions in the learning process, while important, is not often accounted for (Fredricks, Blumenfeld, & Paris, 2004). The reason that we explicitly distinguish between emotional and cognitive

engagement is in order to more accurately separate and discuss the effect of certain game elements on generating those affective reactions (e.g. boredom, happiness, interest, anxiety) that will eventually support or hinder the actual psychological investment in learning (e.g. going beyond the requirements, preference for challenge, being-strategic or self-regulating) (Fredricks et al., 2004).

4.2.1 Game System

The game system incorporates a myriad of rules and mechanics that determine the degrees of freedom that players have during gameplay and define the laws that govern the virtual environment. For the purpose of this paper we are focusing on four game elements that are part of every successful game and we expect to have a strong influence the on the level of engagement that players experience: goals, rewards, feedback, and challenge.

The Role of Goals and Goal Setting

Goal setting in digital games is implemented through a system of quests, sub-quests and objectives which grow more challenging as the game progresses and oftentimes operate on a parallel fashion. Game goals tend to be clear, specific, and challenging therefore they generate greater persistence and enhanced performance on behalf of the players (Locke & Latham, 2004; Locke, Shaw, Saari, & Latham, 1981). At the same time, games utilize an array of mechanisms that generate a perception of progress towards attaining each goal and the associated reward. Such mechanisms are progress bars, experience bars, level ups and more.

Experience has shown that gamers tend to be more engaged towards achieving a particular goal when they have the sense that they are gradually moving towards it (Lewis-

Evans, 2013). Such a behavior is in line with the behaviorist theory of goal-gradient, that predicts that subjects expend more effort as they approach a reward (Kivetz, Urminsky, & Zheng, 2006). Therefore, the existence of proximal goals, building up to larger prospective ones, enhances the engagement levels of users in two ways. They provide with immediate incentives that deter players from temporizing and getting detached from the distant goal through clear and attainable sub-goals, and reinforce self-efficacy by providing players with indicants of mastery as sub-goals get gradually achieved (Bandura & Schunk, 1981).

Rewards

The reward systems found in digital games can be fairly complex and variable as they can include rewards associated with effort, progress, performance, luck or creativity. Certain types of rewards however have been found to have a higher impact on the cognitive engagement of players. Gamers for instance tend to prefer unpredictable rewards more than steady and predictable ones (Howard-Jones & Demetriou, 2008). A great example of this mechanic is the "loot drops" that can be found in many commercially successful games like Diablo or World of Warcraft. Such a mechanic regulates the in-game value of the reward that a player will receive after defeating an enemy based on some pre-determined probability. Such rewards are associated with higher levels of dopamine in the brain that results in higher pleasure and are in part responsible for the compulsive behavior that is oftentimes observed in gamers.

Although the relationship between such oftentimes "unfair" reward systems and the levels of pleasure experienced seems counter-intuitive at first, from an evolutionary theory standpoint it could be justified. In a "state of nature" and in particular in situations of high unpredictability (i.e. a novel environment) the cognitive processing of information is

rendered ineffective. In such a situation the inability to make the correct prediction based on cognition is compensated with the utilization of a motivational process that would stimulate action through the release of dopamine as a reward for such a behavior (Anselme, 2013). In other words, the brain rewards daring and acting in a way that is against logic and fair expectations, in order to maximize the likelihood of survival.

Feedback

Feedback is an integral part of every instructional design and can play a catalytic role in enhancing and maintaining the cognitive engagement of learners. Given the complexity and oftentimes intensity of gameplay, digital games implement feedback devices in order to reduce the high cognitive load and uncertainty that the player would otherwise experience, especially when still a novice. Both these conditions can cause the disengagement of the player. Uncertainty is an unpleasant feeling that can lead to distraction from the task and is often manifested as a gap between the existing and the desired performance levels (Shute, 2008). Similarly, cognitive load theory poses that low prior knowledge regarding a specific domain will generate high cognitive load, since no existing schema is available to process the new information (Moreno, 2004). The negative effect of high cognitive load on cognitive engagement (Brünken, Plass, & Leutner, 2003) is especially true for instructional environments that -much like games- promote exploration, experimentation, interaction and manipulation of objects, or hypotheses testing (Moreno, Mayer, Spires, & Lester, 2001).

Successful digital games try to mitigate these negative effects by delivering timely, frequent, and relevant feedback in order to satisfy the constant need of players for correcting inappropriate strategies, determining the distance and progress towards objectives and identifying their status in the game (Sweetser & Wyeth, 2005). The design challenge

however is not just delimited in condensing and communicating all the required information to the player in a consistent manner. Empirical evidence in the context of learning environments shows that feedback from external sources tends to interrupt the engagement of students during the activity and inhibit learning (Corno & Snow, 1986). It is therefore equally important for the feedback to be incorporated in the game experience in a non-intrusive way.

To illustrate the above design challenge, we can look into two different cases where designers tried to incorporate feedback in a non-intrusive way. In the famous platform game Abe's Oddyssey, the information regarding the health condition of the character is communicated to the player in a visual way, by altering the looks of the avatar upon deterioration or rejuvenation of his health, in contrast to the common approach of on-screen information display (e.g. an information box tracking the health of the character) (Rouse, 2005). The designers tried in this way to remove an obstructive element from the screen in order to avoid disrupting the immersion of the player caused by the limitation of the game-world view. In contrast, the same idea when implemented in the driving game The Getaway failed to maintain the engagement of players because the substitution of a navigation map on screen with a signaling mechanic on the car (the left or right signal light on the car starts flashing right before the player needs to take a turn) proved eventually more cognitively taxing for the players (Rouse, 2005).

Evidently feedback devices can influence the cognitive engagement of players and qualities like immediacy, frequency, clarity and relevance can contribute to that. This relationship however proves rather fragile given the capacity of such mechanisms to disrupt the immersion and engagement of players. It is therefore deemed crucial to consider the

effects of such mechanisms on gameplay when designing or evaluating game-based learning applications.

Challenge

The theory of psychological flow, suggests that the relationship between challenge and skill determines the engagement level of the player during gameplay. At any given level of skill, lower than equal challenge results in boredom and detachment, while higher than equal challenge results in anxiety, stress and ultimately resignation (Csikszentmihalyi, 1975). When challenge is high but within the capabilities of the individual, the result is a state of consciousness characterized by extreme absorption, enjoyment and feelings of achievement (Csikszentmihalyi, 1990). In order to grant this experience to players, digital games design has gradually incorporated sophisticated methods of adapting the difficulty level of the game to the skill level of the player. The straightforward way to achieve this, is by including an adjustable difficulty option which, when present in the game, allows players to manually adapt the game's difficulty to their skill and experience. An alternate way to achieve the same effect is by utilizing artificial intelligence in order to track down the players' performance and adapt the game to their skill level or gameplay style.

From a design perspective this adjustment happens by regulating positive and negative feedback in the game. A positive feedback mechanism is implemented so as to ensure that a certain achievement will make subsequent achievements easier to accomplish. A good example of this, often found in commercial games, is the case where a player upon completing a quest, is granted a special piece of equipment which will from then on grant her an advantage over defeating subsequent opponents. On the contrary, negative feedback mechanisms make sure that the leading players doesn't get too far ahead. As an example, in

many popular racing games, when a player manages to get too far ahead of her opponents the AI controlled drivers will start closing in by increasing their speed and accuracy in order to maintain the pressure on the leading player. These two powerful mechanisms are always present in well-designed games and play a catalytic role in maintaining the optimal level of engagement for the player.

Proposition 1a: Proximal goals are expected to have a higher impact on sustaining the cognitive engagement of the player than distant goals.

Proposition 1b: The incorporation of uncertainty in the game's reward system is expected to further enhance the cognitive engagement of players.

Proposition 1c: Timely and frequent feedback is expected to enhance the cognitive engagement of users when introduced in a non-intrusive way.

Proposition 1d: Adaptable challenge levels are expected to sustain higher levels of cognitive engagement throughout the gameplay experience.

4.2.2 Narrative

Similar to other forms of art, during gameplay players experience intense imaginative involvement to the degree where the boundaries between themselves and the medium begin to fade. Huizinga (1955: p.10) described the place in space and time where participants create and enter when the game begins as a "magic circle"; a temporary world "within the ordinary world, dedicated to the performance of an act apart". The role of plot and theme in games is to reinforce this "magic circle" by stimulating the imagination of users, and enhancing their emotional engagement. While not all successful digital games have an intricate narrative structure (e.g. Tetris), we consider narrative to be one of the main pillars

of educational game effectiveness due to the applied, and often complex nature of these games. In order to support a desirable level of realism, bridge the game experience to its real-world counterpart and, effectively, facilitate situated and experiential learning, educational games could benefit from the embedding of well-established narrative devices in their design.

The existence of characters and narrative devices in games, when properly implemented, inevitably cause identification and empathy that leads to the emotional engagement of users (Bachen, Hernández-Ramos, Raphael, & Waldron, 2016; Coplan, 2004). Due to the nature of game-play, players are exposed only to the spatiotemporal perspective of their character (they are usually always at the center of the action and their character present in the screen), which is the protagonist. This causes them to process the emotional implications of narrative events from the standpoint of their character (Gernsbacher, Goldsmith, & Robertson, 1992). As a result, players imaginatively adopt their character's emotional state further reinforcing their suspension of disbelief.

Proposition 2: Narrative devices that identify the player with her in-game character(s), and the manipulation of tension and climaxes as play progresses, can result in a higher emotional engagement for the users of instructional video games.

4.2.3 Aesthetics

The role of aesthetics in digital games is both functional and hedonic. The more precise and intuitive an environment is, the better can the player navigate through it. The more realistic an environment is, the more able is the player to guess its different properties based on knowledge of its real counterpart. For instance, higher degree of fidelity in graphics

allows for more accurate representations and manipulation of virtualized real world objects or places. These elements might be necessary for a particular learning task, potentially influencing the level of knowledge transfer to the real world due to better achieved similarity between the two environments. Similarly, the more convincing the environment is, be that fantasy or not, the more willing the player will be to let go and immerse herself into it. In fact, empirical evidence demonstrates that a high degree of realism in audiovisual elements greatly determines the success of a digital game (e.g. Wood, Griffiths, Chappell, & Davies, 2004).

Aesthetics however serve another important role besides augmenting human-computer interaction. They maximize the immersion of players in the game world by providing with captivating sensory stimuli and for that reason they have been evolving at exponential rates over the past couple of decades. The prototypical aesthetic experience stimulates intense feelings or emotions and fixates the attention of the participant upon the components of a visual pattern in a way that excludes the awareness of other objects or events (Kubovy, 2000 cited in El-Nasr, 2007). Advances in 3D graphics, animation, simulated physics and photorealism bring games closer and closer to delivering such an experience. Similarly, music and sound effects, can stimulate intense pleasurable responses by stimulating regions in the brain involved in reward and emotion (Blood & Zatorre, 2001). Consequently, besides being important for the semantic operations of games by invoking "cognitive associations between types of music and interpretations of causality, physicality and character" (Whalen, 2004), audio elements enhance the emotional engagement of players, support storytelling (e.g. actor voices) and contribute to the stimulation of players' imagination (Byun & Loh, 2015).

Proposition 3: Sophisticated audiovisual elements in instructional games are expected to enhance the transfer of knowledge and skills to the real world as well as contribute to higher levels of emotional engagement and immersion in players.

All the previously discussed game elements (system mechanics, narrative and aesthetics) facilitate the cognitive and emotional engagement of players by driving them in a condition of psychological flow. Getting players "in the zone" means that they experience intense emotions, high levels of perceived control, focus of attention and cognitive activity. The implications for instructional design are therefore significant since empirical evidence shows that learning in a computer environment correlates with affect (Craig, Graesser, Sullins, & Gholson, 2004) and that flow significantly influences learning outcomes (Choi, Kim, & Kim, 2007; Ghani & Deshpande, 1994; Pearce, Ainley, & Howard, 2005; Webster, Trevino, & Ryan, 1993)..

4.3 The Motivational Pull of Digital Games

Although oftentimes relevant literature uses the terms engagement and motivation interchangeably, existing evidence suggests that they are conceptually distinct phenomena and that the one influences the other (Hektner & Csikszentmihalyi, 1996). Engagement captures a player state that is characterized by deep cognitive and emotional absorption that is over once the playing session ends. Intrinsic motivation presents an inner drive that urges the user to get into and continue coming back to the activity. In the context of learning, intrinsic motivation captures the natural inclination towards assimilation, mastery, spontaneous interest, and exploration which are fundamental for cognitive and social development (Ryan & Deci, 2000). It is the strongest type of self- motivation and according to the self-determination theory (SDT) at the heart of this form of motivation lie three

psychological needs: the need for competence, the need for relatedness and the need for autonomy. Additionally, cognitive evaluation theory (CET) poses that the psychological needs for competence and autonomy can be influenced by socio-contextual factors (e.g. opportunities for self-direction, feedback, communication, rewards) (Deci & Ryan, 1975) which means that they can be influenced by the game design elements that we discussed earlier. Given the strong link between intrinsic motivation and learning, it is interesting to explore the ways that a game based learning environment would appeal to the basic needs of users for autonomy, relatedness and competence consequently enhancing their intrinsic motivation.

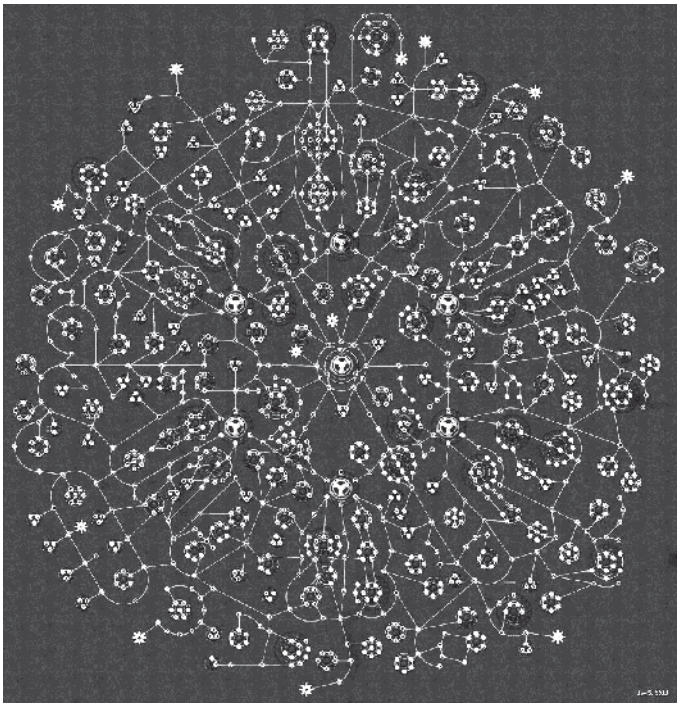
4.3.1 Need for Autonomy

Perceived autonomy is dependent on the amount of control that players experience during gameplay as well as on the available opportunities for self-expression in the game. Digital games typically evoke a sense of personal control by allowing players to select strategies, manage the direction of play, and make meaningful decisions that directly influence outcomes (Garris, Ahlers, & Driskell, 2002). In reality, the players never experience complete control. Like with every other type of game, digital games are bound to rules that are largely determined by design (Becker, 2007). We can argue however that the availability of meaningful choices and the discovery of winning strategies through active experimentation, enhances the perceived autonomy of players and is broadly responsible for the enjoyable and intrinsically motivating nature of digital games. Figure 4.2 illustrates a good example of the way that games achieve the aforementioned “bounded” autonomy. The image depicts the passive skill tree for every character in the MMORPG (massively multiplayer online role playing game) Path of Exile. Every dot in the picture represent a skill

that a player can claim every time they level up their character. Such skills grand the character with special abilities and belong to different domains like intelligence, strength, dexterity etc.

Figure 4.2.

Passive skill tree available in the MMORPG *Path to Exile.*



The skills represented by every dot are pre-determined and available for the player to choose since the start of the game. Zooming in the tree provides extra information for every point and given their starting position (depending on the character's initial setup) every player can form a unique string of skills (they should always be interconnected) that essentially reflect their strategy to winning the game. Despite technically limited, the skill tree offers enough meaningful choices for the players to feel in control of their own destiny.

Such an implementation could also prove highly beneficial for learning applications. Empirical findings suggest that some degree of individual control positively influences learning outcomes by enhancing motivation (Kinzie, Sullivan, & Berdel, 1988; Skinner, Wellborn, & Connell, 1990) and engagement in metacognitive abilities (e.g. actively monitor one's progress, determine areas of weakness, and adjust learning strategies accordingly) (Schmidt & Ford, 2003). When successfully supporting exploration, experimentation, freedom for choice (strategic decision making), self-reflection and self-correction, we would expect instructional digital games to enhance the perceived control of players and consequently lead to higher intrinsic motivation, and consequently learning and knowledge transfer.

Interlinked to the need for control we also find the psychological need for creation and representation of self-identity. Customization of in-game characters (avatar, abilities and stats, class and equipment) and the game interface (layout, color pallet etc.) are trademark mechanisms that games employ in order to gratify the needs of players in terms of self-expression. Allowing players to manipulate their virtual presence in the game environment satisfies not only their need for self-expression, but at the same time reinforces the merge of identity between the player and the game protagonist. The above have important implications for instructional design.

On the one hand, self-expression generates feelings of autonomy and the players' expectations for opportunities of self-expression in virtual environments has increased dramatically in the past couple of decades (Rigby & Ryan, 2011). Instructional design can therefore tap in these expectations, enhance the players' perceived autonomy and support higher intrinsic motivation by incorporating such mechanisms in the learning environment.

On the other hand, self-expression could support behavioral changes that are desirable in a learning context. By customizing their virtual presence, learners tend to construct a virtual identity closer to their ideal self, constituting the merge of the two identities easier. That results in higher efficacy as well as behavioral changes due to identification with the in-game character. Empirical evidence shows that changes in the self-representation of individuals in a virtual environment can cause drastic behavioral changes while operating in such an environment (e.g. taller avatars can result in more confidence while more attractive avatars in higher intimacy with confederates) (Yee & Bailenson, 2007). Further, such a merge could result in the player adopting the goals, attitudes, and evaluations of the game character (Klimmt, Hefner, & Vorderer, 2009). This implies that it is possible to influence the development or adoption of certain beneficial for learning behaviors from the players by scripting them in the in-game characters.

Proposition 4: The satisfaction of the psychological need for autonomy through increased levels of perceived control and provided opportunities for self-representation and expression, is expected to enhance the intrinsic motivation of players.

4.3.2 Need for Competence/ Achievement

The need for competence and its interlinked need for achievement constitute the second pillar of intrinsic motivation. The relevance of perceived competence as a component of intrinsic motivation can be traced in Bandura's theory of self-efficacy (Bandura, 1997). The theory proposes that the actor's perception of competence in carrying out the required behaviors for achieving a desired goal is a key mechanism of human agency (Deci & Ryan, 2000). In the context of instructional design, stimulating the perceived competence of learners is a desired quality as it is expected to encourage learners to seek out and invest the

necessary effort in order to master developmentally appropriate challenges (Deci & Ryan, 1985; Reeve, 2009). Perceived competence is the result of an inferential process during which factors like perceived ability, expended effort, task difficulty, external assistance, and patterns of successes and failures are considered (Schunk, 1990).

Digital games try to support this process by keeping the challenge at an optimal level and by providing positive and useful feedback (Nakamura & Csikszentmihalyi, 2002; Reeve, 2009). In the previous part we've already presented ways through which games maintain optimal challenge during gameplay as well as the role of feedback immediacy, frequency and clarity in sustaining high levels of cognitive engagement in players. The benefits of optimal challenge and certain feedback characteristics however expand beyond engagement, as they can reinforce the perceived competence of players and indirectly influence intrinsic motivation.

This is achieved partly by implementing a method of scaffolding (Dickey, 2006a, 2006b) that allows players to gradually familiarize themselves with the complexity of the virtual environment and successfully advance their skills on their way to mastery. In the service of this purpose, games often incorporate a tutorial –introductory- chapter at the beginning of the game, an AI regulated level of difficulty, and a hint system that gets activated when the user is perceived as "stuck" in a level. This results in a less steep learning curve that enhances the perceived competence of players as they avoid highly challenging situations when still their mastery level is low and the perceived uncertainty is high.

In a complementary way, the nature of feedback provided appears to play a catalytic role in shaping the perceived competence of players. Empirical evidence suggests that formative feedback, which provides cues on how to perform a task or how to improve

oneself, can benefit the self-competence of learners (Chan & Lam, 2008). In a similar way attributional feedback as well as feedback on goal progress when appropriately implemented appear to enhance self-efficacy (Bandura & Cervone, 1983; Relich, Debus, & Walker, 1986).

Nevertheless, in learning contexts the most encountered type of feedback is outcome based (Johnson, Perlow, & Pieper, 1993). Outcome feedback –scores, performance indicators etc.-, despite its, previously discussed, contribution to engagement (Csikszentmihalyi, 1990), does not always contribute to learning, especially during complex, uncertain tasks that require cognitively rich decision making (Jacoby & Mazursky, 1984). In such cases it is important that the player has also access to cognitive-based feedback mechanics like the ones discussed earlier –e.g. hints on the process of performing a task or on what underlines response accuracy. The design challenge in this case though, is the embedding of such sources of cognitive feedback in the application, without disrupting the state of "suspension of disbelief" experienced by the players.

Proposition 5: The existence of optimal challenge and clear and timely cognitive feedback are expected to satisfy the intrinsic need of players for competence and lead to higher intrinsic motivation.

4.3.3 Relatedness

Relatedness expresses the human drive towards forming and maintaining at least a minimum quantity of lasting, positive, and significant interpersonal relationships (Baumeister & Leary, 1995). It is a strong condition for sustaining intrinsic motivation and the latest revolution in gaming (massively multiplayer online games, or MMOGs) does in

fact touch upon this sensitive and very important human need. In essence, these games satisfy the need of players for relatedness by addressing their needs for acknowledgement, support and impact (Rigby & Ryan, 2011). Digital games are fundamentally different from traditional media in the sense that characters in the game don't act for, but react to us (Rigby & Ryan, 2011). Through interaction with other players or non-player characters (AIs), the player gains acknowledgement for her actions (e.g. congratulations on her achievements), support during gameplay (e.g. other players or NPCs can assist her in a time of distress) and most importantly see the impact of her action on other characters (either on a reactional level –greeting back-, or on a narrative level –her decision to sacrifice a team member for the great good).

Proposition 6: Facilitating the development of game related online communities and enabling various types of interaction and self-organization among players is be expected to satisfy their intrinsic need for relatedness leading to higher levels of intrinsic motivation.

In the previous discussion we argued that the needs for autonomy, competence and relatedness as conditions for eliciting or sustaining intrinsic motivation can be satisfied by the design of digital games. In fact, the satisfaction of these basic needs contributes significantly to the enjoyment of players. While most individuals approach gaming under the auspices of "fun" (Hoffman & Nadelson, 2009) what users usually describe as "fun" – or enjoyment- is not necessarily fun, or easy. Challenge and difficulty are typical elements for high engagement and post-play reported enjoyment. The same goes for discovery and social interaction. During game-play it is often the case the players experience momentary episodes of frustration or even anger. However, with careful design, such episodes can be limited to function only as a motivational pull towards trying harder. If the balance between

challenge and skill remains in the flow channel, the player eventually emerges victorious and content, further reinforcing the cycle of engagement.

4.4 The Moderating Role of User Dispositions

In the previous parts we discussed the role of specific game elements nested in the three core layers of digital games (system, narrative, and aesthetics) in enhancing player motivation and engagement as well as the importance of these two constructs in supporting the learning process. Beyond game design choices however, much of the gaming experience is dependent on the personality of players. We have already evidence that players adopt different styles when interacting with digital games (Bartle, 2006) and that could be extended from playing strategies to learning outcomes and technology acceptance.

Based on previous empirical research on personality traits and academic motivation and performance (e.g. Komarraju & Karau, 2005) we identified a set of dispositions that influence the levels of engagement in users as well as the overall acceptance of the technology. Being a novel instructional approach with limited existing counterparts, we consider openness to experience to be a very important trait for user engagement and technology acceptance. Proven to be a valid predictor of training proficiency, openness to experience predicts not only positive attitudes towards learning experiences in general (Barrick & Mount, 1991) but also a disposition to accept a new and unfamiliar technology as a means for training (Devaraj, Easley, & Crant, 2008). The second important personality trait that could allow for unique variance in acquisition of knowledge is conscientiousness (Barrick & Mount, 1991) as it influences the perseverance and dedication of individuals to their learning goals. Finally, we also consider goal-orientation, which determines the

motives and learning strategies of individuals, as an important moderator between engagement, motivation, and learning (Dweck, 1986).

In addition, given the unique properties of digital games we had to expand our inquiry into traits that have not been traditionally associated with academic motivation and performance, but we would nevertheless expect to play a significant role in moderating the effects of instructional design on engagement and motivation. Such traits would be sensation seeking, which outlines an innate preference for varied, novel, and complex sensations and experiences (Zuckerman, 1979) and need for cognition, an individual's tendency to engage in and enjoy effortful cognitive activities (Cacioppo, Petty, Feinstein, & Jarvis, 1996). The above individual characteristics were chosen based on their potential influence not only on game effectiveness in terms of learning outcomes but also in terms of technology acceptance.

4.4.1 Goal Orientation

People differ substantially in the way they perceive challenge and feedback, or accept novel activities for development. Goal orientation provides a framework that accounts for the aforementioned differences by looking at particular individual dispositions toward developing or demonstrating ability in achievement situations (Dweck & Leggett, 1988; C. Dweck, 1986; Pintrich, 2000b). “The two major classes of goal orientation are: a) a learning goal orientation of seeking to develop competences by acquiring new skills and mastering new situations and b) a performance goal orientation of seeking to demonstrate and validate the adequacy of one’s competence by seeking favorable judgments and avoiding negative judgments about one’s competence” (Vandewalle, 1997). While in a digital game based learning context we would naturally expect people with a learning goal orientation to feel

more intrinsically motivated and consequently achieve higher learning, the role of performance goal orientation is not so straightforward.

As learning goals are typically found to be associated with challenge seeking, an effort/strategy focus, positive affect, and high persistence under difficulty (Dweck & Leggett, 1988) such individuals will display high levels of engagement and consciously pursue the mastering of their skills and acquirement of knowledge. On the other hand, performance goal oriented individuals are expected to display lower levels of motivation, avoidance of challenging tasks, negative affect following a failure, limited use of strategy etc. (e.g. Ames, 1992). Recent findings however suggest that in certain occasions a performance goal orientation can actually result to better performance and overall achievement (Pintrich, 2000a). These findings eventually lead to a distinction between approaching performance goals and avoiding performance goals. Individuals that approach goals have an intrinsic need to demonstrate their ability and outperform others while individuals that avoid goals try not to humiliate themselves and avoid undertaking the task.

Under this light we would expect players with a learning goal orientation to display a high engagement/ high learning behavior, players with a performance goal orientation to display a high engagement/ limited learning behavior and players with an avoid goal orientation a low engagement/low learning behavior. The limitation in the learning ability of performance goal oriented individuals would be the result of not consciously acting towards mastering their skills and knowledge but actually limiting their strategies only to low effort/ high gain (in terms of score) ones. That would limit exploration/experimentation and the direct effect of pedagogical elements onto learning outcomes, however even such an approach will result in indirect (unconscious), yet limited, development of skills and

knowledge transfer (typically skill based and affective knowledge). An avoid goal orientation on the other hand is expected to negate the engaging nature of certain game features like feedback and challenge as such elements would be perceived as a threat, and their low persistence in the face of difficulty would quickly lead to disengagement from the activity. Even more so, an avoid goal oriented individual would be more likely to avoid engaging with a novel professional development activity in the first place (Vandewalle, 1997).

Proposition 7: While both performance and goal orientated individuals would be expected to display high levels of intrinsic motivation and engagement during game-play, learning oriented individuals are expected to achieve higher learning outcomes, compared to performance oriented ones.

4.4.2 Openness to Experience

Individuals described as high on the openness-to-experience dimension of personality are typically "[…] imaginative, sensitive to aesthetics, curious, independent thinkers, and amenable to new ideas, experiences and unconventional perspectives" (George & Zhou, 2001). Openness constitutes an important variable for our framework, accounting for individual differences to the extent that learners are intrigued by imagining consequences and experimenting with different strategies (McCrae, 1987) and emotionally sensitive to art and beauty (McCrae & Sutin, 2009), thus enhancing (or in its absence, counteracting) the effect of game features like aesthetics, fantasy and mystery on engagement. More importantly however openness influences the attitude of individuals when entering the training program, giving them a competitive advantage (Goldstein, 1986: 70). Being a rather innovative and unique technology for learning, digital games might be treated with

skepticism or resistance especially from people that are not very familiar with gaming technology. In this case openness moderates the acceptance of technology and the ability to make the best out of it (Colquitt et al., 2002; Devaraj et al., 2008).

Proposition 8: Players with high levels of openness to experience are expected to achieve higher levels of engagement and user acceptance.

4.4.3 Conscientiousness

Conscientiousness seems to have in indirect relationship to learning outcomes in the context of digital games. As it is traditionally related to qualities like being hard-working, ambitious, persevering and energetic (McCrae & Costa, 1987) it has been consistently found to predict higher job performance (Barrick & Mount, 1991). When it comes to learning however, Martocchio & Judge (1997) found that while conscientious individuals typically display higher self-efficacy which is a valid predictor of motivation and learning (Zimmerman, 2000), conscientiousness also introduces self-deception – a positively biased perception of someone's actual abilities or accomplishments- which eventually leads to diminishing learning. It seems that the overall correlation of conscientiousness and learning is determined by the magnitude of two effects. In the case of digital games based learning, we would expect individuals high on conscientiousness but with a learning goal orientation to accept the technology and display higher knowledge transfer than those low on conscientiousness. A learning orientation actually grants them the opportunity to transform their hard work and engagement into increased performance and active learning (Bakker, Demerouti, & Brummelhuis, 2012). On the other hand, it is possible that when highly conscientious individuals adopt a performance goal orientation the drive to excel and prove

their competence is more likely to lead them into self-deception by overestimating their capabilities.

Proposition 9: Conscientious individuals that also possess a learning goal orientation are expected to achieve higher learning outcomes contrary to individuals that display high levels of conscientiousness but possess a performance goal orientation.

4.4.4 Sensation Seeking and Need for Cognition.

Individuals characterized by the trait of sensation seeking typically engage in intense activities that provide them with a good amount of thrill or even danger. Sensation seeking has been typically studied in relation to risk behaviors (e.g. extreme sports, alcohol, high risk sexual behaviors), however it is possible that the trait is also manifested in more disciplined ways (e.g. attaining positions of leadership due the high intensity that such experiences entail). Given that many modern digital games are designed to deliver considerable amounts of adrenaline, intense emotions and complexity, it is natural to expect that players with a high sensation seeking disposition would be drawn to them and practically become more engaged during gameplay. In fact, early empirical findings show that individuals high on sensation seeking, experience higher engagement when involved in an action-filled first person shooter game compared to those that exhibit low levels of the trait, with the reverse being true for more casual games (e.g. Tetris) (Ravaja, Salminen, & Holopainen, 2004). In essence this means that modern action-filled blockbusters may be considered as pinnacles of immersive design, however it could be that they elicit these higher levels of engagement or absorption only on a fraction of gamers.

Proposition 10: Sensation seeking moderates the relationship between instructional design and engagement. Players high in sensation seeking are expected to feel more absorbed when introduced in a novel, intense and complex digital game environment compared to a more relaxed and casual one. In contrast, players low in sensation seeking are expected to feel more engaged when playing in more relaxed casual game environments.

In a similar vein, we would expect individuals that display a higher need for cognition to be more intrinsically motivated to engage with a cognitively demanding and challenging game environment. Such individuals are generally characterized by active, exploring minds, and they naturally tend to seek out stimuli or tasks that require reasoning or problem solving (Cacioppo et al., 1996). Such behaviors can lead to feelings of higher control or mastery over an individual's world, and allow for a greater sense of self-satisfaction (Osberg, 1987). One conceptualization of need for cognition in particular poses that it may lead to feelings of self-esteem, competence and worth (Osberg, 1987). Given its self-motivating nature, we would expect need for cognition to influence the intrinsic motivation of players by moderating the effect of instructional design on satisfying their needs for competence and autonomy.

Proposition 11: Need for cognition is expected to moderate the relationship between instructional game design elements and intrinsic motivation. Individuals that possess this characteristic are expected to feel higher satisfaction when engaging in a cognitively demanding digital game environment, therefore the effect of instructional game design elements on intrinsic motivation will be higher. The opposite is true for individuals that don't possess this characteristic.

4.5 Discussion

In the previous sections we theoretically discussed how the effectiveness of game-based educational technologies is dependent of specific design choices as well as individual user traits. For that purpose, we provided with an integrative framework reflecting a set of propositions in order to guide future research in the field of digital game-based learning. Naturally, not all games deliver all the advantages discussed in the previous sections. Game design typically follows a modular approach where every game incorporates only those sets of elements and mechanics that are considered to promote the desired learning outcomes. Moreover, our framework focused only on a subset of mechanics and individual differences that we consider to play an important role in shaping the educational effectiveness of the medium. Regardless of these limitations, we consider this work as an important stepping stone towards a better understanding of how digital games can support learning and which elements play a vital role in this process.

We would like to dedicate this final part of our paper, in discussing two important topics that directly touch upon the wider discussion regarding the role of digital games in enhancing learning in academic institutions and work organizations: to what extent they can satisfy the need for a more experiential or constructivist approach to learning and what are the major challenges in the development of such applications that could hinder their potential. In other words, we would like to discuss the different opportunities and challenges that spring from the blending of gaming technology and learning both from a theoretical (learning theory) as well as a technical (design and development) standpoint.

4.5.1 Digital games and learning theory.

Digital games and game-based learning in general have been traditionally associated with the constructivist view on learning as they provide with sandbox environments where players are allowed to experiment and construct meaning out of their cognitive and emotional experiences (Kark, 2011). Under such a view, knowledge is built from within and sense-making and understanding are intertwined with our interaction with the environment. Cognition has therefore a functional and adaptive role, constantly filtering environmental input during the process of interpretation. Self-regulation, hands-on experience, mindful reflection, social interaction, critical thinking and reasoning are core elements of the constructivist approach. In order to accommodate for these needs, the instructional environment should provide with a complex and relevant representation of the real world, allow for autonomy, experimentation and social negotiation, present authentic tasks and real world scenarios and foster reflective practice (Driscoll, 2005; Lainema & Makkonen, 2003).

Games are ex vi termini associated with playful imagination -allowing learners to simulate and experiment with real-life scenarios-, social interaction with more capable peers -allowing learners to enhance their cognitive understanding-, and intrinsic motivation -required for sustaining involvement in self-regulating learning over time- (Malone & Lepper, 1987; Malone, 1981). Digital games more than any other technology have the capability to bridge the constructivist learning goals with the constructivist conditions for instruction while controlling to some extent for the potential short-comings that one-dimensional hands-on and discovery applications may have.

However, one major point of critique for constructivist methods of instructions is the element of minimally guided instruction (Kirschner, Sweller, & Clark, 2006). The

prototypical constructivist approach to teaching, is based on the assumptions that having students construct their own solutions to "authentic" problems results in a more effective learning experience and that knowledge can be best acquired though experience with the methods or processes of the discipline being studied (Kirschner et al., 2006). However this approach of minimally guided discovery has been heavily criticized with evidence existing on the contrary (Mayer, 2004). Games however can fluctuate considerably between being heavily structured (restricted play) and having no structure at all (free play) (Zimmerman & Salen, 2003). The problem with heavy structure and frequent corrective feedback is that it can have a negative impact on the engagement of the user (Huang, 2011; Moreno, 2004) while no structure, high complexity and minimal feedback can lead to high cognitive load and subsequent frustration and disengagement (Brünken et al., 2003; Merriënboer & Sweller, 2001). Like we already discussed, well-designed games implement a method of scaffolding for gradually familiarizing players with the complexity of the virtual. Many times this gradual advancement is coupled with a pattern of narrative that resembles that of the Hero's Journey (Campbell, 2003), the classic narrative of the ordinary and unaware individual (low skill level) that after receiving the call embarks on a long and perilous journey where through quests and ordeals will transform himself (advance his skills) and the world around him. Successful games therefore, by design, dictate a reconciliatory path between guided and minimally guided instruction by using engagement as an indicator of how much freedom the user can handle before they feel frustrated or lose interest.

Secondly, simple hands-on experience doesn't guarantee the deep understanding and cognitive development that constructivism envisions. Rooted in the burgeoning field of cognitive science, constructivism poses that cognitive conflict is the stimulus for learning

and determines the organization and nature of what is learnt (Savery & Duffy, 1996). The incorporation of new concepts into existing mental models or the development of new ones requires not only a "hands-on" experience, but also a "minds-on" (Pines, 1985). Games are designed to allow for the development and testing of various meta-cognitive strategies (Kim, Park, & Baek, 2009). Through a well-designed system of rules and mechanics, learners can develop cognitive strategies to win the game, but winning strategies require a gradual gain of certain declarative, procedural and strategic (tacit) knowledge (cognitive knowledge). At the same time, during experimentation and practical application of the acquired knowledge, learners enhance particular psychomotor skills such as perception, readiness to act, adaptation etc. (skill-based knowledge).

A game could therefore aspire not only to allow the transfer or construction of knowledge –factual, conceptual, procedural or meta-cognitive- but also to enhance the skills of comprehension, application, analysis, synthesis and evaluation (Krathwohl, 2002). In other words, grant the players the ability to a) retrieve relevant knowledge from memory, b) determine the meaning of instructional messages, c) apply a procedure to a given situation, d) identify the constituent parts of the material, how they relate to each other and their role in the overall structure or purpose, e) make judgments based on criteria and standards and f) create something novel out of existing elements (Krathwohl, 2002). On top of the above games also generate sets of emotional cues that the learner assigns to different phenomena enhancing the way they internalize values (moral, social or political) or respond to situations (affective knowledge).

4.5.2 Digital game design challenges

Digital games are designed experiences where the "cognitive, emotional, and kinaesthetic feedback loop that is formed between the game process and the player" can significantly affect players' moods and emotional states (Calleja, 2007). Their ability to create accurate spatial, situational or mechanical simulations combined with features that foster high levels of engagement transforms them into powerful vehicles for pedagogy. As a result, the level of sophistication achieved by this emerging technology provides developers with endless possibilities, allowing them to design highly engaging and sophisticated learning/training applications as diverse as the needs of modern institutions and organizations. However, their successful design remains to a great extent a black box, and concerns regarding their real development cost, and their long-term effect on users' attitudes and behaviors need to be explored.

One of our primary concerns regarding the implementation of such instructional tools is the fact that inevitably no game can model or incorporate all views of reality therefore it forces a particular way of thinking on the users, limiting to some extent their strategies and options to the ones the designers consider "appropriate". This particular capacity of games to force people in specific ways of thinking is in fact a double-edged sword as it can expand as well as limit people's thought/action repertoires. Many believe that behavior and the world in general are more than rational, predictable, calculable and systematic. The very use of rules that give games their great appeal, at the same time limit their outcomes. This might not be a problem when it comes to voluntary entertainment, but when it comes to crossing the line between entertainment and "serious" applications however, designers should develop ways to take into consideration the many micro actions that unconsciously influence

behavior and render our reality as complex and unpredictable as it is; ways that the very rules of the virtual world could change so as to accommodate the thirst of users for experimentation and unleash their creativity.

Another important issue that rises from the very definition of games is the result of "conflict" and competition, an integral part of the gaming experience (e.g. Zimmerman & Salen, 2003) when introduced and "endorsed" in the working environment via the use of educational digital games. There exist many theories in management that aim to remove conflict from the workplace advocating safe and cohesive environments. While the wider role of conflict in a working environment is not necessarily negative, to the extent that it creates healthy and positive involvement towards common goals (Robbins, 1978), competitive conflict has a largely negative impact on conflict efficacy –the belief that conflict can be resolved- and overall group performance (Alper, Tjosvold, & Law, 2000). Therefore, introducing an instructional tool that stimulates high competition and could result in subsequent emotional conflict –frustration, irritation, even anger- can be dysfunctional for teams or organizations especially when operating in an already tense environment.

Finally, we would like to stress that much of the desired outcomes that organizations would expect from digital games rely on their inspired design and well thought out implementation, considering every time the given context and environment. However, such talent for design is rare to come across even in the mainstream entertainment digital games industry. As renowned game designer Richard Garriott – creator of the classic Ultima series- puts it in a recent interview: "I think there's really very few great game designers. […] They clearly exist, but on the whole, I think that the design talent in our industry is dramatically lower than we need, as an industry. It's a very hard skill to learn." (Wilde, 2013). Such lack

of talent has unfortunately a negative impact on the cost of production (it costs more to attract talented designers) and also poses serious threats for the successful implementation of such software.

4.6 Conclusion

As Proserpio & Gioia (2007) aptly argue, teaching and learning pedagogies should always be aligned with the wider technical and social changes of the contemporary reality. As expected, education scholars were intrigued by the current digital game (r)evolution primarily due to the fact that: a) gaming technology has reached a level of sophistication that can offer new possibilities for instructional design and b) we welcome for the first time in our academic institutions and workplaces a generation that developed a particular set of dispositions and expectations due to their extensive interaction with digital game platforms (Brown & Thomas, 2008; Carstens & Beck, 2005; Proserpio & Gioia, 2007). This occurrence coincides with the exponential growth of the gaming industry and its consumer base (De Prato, Feijoo, & Simon, 2014), as well as with the successful penetration of digital game elements in different facets of our reality, be that communication, collaboration, learning, consumption or entertainment, via the recently emerged phenomenon of gamification (Zichermann & Cunningham, 2011).

Digital games provide with multiple opportunities for educators, however, harmonically blending pedagogy with gaming technology is not a small feat and requires a very thorough understanding of the interplay between game mechanics, motivation, engagement, subjective user characteristics and their effect on learning behavior. As a first step this paper tried to highlight the role of certain design elements that we consider as the cornerstones of motivation and engagement but are often insufficiently implemented in the design of

instructional digital games. At the same time, we tried to draw attention on the role of user dispositions in technology acceptance and their effect on engagement and learning outcomes, a discussion that is surprisingly absent from the literature.

Despite the theoretical advantages of digital games, truth remains that a large degree of their potential success lies in the quality of the design. Like with other forms of art they reflect to a certain extent the talent and available resources of their creators and as we already discussed above, both are in shortage in the industry. With the gap between existing talent and demand for game applications being as wide as ever, there is a realistic danger that poorly designed and virtually ineffective applications will swarm the market and create a bad precedent that could damage future attempts. Future research could contribute towards identifying and quantifying some of the variables that lead to more successful game-design and help unravel the true potential of the medium.

Chapter 5

Sprites and Stories: Narrative and Aesthetics as Antecedents of Engagement in Game-Based Learning Applications.

Abstract

Digital games are increasingly gaining legitimacy as viable learning/training platforms in educational and work contexts. However, while their competitive advantage is grounded in the hedonic dimension of play and its implications for user engagement and learning, the role of hedonic elements like narrative and aesthetics on player behaviors and responses has been vastly overlooked. The current study reveals the positive relationship between narrative, aesthetics, and player engagement as well as the mediating role of engagement between narrative, aesthetics and perceived learning. Moreover, it reveals that previous gaming experience doesn't moderate the positive relationship between engagement and learning.

5.1 Introduction

Digital games gradually evolved into a ubiquitous and popular medium that not only reshaped the landscape of home entertainment but also stretched the limits of training and instruction technology. Simulation games, the most prominent category of game-based instruction software, have diligently sought for decades to incorporate elements of commercial digital games associated with player enjoyment and engagement in order to

provide students and trainees with an enhanced learning experience. In the minds of educators such a crossover between instructional and digital game technology would result in higher levels of learner commitment and satisfaction, as well as enhanced learning outcomes (Alexiou et al., 2012).

Unfortunately, such implementations have not been consistently successful and oftentimes have been characterized as "dry" or "tedious" (e.g. Van Eck, 2006). In this study we will be arguing that one of the main reasons behind this shortcoming is that both research and practice have largely overlooked the important role of game aesthetics and narrative in stimulating the affective responses of players partly responsible for the high levels of engagement and "fun" that successful commercial games offer. Theories like the Interactive Cognitive Complexity (ICC) learning model (Tennyson & Breuer, 2002; Tennyson & Jorczak, 2008), highlight the role of both affective and cognitive processes in facilitating learning and suggest that successful instructional games should blend both entertainment and active learning principles in order to immerse trainees in the learning content (Sitzmann, 2011). A look at the history of digital games reveals a constant strife for pushing technology to its limits when it comes to audiovisual presentation and for a continuous sophistication of the applied narrative devices, oftentimes resulting in the transformation of games into interactive cinematic experiences. In fact, in a recent empirical study, aesthetic presentation and narrativity have been identified as two of the five most important factors contributing to the perceived enjoyment of a digital game (Hua, Cuihua, & Ritterfeld, 2009). Unfortunately, for both practical (e.g. budget concerns) as well as philosophical (e.g. Okan, 2003) reasons, both these dimensions of digital games remain overshadowed when it comes to instructional game design (Dickey, 2006b; Rice, 2007).

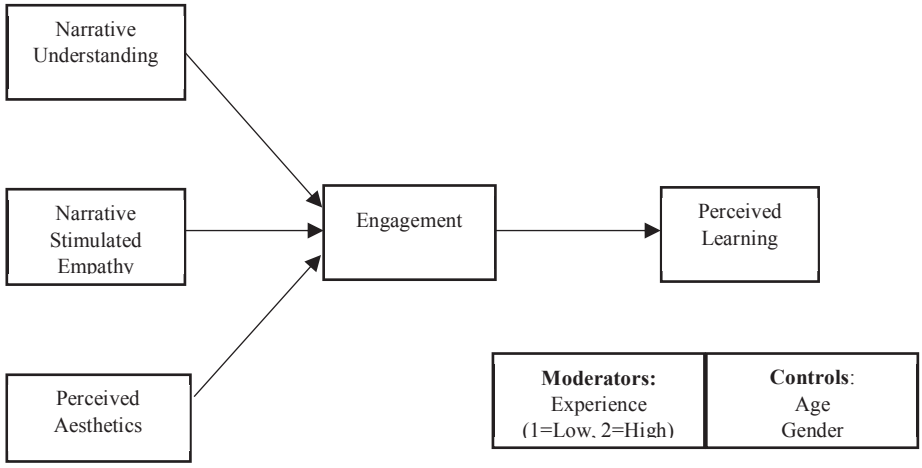
Nevertheless, in order to further explore the potential of digital gaming technology as a vehicle for instruction in organizations, it is important to explore both sides of the gaming experience: playing to learn but also playing to have fun, as the one reinforces the other. This study provides some evidence on the role of hedonic game elements in shaping the perception of users regarding the learning experience. More specifically, it is one of the first to empirically study the role of narrative devices and game aesthetics in enhancing user engagement in the context of game-based learning applications as well as the mediating role of engagement between these game elements and perceived learning. We consider perceived learning an important outcome as it can be a herald of future intention to use (i.e. technology acceptance) (e.g. Bourgonjon, Valcke, Soetaert, & Schellens, 2010), commitment to the learning activity, learner satisfaction (Baturay, 2011), as well as self-efficacy, a significant predictor of learning (Zimmerman, 2000).

In addition to these main questions, we explore the extent to which previous gaming experience moderates the aforementioned relationships (see Figure 5.1). This way we expand our understanding of whether such game elements are appealing only to experienced gamers or they could also influence the engagement levels of non-gamers, given that the recipients of game-based learning in an organizational setting would be a blend of both groups.

5.2 Digital games and Learning

Teaching and learning pedagogies ought to align with the wider technical and social changes of their contemporary times (Proserpio & Gioia, 2007). As expected, digital games were early on identified as a technology that, on one hand, could serve a generation that essentially grew up in constant exposure to the medium (Brown & Thomas, 2008; Carstens & Beck, 2005), but most importantly serve as a means to deliver better learning outcomes and enhance the motivational pull of the more traditional instructional methods. In a recent meta-analysis Wouters, van Nimwegen, van Oostendorp, and van der Spek (2013) found that serious games lead to superior learning outcomes compared to conventional instruction methods while they also foster significant knowledge retention, especially after a prolonged engagement with the medium. Similar results were reported in a meta-analysis performed by Sitzmann (2011) regarding the effectiveness of simulation games.

Figure 5.1
Theoretical Model



Possibly the most discussed attribute of digital games, enhancing their potential as learning vehicles, is their capacity to engage and motivate the user. Motivation is a strong source for learning and achievement (Ryan & Deci, 2000: p.55), and can be systematically influenced by teaching practices (Ryan & Stiller, 1991). Due to this reason, digital game designers have tried to tap into the motivational resources of individuals by incorporating certain elements and mechanics in digital game-based applications. In accordance with the main premises of self-determination theory, Deci, Rigby and Przybylski (2006) have showed that games can in fact satisfy the basic needs of people for competence, autonomy, and sociability and therefore enhance intrinsic motivation. At the same time digital games stimulate high levels of engagement, oftentimes referred to as flow (Csikszentmihalyi, 1990) and in an educational context, such deep levels of engagement can lead to optimal learning experiences (e.g. Csikszentmihalyi, Rathunde, & Whalen, 1993).

5.3 Hypothesis Development

5.3.1 Narrative-engagement link

Fisher (1987) considers human beings the creatures who tell stories –the homo narrans. According to many theorists, the main function of storytelling and the reason it holds such a prominent place in our culture is that it facilitates meaning-making (Bruner, 1990; Irwin, 1996; Sarbin, 1993). While narrative has been primarily studied in the context of literary arts, it has recently captured the attention of social scientists, where the idea of meaning-making –the act of constructing and negotiating meaning- is becoming increasingly more relevant (Jonassen & Hernandez-Serrano, 2002).

Digital games stretch the notion of narrative as it can be emergent, interactive and non-linear. It is often times that the players find themselves following a scripted path (e.g.

scripted games like Max Payne) while other-times they have complete control over the virtual environment and their actions (e.g. open world or sandbox games like Minecraft).

Like with other forms of art, during gameplay people experience intense imaginative involvement to the degree where they "[…] begin to lose track of the boundaries between themselves and the work of art" (Holland, 1989: p.66). Huizinga (1955: p.10) described the place in space and time where participants create and enter when the game begins as a "magic circle"; a temporary world "within the ordinary world, dedicated to the performance of an act apart". The role of plot, theme and narrative in games is to reinforce this "magic circle", by stimulating the imagination of users, and enhance their experienced engagement. This can be achieved primarily via empathy generated through identification with in-game protagonists, as well as through a consistent and coherent story-line that doesn't inhibit the sense-making process of the players.

The existence of characters and narrative devices in games, when properly implemented, lead to character identification and empathy that enhances the emotional engagement of users (Coplan, 2004). Due to the nature of game-play, players are exposed to the spatiotemporal perspective of their character, which is the protagonist (they are usually always at the center of the action and their character present on the screen). This causes them to process the emotional implications of narrative events from the standpoint of their character (Gernsbacher et al., 1992). As a result players imaginatively adopt their character's emotional state further reinforcing their suspension of disbelief (Bowman, Schultheiss, & Schumann, 2012).

At the same time, narrative understanding, as facilitated by a consistent and coherent storyline, plays an important role in retaining high levels of player engagement. A well

understood storyline minimizes the risk of disrupting the immersion experienced by the player due to the generation of potentially conflicting mental models of meaning that continually get constructed during gameplay. Moreover, an incoherent or conflicting storyline can introduce confusion regarding the game goals, thus raising the challenge. As a consequence, a state of deep engagement would break as the higher challenge would outweigh the skill of the player introducing therefore frustration and disrupting progress (Csikszentmihalyi, 1990). Based on the above we hypothesize that:

Hypothesis 1a: *Narrative stimulated empathy will be positively related to player engagement.*

Hypothesis 1b: *Narrative understanding will be positively related to player engagement.*

5.3.2 Aesthetics-Engagement link

The role of aesthetics in digital games is both functional and hedonic. They maximize the immersion of players in the game world by providing high fidelity sensory stimuli and for that reason they have been evolving at exponential rates over the past couple of decades. The prototypical aesthetic experience stimulates intense feelings or emotions and fixates the attention of the participant upon the components of a visual pattern in a way that excludes the awareness of external objects or events (Kubovy, 2000). Advances in 3D graphics, animation, simulated physics and photorealism bring games closer and closer to enabling this state.

Similarly, music and sound effects can arouse intense pleasurable responses by stimulating regions in the brain involved in reward and emotion (Blood & Zatorre, 2001). Besides being important for the semantic operations of games –e.g. invoking "cognitive

associations between types of music and interpretations of causality, physicality and character" (Whalen, 2004)-, audio elements enhance the emotional engagement of players, support storytelling (e.g. actor voices) and contribute to the stimulation of the players' imagination. Hence we hypothesize that:

Hypothesis 2: *Game aesthetics will be positively related to player engagement.*

5.3.3 Engagement and Learning

Perceived learning in the context of instructional design is defined as the "set of beliefs and feelings one has regarding the learning that has occurred" (Caspi & Blau, 2008, p. 327). While in some relevant studies learning is captured by measures of learning achievement (e.g. scores) in this study we chose to focus on the players' self-judgments of learning. Besides evidence that individuals are able to monitor their learning quite effectively (Metcalfe, 2009), perceived learning reflects the learner's sense that "new knowledge has been acquired and some new understanding has been achieved, even if these subjective knowledge and understanding are in contrast to academic conventions" (Caspi & Blau, 2011). As a result, perceived learning is a construct closely related to learner satisfaction (Baturay, 2011; Lee & Lee, 2008) which is of particular importance to organizations that choose to include such applications in their training and development programs.

Furthermore, existing empirical studies have shown that the deep engagement stimulated by the technological interface does indeed influence the perceptions of users regarding the technology's usefulness (Agarwal & Karahanna, 2000). Theoretically, the nature of this relationship can be explained by the theory of self-perception (Bem, 1967). The theory highlights the tendency of individuals to rationalize their actions in order to reduce cognitive dissonance. In the case of technology mediated instruction the state of deep

absorption experienced by players would heighten perceptions of usefulness (Saadé & Bahli, 2005).

Based on the above we would expect that the relationship between engagement and perceived learning to be similar in nature to the relationships between engagement and satisfaction or engagement and perceived usefulness as it captures elements of both. Therefore, we hypothesize:

Hypothesis 3: *User engagement will be positively related to perceived learning.*

5.3.4 The role of engagement as a mediator between game elements and perceived learning

Stories are essentially recognized as part of our cognitive repertoire for thinking, understanding, explaining, remembering and crafting our sense of self (Clark & Rossiter, 2008; Jonassen & Hernandez-Serrano, 2002). As such, narrative is deeply embedded in human learning as it enhances the mental organization of information (Falk & Dierking, 2000), as well as the structuring and remembering of new knowledge and experiences (Mandler, 1984). Given the above we would expect a positive relationship between narrative and perceived learning on the premise that the more the player understands, connects with and follows the narrative, the more knowledgeable about the context, the story and the overall meaning of the exercise she would feel. However, this is an indirect relationship since the involvement and connectedness with the narrative translates in higher engagement that consequently leads to higher perceived learning. A confusing or uninteresting narrative, would fail to motivate the player to invest their cognitive and emotional resources to follow

the story, something that would eventually be translated into limited perceived learning. Based on the above we hypothesize that:

Hypothesis 4a: *User engagement mediates the positive relationship between narrative understanding and perceived learning*.

Hypothesis 4b: *User engagement mediates the positive relationship between narrative stimulated empathy and perceived learning*.

The aesthetics of a game can have a similar effect on perceived learning. The more "orderly", precise and intuitive a virtual environment is, the better the player can navigate through it. The more realistic an environment is, the better able is the player to guess its different properties based on knowledge of its real-world counterpart. For instance, higher degree of fidelity in graphics allows for more accurate representations and manipulation of virtualized real world objects or places. These elements enhance the learning facilitation of games, influence the perceptions of players regarding their effectiveness, and at the same time enhance knowledge transfer to the real world due to better achieved similarity between the two environments.

Given the above, we could expect game aesthetics to positively influence perceived learning. However this relationship, like in the case of narrative, is also mediated by user engagement since the higher the fidelity or appeal, the more engaged the player would be (Wood et al., 2004). Higher engagement results in larger investment of resources to explore and experiment with the game world, consequently leading to higher perception of learning achievement. Therefore, we hypothesize that:

Hypothesis 4c: *User engagement mediates the positive relationship between aesthetics and perceived learning.*

5.3.5 The moderating role of gaming experience

Previous gaming experience is used in this study as a multi-group moderator in order to explore whether players with high previous gaming experience translate their engagement into higher perceived learning outcomes. Due to common misconceptions regarding digital gaming, oftentimes gamers find themselves in a position where they need to defend their passion and justify the time they invest in it. The possibility of gameplay to have a widely-accepted positive impact on the player, ascribes value and a higher meaning to the activity. That could positively influence the perceptions of experienced gamers in a way that the impact of absorption on perceived learning is higher for players that have significant experience with video games compare to those that do not. Hence:

Hypothesis 5: *Previous gaming experience moderates the positive effect of engagement on perceived learning such that the effect is stronger when experience in higher*.

5.4 Research Methodology and Analysis

5.4.1 Study Context and Sample

We empirically tested the relationships implied by our research model and the research hypotheses via a survey. Participants were 133 students from a major university in the Netherlands. The mean age was 22 years, with fifty-eight percent being male. The game of choice for this study was Papers Please (2013) a critically acclaimed game. The game puts the player in the position of an immigration officer in a fictional dystopian country during an era that resembles that of the Cold War. While the player experiences the mundane task

of checking the passports of people entering the country, certain events happen that aim at educating the player on the political background as well as the hardships of living in such a state and era, while enhancing certain skills such as decision making or attentiveness. All participants were asked to join a game session, immediately after which they filled out the survey.

Each game session lasted 45 minutes, thus allowing enough time for the player to get absorbed in the virtual world, the characters and the events that unfolded without however causing extensive fatigue that could influence their responses during the 15-minute surveying session that followed. The sessions took place in a dedicated room at the university campus with a minimalistic interior. Participants' working computers were positioned in such a way so that they never faced each other while they all wore earphones. One of the researchers was always present during the session without however interfering and the players were not allowed to ask questions during the game session or the survey. All participant information was treated confidentially.

5.4.2 Operationalization of Research Variables

All research variables were measured using multi-item scales. User engagement was measured by a latent variable that included two dimensions of the cognitive absorption construct developed and validated by Agarwal & Karahanna (2000). Cognitive absorption is a multidimensional construct that assesses the different manifestations of engagement in human-computer interaction, however due to the nature of this study only the dimensions of temporal dissociation (loosing track of time) and focused immersion (intense concentration) were considered relevant in capturing the state of deep engagement with the digital game. Consequently, the dimensions of curiosity, heightened enjoyment and control were not used

since they are related to but not equivalent to the experience of deep engagement. All items were scored on a seven-point rating scale ranging from 1 ('strongly disagree') to 7 ('strongly agree'). Example questions of the temporal dissociation dimension are "sometimes I lost track of time during the game" and "time appeared to go by very quickly when I was playing the game" while examples of the focused immersion dimension are "during the game, I was able to block out most other distractions" and "while I was playing the game, I was absorbed in what I was doing". In the present study Cronbach's alpha was .91.

Perceived aesthetics were measured following the recommendations of Lee and Koubek (2010). Example items are "overall, I am satisfied with the appearance of this game" and "I feel the design of this game is pleasant". Cronbach's alpha was .88.

Narrative understanding and (narrative-stimulated) *empathy* were measured using the respective narrative understanding and the narrative emotional engagement scales developed and validated by Busselle and Bilandzic (2009). Example items are: "I had a hard time recognizing the thread of the story" and "at important moments during the game, I could feel the emotions the characters felt". Cronbach's alpha was .90.

Finally, perceived learning was measured using four items that relate to the cognitive aspects of perceived learning, adapted from Barzilai and Blau (2014). Examples are: "I learned a lot from the game" and "I learned new things from the game". Cronbach's alpha was .95. Age and gender were used as control variables.

5.4.3 Data analysis and results

As a first step, we performed an exploratory factor analysis (EFA) using the SPSS 21 software package in order to assess the psychometric properties of the scales used in our

model in terms of adequacy, convergent validity, discriminant validity, and reliability. All measures indicated no issues therefore we employed structural equation modelling (SEM) techniques using the AMOS 22 software package to do a confirmatory factor analysis to test the validity and assess our model for common method bias before we proceeded with testing the hypothesized relationships.

5.4.3.1 The measurement model

Table 5.1 shows the means, standard deviations, and correlations between the model variables. The control variables (age, gender) are also included in this table. We assessed our model in terms or convergent and discriminant validity, as well as internal consistency by checking the Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and Average Shared Variance (ASV) scores (see table 5.2). CR was consistently above the 0.7 threshold therefore indicating no reliability concerns, AVE was consistently above the 0.5 threshold therefore raising no convergent validity concerns and finally MSV and ASV were found consistently lower than AVE therefore suggesting no discriminant validity concerns. The aforementioned thresholds follow the suggestions of Hair, Black, Babin, and Anderson (2010).

Due to concerns that the single method used to collect the data (in our case the post-game survey), may have introduced systematic response bias that could either inflate or deflate responses, we tested our model for Common Method Bias (CMD). Given the very limited chance of capturing a social desirability bias with our questionnaire we opted to employ a common latent factor method to address any common method bias issues. By comparing the standardized regression weights between all observed items in the model while the CLF was present and not, we concluded that none of our factors were affected by

Table 5.1
Means, standard deviations and correlations of model variables, N= 133.

	Mean	**SD**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Age	22.44	2.63								
2. Gender	1.42	.49	-.345**							
3. Experience	1.17	.380	-.174*	.415**						
4. Engagement: Focused Immersion	4.85	1.23	-.220*	.026	.024					
5. Engagement: Temp. Dissociation	4.24	1.47	-.098	.024	.045	.654**				
6. Narrative Understanding	4.22	1.38	-.121	-.055	-.052	.240**	.088			
7. Narrative Stimulated Empathy	3.36	1.37	-.149	.001	-.036	.485**	.388**	.065		
8. Perceived Aesthetics	3.48	.98	.044	-.28**	-.067	.398**	.330**	.416**	.481**	
9. Perceived Learning	4.01	1.59	-.109	.014	-.0.43	.608**	.515**	.374**	.514**	.525**

**. Correlation is significant at the 0.01 level.
*. Correlation is significant at the 0.05 level.

CMB as the differences between items were consistently kept at a level lower than 0.2. The measurement model including the variables narrative empathy, narrative understanding, perceived aesthetics, engagement, perceived learning, age and gender fit well to the data, CMIN/DF = 1.38, CFI = 0.98, PCLOSE =0 .79 and RMSEA =0 .04.

Table 5.2
Convergent validity, discriminant validity and reliability tests.

	CR	AVE	MSV	ASV
Engagement: Focused Immersion	0.84	0.58	0.33	0.19
Engagement: Temporal Dissociation	0.92	0.73	0.32	0.17
Perceived Aesthetics	0.88	0.51	0.23	0.16
Narrative Stimulated Empathy	0.90	0.63	0.24	0.16
Narrative understanding	0.78	0.55	0.15	0.07
Perceived Learning	0.95	0.82	0.33	0.23

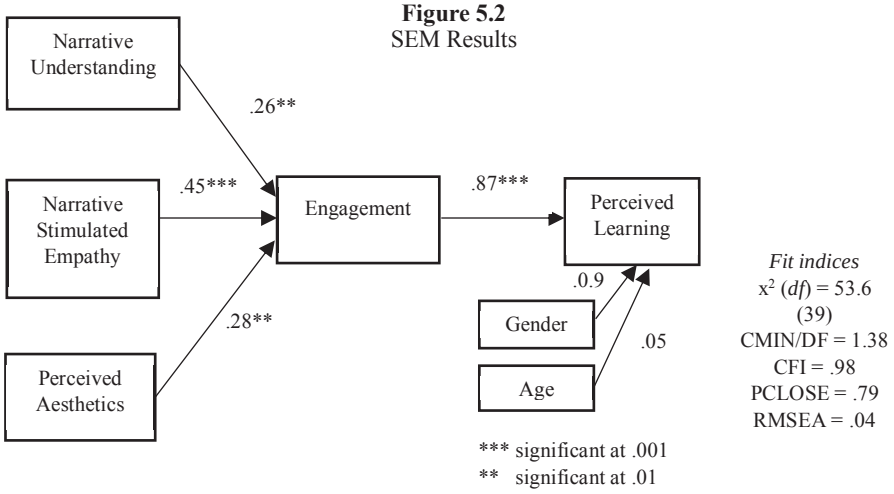
5.4.3.2 The structural model

Figure 5.2 provides the results of the SEM. As can be seen from the standardized regression weights provided in the figure, both the two narrative design dimensions (narrative understanding and empathy) as well as the aesthetic value of the game are positively and significantly related to engagement. As a result, both hypotheses H1a and H1b, as well as Hypothesis 2 are accepted. At the same time, user engagement is positively and significantly related to perceive learning as predicted by hypothesis H3.

We first tested for mediation by following the Baron and Kenny approach and then we applied bootstrapping in our structural model to explore the hypothesized indirect relationships. The direct effects of the two narrative dimensions (understanding and empathy) and aesthetics on perceived learning are strong and significant (β=0.24, p=0.001

β=0.37, p <0.001 and β=0.28, p=0.002 respectively). When the mediator is included in the model the direct effects of narrative understanding and aesthetics on perceived learning are diminished and drop out of significance while the direct effect of empathy remains strong and significant. According to the Baron and Kenny approach the above signify full mediation in the cases of narrative understanding and aesthetics (Baron & Kenny, 1986).

Figure 5.2
SEM Results



We further tested the proposed mediating effects via bootstrapping. Using AMOS 22, we resampled 2000 times and obtained the estimates and the confident intervals for the indirect effects. Analysis resulted in a significant positive indirect effect of narrative understanding on perceived learning mediated by user engagement (β=0.23, CI = 0.11, 0.35, a = 0.05), a significant positive indirect effect of empathy on perceived learning mediated by user engagement (β=0.42, CI = 0.29, 0.55, a = 0.05), and, finally, a significant positive indirect effect of aesthetics on perceived learning mediated by user engagement (β=0.24, CI

= 0.10, 0.37, a = 0.05). The above analysis support hypotheses H4a, H4c while results are inconclusive regarding H4b.

Finally, the multi-group moderation, contrary to expectations didn't support hypothesis 5. As seen in table 5.3, there is no significant difference between the two groups regarding the relationship between engagement and perceived learning nor for any other relationship in the model except for the relationship between narrative understanding and engagement.

Table 5.3
Multi-group Moderation Effects of Video Game Experience on the Relationship between Engagement and Perceived Learning.

			No Previous Experience		Previous Experience		
			Estimate	P	Estimate	P	z-score
Engagement	←	Nar: Understanding	0.04	0.42	0.18	0.00	-1.69*
Engagement	←	Nar: Empathy	0.21	0.08	0.30	0.00	-0.60
Engagement	←	Aesthetics	0.20	0.12	0.27	0.01	-0.41
P.Learning	**←**	**Engagement**	**2.78**	**0.05**	**0.99**	**0.00**	**-0.20**
P.Learning	←	Gender	-0.27	0.57	1.46	0.00	0.90
P.Learning	←	Age	-0.03	0.71	0.30	0.21	-1.07

Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10

5.5 Discussion

In an attempt to further understand the effect of different game elements on player motivation and gameplay outcomes we explored the impact of in-game narrative and aesthetics on user engagement and the perceived learning of players. These two dimensions of games were chosen because they stimulate fantasy, which is an important predictor of immersion (Kenny & Gunter, 2008; Malone, 1981) and are greatly responsible for the enjoyment experienced by the player (Sweetser & Wyeth, 2005). As predicted, both game layers positively influence perceived learning via high levels of engagement. Player engagement and immersion is the main engine of the gameplay experience, therefore design

elements that help to reinforce the absorption of players are important for delivering a variety of outcomes, learning included. This has important implications for the design of learning applications as it highlights the importance of elements that are often disregarded as not directly related to the learning process itself and are typically absent from popular training simulations. Our findings contribute to the recent attempts to better understand and theorize on the components and implications of the gameplay experience.

5.5.1 Main contributions

A major contribution of this study is that it expands previous empirical studies that have shown that certain game elements stimulate high levels of engagement on digital game users (e.g. Hsu & Lu, 2004; Vorderer, Hartmann, & Klimmt, 2003; Westwood & Griffiths, 2010; Yee, 2006). Narrative in particular has been argued to be an inherent part of gameplay (e.g. Busselle & Bilandzic, 2008; Dickey, 2006), however we were missing the mechanism through which such game elements can influence learning and attitude effects on users. Our results show that two instances of narrative experience (i.e. narrative understanding and empathy) positively influence perceived learning via deep engagement. This can be theoretically understood when considering the role of imagination and fantasy on player engagement. Fantasy is an integral part of the gameplay experience and narrative elements in essence stimulate the imaginative involvement of the player, thus leading to higher immersion (Gunter, Kenny, & Vick, 2008; Kenny & Gunter, 2008; Murray & Maher, 2011).

In a similar fashion, the sophistication of the audiovisual elements of the game further influence the engagement level of players, justifying the frenzy with which the gaming industry invests in and advances the graphic engines, the soundtracks as well as the acting and recording of in-game voices oftentimes by professional actors (Collins, 2008). Our

results show that perceived game aesthetics relate significantly with both user engagement as well as perceived learning. The second relationship signifies that the fidelity of a game's audiovisual elements not only generates the desired stimuli enhancing the emotional appeal of a game, but also assists the player to interact and understand better the virtual environment, leading to higher perceptions of learning.

A third important contribution is that previous gaming experience, contrary to our expectations doesn't moderate the perceptions of players regarding the perceived learning achieved in the gaming session. This means that there is no significant difference between gamers and non-gamers regarding how they translate engagement in enhanced learning outcomes. This result has important implications for organizations that consider integrating such tools in the training of a heterogeneous working force.

5.5.2 Limitations

Three limitations of the present study should be emphasized. First of all, this study utilizes a cross-sectional design which by definition precludes conclusions about causal relationships between the variables. While we have theoretically established some causal mechanisms that govern the relationships in our model, the present findings should be interpreted with caution until future longitudinal studies replicate them.

Additionally, our sample is exclusively comprised of student participants, and thus, it might not be fully representative of the general population. However these individuals are destined to become part of the future workforce and are in a sense representative of the virtual generation that possesses certain dispositional characteristics that bear important implications for organizations worldwide (Beck & Wade, 2004).

Finally, the data were collected based on the experience of participants with a single game that was picked based on a particular set of criteria therefore it is difficult to generalize to the whole populations of similar applications, since such games vary greatly in terms of quality and scope. We would expect however similar results with most of the games that have been developed by following modern game design standards.

5.5.3 Implications for future research

Digitals games constitute a prosperous area for research in the field of information systems given their disruptive nature for organizations and their technological underpinnings. Tapping into the potential leaning/training capacity of digital games however requires a good understanding of the interplay between the different game elements, user engagement and its impact on learning outcomes. Thus far, most existing game research focuses on the role of elements like competition, challenge, feedback or goal-setting all of which relate to the design layer of game mechanics and are responsible for the cognitive engagement of users. This study however showed that the hedonic layers of games play an equally important role in enhancing user engagement and supporting perceptions of learning.

There are however still many questions that remain unanswered, especially regarding the role of other potential moderators primarily in terms of individual differences. Dispositional characteristics such as learning goal orientation or learning style preferences could be such factors. Additionally, the fact that a portion of the general population remains unattracted to digital games could also be hinting the potential existence of personality characteristics that regulate attraction and engagement. Such factors could be for example need for cognition, openness to experience or sensation seeking (Alexiou & Oshri, 2013).

In terms of outcomes, this study focused on perceived learning because it was deemed an important predictor for technology adoption, self-efficacy, learner satisfaction and perceived usefulness. However, what remains to be explored is the impact of in-game engagement on objective learning achievements and most importantly learning transfer. Experimental and longitudinal designs would be a great way for exploring the above pressing questions.

5.6 Concluding remarks

Digital games are essentially designed experiences where players experience a cognitive, emotional, and kinaesthetic feedback loop (Calleja, 2007) that stimulates them at different levels. Moreover, their capacity to enrich the spatial, situational or mechanical simulations that often lie in their core with hedonic features that foster high levels of engagement transforms them into a powerful vehicle for pedagogy. The level of sophistication achieved by this emerging technology provides developers with endless possibilities, allowing them to design highly engaging learning/ training applications as diverse as the needs of modern organizations.

Unfortunately relevant research is still at a nascent stage (Liu, Li, & Santhanam, 2013) and the exponential growth and diffusion of such application in organizational settings requires our scholarly attention. Given that this phenomenon has multiple underpinnings (behavioral, technological, organizational), IS scholars, can highly contribute towards the development of the much needed theoretical foundations as well as the first wave of empirical evidence that will allow organizations to better integrate such tools in their operations as well as contribute to the design of more relevant and effective training solutions.

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Thesis Summary

The aim of this PhD thesis is to shed light on different aspects of the phenomenon of emerging technologies and their implications for modern organizations. Emerging technologies are leading-edge innovations (e.g. nanomaterials, 3D-printing, 5G cellular communications) that are often considered harbingers of change for firms operating within the affected industries. As such, they are often found at the epicenter of both scholarly and managerial attention. The thesis is comprised of five chapters and it is structured around the relationship between emerging technologies and learning in an organizational context.

The thesis is organized around two main parts. In the first part, I take organizational learning as a starting point in order to investigate its relationship with two important organizational challenges inherent to the management of emerging technologies: a) the successful adoption of emerging technologies and b) the management of change that emerging technologies stimulate for incumbent firms at an internal (the firm itself) and external level (it's wider environment). In this context, absorptive capacity and organizational resilience are proposed as two valuable capabilities that contribute towards the successful technology adoption and management of radical technological change. Absorptive capacity reflects the ability of a firm to recognize the value of new information, assimilate it, and apply it to commercial ends while organizational resilience represents the meta capability of firms to manage and capitalize on adversity. The second part of the thesis looks at how and under which conditions emerging technologies (in this case Serious Games) facilitate learning among organizational members. The two chapters of this part

(chapter 4 and 5) explore in detail the technological, motivational and psychological antecedents of learning in the context of Serious Games technology.

In chapter 2, I argue that structural conditions influence organizational members at an affective/cognitive level, which through the processes of affective contagion and social interaction manifests at an emergent, collective level. This phenomenon of collective energy, represents the degree of mobilization of an organization's affective, cognitive and behavioral resources. In turn, it enables the indirect relationship between organizational structure and the learning processes related to the absorption and exchange of knowledge within the organization. Through a field study among 111 firms I find confirmation of my hypotheses that organizational structure is a key antecedent of absorptive capacity and that organizational energy plays a mediating role in the above relationship. Finally, my findings validate the positive effect of absorptive capacity on the adaption of emerging technologies.

Chapter 3 is a conceptual study that focuses in conceptualizing and uncovering the antecedents of organizational resilience. Organizational resilience is this context is perceived as the capacity of firms to capitalize on environmental change such as the one caused by the arrival of emerging technologies. By fusing on theories and insights from the fields of strategy, human resource management and organizational behavior this paper departs from the traditional definition of organizational resilience as the capacity to bounce back from adversity. Instead, this chapter conceptualizes organizational resilience as a meta-capability that allows an organization to not only recover but also capitalize on adversity (something important for its long-term survival). This valuable meta-capability derives from a group of distinct capabilities that get enacted during the three major phases of an organization's response to radical change, namely, the incubation phase, the impact phase and the enhanced

equilibrium phase. Building around this premise the paper synthesizes a working definition of organizational resilience and explores the construct's dimensions and outcomes as well as the behavioral, operational and strategic underpinnings of its antecedents. In doing so, it contributes to the fragmented and undertheorized literature of organizational resilience and provides with a foundation for future empirical research in the context of emerging technologies.

The first chapter of the second part of this thesis (Chapter 4), is a conceptual paper that explores the learning potential of Serious Games technology. In this chapter, I provide a novel integrative conceptualization of the role of game elements and user characteristics in supporting desirable learning outcomes. By means of eleven propositions, I formalize the relationships between specific game elements, user engagement and learning outcomes. By drawing upon theories of motivation, personality and game design, the paper theoretically explores the role of narrative, aesthetics and core game mechanics in facilitating higher learning outcomes through a motivation-engagement loop. At the same time, it takes into consideration the moderating role of player personality dispositions such as goal orientation, sensation seeking and need for cognition. The chapter provides future research with a foundation on the different game components that could be influencing learning in the context of gaming technology. It also contributes to our limited understanding of how user dispositions could be influencing the effectiveness of such technologies, an aspect that has been vastly neglected by relevant literature. Finally, by adopting a constructivist learning lens, it discusses the different opportunities and challenges that spring from the blending of gaming technology and pedagogy.

Chapter 5 of the thesis draws on the conceptual work of the previous chapter. I empirically investigate the nature of the relationship between narrative, aesthetics, player engagement and perceived learning by analyzing survey data from 133 users that participated in a specially designed gaming session. This study successfully contributes to the limited existing empirical evidence linking specific game elements to user engagement. In particular, it theoretically establishes and empirically validates the important role of narrative in facilitating user engagement, reinforcing the view that digital games can provide with a fulfilling narrativist experience that complements the ludic experience of gameplay. Similarly, audiovisual elements further enhance user engagement justifying the continuous growth in investment of the gaming industry in increasing the fidelity and realism of their game engines. Lastly, this study explores whether certain effects in the model tend to be stronger for experienced gamers compared to non-gamers. Contrary to expectations, previous gaming experience doesn't influence the perceptions of players regarding the perceived learning achieved in the gaming session. The above, constitutes encouraging evidence in that the learning effectiveness of such applications is not heavily dependent on the predisposition of users towards digital game technology.

Samenvatting (Dutch Summary)

Het doel van dit proefschrift is om inzicht te bieden in verschillende aspecten rondom het fenomeen opkomende technologieën en de implicaties ervan op moderne organisaties. Opkomende technologieën zijn innovaties van het hoogste niveau van ontwikkeling (bijvoorbeeld nano-materialen, 3D-printen, en 5G cellulaire communicatie). Deze technologieën worden vaak gezien als een voorbode voor verandering voor bedrijven die opereren in een industrie dat beïnvloedt wordt door de technologie. Om deze reden staan opkomende technologieën dan ook in het middelpunt van aandacht van zowel wetenschappers als managers. Dit proefschrift bestaat uit vijf hoofdstukken die gaan over de relatie tussen opkomende technologieën en het leerproces in organisaties.

Het proefschrift bestaat uit twee delen. In het eerste deel neem ik het leerproces in organisaties als startpunt en bestudeer ik de relatie ervan met twee belangrijke organisatie uitdagingen die inherent zijn aan het managen van opkomende technologieën: a) het succesvol adopteren van opkomende technologieën, en b) het managen van de veranderingen die de opkomende technologie met zich meebrengt voor de gevestigde organisatie op zowel intern niveau (binnen de organisatie zelf), als extern niveau (in de omgeving van de organisatie). Hierbij wordt de absorptiecapaciteit en veerkracht van organisaties geïntroduceerd als twee waardevolle eigenschappen die bijdragen aan het succesvol adopteren van een opkomende technologie en aan het managen van radicale technologische verandering. Absorptiecapaciteit is de capaciteit van een organisatie om nieuwe informatie te kunnen herkennen, assimileren, en toe te passen op commerciële doeleinden. Organisatieveerkracht is een meta-vaardigheid van organisatie die hen in staat stelt om tegenspoed te managen, en erop te kapitaliseren. Het tweede deel van dit proefschrift

bestudeert hoe, en onder welke omstandigheden opkomende technologieën (in dit geval: Serious Games) het leerproces in organisaties kan faciliteren. De twee hoofdstukken van dit deel (Hoofdstuk 4 en 5) onderzoeken in detail de technologische, motiverende en psychologische antecedenten van het leerproces in de context van de Serious Games technologie.

In Hoofdstuk 2 beargumenteer ik dat structurele karakteristieken van organisaties, organisatieleden op een affectief/cognitief niveau beïnvloeden wat zich daarna, door processen van affectieve besmetting en sociale interactie, manifesteert op een opkomend, collectief niveau. Dit fenomeen van collectieve energie representeert de mate van mobilisatie van de affectieve-, cognitieve- en gedragsmiddelen. Het zijn deze middelen die de indirecte positieve relatie tussen organisatiestructuur en het leerproces met betrekking tot absorptie en uitwisseling van kennis, mogelijk maken. Door middel van een veld studie onder 111 organisaties toets ik mijn hypotheses. Mijn bevindingen laten zien dat organisatiestructuur een kern antecedent is van absorptiecapaciteit en dat organisatie energie een mediërende rol speelt in deze relatie. Bovendien valideren mijn bevindingen het positieve effect van absorptiecapaciteit op het succesvol adopteren van opkomende technologieën.

Hoofdstuk 3 is een conceptuele studie met als doel het conceptualiseren en ontdekken van de antecedenten van organisatieveerkracht. Organisatieveerkracht wordt in deze context gezien als de mate waarop bedrijven kunnen kapitaliseren op veranderingen in de omgeving, zoals bijvoorbeeld veranderingen die veroorzaakt worden door de opkomst van nieuwe technologie. Door theorieën en inzichten uit het gebied van strategie, human resource management en organisatiegedrag met elkaar te fuseren, neemt dit onderzoek afstand van de traditionele definitie van organisatieveerkracht als zijnde de capaciteit van organisaties om

terug te komen van tegenspoed. In plaats daarvan, wordt organisatieveerkracht gedefinieerd als een meta-vaardigheid die organisaties in staat stelt om niet alleen terug te komen van tegenspoed, maar ook te kapitaliseren op tegenspoed (iets dat belangrijk is voor de lange-termijn overlevingskansen van organisaties). Deze waardevolle meta-vaardigheid kan worden afgeleid van een aantal specifieke vaardigheden die worden geactiveerd tijdens de drie hoofdfases van response op radicale verandering; de incubatie fase, de impact fase en de versterkte evenwichtsfase. Voortbouwend op deze premisse, ontwikkelt dit onderzoek een definitie van organisatieveerkracht en bestudeert het zowel de dimensies waaruit dit construct bestaat, als de gevolgen, en de operationele, strategische en gedragsantecedenten ervan. Hiermee draagt mijn conceptuele studie bij aan de literatuur over organisatieveerkracht welke sterk gefragmenteerd is en een gebrek heeft aan een sterke theoretische basis. Deze studie biedt daarom een fundatie voor toekomstig empirische onderzoek over opkomende technologieën.

Het eerste hoofdstuk van deel twee van dit proefschrift (Hoofdstuk 4) is een conceptuele studie naar de leerpotentie van de Serious Games technologie. In dit onderzoek leg ik een nieuwe, geïntegreerde conceptualisatie voor over de rol van spelelementen en gebruiker karakteristieken in het behalen van gunstige leerdoelen. Door middel van elf proposities formaliseer ik de relatie tussen specifieke spelelementen, gebruiker betrokkenheid, en leerdoelen. Door inzichten te halen uit theorieën over motivatie, persoonlijkheid en spelontwerp onderzoek ik de rol van narratief, esthetiek en kern spelmechaniek in het faciliteren van betere leerresultaten door middel van de motivatie-betrokkenheid loop. Hierin wordt bovendien ook de modererende rol van gebruiker disposities, zoals doel oriëntatie, het verlangen naar sensatie, en de behoefte aan cognitie, meegenomen. Dit hoofdstuk biedt toekomstig onderzoek inzicht in de spelelementen die

invloed kunnen hebben op het leerproces bij het gebruik van de gaming technologie. Het draagt ook bij aan de gebrekkige kennis over hoe gebruiker disposities de effectiviteit van deze technologie kan beïnvloeden. Dit is aspect heeft tot nu toe zeer weinig aandacht gekregen in de literatuur. Tenslotte, door een constructivistische leer lens op te doen, bespreekt dit onderzoek de verschillende kansen en uitdagingen die ontstaan wanneer de gaming technologie wordt gebruikt in pedagogie.

In Hoofdstuk 5 van dit proefschrift bouw ik voort op het conceptuele werk in Hoofdstuk 4. Ik onderzoek empirisch de relatie tussen narratief, esthetiek, gebruiker betrokkenheid en gepercipieerd leereffect, door enquête data te analyseren van 133 gebruikers die deel hebben genomen aan een speciaal ontworpen gaming sessie. Dit onderzoek levert een waardevolle bijdrage aan de beperkte empirisch onderzoek dat specifieke spelelementen verbindt met gebruiker betrokkenheid. In meer specifieke termen, valideert dit onderzoek de belangrijke rol van narratief in het faciliteren van gebruiker betrokkenheid. Hiermee wordt het argument versterkt dat digitale spellen een voldoening gevende, narratieve ervaring kunnen bieden waarmee de ludieke ervaring van gaming gecomplementeerd kan worden. Ook audiovisuele elementen dragen bij aan het versterken van gebruiker betrokkenheid. Dit rechtvaardigt de aanhoudende investeringen in de gaming industrie om spellen meer realistisch en natuurgetrouw te maken. Als laatste bestudeert dit onderzoek of de gevonden relaties in het model sterker zijn voor ervaren gamers dan voor niet-ervaren gamers. In tegenstelling tot wat verwacht werd, beïnvloedt gaming ervaring niet het gepercipieerde leereffect van gebruikers na een gaming sessie. Deze bevindingen zijn aanmoedigend omdat ze laten zien dat het leereffect van deze applicaties niet sterk afhankelijk is van de aanleg van gebruikers om digitale spel technologie te gebruiken.

About the Author

Andreas Alexiou has studied International and European Economics and Politics at the University of Macedonia, Thessaloniki, Greece where he obtained a bachelor's and a master's degree focusing on International Economics (2005, 2007). He then continued his studies at the Warwick Business School, University of Warwick, UK, where he graduated with a master's degree in Information Systems and Management (2008) before continuing his academic journey as a PhD Candidate at the Rotterdam School of Management, Erasmus University, the Netherlands. He joined the Strategy and Entrepreneurship department of RSM in 2010 as a Marie Curie early stage researcher and was part of the MANETEI (Management of Emerging Technologies for Economic Impact) network. While at RSM he was a member of the Erasmus Centre for Behavioural Operations Management (ECBOM).

His main research interests include the micro-foundations of organizational learning, the management of emerging technologies and the learning/training implications of digital game-based technology such as Serious Games and Virtual Worlds for organizations. He presented his work at leading international conferences including Academy of Management (2013, 2014, 2015), European Group for Organizational Studies (2013) and European Academy of Management (2011, 2012) annual meetings. His articles have been published in *Psychology* (2012) and the *Managing Emerging Technologies for Socio-Economic Impact,* Assimakopoulos, D., Oshri, I., Pandza, K. (Eds.), Edward Elgar (2015), while other articles are currently under review in leading management and information systems journals. In addition to his research he has lectured and supervised students at the bachelor's and master's programs of Rotterdam School of Management, Erasmus University and Amsterdam Business School, University of Amsterdam.

Author Portfolio

Publications

Publications in journals and conference proceedings:

Alexiou, A., (2015), Taming the waves of adversity: Exploring the multidimensional construct of organizational resilience. In: D. Assimakopoulos, I. Oshri, & K. Pandza, (Eds.). Managing Emerging Technologies for Socio-Economic Impact. Edward Elgar, Cheltenham, UK.

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Alexiou A., Khanagha, S., Productive Organizational Energy mediates the impact of organizational structure on Absorptive Capacity.

Alexiou A., Sprites and stories: The impact of hedonic game elements on perceived learning outcomes.

Selected work in progress:

Alexiou A., Shared leadership and team learning behaviors: The mediating role of productive energy.

Alexiou A., Khanagha, S., Restructuring and the shaping of productive organizational energy: The impact on absorptive capacity in the context of M&As.

Selected Conference presentations:

Alexiou, A., Doerga, A. (2015), Sprites and stories: The impact of hedonic game elements on perceived learning outcomes. *Academy of Management annual meeting*, Vancouver, Canada.

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Alexiou, A., Schippers, M. C. & Oshri, I. (2013), Exploring the learning potential of serious games: The role of game features and individual differences in user engagement and learning*, Academy of Management annual meeting,* Florida, US.

Teaching and supervising activities:

Microeconomics & Markets (International Business Administration Bachelor's programme, RSM, Erasmus University).

Strategic Management (Business Administration Bachelor's programme, ABS, University of Amsterdam).

Strategic Management Research Clinic (Strategic Management Master's programme, RSM, Erasmus University).

Research Training and Bachelor Thesis Course (Business Administration Bachelor's programme, RSM, Erasmus University).

Master's Thesis Supervision (Strategic Management/Information Systems, RSM, Erasmus University).

Master's Thesis Supervision (Strategic Management, ABS, University of Amsterdam).

Bachelor's degree in International Business Administration, thesis supervision (RSM, Erasmus University).

Summer Schools and Special Training (selected):

Grenoble Ecole de Management, France (2012): Summer School on *Technology Dynamics & Knowledge-Based Innovation.*

Bayer, Cologne, Germany: Bayer Industry Event (2013) on *Open Innovation: Opportunities and Challenges.*

Rotterdam School of Management, Erasmus University, the Netherlands (2013): Summer Training School on *Entrepreneurship and Creation of New Capabilities.*

European Institute for Advanced Studies in Management (2013): *EDEN doctoral seminar on Social Network Analysis: Theory and Methods.*

Facilitating ERPsim: Running Successful Business Simulation Games with ERPsim (openSAP certification).

Language skills and certifications:

Michigan University English Proficiency

TOEFL

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Andreas Alexiou was born on August 3rd, 1981 in Larisa/Greece. He studied International and European Economics and Politics in the University of Macedonia, Thessaloniki, Greece where he obtained a bachelor's and a master's degree. He then continued his studies at the Warwick Business School, University of Warwick, UK, where he graduated with a master's degree in Information Systems and Management in 2008, before continuing as a PhD Candidate at the Rotterdam School of Management Erasmus University. He joined the Strategy and Entrepreneurship department of RSM in 2010 as a Marie Curie early stage researcher and part of the MANETEI (Management of Emerging Technologies for Economic Impact) project.

His main research interests include the micro-foundations of organizational learning, management of emerging technologies, and learning/training effectiveness of digital game-based technology. He presented his work at leading international conferences including Academy of Management (2013, 2014, 2015), European Group for Organizational Studies (2013) and European Academy of Management (2011, 2012) annual meetings. His articles have been published in **Psychology** (2012) and the **Managing Emerging Technologies for Socio-Economic Impact**. Assimakopoulos, D., Oshri, I., Pandza, K. (Eds.), Edward Elgar (2015), and other articles are currently under review in leading management and information systems journals. In addition to his research he has lectured and supervised students in the bachelor's and master's programs of Rotterdam School of Management, Erasmus university and Amsterdam Business School, University of Amsterdam.

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