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Virtual Worlds: S(t)imulating Creativity in Decision Making

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ABSTRACT. *The significance of the earliest phase of decision making stems from the fact that decision makers 'frame' problems during this phase. These frames shape all subsequent decision making phases (Beach, 1997), fundamentally conditioning decision making outcomes (Daly et al., 2008). Avenues not considered at this stage are unlikely to be considered in the future (Adam, 2008). Further, decision making is most creative at these stages: there is a great deal of uncertainty at play but there are fewer constraints and there is less at stake. This paper argues that virtual worlds offer a potent combination of social, sensory and simulational capabilities that can stimulate creativity in decision making; and it also reports the findings of an investigation of the behavioural and cognitive aspects of creative decision making in Second Life®. The findings illustrate that Second Life users are faced with a kind of "tyranny of freedom": if anything is possible, where does one start? The answer appears to lie in a kind of "retrospective foresight" whereby decision makers draw upon prior experiences and use analogical reasoning to articulate metaphorical systems of thought.*

KEYWORDS: *problem definition; framing; creative decision making; virtual worlds*

1. Introduction

Scholars (Ford, 2000; Malaga, 2000; Volkema and Evans, 1995; Elam and Mead, 1990; Young, 1987) in the Decision Support Systems (DSS) field have repeatedly called for research that attempts to directly support creativity in decision making. The significance of creativity in decision-making is that it leads to the identification of novel solutions (Forgionne and Newman, 2007). Thus, organisational creativity leads to better corporate financial performance and is linked to overall business excellence (Malaga, 2000; Eskildsen *et al.*, 1999).

Researchers have established that creativity can be 'learned'; in particular, decision support systems can be used to improve creativity in decision making (Forgionne and Newman, 2007). Thus, a number of tools have been designed to support creativity in decision making (see Forgionne and Newman, 2007; Malaga, 2000; Young, 1987 for examples). These studies show, for example, that different types of stimuli (e.g. verbal versus non-verbal stimuli; text-based versus visual stimuli) influence creativity in different ways (Malaga, 2000). As a result, Chen and Lee (2003) specifically call for further research to investigate the incorporation of multimedia and virtual reality technologies into decision support systems.

The greatest scope for creativity in decision making exists in the early phases of the decision making process: there is a great deal of uncertainty at play; but there are fewer constraints and there is less at stake. During these phases, problems are defined and structured (Csikszentmihalyi, 1996; Cougar, 1995; Amabile, 1983). More specifically, problems are 'framed' by decision makers and these frames are used in turn to shape all subsequent decision making phases (Beach, 1997). Avenues not considered at this stage are unlikely to be considered in the future (Adam 2008; Adam and Pomerol, 2008).

This paper argues that 3D virtual worlds represent an important and unique opportunity to stimulate creativity in decision making. The paper also reports the findings of an empirical study of creativity in decision making in the virtual world of Second Life®. The study explicitly addresses both the cognitive and behavioural aspects of creative decision making in virtual worlds. The paper is structured as follows: Section 2 discusses creativity in decision making, particularly in the earliest stages of the decision making process. Section 3 argues that virtual worlds represent a potent combination of social, sensory and simulational capabilities that can be used to stimulate creativity in decision making. Sections 4 and 5 report the findings of the study. Section 6 presents a theoretical framework of decision making in virtual worlds and discusses the implications of the study for research and practice.

2. Creativity in decision making

According to Simon (1987, p. 12), "there are no more promising or important targets for basic scientific research than understanding how human minds, with and without the help of computers, solve problems and make decisions". Together, decision making and problem solving steer "the course of society and its economic and governmental organisations" (Simon, 1987, p. 11). In particular, creativity in decision making is especially important: the creation of alternatives is one of the decision maker's core activities (Pennington and Hastie, 1988) and creativity in decision making leads to the identification of novel solutions to organisational problems (Forgionne and Newman, 2007).

This section considers a number of normative models of the decision making process. The analysis draws attention to the traditional emphasis placed on the identification and evaluation of alternatives. It also highlights the importance of the initial phases of the decision making process. In particular, the analysis suggests that creativity in decision making is most likely to occur in the early phases of the process.

2.1. *The decision-making process*

Normative models of the decision-making process are widespread; they allow complex process to be broken down into more manageable units for study and have been used as the basis upon which most DSS tools have been created. Table 1 presents a chronologically ordered summary of well established theoretical models of the decision-making process.

Overall, the table reveals broad agreement amongst scholars with regard to the kind of activities that take place during decision making. The table also underlines the fact that 'choice' is "only one phase in a complex process" – one that is fundamentally bounded or constrained by earlier phases (Pomerol and Adam, 2008, p. 28). In fact, none of the frameworks completely 'cover' all of the activities included in the table. More specifically, the table suggests that the earliest frameworks emphasise earlier stages of the process and that latter frameworks emphasize post-selection activities.

The table also reveals that scholars are primarily focused on the identification and evaluation of alternatives - only one framework (Klein, 1987) fails to include this stage. This focus on the identification and evaluation of alternatives reflects the influence of Osborn's (1957) brainstorming research on the field. This research underlines the importance of generating as many ideas as possible in order to discover ideas of quality; it also asserts that the evaluation of ideas should only take place after brainstormers have identified as many ideas as possible. At the same time, it also shows that scholars place less emphasis on information gathering and analysis activities than in the past. This is partly because of a growing disillusionment with the assumption that the effective provision of quality information to the (rational) decision maker (by means of DSS) can result in better decision making. It also reflects (i) a growing disillusionment with information-based views of the firm and (ii) a growing interest in the knowledge-based view of decision making and in the cognitive aspects of decision making (which is being fuelled by neuroscientific advances).

Whilst there has been a proliferation of normative models of the decision making process, it is suggested that these models have served to impede cumulative research in the area (Adam, 2008). Even in the construction of Table 1, it has been necessary to omit a number of models (e.g. Humphreys (1985) and Saaty (1994)) that defied easy classification. It is also recognised that these models are 'artificial' (Pomerol, 1994) and may therefore be unhelpful in terms of supporting real-life decision-making (Adam, 2008; Janis and Mann, 1977).

As a result, scholarly attention has only recently begun to address the idiosyncratic nature of human decision-making (Pomerol and Adam, 2008). In particular, scholars are increasingly focused on developing an understanding of (i) the manner in which "cognitive biases" affect decision making (Chen, 2003); (ii) the manner in which creativity in decision-making arises (Forgionne and Newman, 2007; Ford, 2000; Malaga, 2000; Volkema, 1995; Young, 1987); and (iii) the manner in which "problem framing" (Nutt, 1998; Nutt, 1993) or "problem structuring" (Rosenhead, 1996) affects decision making. These trends, in turn, have brought the earliest stages of the decision-making process into sharper focus.

Phase / Author	Identify problem / opportunity	Gather information	Analyse information	Determine measures of performance	Identify alternatives	Evaluate alternatives (incl. simulation)	Model (or simulate)	Make selection	Implementation	Review
Dewey (1933)	1. Suggestion	2. Intellectualisation		3. Development of hypotheses	4. Reasoning or mental elaboration	5. Testing of hypotheses				
Simon (1960, 1977)		1. Intelligence			2. Design				3. Choice	4. Review
Janis (1968)	1. Appraise the challenge				2. Survey alternatives	3. Weigh alternatives		4. Deliberate about commitment	5. Adhere (despite negative feedback)	
Eilon (1969)		1. Gather information	2. Analyse information	3. Select performance measures	5. Enumerate alternatives ('strategies')	7. Apply criteria to evaluate outcomes	4. Describe the behaviour of the system 6. Make predictions regarding outcomes	8. Make selection		
Klein (1997, 2008)	Pattern recognition (matching and diagnosis)						Mental simulation (simulate course of action)			
Nutt (1998)	Framing			Direction setting	Option generation	Option evaluation			Implementation	
Pomerol & Adam (2008)	Diagnosis					Look ahead		Chosen action		

Table 1. *Summary of well established theoretical models of the decision making process*

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2.2. ***The early stages of the decision-making process***

Despite the recognised importance of the early stages of the decision making process, they are often overlooked in decision research (Nutt, 1998; Isabella 1990; Daft and Weick 1984). As a result, traditional problem-solving techniques offer "remarkably little assistance in deciding what the problem *is*" (Massey and Wallace, 1996).

In the earliest phases of the decision-making process, problems and opportunities are identified, recognised, formulated, defined and structured (Csikszentmihalyi, 1996; Cougar, 1995; Amabile, 1983). Thus, decision researchers refer to the earliest stages of the decision-making process using a variety of terms. These include:

- Agenda setting (Simon, 1997)
- Diagnosis (Pomerol and Adam, 2008)
- Framing (Nutt, 1998)
- Identification (Mintzberg, 1976)
- Recognition and label (Pokras, 1989)
- Problem finding (Pounds, 1969); Problem definition (Hall and Paradice, 2005); Problem formulation (Tsoukias, 2008; Hall and Paradice, 2005; Nutt, 1993)
- Projection (Pomerol and Adam, 2008)
- Opportunity delineation (Cougar 1995)

Decision researchers agree that the early steps in decision making are crucially important (Cyert and March 1963; Mintzberg *et al.,* 1976; Nutt 1993). These stages play a 'pivotal role' (Nutt, 1993) in guiding the search for solutions. The manner in which problems are formulated during these stages fundamentally affects the direction of all succeeding problem solving activities (Beach, 1997; Massey and Wallace, 1996). It determines the possible solutions that are investigated (Adam, 2008; Nutt, 1993) and ultimately used (Volkema and Evans, 1995). Avenues not considered at this stage are unlikely to be considered in the future (Adam *et al.*, 2008). It is therefore crucial that a 'good' problem definition is developed (Massey and Wallace, 1996)

Perhaps most importantly, decision makers are most likely to uncover creative or breakthrough ideas during problem formulation stages (Forgionne and Newman, 2007; Volkema and Evans, 1995). History offers many examples of decision makers who created a breakthrough by looking at a problem in a new way (Volkema and Evans, 1995). Whilst there is a great deal of uncertainty at play, decision makers are constrained by fewer constraints and there is less at stake. Creative solutions arise when decision makers (i) allocate time to the formulation process; (ii) challenge initial formulations; (iii) separate problem formulation from the generation and evaluation of alternatives; and (iv) reformulate problems into opportunities (Volkema and Evans, 1995).

3. S(t)imulating creativity in decision making: making a case for virtual worlds

A variety of DSS systems have been developed to support decision making in organisations. These include: executive information systems (EIS), group decision support systems (GDSS), and organizational decision support systems (ODSS); intelligent DSS (cf. Pomerol and Adam, 2008; Angehern and Lüthi, 1990); and stimulus-based DSS (cf. Angehern, 1993). In particular, a number of tools have been specifically designed to support creativity in decision making (see Forgionne and Newman, 2007; Malaga, 2000; Young, 1987 for examples). However, a wide gap still remains between the high potential of DSS and its limited use in organisations (Adam, 2008; Ferioli and Migliarese, 1996; Teng and Galetta, 1991; Galliers, 1987; Alter, 1992).

More recently, the advent of web-based technologies has had a major impact on the design, development, and implementation processes of decision support systems (Bharati and Chaudhury, 2004). Further, web-based DSS will be more important in the future as a result of (i) the increased geographical dispersion of organisations and (ii) the increased globalisation of markets (Schouten *et al.*, 2010; Chen *et al.*, 2007; Power and Kaparthi, 2002). Web-based DSS are cheaper to build and to deliver (Power, 2002, p. 180) but their key advantage is that unlike traditional DSS, the user community for web-based DSS is no longer limited to the managers and experts working on business-related problems (Bharati and Chaudhury, 2004). In particular, a well-designed web-based DSS should "promote greater creativity" in solving business problems (Power, 2002, p. 186). Thus, scholarly attention is now firmly focused on web-based DSS.

Virtual worlds - online, immersive, interactive environments (O Riordan *et al.,* 2009) - lie at the forefront of the evolution of web-based technologies. These worlds are currently used by somewhere between nineteen and twenty million people (Jackson and Favier, 2008; Castronova, 2007, pp. 33-34; Noveck, 2004). Virtual worlds will become more pervasive and widely adopted over time (Tampieri *et al.,* 2009). Thus, there is a growing belief that virtual worlds may replace the web browser as the way we interface with the Internet (Wyld, 2010). It is clear, then, that virtual worlds have "critical implications for business, education, social sciences, and our society at large" (Messinger *et al.,* 2009, p. 204).

In particular, virtual worlds represent new opportunities in terms of (i) creativity (Kohler *et al.,* 2011; de Freitas and Veletsianos, 2010; Giovacchini *et al.,* 2009; Ondrejka, 2007) and (ii) decision making (Chaturvedi *et al.,* 2011; Schouten *et al.*, 2010; Spann *et al.*, 2010; Chung *et al.,* 2003). In terms of creativity, virtual worlds afford a freedom to experiment that triggers creativity and leads to “unprecedented rates” of innovation (Kohler *et al.,* 2011, pp. 160- 161; cf. Ondrejka, 2007, Giovacchini *et al.,* 2009). In terms of decision making, Chaturvedi *et al.,* (2011) investigate the use of virtual worlds for strategic decision making and find that “virtual worlds can effectively support mission-critical decision making” (p. 682). Similarly, Schouten *et al.* (2010) demonstrate that virtual worlds can influence levels of shared understanding within teams leading to better performance in decision making tasks. On an anecdotal level, Spann (2010) explains how architects and designers working for Starwood Hotels used Second Life to build a 3D prototype of a new hotel and solicited feedback from users that was then used to enhance the design of the (real world) building.

Whilst the results of these studies are promising, research on virtual worlds is still in its infancy (Kohler *et al*., 2011); and empirical virtual world research is especially lacking (Jung and Kang, 2010). In particular, little is currently known about decision making in virtual worlds (Spann *et al.*, 2010). In the absence of empirical research to guide the study, the remainder of this section develops three theoretically based arguments in favour of using virtual worlds to stimulate creativity in decision making.

3.1. ***Leveraging the social affordances of virtual worlds***

The first argument that virtual worlds can affect creativity in decision making is based on the *social affordances of virtual worlds*. Research shows that online environments in general (Benbunan-Fich *et al*., 2002; Nunamaker *et al*., 1991) and virtual worlds in particular (Schouten 2010; Goh and Paradice, 2008; Giovacchini, Kohler *et al*., 2009) alter the dynamics of interpersonal communication and collaboration. Virtual worlds can also alter the social structures in which their users are embedded (O Riordan *et al*, 2009; Bakshy *et al* 2009). The significance of these observations stems from the fact that a substantial body of research suggests that creative actions are influenced by communication networks (Ford, 1996) and by the social environment (Shalley and Gibson, 2004; Perry-Smith *et al*., 2003; Amabile, 1996). At the same time, decision making is often the result of collaborative processes; this is especially true of business leaders (Nutt, 1998; Mintzberg, 1976) and for strategic decision making (Adam, 2008, pp. 67-68).

3.2. *Leveraging the sensory affordances of virtual worlds*

The second argument that virtual worlds can affect creativity in decision making is based on the *sensory affordances of virtual worlds*. According to Malaga (2000), the environment in which the creative process occurs may influence creative performance. The experience of being in a virtual world differs from the experience of being in other environments in a number of important ways (Kohler *et al*., 2011; Chittaro and Ranon, 2007).

More specifically, users experience heighted levels of presence (Dalgarno and Lee, 2010; Hooker *et al*., 2009; Barnes, 2007) or immersion (Childs, 2010; de Freitas *et al*., 2010; Tampieri, 2009) in the virtual world. This can lead to a heightened sense of 'flow' (cf. Csíkszentmihályi, 1975), which is in turn associated with creative action.

In addition, virtual worlds contain objects (in either two or three dimensions) that are possible in those worlds, but impossible in the real world (Ward and Sonneborn, 2009; Chittaro and Ranon, 2007). The opportunity wander *within* 3D works in a virtual "provides a kind of learning experience unmatched by anything in the real world" (Ward and Sonneborn, 2009, p. 217). This, in itself, encourages virtual world users to identify and challenge some of our implicit conventions and taken-for-granted assumptions about the real world. It is not necessary, for example, to build to scale or to take a human form in the virtual world. The significance of these observations is that sensory experience lies at the heart of cognitive mental processes (such as decision making).

Furthermore, virtual worlds allow data and information to be represented and visualised in unique and compelling ways (Massey and Wallace, 1996). This is especially true of contemporary 3D virtual worlds. This is significant in terms of decision making because visual interactive modelling have long been used to solve decision problems (cf. Bell, 1985). This is also significant in terms of creativity because the use of imagery is known to positively influence creativity in problem solving (Malaga, 2000; Shepard, 1978).

3.3. *Leveraging the simulational affordances of virtual worlds*

The final argument that virtual worlds can affect creativity in decision making is based on the *capacity to create simulations and carry out experiment in virtual worlds*. Virtual worlds allow decision makers to take risks and fail without the same consequences as real life. Thus, research has shown that virtual world users are more outgoing and risk-taking in the virtual world than in the real world (Messinger *et al*., 2009). According to Levasseur (2011), this can encourage a different type of problem solving, based on trying different paths to find a solution. More specifically, it can foster creative thinking. The interactive and immersive capabilities of virtual worlds allow people to "implement their thinking into actual actions, which helps them to evaluate the success of their ideas, at minimum cost" (Ip et al., 2008, p. 1).

4. Research methodology

To recapitulate, this paper argues that there is decision researchers are increasingly interested in stimulating and supporting creativity in decision making. Existing research suggests that the key to unlocking creativity in decision making lies in supporting the earliest stages of the decision making process. Finally, the recent emergence of virtual worlds represents a compelling opportunity to investigate creative decision making.

The research objective of the study was *to investigate the cognitive and behavioural aspects of the early stages of the decision making process in virtual worlds*. The study was carried out entirely in Second Life. Second Life was chosen for the study as it had attracted significantly more commercial users than other virtual worlds. In order to achieve the research objective, qualitative research methods were used so that it would be possible to identify what decision makers actually did during the decision process and also to develop an understanding of how meaning was created by decision makers at the time. More specifically, a combination of participant observation and case study methods were used. Participant observation was useful in allowing the researchers to experience Second Life as the participants do (cf. Marshall and Rossman, 2006, p. 79). The combination of participant observation with case study research was an especially powerful tool in terms of corroborating, validating and triangulating data in the unfamiliar research context of a virtual world.

According to Benbunan-Fich *et al.* (2002), it is 'crucial' to analyse the process whereby groups of decision makers arrive at decisions and produce their outcomes. Therefore, the unit of analysis for the study was the "innovative virtual world project". Preliminary observations in the field indicated that a large number of real world educational institutions were actively carrying out educational projects in Second Life. At this time, educators were faced with a highly 'unstructured' challenge – no accepted framework existed for educators in terms of using Second Life for education. Therefore a criterion sampling technique[1] was devised in order to identify innovative educational projects carried out in Second Life as potential cases. Six case studies were carried out (summarised in Table 2). Each project had been

[1] More specifically, the researcher evolved a list of qualitative criteria (together with a points system) which could be used to 'rank' projects in terms of their suitability for the study

carried out at a third level institution and had been carried out by a minimum of three individuals.

Case	Overall aims of project
BOF	To bring students into a virtual world; an intrinsically cybernetic and artificial cultural landscape, born of science fiction and inhabited by the virtual human in order to explore the implications of scientific and technical advances for the future of humanity
TEX	To leverage the unique affordances of Second Life to create educational materials that could not feasibly be created using other technologies and to package those materials by means of a Machinima video so that they could be published online for future use
TIR	To use Second Life to create demonstrations and simulations of animation algorithm concepts that are difficult or impossible to create in the real world
GAL	To use scenario driven and problem based learning to improve nurses' skills in taking patient histories and undertaking physical examinations in real life
ZOM	To follow a structured and formalised research agenda over a three year period in order to incrementally develop and use a virtual laboratory in Second Life to teach lab and experimental skills to science students
OLY	To improve students' chances of being hired as border control officers by allowing them to rehearse the role of a border control officer in a virtual border setting

Table 2. *Summary of the case studies*

Data collection was carried out during the first six months of 2010. In terms of the cases, guided interviews (cf. Patton, 1990) were carried out inworld and lasted an average of 90 minutes. In each case, interviews were carried out with at least one educator, one developer and one project facilitator. Each interview was broadly structured using a series of predetermined topics. These topics included: (i) the origins of the project; (ii) their background, role and participation in the project; (iii) the manner in which the project was carried out (in the real world, in Second Life, and online); (iv) the nature of the group's participation in the project; and (v) the outcomes of the project. Participants were also asked to consider the nature of the creative process in Second Life and to share their own personal insights on Second Life and education in Second Life. As such, retrospective data (in which people reconstruct events) was used in the study to get close to the phenomenon of interest: creativity in decision making. Interviews were recorded to facilitate subsequent analysis. Interview transcripts were produced for each of the case study interviews. Inworld site visits were typically undertaken when interviews were carried out. In addition, permission to return to project sites for subsequent visits was typically provided. The researchers also had access to extensive web-based documentation. Participant observation was carried out both prior to and during interviews; this was primarily focused on the activities of the educational community in Second Life but it also involved a substantial amount of general exploration in Second Life. These transcripts were subsequently coded. Case contact summaries were also created immediately after each interview using an audio recording. These summaries were periodically reviewed during the study in order to bring to mind the most salient aspects of each case prior to each subsequent interview in that case.

Data collection and data analysis activities overlapped. Data was analysed in accordance with Miles and Huberman (1994). The strength of this approach is that it enables the researcher to configure approaches to data reduction, data display and conclusion drawing/verification in accordance with the particular needs of their own study. This approach has therefore enjoyed widespread use and is considered both elegant and systematic (Denzin and Lincoln, 1998, p. 40). A variety of analysis materials were generated during the early stage of the study. These included field notes, memos, pattern codes, and methodological memos. These materials were repeatedly reviewed by the researcher during data collection and data analysis phases of the study. In the latter stages of the study, data was coded. In accordance with Miles and Huberman (1994), the data was initially coded using a "start code list". This list evolved in an emergent fashion as data analysis proceeded. A series of within-case and cross-case data displays were then developed. The researchers experimented with numerous data displays (tables, matrices, radar charts and line charts were all developed) during the course of data analysis. This is considered a fitting way to approach the construction of data displays: the design of qualitative research "cannot be given in advance; it must emerge, develop, and unfold" (Lincoln and Guba, 1985, p. 225). These displays were an indispensible tool for escaping data overload during the study and proved to be a tangible, traceable and explicit means of addressing the study's research objective.

5. Presentation of research findings

The research objective for the study was *to investigate the cognitive and behavioural aspects of the early stages of the decision making process in virtual worlds.* This section therefore presents an analysis of the behavioural procedures used by study participants during the earliest stages of the decision making process. This is followed by an analysis of the cognitive processes that underpin problem formulation in virtual worlds.

5.1. *Behavioural aspects of creative decision making in virtual worlds*

Table 3 presents an analysis of the behaviours used to facilitate problem definition that emerged during the study. The table shows the variety of behaviours used by virtual world users in an effort to facilitate problem definition. Prima facie, one may observe that these types of behaviours are conceptually similar to the behaviours of participants in real life projects. However, deeper analysis reveals that these behaviours were carried out in fundamentally different ways in Second Life. In particular, the unique spatial and communicative properties of Second Life meant that it was possible to carry out these activities quickly and in some cases simultaneously. For example, participants could explore locations of interest in Second Life at the click of a button and simultaneously communicate and collaborate with fellow team members using Second Life's inworld communication channels (e.g. private instant messaging or private voice chat); whilst at the same time 'tabbing' out of Second Life to use related online information resources.

Table 3 presents a count of the number of behaviours used in each ease and in each role. 86 unique behaviours were identified. The table distinguishes these behaviours according to when they were typically used during projects and also classifies these behaviours as passive, active and proactive behaviours. This taxonomy is a useful and extendable means of classifying decision-making behaviours in virtual worlds and has been successfully used in this study as a means of identifying patterns in the distribution and temporal arrangements of these behaviours in the cases.

Type	Stage	Level	Behaviour*	CASES BOF	TEX	TIR	GAL	ZOM	OLY	ROLES FAC	DEV	EDU	Tot
Passive	Early	IND	Research	1	2	0	1	1	0	2	2	1	5
		IND	Opportune inworld exploration	2	1	1	2	0	1	3	1	3	7
		COM	Community participation	1	0	1	2	3	1	4	1	3	8
				4	**3**	**2**	**5**	**4**	**2**	**9**	**4**	**7**	**20**
	Late	IND	Purposeful inworld exploration	0	1	0	1	0	1	0	1	2	3
				0	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**2**	**3**
Active	Early	IND	Self directed learning	0	1	1	2	1	1	1	4	1	6
		IND	DIY / Practice	2	1	1	3	1	1	2	3	4	9
				2	**2**	**2**	**5**	**2**	**2**	**3**	**7**	**5**	**15**
	Late	GRP	Endogenous collaboration	3	3	3	3	3	1	5	5	6	16
		IND	Imitation	1	0	0	1	0	1	0	1	2	3
				4	**3**	**3**	**4**	**3**	**2**	**5**	**6**	**8**	**19**
	Both	GRP	Meetings	3	0	0	0	2	0	1	2	2	5
				3	**0**	**0**	**0**	**2**	**0**	**1**	**2**	**2**	**5**
Proactive	Early	I/G	Formal training	0	0	1	2	0	0	1	1	1	3
		GRP	Pilot project(s)	2	0	0	0	2	2	2	2	2	6
		GRP	Brainstorm	2	3	2	0	0	3	4	3	3	10
				4	**3**	**3**	**2**	**2**	**5**	**7**	**6**	**6**	**19**
	Late	COM	Exogenous collaboration	1	0	0	1	2	1	2	1	2	5
		GRP	Experiment	1	1	1	1	0	1	0	4	1	5
				2	**1**	**1**	**2**	**2**	**2**	**2**	**5**	**3**	**10**
	Both	GRP	Development methodology	1	0	0	0	2	2	0	3	2	5
				1	**0**	**0**	**0**	**2**	**2**	**0**	**3**	**2**	**5**

** A description of each behaviour appears in Appendix A*

Table 3. *Summary of behaviours used to facilitate problem definition across cases and roles*

Passive behaviours are inactive, nonparticipatory behaviours carried out in an open-ended manner. Passive behaviours were considered *vital in terms of allowing study participants to gain new insights into how Second Life was actually used for education*. One participant therefore explained that in order to be able to do "the best work" in Second Life, he needed to "see the state of the art". Study participants suggested much could be learned simply from visiting other educational locations in Second Life and from interacting with others in Second Life. Thus, members of the educational community strongly encouraged new residents to explore successful educational projects and to attend well known educational forums in Second Life. . In effect, the nature of connectivity in virtual worlds has granted study participants with additional freedoms in terms of how they construct and maintain inworld social networks (O Riordan *et al.,* 2009). The table shows that these behaviours were most commonly used in the earliest stages of projects and were most commonly used by project facilitators. However, these behaviours were used less frequently than active and proactive behaviours, suggesting that study participants preferred to approach decision making in Second Life in an active and action-oriented fashion. Drilling a little further into the detail, the table shows that four distinct types were identified in this study. All of these behaviours were carried out away from fellow project team members.

Active behaviours are participatory behaviours carried out in an applied fashion. The table shows that these behaviours were used most often across the cases; they were also equally common during the early and late stages of projects. Developers and educators were also far more likely to use these behaviours than project facilitators, suggesting that the role people played in projects was a powerful force influencing their behavioural approaches to decision making. Drilling a little further into the detail, the table shows that five distinct types were identified in this study. Three of these behaviours (self-direct learning, DIY/practice and imitation) were carried out away from fellow project team members. The remaining two behaviours (endogenous collaboration and meetings) were carried out with fellow team members.

A closer inspection of the data does however reveal that *it is difficult to create effective collaborative relationships outside of one's own teams* in Second Life. Whilst educators in Second Life are happy to share resources, it seems that study participants had unsuccessfully attempted to identify and partner with potential collaborators. There was a strong recognition in Second Life (and amongst study participants) that the ability to stimulate effective collaborations in Second Life is a skill in itself; this was described by two study participants as "community building". This sentiment suggests that virtual world users face similar challenges to individuals working in distributed teams: they must work hard to overcome the challenges of communicating without face-to-face cues so that they can develop "collaboration know-how" in order to work effectively with others (Majchrzak *et al.,* 2005) in the virtual world.

Proactive behaviours are anticipatory, active behaviours designed to attempt to achieve particular outcomes. The table shows that these behaviours were used quite often across the cases; but they were twice as common in the early stages of projects as they were in the later stages of projects. Developers were the most proactive group of individuals in the cases and facilitators were the least proactive group of individuals in the cases. Drilling a little further into the detail, the table shows that six distinct types were identified in this study. Whereas passive behaviours were most commonly carried out away from fellow team members, four of the six behaviours were largely carried out with fellow project team members. This suggests that it may be possible to stimulate proactive behaviours by designing tools and techniques that enable teams to work together in virtual worlds.

In terms of individual behaviours, participants described *inworld community participation* in terms of attending weekly inworld meetings such as the VWER (Virtual Worlds Education Roundtable) or ISTE (International Society for Technology in Education) meetings. Opportunistic inworld exploration allowed individuals and teams gain a fuller overall understanding of what was possible in Second Life. It was considered a source of inspiration as it afforded the opportunity to observe what others were doing. This behaviour was used by individuals regardless of role, usually in their earliest stages of involvement.

Inworld brainstorming was also seen as an effective means of identifying creative solutions to problems. Inworld brainstorming differed from real world brainstorming in the sense that study participants could instantly and collaboratively “play with” decisions and ideas. In the real world, ideas and concepts are rendered on whiteboards; in Second Life, they are easily rendered and ‘toyed’ with in three dimensions. This is a significant finding as the importance of brainstorming for group level idea generation is already well established (Litchfield, 2008). It suggests that virtual worlds allow users to ‘improvise’ (in the sense of musical improvisation) new ideas through creative ‘performance’ in a way manner that is not easily replicated in the real world.

Participants observed that it was easier to borrow ideas from other projects than to develop ideas from scratch. Thus, *imitation* was seen as an effective means of carrying out projects. Developers, in particular, tried to reverse engineer things that they had seen in Second Life. Educators also deliberately incorporated ideas and concepts that they had discovered in Second Life into their projects. This finding supports extant research which suggests that creativity can be inspired by a recombination (Zaltman *et al.*, 1973; Van de Ven *et al.*, 1986) or reinvention (Fagerberg, 2006, p.22) of existing ideas.

5.2. *Cognitive aspects of creative decision making in virtual worlds: formulation*

In order to focus on the creative aspects of decision making in virtual worlds, the remainder of the analysis is based on the cognitive aspects of the earliest stages of the decision making process. That is to say, the analysis is focused on the cognitive aspects of the problem formulation stage. The analysis suggests that participants were initially concerned with establishing an overall '*vision*' of Second Life in general and of education in Second Life in particular. Once that overall vision had been established, study participants were able to '*frame*' their projects with reference to their overall vision. Each point is considered in turn.

5.2.1. *Vision*

The analysis suggests that study participants first sought to establish an ***overall vision of Second Life***. The need to establish an overall vision of virtual worlds is explicated by L.FAC who states that "if you don't have a clear vision, it is hard to know what to do". This idea was described by one study participant as the "tyranny of freedom". Schwartz (2000) argues that freedom, autonomy, and self-determination can become excessive and when that happens, freedom can be experienced as a kind of tyranny. The argument made by the educator was that if anything is possible, if every avenue is open to consideration, nothing gets done. In other words, there is a kind of paralysis by analysis.

Study participants suggested that this vision should be based on understanding what is possible rather than what already is[2]. For example, M.DEV argues that the real world should not be taken as a point of departure when designing educational projects in Second Life. Similarly, G.PM and G.FAC are agreed that a 'hacker' ethos[3] facilitated the development of an overall vision of virtual worlds. G.PM explains that it is

> less to do with what you can do than with what you can imagine… you need to be a hacker to lift the bar and not just do good stuff, but try to regard [Second Life's] potential

The analysis also suggests that study participants also sought to establish an ***overall vision of project goals*** as soon as possible. Participants explained that that this was important because it helped to ensure that projects were carried out purposefully; that energy was not needlessly expended pursuing frivolous goals; and that participants did not lose focus by virtue of Second Life's numerous technical

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[2] As an aside, the researcher came across a Second Life group called "Not Possible in Real Life" which is popular amongst educators in Second Life

[3] The term 'hacker' is contentious and can be used in a number of ways; it is used in this context to refer to a person who follows a spirit of playful cleverness and loves programming

distractions. In addition, developing a project's goals was a source of motivation for project participants. Participants argued that project goals should (i) be appropriate for Second Life (ii) be determined according to pedagogical rather than technological perspectives (iii) be of appropriate scope and (iv) be sufficiently specified or articulated.

In several cases, this overall vision had already been established by the time the projects began. At OYL, the team had a "problem to solve" that was presented in terms of 'requirements' or 'variables'. At BOF, the team were able to stay true to the project's original vision to such an extent that they are still to this day able to use the same language they used to express it at the outset. At ZOM, the team had a very clear set of questions from the outset. These questions were drawn from prior institutional experience at ZOM.

5.2.2. *Framing*

The findings suggest that study participants actively sought to 'frame' their decision making in Second Life. That is to say, study participants – even when Second Life was utterly unfamiliar to them – sought to quickly establish particular frames of thought and established project goals within those frames. This finding resonates with Berthoz' (1996) observation that "the brain is a matching machine and a simulator of action, not a 'representational machine'" (p. 89) and also supports Klein's (1993) model of recognition primed decision making, which suggests that decisions are based on the recognition of previously known patterns.

In terms of how participants 'framed' their decision making, the analysis suggests that *participants drew upon a wide range of prior experiences that were not obviously relevant to Second Life* in order to do so. These frames were in turn externalised as metaphors which could be used to guide their projects and which could be shared with colleagues and with other virtual world users. One participant argued that his experience in digital media and theatre gave him "a real insight" into how you might construct a reality around the experience you are trying to create for students in Second Life. Another participant relied heavily on a web services metaphor in terms of his project: he explained that whilst the work he was trying to accomplish in Second Life had never been done before, he was confident that it could be done in theory because of this prior knowledge. These observations supports the view that decision makers 'anchor on past experience' when planning for uncertain futures (Chen, 2003).

The tendency to frame decisions in terms of prior experiences was especially strong amongst project developers, many of whom were relatively inexperienced in terms of Second Life. Educators, on the other hand, appear to have been less successful in terms of framing their decision making according to their prior knowledge. One participant explained that individuals do not always realise that they can draw upon their previous experiences when designing and developing new educational applications of Second Life.

The analysis suggests that a great deal of the creativity manifesting in these projects was inspired by attempting to 'associate' future projects with prior experiences. That is to say, in virtual worlds – environments that have no clear equivalent – users are forced to engage in an act of "retrospective foresight" in order to frame problems. This observation supports the argument that "the person who can combine frames of reference and draw connections between ostensibly unrelated points of view is likely to be the one who makes the creative breakthrough" (Shekerjian, 1991). Further, it contradicts a number of studies which suggest that existing knowledge can inhibit creativity during product innovation (cf. Brockman and Morgan, 2003).

6. Conclusion

In conclusion, this paper argues in favour of, and then illustrates, the potent opportunities to stimulate creativity in decision making using the social, sensory, and simulational affordances of virtual worlds. The paper also presents an analysis of the behavioural and cognitive aspects of the early stages of the decision making process in the virtual world of Second Life. This analysis reveals that virtual world users utilise a broad range of passive, active and proactive behaviours during the early stages of the decision making process. Further, it draws particular attention to significance of community participation, inworld brainstorming and imitative practices in terms of inspiring creativity in Second Life. In addition, the study reveals the importance of establishing an overall vision and also the need to 'frame' decision problems in virtual worlds. Finally, the analysis draws attention to the significance of prior experiences in shaping the outcomes of these processes, suggesting that decision makers in virtual worlds engage in a kind of "retrospective foresight" where prior experiences are 'projected' (cf. Pomerol and Adam, 2008) onto possible future states.

It is possible to synthesise the findings of the study into a preliminary framework of the decision making process in virtual worlds (see Figure 1). It consists of two interconnected dimensions: a behavioural dimension and a cognitive dimension.

The cognitive dimension distinguishes (based on extant literature) between formulation, direction, and implementation phases in decision making. This study addresses the first phase: formulation. This element of the framework does not represent time in a linear fashion. Instead, the figure suggests that these three phases are reciprocally interactive over time.

The behavioural dimension distinguishes between passive, active, and proactive behaviours associated with the early stages of the decision making process. Time moves from left to right in this portion of the framework. The framework describes the relative importance of each type of behaviour over the lifetime of the process. For example, the figure shows that proactive behaviours (e.g. brainstorming) are used in both early and late stages of the decision making process. Passive behaviours (e.g. inworld exploration and community participation), on the other hand, are decidedly more commonplace in the earliest stages of decision making. One of the implications of the framework, for example, is that these behaviours have an important role to play in terms of stimulating creativity in decision making and should therefore be prioritised.

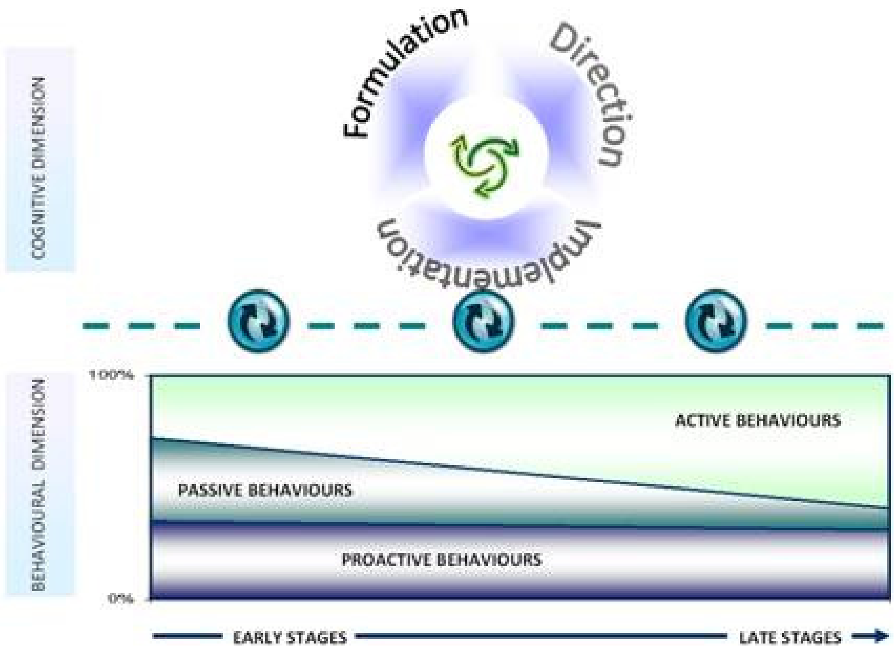

Figure 1. *Preliminary framework of the decision making process in virtual worlds*

The study's findings have a number of important implications for both research and practice. In terms of research, the findings of this study call into question the considerable body of research that assumes that people process information or arrive at decisions in a similar manner (cf. Chackraborty, 2008). In particular, the study supports Chen and Lee's (2003) calls for decision support to attempt to focus on cognitive modelling; in particular, there is a need to establish a means of attempting to support decision makers' backward and forward thinking. In terms of practice, the study's findings can be used to assist virtual world designers in terms of providing effective tools to stimulate creativity in the decision making processes of virtual world users.

APPENDIX A. – *A description of each behaviour identified in the study*

Type	**Behaviour**	**Description**
Passive	Research	Involves carrying out formal research in Second Life
	Opportune inworld exploration	Involves open ended explorations of Second Life itself
	Community participation	Involves efforts to participate in Second Life communities (educational communities or other communities)
	Purposeful inworld exploration	Involves purposeful or deliberate or specific or focused exploration of Second Life where the individual(s) concerned is seeking something specific narrowly focused Second Life exploration for something in particular
Active	Self directed learning	Involves utilizing online, offline and inworld informational resources to become familiar with Second Life's technical and educational aspects
	DIY / Practice	Involves efforts on the part of individuals to acquire Second Life skills such a building or scripting skills
	Endogenous collaboration	Involves individuals within teams within teams working together to achieve a specific goal
	Imitation	Involves attempting to imitate (i) another build or elements of another project or (ii) behaviours used by others (for instance through watching others build inworld)
	Meetings	Involves team members meeting inworld to discuss and coordinate projects in real or virtual world
Proactive	Formal training	Involves taking a formalised training course or apprenticeship in some aspect of Second Life
	Brainstorming	Involves several team members meeting to explore ideas
	Pilot project	Involves carrying out small scale projects to operate as a proof of concept
	Exogenous collaboration	Involves working with individuals, groups or communities
	Development methodology	Involves using behaviours typically associated with software development.
	Experiment	Involves learning by doing or trial and error

7. References

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