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Machine Ethics for Gambling in the Metaverse: *An "EthiCasino"*

By Anna Vartapetiance Salmasi and Lee Gillam, University of Surrey, UK

Abstract

Online gambling of various kinds produces substantial financial returns but brings with it a range of challenging issues. Different countries variously allow or disallow gambling or online gambling depending on religious and legal considerations. There are then ethical considerations of risk aversion and loss aversion relating to addiction in the isolated online pursuit. Open Grid Protocols for virtual worlds, enabling interoperability amongst virtual worlds, could benefit implementers of virtual world gambling, reversing a substantial decline in turnover due to gambling being banned in one particular virtual world. In this paper, we consider the combined legal and ethical issues of gambling online and in virtual worlds, and discuss the construction and evaluation of a system with computational oversight: an ethical advisor.

Keywords: EthiCasino; machine ethics; virtual worlds; Second Life; online gambling; responsible gambling.

Machine Ethics for Gambling in the Metaverse: *An "EthiCasino"*

By Anna Vartapetiance Salmasi and Lee Gillam, University of Surrey, UK

The Second Life Grid Open Grid Protocol (SLGOGP) provides a standard for allowing avatars to move between virtual worlds (Linden Research Inc, 2008), bringing with it the potential for interoperable virtual worlds and for hybrid considerations: a mixture of public and private virtual worlds. In principle, it becomes possible to run a virtual world in the same way in which one may run a web server, and to be able to provide for areas within a virtual world with access restricted to certain members. UK-based PKR is a virtual world specifically created as a private virtual world for gambling. The much-publicized prohibition of gambling in the core of Second Life suggests that potential exists for virtual world gambling "off grid" supported by such an interoperability standard that could enable residents of Second Life to step out into a world such as PKR, in what might be considered by some as a kind of virtual underworld. However, the reputations of providers of these public virtual worlds and the designers of the protocol might be negatively impacted if they are recognized as condoning such activity. Furthermore, companies offering such private worlds may have a professional responsibility to ensure that sufficient regulatory checks are in place and that activities can take place in a safe environment, necessitating the consideration of extensions to such a standard to assure others that their professional responsibility has been fulfilled.

With the scale of turnover estimated for online gambling - revenues of over US$24 billion by 2010 (CCA, 2004) - there are likely to be organizations already considering how to leverage their share of this market. This could include, in particular, organizations that were previously providing for virtual world gambling in Second Life prior to the ban. However, online gambling in general brings with it a range of challenging issues. Different countries variously allow or disallow gambling or online gambling depending on religious and legal considerations. Where it is allowed, different age restrictions may apply. There are then ethical considerations relating to harm, through knowledge of risk aversion and loss aversion, to increased risk of addiction in the isolated online pursuit. Where problems exist in the real world, virtual worlds may produce their own variations yet are bound by the laws of the jurisdiction in which they are considered to be operating. One question for the creators and maintainers of public virtual worlds is whether gambling should take place at all. For the Second Life virtual world, with their servers residing in the US, Linden Labs' US-centric terms and conditions forced them to "comply with state and federal laws applicable to regulated online gambling" irrespective of the geographical location of the end user (Pasick, 2007; Wagner, 2007). For users of Second Life, this currently acts as a ban on gambling in that virtual world, enforced by the Federal Bureau of Investigations (FBI). This has had demonstrable impacts on the economy of that virtual world.

We believe that it should be possible to construct a system with computational oversight—an ethical advisor, enabling support for different regulations and ethical viewpoints. This should provide assurance that the system not only complies with local laws, but also appreciates human values and social well-being. In this paper, we make a novel consideration of the application of machine ethics to gambling, with a focus on online gambling where individuals may act largely in an isolated context that may promote addiction, where assistance and advice may be less apparent or available (Comeau, 1997). We discuss how to design a virtual world environment based on prior literature and systems in Machine Ethics, including Truth-Teller (Ashley and McLaren, 1995), SIROCCO (McLaren, 2003), MedEthEx (Anderson,

Anderson and Armen, 2005) and EthEl (Anderson & Anderson, 2008) to account for legal and ethical considerations in relation to gambling. Risk profiles are constructed based on the demonstration of knowledge of gambling of end users, and these risk profiles are used as part of a monitoring mechanism – a *nagware*. The aim is to inform both the less knowledgeable gamblers and those whose behaviors are becoming increasingly risky and leading to the potential for harm. Only where advice is ignored should it become necessary to consider computational intervention. We expect that it would prove difficult generally to outlaw gambling in virtual worlds. An alternative would be to clarify how the ethical responsibilities are shared between both gamblers and casinos and what the expectations are on each. Responsible gambling, then, implies responsibilities on both the gamblers, in relation to their behaviors, and the casinos in relation to identifying problematic behavior and acting or intervening accordingly. However, this will not be possible unless a system can harmonize the action for both sides. We refer to this framework, as implemented, as an EthiCasino, and discuss outcomes of our research to date.

This paper is an extended, revised and improved version of our previous paper (Salmasi and Gillam, 2008) presented at the IEEE Conference in Games and Virtual Worlds for Serious Applications (VS-Games). In contrast to our previous paper, here we provide a detailed background, including substantial sections regarding the legal and ethical dimensions of gambling in general and online gambling in particular, as well as the comprehensive review of related literature in machine ethics which we use to justify our approach. While the steps involved in our system remain largely similar between these two papers, additional supporting data is provided to demonstrate the variation in responses to questions - and therefore the inconsistency in understanding the risk and losses - across users. The closing discussion is also a substantial new contribution which relates strongly with the machine ethics literature and which verifies our approach. Additionally, we state the size of the market at $24bn by 2010 (CCA, 2004), fixing one of our own errors in interpretation.

Background

The Second Life (SL) virtual world was described by Linden Lab CEO Philip Rosedale as a land “owned, controlled and built by the people who are there” (Claburn, 2007). A currency, the Linden Dollar (L$), provides for the virtual economy by allowing limited rights to own and buy and sell digital artefacts (Linden, 2007). Rosedale’s statement suggested that the “people who are there” would be bound only by the rules and social norms of the virtual world and freed from laws of real life. According to Benjamin Duranske, author of *Virtual Law*, “If this is real money, there is an argument that you need to follow real law” (Sidel, 2008). On 25 July 2007, the real-world laws encroached, and due to “conflict within international laws regarding online gambling” Linden Labs announced that all gambling activities were banned. Some were happy that this would remove gambling from SL since fewer users overall would reduce the network latency of the virtual world. However, organizations invested in virtual world gambling now had to unwind their virtual world positions and presences, and some suggested that if SL were still considered a microcosm of the world, it should also include gambling (Chang, 2009).

The effect on the SL economy was dramatic, with a near 50% drop in money changing hands in-world (Yahia, 2007). This led indirectly to the collapse of a virtual bank, Ginko Financial, rumoured to have been a Ponzi scheme that lost its investors upwards of $700,000. Following a series of complaints (Gardiner, 2007), Linden Lab announced:

> *We're implementing this policy after reviewing Resident complaints, banking activities, and the law, and we're doing it to protect our Residents and the integrity of our economy. […] Since the collapse of Ginko Financial in August 2007, Linden Lab has received complaints about several in-world "banks" defaulting on their promises.[…]As these activities grow, they become more likely to lead to destabilization of the virtual economy. At least as important, the legal and regulatory framework of these non-chartered, unregistered banks is unclear, i.e., what their duties are when they offer "interest" or "investments."[…] Thus, as we did in the past with gambling, as of January 22, 2008 we will begin removing any virtual ATMs or other objects that facilitate the operation or facilitation of in-world "banking…"*

It was anticipated that Linden Lab might be able to evolve adequate technical solutions to such problems, but the importance of real-world laws was now firmly established. It was clear, however, that the economy of this virtual world had changed substantially and suddenly.

The banning of gambling related purely to the location of Linden Labs and their servers, and had nothing to do with local laws relating to the location of the gambler using the software client or taking an ethical or responsible approach to gambling. It should be possible to construct a system that can robustly support legal enforcement in relation to gambling, hosted in an appropriate location and interoperable with various virtual worlds, and that provides support for wider considerations of ethical issues such as responsible gambling. Such considerations can present opportunities for the re-emergence of virtual world gambling and concomitant revenues, and could more generally provide for a less harmful approach to online gambling.

Were one to be concerned about wider ethical considerations of virtual world economies, the notion of "Camping" in Second Life - where users get their avatars to sit or dance on predefined paths for a specified period of time to earn L$1 - would be one place to start. With an exchange rate around L$260 to US$1, this financial reward is highly unlikely to match the costs of the electricity used in supporting, largely, inactivity. Users are paying to support activities that are not particularly beneficial to the environment, in order that higher search ratings can be achieved by others. These users may be placing excitement about limited financial reward over and above their own financial or wider environmental concerns, or are simply lacking sufficient information to make robust decisions. The latter reason would provide particular concern in relation to gambling.

Online Gambling

Gambling can be defined as:

> *... betting or staking of something of value, with consciousness of risk and hope of gain, on the outcome of a game, a contest, or an uncertain event whose result may be determined by accident. Commercial establishments such as casinos ... may organize gambling when a portion of the money wagered by patrons can be easily acquired by participation as a favoured party in the game, by rental of space, or by withdrawing a portion of the betting pool (Gilmne, n.d.).*

Given hope of gain, people are likely to play for money not for fun, despite those who suggest gambling is for entertainment purposes only. By and large, the odds of losing are higher

than winning, and the providers will mostly benefit. Losing money in an environment where it appears possible to win money can lead to people making additional bets. The hope that further gambling will result in recouping existing expenditure is often referred to as chasing losses and unlikely to be successful due to the odds involved.. Most importantly, this is not necessarily considered a game of skill, so extensive knowledge about how to play is not always a necessary pre-condition for participation. These observations present risks of harm to the gambling individuals and, by extension, to the gambling industry, with potential for addiction at minimum. Gambling provides for a host of ethical questions when within a social environment in which others are present, but website-based online gambling changes the social dynamic by disassociating the action from both a location and from a physical co-presence. As stated by Price (2006), "internet gambling, unlike many other types of gambling activity, is a solitary activity, which makes it even more dangerous: people can gamble uninterrupted and undetected for unlimited periods of time."

Different countries have legislated for and against the gambling industry to try to reduce the risks and possibilities of harm both to the players and the society. The UK's Gambling Act 2005 discusses limiting the number of casinos, and forcing industry to demonstrate their plans for contributions to research, for raising public awareness about the problems gambling can cause, and for helping to treat those affected (Russell, 2006). The USA approached awareness issues by introducing The National Gambling Impact Study Commission Act 1996 (NGISCA; H.R.5474) which conducted a comprehensive legal and factual study of the social and economic impacts of gambling. Some other steps for awareness have been taken by NGOs by introducing "responsible gambling"; players should be aware of the time and money that they spend on gambling plus the consequences and risks that are involved. When gambling websites are attempting to be responsible, they may produce documents containing the kinds of rhetoric presented below:

- We are there to help whenever you realize that you need a control over the money that you spend
- We can decrease the amount of money you can put into your account if you ask.
- You can increase it again if you feel you are in control.
- If you think you need a break from gambling, you can use self-exclusion tool
- If you suspect that you may have a gambling problem, you may seek professional help from the following links
- Make sure gambling does not become a problem in your life and you do not lose control of your play.
- Make sure that the decision to gamble is your personal choice.

For success, such statements rely on individuals who may be experiencing addiction to be aware of it, and to be in sufficient control to do something about it. The "problem" is then for the end user to deal with, and the organization has effectively absolved itself of responsibility. Gambling addiction is identified as one of the most destructive addictions which is not physically apparent - an "invisible addiction" (Comeau, 1997). Psychologists believe that online gamblers are even more prone to addiction mainly because users can play without distraction and recognition. It is unlikely, then, that self-control could be exerted in the case of online gambling.

Websites such as gambleaware.co.uk give potential players and gamblers knowledge about the odds of winning, the average return to players, "house edge," a gambling fact and

fiction quiz and more, to make sure that players are aware of the results of their actions in this industry. Gambleaware (n.d.) defines a responsible gambler as a person who:

1. Gambles for fun, not to make money or to escape problems.
2. Knows that they are very unlikely to win in the long run.
3. Does not try to "chase" or win back losses.
4. Gambles with money set aside for entertainment and never uses money intended for rent, bill or food.
5. Does not borrow money to gamble.
6. Does not let gambling affect their relationships with family and friends.

Defining measures to differentiate between the healthy responsible players and addicted gamblers provides potential for controlling actions of gamblers to act to prevent addiction, but without interrogating each individual, how would it be possible to evaluate against these criteria and determine a responsible gambler from an irresponsible one? It would appear, then, that there is an opportunity for the online gambling companies, and in particular those wishing to enhance their activities in virtual worlds, to account for legislative concerns and age constraints, and also to provide assistance in a responsible gambling environment.

To become an "Ethical Corporation" there are three reasons the online gambling industry should take its responsibilities seriously (Saha, 2005):

1. To clear up the industry's traditional image
2. To attract potential customers that steer clear because of this image, and
3. To comply with regulations

Online Gambling Laws

Online activities generally present a challenge in enforcement, with Computer Law a growing area of challenge. While virtual world gambling returns some hint of a social dynamic lost from website-based gambling, with the appearance of virtual others, legal complexity remains. With US$24 billion predicted for the online gambling market by 2010, extracting such revenues suggested a need for laws applicable to online gambling; some tackled this by making specific laws, others amended old ones. A few considerations include:

- **US:** The Unlawful Internet Gambling Enforcement Act 2006 (UIGEA, H.R.4411): Prohibiting financial institutions from approving transactions between U.S.-based customer accounts and offshore gambling merchants (Carlson, 2007; Humphrey, 2006).
- **US:** Internet Gambling Regulation and Enforcement Act 2007 (IGREA, H.R.2046): "Providing a provision for licensing of internet gambling facilities by the Director of the Financial Crimes enforcement network"
- **US:** Skill Game Protection Act 2007 (SGPA, H.R.2610): "Legalize internet skilled games where players' skills are important in winning or losing games such as poker, bridge and chess"
- **US:** Internet Gambling Regulation and Tax Enforcement Act 2007 (IGRTEA, HR 2607): "Legalize internet gambling tax collection requirements"
- **Australia:** Interactive Gambling Act 2001 (IGA): Provides protection for Australian players from the harmful effects of gambling

- **UK:** Gambling Act 2005 (c. 19): "it is not illegal for British residents to gamble online and it is not illegal for overseas operators to offer online gambling to British residents (though there are restrictions on advertising)"

Approaches that countries take to online gambling can be divided into three main groups:

i. Those who do not allow gambling e.g. Islamic countries (Lewis, 2003);
ii. Those who may allow gambling, potentially in some states, but not online e.g. USA (GAO, 2002);
iii. Those who allow gambling, e.g. UK.

A glimpse of considerations in 100 countries is shown in Table 1:

Table 1: Online Gambling in 100 countries

Countries and territories where online gambling is legal							
1	Aland Islands	19	Dominican Republic	37	Lithuania	55	Seychelles
2	Alderney	20	Estonia	38	Luxembourg	56	Singapore
3	Antigua	21	Finland **	39	Macau	57	Slovenia
4	Argentina	22	France ***	40	Malta	58	Solomon Islands
5	Aruba	23	Germany	41	Mauritius	59	South Africa
6	Australia *	24	Gibraltar	42	Monaco	60	South Korea
7	Austria	25	Grenada	43	Myanmar	61	Spain
8	Bahamas	26	Hungary	44	Nepal	62	St. Kitts and Nevis
9	Belgium	27	Iceland	45	Netherlands Antilles	63	St. Vincent
10	Belize	28	India	46	Norfolk Island	64	Swaziland
11	Brazil	29	Ireland	47	North Korea	65	Sweden
12	Chile	30	Isle of Man	48	Norway	66	Switzerland
13	Colombia	31	Israel	49	Panama	67	Taiwan
14	Comoros	32	Italy	50	Philippines	68	Tanzania
15	Costa Rica	33	Jamaica	51	Poland	69	United Kingdom
16	Czech Republic	34	Jersey	52	Russia	70	US Virgin Islands
17	Denmark	35	Kalmykia	53	Sark	71	Vanuatu
18	Dominica	36	Latvia	54	Serbia	72	Venezuela

Countries where online gambling is illegal							
1	Afghanistan	8	Greece	15	New Zealand	22	Taiwan
2	Algeria	9	Hong Kong	16	Nigeria	23	Thailand
3	Bahrain	10	Indonesia	17	Pakistan	24	The Bahamas
4	Brunei	11	Iran	18	Portugal	25	The Netherlands
5	China	12	Japan	19	Saudi Arabia	26	Turkey
6	Cyprus	13	Jordan	20	South Korea	27	United States
7	Dubai	14	Libya	21	Sudan	28	Vietnam
* For Australia, different regulations might apply to different states.							
** Must be a Finnish resident with a Finnish bank account.							
*** France does not allow online gambling companies within its borders, but its citizens can gamble.							

There may be arguments that users should take responsibility for choosing whether or not to gamble based on whether the laws of the country they are in at the time allows. In the online world, one would be hopeful that the online gambling website has been legitimately set up in the host country, however this is not necessarily a given. This is further complicated by individuals being able to gamble in different ways at different ages in different countries – for example, at 18 in the UK, 20 in New Zealand, 21 in Nepal. In principle, then, an account registered by an 18-year-old in the UK for a UK-based online gambling site should prevent them from gambling if they travel to New Zealand or Nepal and log in. However, in the UK a 16 year old is able to buy tickets for the National Lottery, although the website advises: "players to assume that it is unlawful to purchase a ticket whilst abroad, and to only buy their tickets whilst located in the UK or Isle of Man" and rules have been criticized for being unclear (BBC News, 2009). The burden, here, is primarily on the user, though the technologically-savvy user may be able to make use of a virtual private network (VPN) or web proxy to avoid restrictions placed on network addresses and shift a burden back to the company. The challenge of age verification in general has been identified for online retailers in general by UK-based trade group IMRG (2009).

Machine Ethics

Machine ethics, generally, is concerned with defining how machines should behave towards human users and other machines, with emphasis on avoiding harm and other negative consequences of autonomous machines, or unmonitored and unmanned computer programs. Researchers in machine ethics aim towards constructing machines whose decisions and actions will honour privacy, protect civil rights and individual liberty, and further the welfare of others (Allen, Wallach and Smit, 2005). To produce ethical machines, it is necessary to understand how humans deal with ethics in decision making, and then try to construct appropriate behaviors within machines or autonomous avatars which, given continuous availability and unemotional responses, might start to replace human (ethical) advisors in a near future. Steps towards ethical

machines have been taken that focus on medical ethics, attempting to ensure human safety and social health. Such systems are intended towards understanding, and possibly reducing or avoiding, the potential for harm to an individual from, for example, unnecessary or incorrect medical intervention. In these systems, the final decision remains one of a human decision-maker, informed by ethical considerations. The mainstream literature largely discusses using Case-Based Reasoning and machine learning techniques to implement systems that can mimic the responses of the researchers (Anderson, Anderson and Armen, 2005b; McLaren and Ashley, 2000). A future machine-based ethical advisor has the following anticipated advantages, many of which are familiar arguments in the development of intelligent systems:

- Always available
- Unemotional
- Employ mixture of ethical theories
- Can explain reasoning
- Capacity for simulations
- Capacity for range of legal considerations
- No hypothetical limits on the number of situations assessed

A synthesized overview of many of the systems reported in the literature as ethical machines is shown in Table 2. Each of them has a specific "ethical approach" and "technique" to solve the ethical dilemmas and is targeted at particular audiences and challenges for those audiences.

Table 2: Evaluation of existing applications

Name	Developed by	Ethical approach	Techniques	Suitable	Ethical area
Ethos	Searing, D.	Moral DM	Not AI Some ethical samples	Engineering Students	Practical-ethical problems
Dax Cowart	Multiple writers	Moral DM	Not AI	Students, Teachers	Biomedical ethics, Right to die
Metanet	Guarini, M.	Particularism Motive consequentialism	Pair case (SRN), Case base, Neural network (training), Three layers	Problems in flagging	Killing or allowing to die
	Robins, R. & Wallach, W.	Desire-intention	Multi-agent	Not implemented	

Truth-Teller	McLaren, B. M.	Casuistry	Pair case, Case-Based Reasoning,	Ethical advice	Pragmatic or hypothetical cases
HYPO	Ashley, K. D.	Legal- reasoning	Case base	Legal advice	Hypothetical cases
SIROCCO	McLaren, B. M	Casuistry	Pair case, Case-Based Reasoning, Simulating "moral imagination"	Ethical device	NSPE Code of Ethics
Jeremy	Anderson, M. Anderson, S. Armen, C.	Hedonistic act utilitarianism	"Moral arithmetic"		Rule generalization
W.D.	Anderson, M. Anderson, S. Armen , C	Prima facie duty, Casuistry	Inductive-logic programming, Learning algorithm, Reflective equilibrium		Rule generalization
MedEthEx	Anderson, M. Anderson, S. Armen , C.	W.D. Medical ethics, Casuistry	Inductive-logic programming, Machine learning, Reflective equilibrium	Health care workers	Biomedical ethics
EthEl	Anderson, M. Anderson, S.	Prima facie duty, Casuistry, W.D., Medical ethics	Inductive-logic programming, Learning algorithm, Reflective equilibrium	Eldercare	Biomedical ethics

Machine Ethics for Online Gambling: EthiCasino

Machine ethics has not, until now, been applied for avoidance of harm in relation to online gambling. Alongside a number of other pursuits, and because gambling has potential for addiction, it could be claimed that a system for ethical gambling may be as effective for humans and social health as medical ethics. Machine ethics may not cure addiction, but it may be able to act to reduce the likelihood of addiction. Our consideration here is how Machine Ethics may support responsible gambling and lead towards such an Ethical Corporation.

We base the design of EthiCasino on prior literature and systems in Machine Ethics as shown in Table 2, including Truth-Teller, SIROCCO, MedEthEx and EthEl. Truth-Teller and SIROCCO implement case-based reasoners, comparing structured descriptions of the current scenario with previously resolved cases to support decision-making. Since each user's session is likely to have some unique characteristics, case-bases may need to be populated with large numbers of variant cases comprising different outcomes. We have been inspired in particular by three of the systems above, W.D., MedEthEx and EthEl, that have used Ross' *prima facie* duties (1930), extended by Garrett (2004). Ross introduced seven "prima facie duties" as guidelines for solving ethical dilemmas but not rules without exception. If an action does not satisfy a "duty", it is not necessarily violating a "rule"; however if a person is not practising these duties then he or she is failing in their duties. Garrett (2004) believed there to be aspects of human ethical life not covered by Ross, and extended this list with three further duties. MedEthEx uses a series of questions with a three responses, "Yes", "No" and "Don't know", to decide the outcome in relation to three of Ross' and Garrett's duties: *non-injury*, *beneficence* and *freedom* (autonomy). By weighting outcomes between -2 and +2, the application explains the likely impact on the patient ability to clarify the areas in which decisions will be made. EthEl takes two kinds of actions based on decisions made: (i) reminding users; (ii) notifying overseers. A system using Ross' and Garrett's duties for responsible gambling should consider the potential for the duties not being satisfied and act accordingly. For EthiCasino, we have addressed 5 main, often inter-dependent, stages involving legal and ethical considerations:

Stage 1: Legal considerations

Consideration of legal issues involves variations in acceptability of online gambling and associated age restrictions in 100 countries, as presented above. Here, online gambling environments in general and EthiCasino in particular can attempt to capture the geographical location (DNS lookup) of the end user, and act accordingly, but because of the capacity for technological circumvention the gambler needs to self-certify. Self-certification is required, also, for confirming the age of the end user. Should the location of the end user change over time from the original registration, the legal situation may change accordingly and location information must be captured and verified for each session.

Stage 2: Knowledge of Risk

Decisions related to financial risks may be taken in a number of business environments, especially in relation to stock markets and world economies. Those involved in taking such decisions are usually considered well-informed and have a number of checks and balances against which to validate their decisions or off-set their risks and/or losses. The person's knowledge is the effective tool in making the final decision. Unfortunately, because of the purported

"entertainment" aspect of gambling, it is less important for users to have such knowledge or to consider how to off-set risks and losses and more favorable to revenues if users are less well-informed.

To evaluate the risk behaviors of end users, we designed a questionnaire comprising 12 questions related to gambling fact and fiction and 8 related to risk and loss aversion. We offered L$10 to participants, equivalent to around 2½ hours camping, and obtained 61 responses to this questionnaire from Second Life users within a week. On average, 12.22 questions were correctly answered, with 7 and 17 as minimum and maximum. We *a priori* weighted questions based on our own perceptions of associated risk or negative impact on users in the absence of knowledge, leading to a division of questions into four categories:

1. **Low risk:** users should be able to learn quickly or lack of knowledge will not have much negative impact. e.g. Q3: "Some people are luckier than others" (fact or fiction)
2. **Medium risk:** users may believe in luck. e.g. Q6: "My lucky number will increase my chance of winning the lottery" (fact or fiction)
3. **Medium-high risk:** questions relate to calculations and predictability of results e.g. Q14: "Assume you bet $1 on the toss of a coin the chances of heads or tails are 50/50. If you win and 'house edge' is 10% how much you will be paid? (10c, 50c, 90c, $1)"
4. **High risk:** question regards perceptions of earning money and realistic facts of gambling. e.g. Q1: "Gambling is an easy way to make money" (fact or fiction)

User answers and weightings led to three distinct classes of users (Figure 1). Broadly identifying these classes of user allows our system to vary its responses to gambling behaviors depending on how informed the user appears to be:

- **Group one:** Those who may only need additional information about the games (low and medium risk questions)
- **Group two:** Those who need to be reminded about the facts (medium-high risk questions), and
- **Group three:** Those who need full monitoring and potential intervention because they are less informed and might be more prone to addiction (high risk questions)

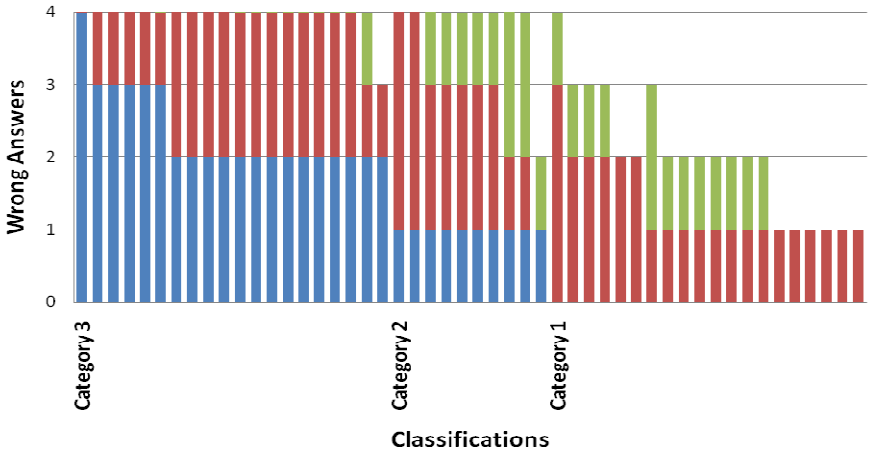

Figure 1:Risk groups based on responses to questions on gambling

To evaluate these behavior profiles, we analyzed the correlations between the 20 questions for 50 users (Table 3), hoping that diversification would exist across the various responses. The resulting correlation matrix showed maximum correlation between 18 of the questions of less than 0.5 (-1/+1), suggesting that the questions themselves had a reasonable degree of independence. On this basis, the risk classification becomes the important factor since the individual questions themselves do not act as a reliable predictor for others in the same class.

Table 3: Correlation matrix of collected data

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
1	1	-0.11	0.22	0.09	**0.81**	0.12	0.15	0.43	0.04	-0.05	0.43	-0.11	0.22	0.29	0.17	-0.25	-0.06	0.01	0.20	-0.01
2	-0.11	1	0.08	0.21	-0.11	0.29	0.26	0.16	0.04	-0.14	0.11	-0.19	-0.01	-0.14	0.19	-0.18	0.29	0.07	0.24	-0.01
3	0.22	0.08	1	0.47	0.22	0.27	0.22	0.09	0.25	0.20	0.26	0.12	0.00	0.25	-0.22	-0.32	0.18	-0.08	-0.20	0.15
4	0.09	0.21	0.47	1	0.09	-0.08	0.28	-0.16	0.39	0.08	0.12	0.07	0.09	0.30	0.15	-0.22	0.37	0.07	0.02	-0.04
5	**0.81**	-0.11	0.22	0.09	1	0.12	0.31	0.43	-0.08	0.10	0.43	0.12	0.22	0.29	0.17	-0.38	-0.06	-0.11	0.20	0.12
6	0.12	0.29	0.27	-0.08	0.12	1	0.05	0.34	0.18	0.38	0.22	-0.09	-0.16	0.04	-0.25	-0.26	0.17	-0.28	0.16	0.10
7	0.15	0.26	0.22	0.28	0.31	0.05	1	0.15	-0.10	0.13	0.03	0.05	0.28	0.21	0.08	-0.21	0.16	0.18	0.12	0.10
8	0.43	0.16	0.09	-0.16	0.43	0.34	0.15	1	0.17	0.10	0.43	-0.11	-0.06	0.04	0.01	-0.38	-0.06	0.01	0.05	-0.01
9	0.04	0.04	0.25	0.39	-0.08	0.18	-0.10	0.17	1	0.21	0.16	0.18	-0.12	0.11	-0.21	-0.13	0.25	0.04	-0.21	-0.13
10	-0.05	-0.14	0.20	0.08	0.10	0.38	0.13	0.10	0.21	1	0.10	0.02	-0.02	0.11	-0.25	-0.03	-0.02	-0.03	-0.07	0.13
11	0.43	0.11	0.26	0.12	0.43	0.22	0.03	0.43	0.16	0.10	1	0.22	-0.05	0.16	0.10	-0.49	-0.16	0.02	0.02	-0.04
12	-0.11	-0.19	0.12	0.07	0.12	-0.09	0.05	-0.11	0.18	0.02	0.22	1	0.01	0.18	-0.05	-0.26	0.01	-0.14	-0.20	0.10
13	0.22	-0.01	0.00	0.09	0.22	-0.16	0.28	-0.06	-0.12	-0.02	-0.05	0.01	1	0.34	0.08	-0.04	-0.04	0.11	-0.20	-0.25
14	0.29	-0.14	0.25	0.30	0.29	0.04	0.21	0.04	0.11	0.11	0.16	0.18	0.34	1	0.10	-0.21	0.16	0.28	0.08	-0.04
15	0.17	0.19	-0.22	0.15	0.17	-0.25	0.08	0.01	-0.21	-0.25	0.10	-0.05	0.08	0.10	1	-0.01	-0.04	0.03	0.25	0.01
16	-0.25	-0.18	-0.32	-0.22	-0.38	-0.26	-0.21	-0.38	-0.13	-0.03	-0.49	-0.26	-0.04	-0.21	-0.01	1	-0.14	0.18	0.03	-0.02
17	-0.06	0.29	0.18	0.37	-0.06	0.17	0.16	-0.06	0.25	-0.02	-0.16	0.01	-0.04	0.16	-0.04	-0.14	1	0.02	-0.09	-0.15
18	0.01	0.07	-0.08	0.07	-0.11	-0.28	0.18	0.01	0.04	-0.03	0.02	-0.14	0.11	0.28	0.03	0.18	0.02	1	0.12	-0.01
19	0.20	0.24	-0.20	0.02	0.20	0.16	0.12	0.05	-0.21	-0.07	0.02	-0.20	-0.20	0.08	0.25	0.03	-0.90	0.12	1	0.28
20	-0.01	-0.01	0.15	-0.04	0.12	0.10	0.10	-0.01	-0.13	0.13	-0.04	0.10	-0.25	-0.04	0.10	-0.25	-0.04	0.01	0.28	1

Stage 3: Boundaries for time and money

For a user to stay in control - part of the main challenge of gambling - the system should allow them to opt for boundaries. Considering that each user background and experience is different, and that there is such variation across responses to 20 questions about gambling, it could be unethical to enforce boundaries without end user permissions. Users are asked to define their own boundaries both for the amount of time and the amount of money they plan to spend: these two elements are core in addiction and harm. The user's choice of boundaries is checked against their apparent riskiness. For users with profiles in Groups 1 and 2, the system will allow users to participate with limited interference; users in Group 3 will receive a moderated limit as the maximum boundary (Figure 2).

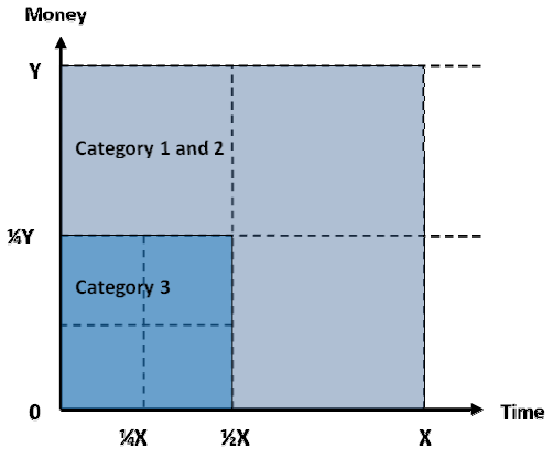

Figure 2: Maximum boundaries for each category

Stage 4: Appropriate reminders: "nagware"

In EthiCasino, to minimize the potential for destructive behaviors, we adopt the idea of "nagware" [A] as used by a number of software providers to remind users of specific actions, e.g. that they should pay for the software they have been using. In EthiCasino, this nagware has been called **VIKI**[B] and undertakes specific responsibilities:

- **Artificial ethical conscience:** suggestions allied to risk taking and user's circumstances, e.g. "high risk of losses, do you still what to bet?"
- **Educational:** providing access to information about each game, risks and odds associated to it, e.g. "roulette, your odds are 35 to 1"
- **Nagging:** Regularly reminding users, depending on their risk profiles, about the time and money spent, as both diminish.

Users receive reminders depending on how they approach their own specified limits. Those identified as having riskier behaviors will receive more reminders compared to other users. Those who have spent their money more quickly may be tempted to spend more, sometimes chasing losses. Those who manage not to make losses within the initial time period may be encouraged to continue and to make assumptions over the likelihood of larger future wins. Of course, user profiles may change over time depending on the increased or decreased risky behavior of the end user (Fig. 3).

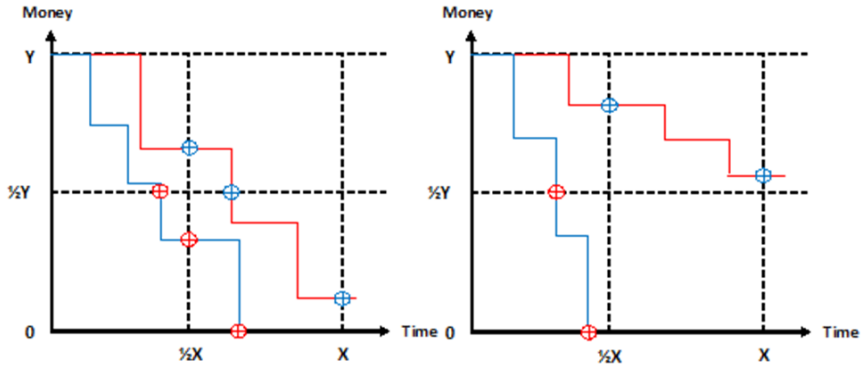

Figure 3: Possible users' behavior

Stage 5: Boundary conditions

A virtual doorman who ejects non-conforming end users is a possible future consideration. After users receive their final reminder from VIKI, they will be prevented from further gambling. The purpose here is to ensure the user's own boundaries are enforced and to ensure the risky behaviors do not lead to harm. In other words, EthiCasino acts to prevent behaviors that might lead to addiction. Those continuing beyond their own time and financial limits may also be going beyond their own limits of rational behavior. A virtual doorman who ejects non-conforming end users is a possible future consideration.

Discussion

In this paper we have discussed the legal and ethical issues relating to online gambling of various kinds, and how the construction of Open Grid Protocols for virtual worlds enables interoperability amongst virtual worlds and between public and private systems that could provide benefits to those implementing, or in some cases returning, online gambling into virtual worlds. In particular, such considerations could reverse the substantial decline in in-world turnover seen due to gambling being banned in one particular virtual world. We have demonstrated the legal and ethical issues of gambling online and in virtual worlds, and discussed the construction and evaluation of a system with computational oversight: the EthiCasino. The EthiCasino is grounded in recent research into Machine Ethics, which offers insights into other legal and ethical matters, and provides a framework for responsible gambling in our prototype in Second Life. EthiCasino's goal is to prevent ethical and legal issues, not to resolve them. EthiCasino is a prototype system[C] that implements specific ethical theories and learns about the

risky behavior and (lack of) knowledge of its users. It is an attempt to prevent harm through increased risk taking. The majority of existing Machine Ethics systems provides advice to help users, often medical practitioners, to make decisions that are ethically acceptable. EthiCasino takes a step forward with a testable implementation of its framework in Second Life which tries to improve not only the users' decisions but also its own ethicality through different stages.

While most of the ethical systems considered in this paper are either conceptual or prototype conceptual models, which have never been tested with actual users, the ethical principles behind EthiCasino have been implemented and tested to a certain extent. Excluding MedEthEx and SIROCCO, other ethical systems are unavailable, and in some instances the data and the code have been discarded. Systems such as Metanet and SIROCCO rely on subject-specific knowledge, whereas EthiCasino tests the knowledge of the participants. Most systems in machine ethics are based on application of absolute rules; a few consider *prima facie* duties e.g. W.D., MedEthEx and EthEl. EthiCasino is comparable with W.D. and MedEthEx because of adoption of Ross's duties, and with EthEl because of reminders and actions. Where MedEthEx is creating a simple expert system to give ethical advice, EthiCasino is combining technologies and techniques to assure ethics throughout. While MedEthEx and EthEl concentrate on three main duties of non- injury, beneficence and freedom, EthiCasino considers a wider range of duties; in particular, EthiCasino employs 6 of Ross' 7 duties and all 3 duties defined by Garret in different stages (Table 4). Using these Prima facie duties enables the system to learn from users' behavior even if they might not match exactly the original definition of the duties.

Table 4:Duties of Ross and Garret in each stage

Stage	**Name**	**Ross's duties involved**
Stage one	Legal issues	Justice, Harm prevention, Non injury, Beneficence, Self-improvement
Stage two	Ethical issues	Justice, Harm prevention, Non- injury
Stage three	Boundaries	Justice, Harm prevention, Respect of freedom, Fidelity, Gratitude
Stage four	VIKIs reminders	Non-injury, Beneficence, Self improvement, Care
Stage five	VIKIs alert	Justice, Harm prevention, Non-injury, Beneficence

EthiCasino takes certain actions to assure users' safety and wellbeing by minimizing possibilities of problematic and addictive behavior, providing ethically-acceptable support, and meeting the requirements of mimicking action of human ethical advisors. This aims at ensuring fair actions for both virtual gambler and virtual casino:

1. Gambler:
    a. Clarify the possible risks of gambling online
    b. Choose playing hours and amount of money they wish to gamble
    c. Remind the users of their playing hours and the amount money they are losing
2. Casino:
    a. Take decisions about whether or not to let specific persons play based on their answers
    b. Notify the company if a user is going over their own limitation
    c. Log the user off if they don't take action after being reminded by the system

With its substantial estimated revenues, a system such as EthiCasino may help to ensure that the ethical side of gambling remains to the fore by addressing issues relating to the impulse to gamble (Cutter and Smith, 2008). Reactive and non-intervening systems will not effectively deal with these issues because problem gamblers deny the problem. EthiCasino requires users to define their knowledge and limitations before they start, and takes actions if their self-imposed limits are being exceeded; it may not allow users who demonstrate limited knowledge of risks and losses to increase their limits. We claim that EthiCasino could create a situation where users should not worry about addiction and gambling problems and can treat their interaction as entertainment. The prototype framework of EthiCasino is relatively well-developed, and EthiCasino has been evaluated by a number of machine ethicists and experts in philosophy, computer science and business. However, a large-scale user-based evaluation is needed in order to fully explore the effectiveness of this framework. Such an evaluation currently presents a Catch-22: it is currently difficult to conceive of such an evaluation since this testing would currently entail gambling being allowable in Second Life. The move to a different virtual world, such as Open Sim, or the creation of a private virtual world may allow for such an evaluation. Successful outcomes could lead to wider considerations for business ethics and decision making.

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[A] The idea to describe this as "nagware" was introduced by Prof. Allen, Indiana University (private correspondence, 16/6/2008)

[B] Virtual interactive Kinetic Intelligence (VIKI) is a fictional computer introduced by Isaac Asimov. She serves as a central computer for robots to provide them with a form of "consciousness" recognizable to humans

[C] The prototype has been built on Surrey Island http://slurl.com/secondlife/Surrey%20Island/144/149/25