Using Motivation Derived from Computer Gaming in the Context of Computer Based Instruction

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***Abstract*— this paper explores how to exploit game based motivation as a way to promote engagement in computer-based instruction, and in particular in online learning interaction. The paper explores the human psychology of gaming and how this can be applied to learning, the computer mechanics of media presentation, affordances and possibilities, and the emerging interaction of playing games and how this itself can provide a pedagogical scaffolding to learning. In doing so the paper focuses on four aspects of Game Based Motivation and how it may be used; (i) the game player's perception; (ii) the game designers' model of how to motivate; (iii) team aspects and social interaction as a motivating factor; (iv) psychological models of motivation. This includes the increasing social nature of computer interaction. The paper concludes with a manifesto for exploiting game based motivation in learning.**

Keywords— eLearning, Game based learning; gamification; motivation, Computer Based Instruction, Education Systems Design; Computer Based Instruction.

I. INTRODUCTION

Users of Computer Games can spend hours engrossed in game play. At the same time, Computer Based Instruction and eLearning authors and designers have been striving to make their material - and the study of it - more captivating and engaging. This material is frequently studied online leading to the opportunities to introduce social interaction into the mix. This is an important consideration given that computer based instruction can often be lonely activity. It is thus a timely exercise to see if approaches from the world of Gaming can be applied to eLearning: not just in the sense of gamification but on other levels such as motivation, interaction, dynamics, and socialisation. One approach to overcome this involves enrichment of the environment and the addition of value added extras like interactive internet based lectures and virtual socialisation [1]. Communication clearly is an important part of the mix here, both synchronous and asynchronous interplay between users. Engaging students in more flexible learning, work based learning, and curricula that are more global and supporting international cohorts follows. This paper explores how to exploit game based motivation, not for playing games but for use in the design of interactive learning technologies. Furthermore, it considers the use of game based motivation to improve learner engagement. Gordon et al [2] have discussed approaches of using typical game dynamics, such as allowing multiple attempts as a zero or low cost option and high scores as a way of encouraging users to improve their course assessment grade.

Modern game environments provide a rich environment, which can be engrossing, involving multiple players in immersive game environments and enabling fantasy scenarios. In this paper, the focus is on motivation, something that is clearly very high for game players, and is therefore something very powerful that educators would wish to capture in Learning Interaction. The paper describes what can be captured from gaming dynamics that could increase engagement in pedagogical activity, and explores whether this motivation is solely about having fun or if there are deeper things in play. To this end, consider four aspects of Game Based Motivation and how to use this;

(i) The game player's perception;

(ii) The game designers' model of how to motivate;

(iii) Team aspects and social interaction as a motivating force;

(iv) Psychological models of motivation.

To explore the psychological forces at play it is necessary to consider what drivers might be in play. The paper will use Self-Determination Theory [3] as applied to Games [4] to inform interaction and dialog design. This paper will look at intrinsic and extrinsic sources of motivation that the above four aspects can provide. The paper will develop an argument that, in order to motivate, desirable properties include rich, immersive

interactions, levels of achievement through appropriate feedback and the movement to higher levels reflecting and rewarding this, user ownership of their learning, self-autonomy and lack of imposed control, and the importance of learning as a social endeavour. Learning, as game playing may also be a social activity that users desire to engage with. Interacting with others can be motivating in itself, as well as being engaging. Learning may also be peer-to-peer and involve social interaction. Frequently, such social interaction now takes place in the context of gaming. Indeed, the emergence of things like Frag fests - where groups of gamers come together for a games fest meeting and events - have moved social game computing into a new era.

The remainder of the paper is structured as follows: a review of HCI and computer games, concepts and approaches to educational interfaces, the distinction between using games and using game mechanics in teaching and learning; finally, the paper concludes with an outline manifesto for game based learning and teaching.

II. HCI AND GAMES

Laurel [5] proposed thinking of HCI from the starting point of theatre, considering the most common acts of stagecraft and how they can map onto HCI and user interaction. In this manner, games can be considered as the next modern stage, with performance characteristics that can be identified and analysed, for potential exploitation. Like theatre they can be dramatic, chart the interaction and interplay of the agents that compose them, and engross people in their action, encouraging them to stay to the end. Thus in this paper, rather than theatre, it is games that are used in order to design new interaction techniques for learners. In Homo Ludens, Huizinga [6] notes the play element for culture and considers play as a culture phenomenon. Specifically, (ibid, page 13) play is a free activity, since it

- Stands quite markedly outside ordinary life;
- It is not serious;
- Leads to players being intensively absorbed in their activity;
- It is not connected with material profit or gain;
- Proceeds with its own boundaries of time and space;
- It promotes the development of its own social groups; these groupings may develop their own characteristics and stand apart.

Huizinga then goes on to consider how play is used and expressed in language, and then used as a civilising function, and then in turn its use in law, poetry, war, mythopoiesis (myth making), philosophy, art, and knowing. From this, it is apparent that many of the notions that are typically applied to education interactions, like absorption and the social nature of the interaction, match concepts from the domain of play.

III. EDUCATIONAL COMPUTER INTERFACES

Computer Based Instruction (CBI) and Learning (CBL), or Computer Based Training (CBT) interfaces reflected the era in which they were built: starting with terminal interactions, which could be line, based (e.g. LOGO [7], [8] or ASCII graphics [9]). The Interfaces used for CBI/CBL and CBT are largely branching trees – they branch as they traverse the knowledge base depending upon the user's previous answers. Sometimes the trees might pause for the presentation of remedial material. Stages might also be present that would prevent users continuing to a next stage until they have demonstrated sufficient mastery of the current one. Artificial Intelligence in the form of an Intelligent Tutoring System (ITS) formed the next generation [10], [11], [12], which might contain an intelligent critic, planner, expert system style knowledge [13], and/or a user model [14]. The user model tried to model the user and - based on this model - offer the next phase of the learning interaction as it saw fit. Crudely this was often based on a confidence factor, on whether a concept e.g. such as multiple column subtraction, was known. The confidence factor could be doubled each time an instance of a question was asked correctly and halved if it were not. Rather than use Intelligent Tutoring Systems, others tried to use a transparent interface as a way of getting round these problems [15].

More recently, the advent of Internet, Web 2.0, and multimedia delivery of material has altered the delivery and environment for computer based instruction. Such material can be delivered by general purpose Content Management Systems (CMS) such as SharePoint [16] that allow sharing of web-based content. Alternatively, application focussed management systems such as Learning Activity Management Systems (LAMS) [17], Reusable E-Learning Object Authoring and Delivery (Reload) [18], WebCT [19] and Schema-Driven Personalisation [21], [20] have led to modern Learning Management Systems (LMS). Virtual Learning Environments (VLE) typically integrate delivery, interaction, assessment and marking, along with tracking, administration, and management of the student journey. This management may include fine-grained data analytics of student performance and the investigation of the criteria that have affected it. The analytics may be generated by data mining and delivered by visualisation. Linked to this may be authoring tools. Leading contemporary systems are SAKAI [22], Blackboard [23], Moodle [24], Desire2Learn [25], and Canvas [26], which may be cloud based services or hosted on local servers. A leading new trend is for Massive Online Open Courses [27]. Here the internet delivers content to large cohorts of students who study remotely and on mass. The access and delivery of the material is free although institutions may charge for additional human tuition and assessment – and for accreditation and academic award. The paper now considers learning interaction in the context of the above contemporary delivery.

IV. GAMES VS GAME BASED MOTIVATION

There is a distinction here between using games for teaching and using game based motivation in education interaction design. Teaching via games goes back to Wumps [27] and WEST [29], where essentially a game implicitly teaches a

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particular skill e.g. learning mathematics. The advantage over a traditional tutoring system is essentially the notion of play and fun. This learning via game playing is in contrast to the approach advocated in this paper where it is the game mechanics and affordances that are exploited in building and designing learning interaction. Gordon et al [2] used simple game mechanics to teach an introductory mathematic course at university. Low cost game mechanics, such as having another go and trying to maximise your score were used. The aim in this paper is to go further and look at how other game dynamics and social interaction are used and how to apply it to learning interaction. Exploiting Games Based Motivation in Learning Interaction involves understanding human psychology, computers, and the interaction between them.

A. Humans

The question of what is behind human behaviour and what motivates and drives it has deep roots [30]. The aim here is to understand the psychology of gaming and apply it to learning. Here the focus is restricted to considering two models that tie closely into gaming – Soar and Self-Motivation Theory. Soar was proposed as a Unified Theory of Cognition [31], being a cognitive architecture aiming to enable the modelling of intelligent agents. Whilst SOAR provides a theory of how humans function, it is most relevantly applied to providing artificial characters in agents that can provide motivation to players [32], and so it is considered below in the discussion of interaction and motivation.

Self-Motivation Theory [3] is also a general approach to human motivation and personality, with a background context of clinical psychology. It is a model of motivation that looks to base motivation upon rewards. These rewards can result from both internal and external drivers. Individual differences may be derived both from an individual's cognitive and social development. The key traits identified are autonomy, competence, and relatedness.

Rigby and Ryan [4] have applied Self-Motivation Theory to the study of Video Games. The key traits of Self-Motivation Theory underpin their arguments. Games allow individuals to demonstrate their competence; the desire for the high score or of beating ones' opponents enables individuals to demonstrate their domain power. Mission, purpose, and individual empowerment demonstrate autonomy. Relatedness incorporates both self-perception and the realization of oneself and the rest of the game community.

Rigby and Ryan note that self-motivation and gaming is not necessarily about fun – at least in the short-term vision. Indeed, much, highly motivated game playing is anything but fun, but deeply painful and frustrating. However, to echo Huizinga, they note the social interaction that takes place amongst fellow gamers, the development of social group and localised group language (e.g. in the World of Warcraft game the notion of "theorycraft"). They also note that the failure of common experience to fulfil basic needs can be made up for in the gaming experience.

B. Computers

The computer-based environment – the game – can also provide information about the game based motivation; through looking at the behaviour of the computer system; it is possible to identify what the players were doing. In doing this the Game Mechanics can be explored: this is equivalent to learning from stage mechanics – these are the mechanics, which implement aspects of the game. There may be interaction patterns, media patterns, and use of sound, dramatic effects, entrances, exits, or combinations of these things. The identification of Games Mechanics and the study of how they are mapped to reported Motivational Responses in users provides a way to understand how actions taken at the level of the computer influence motivational behaviour. For design, this would inform how a media producer could look to influence the interaction. Generating metrics is a long understood software engineering technique; therefore, the aim here is to utilise this approach to underpin the underlying design manifesto, thus enabling a direct mapping between the observed behaviour experiences of the user and the implementing technology.

C. Interaction

Gamification [33] is the use of game based mechanics in ordinary interaction. The interaction is turned into a game or has game like properties. People enjoy playing games, so the intention is to exploit this to encourage and improve human behaviour; achieving this would be potentially useful and valuable. Examples might include the use of a high score table in a computerised telephone call centre to encourage competition between operatives and thereby actually increase the number of call being made; a points based award towards task completion; or the use of levels within an interaction.
Therefore, scenarios and techniques that users have previously met in a game context now appear in the context of an otherwise standard interaction with the user. The important notion is the program employing these techniques is not one that is necessarily a game per say. Typically, they are not out there to be played as a game. The examples of the Call Centre Software is designed to manage and make calls – though it can be played as a sort of a game. One model of eBay can be thought of in this way; it is a competition about who can get the most positive feedback and make their stars turn a different colour. However, the primary focus of an individual's eBay activity is to secure themselves a bargain.

Chin [34] argues that the use of mobile technologies and social networks - alongside gamification - can be used to provide learners with improved interaction. Learners are changing and naturally using these methods of interacting, so they form a natural platform upon which to use gamification interaction techniques. Those learners will also be already playing games on the very devices they use for learning, so they will be used to this type of interaction and platform. Utilising this interaction for learning becomes a positive outcome.

This type of interaction in mobile learning (mLearning) and social networks provides for social interaction and shared space. Many ordinary learning episodes and

journeys are done by the user alone. Loneliness and isolation are one of the problems of distance education. With the rise of mLearning [35] and MOOCs this is becoming an increasing issue.

Many of the game based interactions considered here are taken from interactive games. The competition of high score, or playing competitively, interacting with others, acts of confederacy or betrayal all require interaction with others.

At other times this interaction may not be with be with humans but with AI. Soar is a good example of embedding AI's as characters within games [36], [37]. So social interaction within games is not just limited to talking with fellow humans but now embraces the synthetic. Based on this, the focus becomes on engineering agents within games that can be made sensitive to, and may enable, motivational dynamics. Thus, the developer is able to get the AI agents to behave in a predetermined manner to maximise motivation dynamics. Given a choice in their behaviour, the AI agent can choose to behave in ways that will likely to induce enhanced learner based motivation. Therefore, interaction is an important factor for the use of techniques of gamification. It is also important because much of the interaction now undertaken by users is computer-mediated and often of a social form.

V. WORKED EXAMPLES: A MANIFESTO

In order to illustrate how this might look in practice, the different roles are now considered: from a perspective

Of individual players,

Of team aspects, and finally

Of game designers.

By looking at individual learners, it is possible to consider how the individual might benefit from this approach. The next category to consider are how groups might be the best model to use here. Finally, the role of the designer is considered and explored in terms of how authors of education-based material could go about the task to better use these techniques in order to exploit game based motivation. In order to structure this discussion for each scenario, the focus will be on the four following factors:

- Competence;
- Autonomy;
- Relatedness – Social Communications;
- Gamification.

Competence and Autonomy are taken from Self Determination Theory (ibid) and [4]. In the context of the use of social networking and social computing (as discussed in the previous section on Interfaces), this is grouped with the Self Determination Theory concept of Relatedness. Gamification is considered as the final factor in this particular categorisation. Where an example from video games is taken from [4] it is marked as (R&R).

1) An individual Learner/Typical User

Competence: This may be through achieving the highest score, a score better than the competition, the longest, highest, most extreme value, task completion, game level completion, beating competition, beating friends/family, Health/Strength of Player, Health/Strength of Opponents, Layer Difficulty, Ability of User with Weapons, Track Complexity, Track Difficulty, Navigation of Current Space (e.g. Level, Obstacles) (R&R), Competence of Opponents, Complexity of Players Actions to Succeed (R&R).

Autonomy: The ability of the player to customise their representation in terms of their Avatar; how the Avatar looks, the Avatars Aspirations, Axiological Behaviour e.g. via Avatars' Beliefs, Desires, and Intentions, Artificial Intelligence Ability, Perception of Self, Goal Identity, Goal Directed Behaviour, Machine Learning Ability, Heroic Narrative (R&R), Customised Personality (e.g. The Sims) – (R&R). Autonomy is also noted as an important factor in motivation of learners e.g. homework (R&R).

Relatedness: Social Communications: Interaction in a multi-player game, One-to-One Communication, Humans/ AI Agents/Non Playing Characters (NPCs) able to communication with each other in a game leading to one-to-one/one-to-many chats, Private Chat between players in a game, Public Chat and Open Forums for Players so they can share their thoughts and feeling and empathize with each other, Team Strategies, Cooperative Play (R&R), "End Game Raids" (R&R), Social Networking inclusion in a game, Social Media, YouTube, Sharing Media, Sharing the Experience, Fellow travellers on a shared journey.

Gamification: immersive interactions, Have another free go, Physical/Emotional/Narrative Presence (R&R), levels of achievement through appropriate feedback/rewards and the movement to higher levels reflecting and positively reinforcing this, user ownership of their learning, self-autonomy and lack of imposed control (this clearly reflects back to autonomy above), and the importance of learning as a social endeavour.

*2) **Team aspects and social interaction as a motivating force**.*

Competence: Best team score, a team score better than the completion, the longest, highest, most extreme team value, team task completion, team game level completion, member of team winning, member of team getting highest score, team beating competition, team beating friends team/family team , Health/Strength of Team, Health/Strength of Opponents Team, Layer Difficulty, Ability of Team with Weapons, Track Complexity, Track Difficulty, Team Navigation of Current Space (e.g. Level, Obstacles) (R&R), Competence of Opponents, Complexity of Teams Actions to Succeed.

Autonomy: Customised your Teams looks, Aspirations, team sharing of Beliefs, Desires, and Intentions, Intelligence of Groups (more heads are better than one), Shared Goal Identity, Shared Goal Directed Behaviour, Emergent Group Intelligence, and Swarm Intelligence.

Relatedness: Social Communications: Recognise Others' Goals, See how other Peoples' Goals Relate to Your Own Goals, Recognising Axiological Relatedness to Others, Team Work, Confederacy, Betrayal, Delegation and Leadership, Role Playing, Socialising.

Gamification: Group Shared immersive interactions, Physical/Emotional/Narrative Presence that the Group Share (R&R), levels of achievement through appropriate group feedback/rewards and the movement to higher levels reflecting and positively reinforcing this, group ownership of their learning, group-autonomy and lack of imposed control, and the importance of learning as a group social endeavour.

*3) **The game designers' model of how to motivate***

Competence: Users want to see the top score, the competition, how others are doing. They want to see what the records are. They can be in terms of the best and worst but other things are important to games players. These can often be extreme values – longest time before someone scored anything, best score for first time user, longest/oldest player, previous champions, or even worst player ever! These can be both in terms of an individual player or a team. Competence at Game Specific Features is also important. Therefore, this can be in Ability with a Particular Weapon or on a given Track, dealing with Special Obstacles, or NPC Adversaries. Statistics in terms of other teams or individuals would also be useful.

Autonomy: Customisation is a key thing here. Giving payers control of their own agency/avatar in a game. The ability of a player to do their own thing or to interact with groups as they wish. This requires that the game writer think about how to motivate game players by giving them a sense of control and autonomy.

Relatedness: Social Communications: The importance of synchronous and asynchronous computer mediated communication. Building social networking and social computing into the fabric of a game is a key.

Gamification: Group Shared immersive interactions, Physical/Emotional/Narrative Presence that the Group Share (R&R), levels of achievement through appropriate group feedback/rewards and the movement to higher levels reflecting and positively reinforcing this, group ownership of their learning, group-autonomy and lack of imposed control, and the importance of learning as a group social endeavour.

VI. CONCLUSIONS

Engagement and success in education remains a challenge, one that can potentially be addressed through Game Based Motivation in Learning Interaction. This paper has developed an argument that, in order to motivate, desirable properties include *understanding* and using *competence*, *autonomy* and *relatedness* alongside *rich*, *immersive interactions*, *levels of achievement* through appropriate feedback and the movement to higher levels reflecting and rewarding this, user ownership of their learning, and the importance of learning as a social endeavour. This paper has also identified the changing environment that contextualised this study. Users are social media savvy. They will want to learn on the move. They want instant gratification and feedback. They are used to playing computer-based games. Their learning, as game playing, should be a social activity that users desire to engage in. Educational authors can thus look to build upon this. By using Game Based Motivation they can deliver

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REFERENCES

1. Eisenstadt, M., Brayshaw, M., Hasemer, T. and Issroff, K. Teaching, Learning and Collaborating at an Open University Virtual Summer School, in A. Dix and R. Beale (Eds.) Remote Cooperation: CSCW Issues for Mobile and Teleworkers. London: Springer (1996)
2. Gordon, N., Brayshaw, M. and Grey, S. Maximising Gain for Minimal Pain: Exploiting Natural Game Phenomena. Innovation in Teaching and Learning in Information and Computer Sciences 12(1), 27-38 (2013)
3. Deci, E., & Ryan, R. (Eds.), Handbook of self-determination research. Rochester, NY: University of Rochester Press (2002)
4. Rigby, S., and Ryan, R.M. Glued to Games: How Video Games Draw Us In and Hold Us Spellbound, Praeger (2011)
5. Laurel, B., Computers as Theatre (2nd Edition), Addison-Wesley Professional (2013)
6. Huizinga, J., Homo ludens; a study of the play-element in culture. , Routledge & Kegan Paul Ltd (1949)
7. Abelson, H., and di Sessa, A. Student Science Training program in mathematics, physics, and computer science, LOGO Memo No 19, MIT, Cambridge (Mass) (1976)
8. Abelson, H., and di Sessa, A., Turtle Geometry: the Computer as a Medium for Exploring Mathematics, Cambridge, Mass: MIT Press. (1981)
9. Hasemer, T., A very friendly software environment for SOLO, in M. Yazdani (Ed) New Horizons in Educational Computing, Ellis Horwood (Chichester, UK) (1984)
10. Sleeman, D., and Brown, J., Intelligent Tutoring Systems, London: Academic Press.
11. Wenger, E. (1987). Artificial Intelligence and Tutoring Systems: Computational and Cognitive Approaches to the Communication of Knowledge. Los Altos, CA: Morgan Kaufmann Publishers. (1982)
12. Ong J and Ramachandran S, Intelligent Tutoring Systems: Using AI to Improve Training Performance and ROI, http://www.stottlerhenke.com/papers/ITS_using_AI_to_improve_training_performance_and_ROI.pdf (2003)
13. McFarland T and Parker R, Expert Systems in Education and Training, USA: Education Technology Publications, Inc (1990)
14. Self, J.A. Student Models in Computer-Aided Instruction, International Journal of Man-Machine Studies, 6, 261-76 (1974)
15. Brayshaw, M. and Eisenstadt, M. A Practical Graphical Prolog Tracer. International Journal of Man-Machine Studies., 35, pp. 597-631, 1991 ISSN 0020-7373

16. Microsoft, what is SharePoint. Microsoft.com. Microsoft Corporation. https://support.office.microsoft.com/en-us/article/What-is-SharePoint-97b915e6-651b-43b2-827d-fb25777f446f (2013)
17. Dalziel J, Implementing learning design: the Learning Activity Management System (LAMS) In Interact, Integrate, Impact. (pp.593-596). Proceedings ASCILITE, Adelaide (2003)
18. Beauvoir P et al, RELOAD Reusable eLearning Object Authoring & Delivery: Reload Editor & Content Packaging: A Quick Start Guide http://www.reload.ac.uk/ex/ReloadQSv1.pdf (2004)
19. Goldberg M W, WebCT, a tool for the creation of sophisticated web-based learning environments (demonstration) [Online], ACM. http://portal.acm.org/citation.cfm?id=266057.266195&coll=Portal&dl=GUIDE&CFID=16355218&CFTOKEN=76882829 (1997)
20. Wen. L , Brayshaw, M., and Gordon, N. Personalized Content Provision for Virtual Learning Environments via the Semantic Web, ITALICS, ISSN 1473-7507 (2012)
21. Wen, L., Jesshope, C., A General Learning Management System Based on Schema-Driven Methodology, Proceedings of the 4th IEEE International Conference on Advanced Learning Technologies (ICALT2004), Finland, ISBN 0-7695-2181-9, pp. 633-635 (2004)
22. The Sakai Foundation, Sakai, http://sakaiproject.org/ (2011)
23. Bradford, P, Porciello, M, Balkon, N., Backus,D., The Blackboard Learning System, The Journal of Educational Technology Systems, 35, pp. 301-314, http://uupinfo.org/research/working/bradford.pdf (2007)
24. Moodle, https://moodle.org/ (2015)
25. Desire2Learn, http://www.d2l.com/ (2015)
26. Canvas, http://www.canvasvle.co.uk/ (2015)
27. Kolowich, Steve. The professors who make the MOOCs. The Chronicle of Higher Education 18 (2013)
28. Yob, G. Hunt the Wumpus. The Best of Creative Computing 1, 248–251 (1976)
29. Brown, J.S. and Burton, R.R., Diagnostic models for procedural bugs in basic mathematical skills. Cognitive Science 2, 155–192 (1978)
30. James, W., the Principles of Psychology, Volume 2, New York: H. Holt. and Company (1890)
31. Laird, J.E., Newell, A., Rosenbloom, P.S., SOAR: Architecture for General Intelligence, 33(1), pp. 1–64 (1987)
32. Macedonia, M.R, and Rosenbloom, P.E., Entertainment Technology and Virtual Environments for Training and Education, http://www.infor.uva.es/~jvegas/cursos/buendia/documentacion/internetuniversity/6.PDF (2015)
33. Renaud, C. and Wagoner, B. The gamification of learning. Principal Leadership, 12(1), pp. 56–59 (2011)
34. Chin, S, Mobile technology and Gamification: The future is now!, Proc Fourth International Conference Digital Information and Communication Technology and it's Applications (DICTAP), pp.138,143, 62014 doi: 10.1109/DICTAP.2014.6821671 http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6821671&isnumber=6821645 (2014)
35. Quinn, C. mLearning: Mobile, Wireless, in your Pocket Learning. LineZine, Fall 2000. http://www.linezine.com/2.1/features/cqmmwiyp.htm (2000).
36. Laird, J.E. It Knows What You're Going to Do: Adding Anticipation to a Quakebot, Agents Spring Symposium Series: Artificial Intelligence and Interactive Entertainment, AAAI Technical Report SS-00-02. http://ai.eecs.umich.edu/people/laird/papers/Agents01.pdf (2000)
37. Laird, J E., and Duchi, J.C., Creating human-like synthetic characters with multiple skill levels: A case study using the soar quakebot. AAAI 2000 Fall Symposium Series: Simulating Human Agents, 1001 48109-2110.3. (2000)

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