JAIST Repository
https://dspace.jaist.ac.jp/

Title	ゲーム洗練度の理論の連続的ゲームへの拡張とゲームプレーヤの機能性脳活動測定
Author(s)	Nossal, T Nathan
Citation	
Issue Date	2015-09
Type	Thesis or Dissertation
Text version	ETD
URL	http://hdl.handle.net/10119/12967
Rights	
Description	Supervisor:飯田　弘之，情報科学研究科，博士

JAIST
JAPAN
ADVANCED INSTITUTE OF
SCIENCE AND TECHNOLOGY

Japan Advanced Institute of Science and Technology

Expansion of Game Refinement Theory Into Continuous Movement Games with Consideration on Functional Brain Measurement

Abstract

Game theory has expanded far and beyond its original contexts into all manner of subjects. There are still many unsettled questions at both ends of the spectrum of applied, normative uses, and theoretical, descriptive inquiry. A wide range of scientific inquiry explores the domain of games for various purposes from that of pure play to serious business, and all of the many combinations thereof. Among these, game refinement theory is a child of the computer chess problem, and a close relative of artificial intelligence for games. Survey work of game theory, game refinement theory, the game progress model, and functional brain imaging for gamers during gaming is briefly undertaken throughout the relevant sections. The introductory chapter presents considerations on the study of recreational games and strategic interplay, and some of the problems facing game refinement theory. Namely, there is a lack of experimentation to test the theory that information accelerates in the mind of players and observers as the game progresses.

In Chapter 2, game theory as the game player's paradigm is discussed. Some of the tools which have been adopted for use in the study of recreational gaming are examined, and game refinement theory is explained in the framework of its theoretical relatives.

In Chapter 3, game refinement theory as the game maker's paradigm is discussed. Past studies of the state of AI for board games are mentioned and updated. The game refinement model and prior works are broken down, and game refinement values for various games and game types are compared. Also, recent work in the search for reasonable quantities to relate the model of discrete board game measures to that of continuous movement games is presented. The results of sub-studies and experiments relating discrete elements of non-discrete games in the board game format are considered. A bridging principle is now sought for guidance to help prove the acceleration of information in the brain during games. Game information dynamic theory makes a bold claim that information ow is governed by physical laws of motion. Without denying or supporting this claim, it is explored briefly with consideration on the principle bridging information and hydrodynamics.

Preliminary work in functional brain measurement of gamers during gaming is

presented in Chapter 4 with potential for becoming a useful component of verification for game refinement theory. The intersection of fNIRS brain measurement and games is an expanding field with excellent potential for game scientists. Prior studies have been carried out within the established protocols and frameworks of cognitive neuroscience. The well-developed model of games as a vehicle of experimentation for neuroscientists is being established, and games are recommended for those engaged in brain studies, as with brain activity measurement for those in the research of AI and games.

Lastly, results and implications from observations in continuous movement games are discussed along with the fitness of the model. Rule changes in most of the observed games show game refinement values for continuous movement games gravitating towards that seen in early work in board games. Theorists have been careful not to venture why the phenomenon of a game refinement window appears, noting a dearth of knowledge of the physics of information in the mind. Game information dynamics proposes that information might have measurable physical properties. Considering both these thoughts, the next experiments using functional brain imaging are outlined with the intention of capturing evidence of game information accelerating at game's end in the brains of gamers.

Keywords: *game theory, game refinement theory, sports, brain imaging, fNIRS*