ADVANCES IN INTELLIGENT SYSTEMS AND COMPUTING 209

Phayung Meesad
Herwig Unger
Sirapat Boonkrong (Eds.)

The 9th International Conference on Computing and Information Technology ($IC^2IT2013$)

May 9th–10th, 2013
King Mongkut's University of Technology North Bangkok,
Bangkok, Thailand

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Advances in Intelligent Systems and Computing 209

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Preface

This volume contains the papers of the 9^{th} International Conference on Computing and Information Technology (IC^2IT 2013) held at King Mongkut's University of Technology North Bangkok (KMUTNB), Bangkok, Thailand, on May 9^{th}-10^{th}, 2013. Traditionally, it is organised in conjunction with the National Conference on Computing and Information Technology, one of the leading Thai national events in the area of Computer Science and Engineering.

For the first time, the conference has been structured into 3 main tracks on Data Networks/Communication, Data Mining/Machine Learning, and Human Interfaces/Image processing. This year, the international program committee received exactly 100 submissions from authors of 21 countries on 5 continents. Each submission was reviewed by at least 2, mostly 3 members of the program committee to avoid contradictory results. On these judgments, the committee decided to accept 29 papers for oral presentation and inclusion in the conference proceedings. Moreover, this is the first time we published within the Springer series on Advances in Intelligent and Soft Computing. In addition, four internationally well-known scientists have been invited and accepted to give keynote talks to our participants.

A special thanks is given to KMUTNB President, Professor Dr. Teeravuti Boonyasopon for his support of our conference from the first year on, and for providing us with a lot of resources from KMUTNB. We hope that IC^2IT again provides great opportunities for academic staff, students and researchers to present their work. IC^2IT is also a platform for exchange of knowledge in the field of computer and information technology and shall inspire researchers to generate new ideas and findings and meet partners for future collaboration. We also hope that our participants use this occasion to learn more about Thailand and its beautiful scenery, people, culture and visit its famous historic sights before or after the conference.

We would also like to thank all authors for their submissions and the members of the program committee for their great work and valuable time. A lot of technical and organizational work has been done by the staff of the Information Technology Faculty at KMUTNB. A very special and warm thank you is given to our web masters: Ms. Kanchana Viriyapant, Mr. Jeerasak Numpradit, and Mr. Armornsak Armornthananun. Without the meticulous work of Ms. Watchareewan Jitsakul and Ms. Thitinan Ngamsanguan the proceedings could not have been completed in the needed form at the right time.

After so much preparation, all of the organisers of course hope and wish that IC^2IT 2013 will again be a successful event and will be remembered by the participants for a long time.

February 15th, 2013
Bangkok

On behalf of all organizers
Phayung Meesad
Herwig Unger
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Session III: Human Computer Interface/Image Processing

Bipolarity in Judgments and Assessments: Towards More Realistic and Implementable Human Centric Systems

Janusz Kacprzyk

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Abstract. We are concerned with the conceptualization, analysis and design of human centric systems. Such systems are meant, roughly speaking, as those in which a human being is a relevant (if not principal) element of a computer based system, and – by obvious reasons – there exists an inherent communication and articulation gap between the human and the computer implied first of all by different languages employed, i.e. strings of bits and natural language. Some human-computer interface (HCI) should therefore be employed to bridge that gap. Its very essence and purpose boils down to the use of most human consistent tools, techniques and solutions assuming that it is easier to change the machine than the adult human being. Obviously, there is a multitude of possible options in this respect and in our talk we consider one that is related to a proper representation and processing of human judgments and assessments that are crucial while considering any human – computer interaction. In this context we consider a known fact that when a human being is requested to provide a judgment or assessment concerning an option or course of action, he or she very often tends to to provide them in a bipolar version. This is meant in the talk in the sense of providing testimonies concerning separately positive and negative aspects (pros and cons), mandatory and optional conditions to be fulfilled, etc. To start with, we review two types of scales employed to quantified such type of bipolar testimonies. The first is the bipolar univariate scale, in which there is a neutral (0) point, and the negative part (0-1], related to a negative testimony, and a positive part (0,1], related to a positive testimony. The second is the unipolar bivariate scale in which two separate scales are employed, both with values in [0,1], expressing separately the positive and negative testimonies. The main problem is how to aggregate the positive and negative testimonies related to an option in question. We present two basic approaches, one that is decision theoretic and is based on some special multicriteria decision making scalarizing functions, and one which is logical and is based on multivalued logic with properly chosen definitions of logical operations. We present applications of these approaches to database querying and information retrieval, and to a multicriteria choice of design options of computer systems. We advocate such a bipolar setting and outline some possible future direction.

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Curriculumn Vitae: Janusz Kacprzyk graduated from the Department of Electronic, Warsaw University of Technology in Warsaw, Poland with M.Sc. in automatic control, his Ph.D. in systems analysis and D.Sc. ("habilitation") in computer science from the Polish Academy of Sciences.

He is Professor of Computer Science at the Systems Research Institute, Polish Academy of Sciences, Professor of Computerized Management Systems at WIT – Warsaw School of Information Technology, and Professor of Automatic Control at PIAP – Industrial Institute of Automation and Measurements, in Warsaw, Poland, and Department of Electrical and Computer Engineering, Cracow University of Technology, in Cracow, Poland.

He is Honorary Foreign Professor at the Department of Mathematics, Yli Normal University, Xinjiang, China, and Visiting Scientist at the RIKEN Brain Research Institute in Tokyo, Japan. He is Full Member of the Polish Academy of Sciences and Foreign Member of the Spanish Royal Academy of Economic and Financial Sciences (RACEF). He is Fellow of IEEE and of IFSA.

He was a frequent visiting professor in the USA, Italy, UK, Mexico and China. His main research interests include the use of computational intelligence, notably fuzzy logic, in decisions, optimization, control, data analysis and data mining, with applications in databases, ICT, mobile robotics, etc.

He is the author of 5 books, (co)editor of 60 volumes, (co)author of ca. 400 papers. He is the editor in chief of 5 book series at Springer, and of 2 journals, and a member of editorial boards of more than 40 journals. He is a member of Award Committee of IEEE CIS, a member of Adcom (Administrative Committee) of IEEE CIS, and a Distinguished Lecturer of IEEE CIS.

He received many awards, notably: The 2006 IEEE CIS Pioneer Award in Fuzzy Systems, The 2006 Sixth Kaufmann Prize and Gold Medal for pioneering works on soft computing in economics and management, and The 2007 Pioneer Award of the Silicon Valley Section of IEEE CIS for contribution in granular computing and computing in words, and Award of the 2010 Polish Neural Network Society for exceptional contributions to the Polish computational intelligence community. Currently he is President of the Polish Operational and Systems Research Society and Past President of IFSA (International Fuzzy Systems Association).

Critical Issues and Information Security and Managing Risk

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Abstract. Threat vectors against information systems are constantly changing and increasing in both diversity and frequency. This talk will review the latest threats to global information assets and mechanisms to assess risk exposure and mitigation approaches. Using examples from academia, industry, personal experience, and audience members; a spotlight will be cast on the major vulnerabilities that pervade our daily lives.

Appropriate access to most information technology resources inherently requires some risk. Assessing, eliminating, mitigating, and accepting risk then become functions that are necessarily performed by both individuals and organizations. Just as the threats themselves are misunderstood, so too are each of these four risk management elements often mismanaged. We'll explore structures to address each element, common theoretical and practical errors in application, and how these gaps might be closed by a different approach or through future research.

Finally, we'll review how the very actions that expose individuals and companies to significant risk may be exploited to thwart and prosecute criminals, by looking at recent approaches in digital forensics.

Curriculum Vitae: Mark Weiser is the Fleming Professor of Information Technology Management and Professor in Management Science and Information Systems and serves as Associate Dean for Undergraduate Programs, Spears School of Business at Oklahoma State University, Stillwater, USA since 2006. He is also the director of center for Telecommunications and Network Security since 2003. In addition, he is in charge of the Master of Science in Telecommunications Management program. His research interests are in the area of Information Assurance & Forensics, Applied telecommunications and applications, Technology to support education and training, and Organizational Memory.

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Visualising the Data: Now I Understand

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Abstract. Visualising information is increasing in situations where complex events are being presented to people who often have no understanding of what has/could have happened, procedures, methodologies or science. Computer Graphics (CG) can visually present scenarios based on scientific methodologies as well as depicting the perception of a witness to show what may have occurred. But more importantly CG can illustrate "what if…" questions and explore the inconsistencies and discrepancies within evidence and expert witness testimony. Therefore representing an important development in forensic graphics that are unparalleled due to its ability to assimilate and analyse data. However it is very important that when we use "science" to determine the validity of evidence or information that is done in a manner that is acceptable to the scientific community.

Curriculumn Vitae: Ken Fowle is currently the Head of School, Computer and Security Science, at Edith Cowan University (ECU), Western Australian and a Adjunct Associate Professor at the University of Western Australia, Centre of Forensic Science (CFS). Prior to moving over to academia in 2011, Dr. Fowle was employed by the Department of Mines and Petroleum in the Investigation Branch.

His research interest is in the use of 3D laser scanners in incidents and accidents and the use of visualisation as a tool for law enforcement and security. He works closely with the WA Police Sevices Forensic Surveying Branch and other national and international law enforcement agencies.

Dr. Fowle's interest in visualisation and accident reconstruct started back in 1996, when seconded to the departments Mine Safety Branch to assist with developing computer applications for mining accident and incidents. This interest was further enhanced in 1999 when he was seconded to Central Tafe to establish a research and development group specifically for developing computer graphics for the resource sectors of Western Australia. During his time at Central Tafe, Dr. Fowle undertook a PhD with the University of Nottingham (UK) and was conferred in 2003.

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In 2003 Dr. Fowle returned to the Department of Mines and Petroleum where he continued his research into visualisation and won funding from the Western Australian Government, to continue research in the use of 3D environments for accident reconstruction.

Dr. Fowle is past president of the Australian and New Zealand Forensic Science Society (WA) and is still an active committee member, a member of the International Association for Forensic Survey and Metrology, American Society for Industrial Security, Australian Computer Society and the Australian Law Enforcement Forensic Surveying Working Group.

Improved Computational Intelligence through High Performance Distributed Computing

David Abramson

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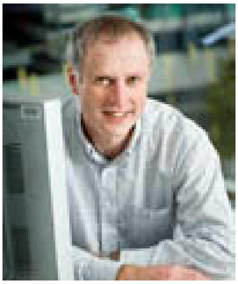
Abstract. Modern computational and business intelligence techniques are increasingly used for product design and complex decision making. However, as the problems they solve become more difficult, the need for high performance computing becomes increasingly important. Modern Cloud and Grid platforms provide an ideal base for supporting this work, but typically lack software support. Over the past 20 years we have developed a computational framework, called Nimrod that allows users to pose complex questions underpinned by simulation technologies. Nimrod allows users to perform what-if analysis across an enormous number of options. Nimrod also supports experimental design techniques and provides automatic optimisation algorithms (e.g. genetic algorithms) that search through design options. Nimrod has been used globally to across a wide range of application in science, environmental modelling, engineering and business.

In this talk I will describe the Nimrod framework, and show examples of how it has supported a range of scientific and engineering questions. I will show how Clouds and Grids support these case studies, and outline our continued research in the area.



Curriculum Vitae: David Abramson is currently a Professor and the Director of the Centre for Research Computing at the University of Queensland, Brisbane, Australia. Prior to that, he was the Director of the Monash e-Education Centre, Science director of the Monash e-Research Centre and a Professor of Computer Science in the Faculty of Information Technology at Monash University, Australia. He has also held senior appointments at Griffith University, CSIRO, and RMIT. He is a fellow of the Association for Computing Machinery (ACM), the Australian Computer Society and the Academy of Science and Technological Engineering (ATSE), and a Senior Member of the IEEE.

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Abramson has served on committees for many conferences and workshops, and has published over 200 papers and technical documents. He has given seminars and received awards around Australia and internationally and has received over $8 million in research funding. He also has a keen interest in R&D commercialization and some of his research tools are available commercially.

Abramson's current interests are in high performance computer systems design and software engineering tools for programming parallel and distributed supercomputers.

Lying in Group-Communication in El-Farol-Games Patterns of Successful Manipulation

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Abstract. The El-Farol-Bar-Problem is a well-established tool for behavior analysis. Recent studies focused on group communication in minority games of this kind. We introduce the possibility of lying to the behavior of agents in communicating groups. We found a successful strategy for lying, if the group is composed by specific characters.

Keywords: El-Farol, Group-Communication, Limbic, Lying, Manipulation, Minority Game, Psychology.

1 Introduction and Motivation

Group communication may be viewed as a tool to accomplish a common task and therefore a way to identify the best decision for all. In this case the efficiency of decision-making tends to increase as the complexity of the task increases [1].

On the other hand group communication may be used to gather information (passive) and to influence others (active) to accomplish individual success. In situations of competition it is impossible to achieve individual success for all group members. Situations like these are modeled in minority games, e.g. the El-Farol-Bar-Problem by Brian Arthur [2]:

"*N* people decide independently each week whether to go to a bar that offers entertainment on a certain night. For correctness, let us set *N* at 100. Space is limited, and the evening is enjoyable if things are not too crowded specifically, if fewer than 60 percent of the possible 100 are present. There is no sure way to tell the numbers coming in advance; therefore a person or an agent goes (deems it worth going) if he expects fewer than 60 to show up or stays home if he expects more than 60 to go." [3]

The original El-Farol-Bar-Problem has no kind of group communication. Each agent had to decide individually and without any knowledge about the decisions and motivations of the others.

When introducing group communication in El-Farol, the population of players can be understood as a social network. Within this network the individual decisions are submitted to the peers of an agent, which may their decision subsequently influenced

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by the knowledge about the others. The ratio of agents changing their decisions tends to increase, when the communication between agents is increased. Also, communication increases the success of the group itself proportionally [4].

Daniel Epstein replaced in his work the information-basis for individual decision in El-Farol with the input of peers in randomly created social networks. The group communication is the only phase of decision making for him. He concluded, even with this kind of limited information, "(…) each agent was able to select an action that would bring good result for itself and for other agents as well." [5].

We will enhance the agents in El-Farol with the possibility of communicating their decision to each other and eventually alter their decision as a result of communication. They will be able to lie within the group-communication-process. The lying may be directly caused by a character of an agent or indirectly a strategic act of manipulation. We will analyze the effects and results for the individual agents and for the group(s). Is lying a viable strategy to achieve individual success in competing groups, e.g. in minority games? Which circumstances are advantageous for lying? Is it in general good to change a decision after submitting it to others?

The decision about lying should be individual and according to the current situation of the game. Therefore we need a psychological model to create different characteristics and algorithms for the agents.

We decided to base our work on the psychological theory of limbic characteristics for human behavior. This concept, described by Häusel [6], defines human behavior as a result of three basic instructions: balance, dominance and stimulant. He further forms eight stereotypes with different emphases on these desires (see Table 1).

Table 1. Limbic types as described by Häusel [6]. Each instruction may be activated (1) or deactivated (0). The binary representation of instructions allows eight different types.

No.	Name	Balance	Dominance	Stimulant
0	Apathetic person	0	0	0
1	Hedonist	0	0	1
2	Technocrat	0	1	0
3	Entrepreneur	0	1	1
4	Harmonizer	1	0	0
5	Epicure	1	0	1
6	Stress-Type	1	1	0
7	Eccentric	1	1	1

There is already a complete simulation framework for El-Farol based on limbic characteristics. This includes established algorithms for individual decision-making for the limbic types [7].

In section 2 of this paper we extend this framework with algorithms for group communication and eventually lying. These algorithms are also based on limbic characteristics and define different strategies for the limbic types. This way we obtain a complete and well-founded simulation framework for group communication in El-Farol-Bar-Problems.

In section 3 we consecutively test our framework with different configurations and discuss the results and findings. First we run simulations within the complete framework without lying applied by the agents. Subsequently we repeat these simulations, but then with lying applied. We compare the results to look for significant effects of lying. Are there configuration patterns favorable for lying? Is there an efficient strategy or pattern that includes lying?

Finally in section 4 we make conclusions and suggest future studies and researches based on the established simulation framework.

2 Extending the Simulation Framework

Taking the established framework for limbic types in El-Farol-Bar-Problems [7], we extend it by implementing group communication and possible lying. First we define the new decision making algorithm (2.1). Then we describe the type-specific algorithms for lying (2.2) and eventual decision-altering, called "reflection" (2.3).

2.1 Decision-Making with Group Communication and Reflection

The population of players (the agents) is distributed into one or more groups. Every agent must be a member of only one group. Each group is understood as a social network. This means each agent is linked with every other agent in the group. Linked agents are able to communicate with each other.

The extended algorithm for decision-making is done every round for every agent in the game. The respective next step of the algorithm starts only, when the previous step is finished for all agents in the game.

1. Individual decision-making based on the history of the game as described by its limbic type [7].
2. Polling the individual decisions of its group-members. A polled agent may decide to lie about its true decision. If so, they submit the inverted version of their decision. The algorithm to decide about lying is based on the limbic type of the agent (described in section 2.2).
3. Viewing the results of the poll and eventually altering the decision. This is called "reflection". The algorithm for reflection of an agent is also based on its limbic type (described in section 2.3).

For example: An agent decides individually to visit the bar. It polls its group members for their respective individual decision. As a result, it will get percentages of the decisions of the group members. X percent submit that they will go to the bar, Y percent submit that they will stay home. The agent now reflects its own decision against these percentages. It may eventually decide to alter its decision. It will try to stay or become part of the minority. But this is (mostly) the exact consideration of the other agents, too.

This dilemma is solved in a different way by each limbic type. Indeed an agent does not know about the limbic type or characteristics of its other group members. It only knows their decision, as they submitted it during polling.

2.2 When to Lie or Not to Lie

When an agent has made the individual decision to visit the bar and is polled by the other players of its group, it may either decide to tell the truth (that it will visit the bar) or to “lie” (that it will not visit the bar) and vice versa.

In short, if an agent decides to lie, it will report the inverted value of its individual decision. The decision to lie is based on the limbic type of each agent again. It is made individually in every round of a game as described in the table below. The algorithms are based on the description of the limbic types by Häusel [6 S. 99-103].

Table 2. Type-specific algorithms for each limbic type, to lie or not to lie when polled about its individual decision

Type	Decision to lie - algorithm
0	Is not driven by any limbic instructions. No curiosity. No fear. Totally unpredictable. Decides randomly to lie or not.
1	As a hedonist character follows only its own stimulant desire. Has a high inner stability und is not very fearful. Does not strive for power and is not worried a lot. Always tells the truth.
2	As a totally dominant type it is unethical, tries to win at all costs and to prove its superior methods. So this type tries to manipulate strategically: It will lie if it lost the last round and its current decision is the same as in the round before. This way it tries to manipulate the others against its own decision to become minority itself. This is complementary to its reflection logic (see section 2.3).
3	Not only dominant, but also stimulant. This type tries to balance both instructions for success. It considers lying, if it lost the last round. If so, its decision to lie is based on the risk tolerance configured for the stimulant instruction in the simulation framework [6]. In other words, it listens to its “stomach”.
4	The fearful type does not want to anger its group members and has no “claim to power”. This purely balanced type will always tell the truth.
5	The combination of stimulant and balanced characteristics makes this type likable to others. Has some good ideas, but does not dare to enforce those. Therefore it will always tell the truth.
6	The stress-type will always lie, if it lost the last round. Representing stressful counter-actions.
7	This type is driven by all limbic instruction. Has good ideas, but is choleric in times and driven by its erratic mood. Therefore it is as unpredictable as type 0. Decides randomly to lie or not.

There are basically three types of algorithms:

- Random lying.
- Always lie/always tell the truth.
- Analyze the situation and try to determine the more advantageous action.

The types 0 and 7 are totally unpredictable and will always decide randomly. Types 1, 4 and 5 will always tell the truth, but caused by different motivations. Types 2, 3 and 6 will try to implement strategic lying in some kind.

This will probably make the composition of a group a big influence by itself. The distribution of limbic types among the agents is expected to have a significant effect on the success of lying.

An important feature of the simulation framework: The ability of lying may be deactivated for the agents. This enables the possibility to compare identical configurations with the only difference in the implementation of lying.

2.3 Algorithms for Reflecting the Individual Decision

The reflection starts, when all agents have finished polling their group members. No agent will submit a reflected decision when polled. So this phase is clearly differentiated from the others.

The result of reflection may be to keep the individual decision or to invert it. This means, going to the bar when the former decision was to stay home and vice versa. Parameter for this decision is the complete polling result: The submitted individual decision of the group members. Within the reflection, the submitted decisions are not doubted, but always taken as the truth.

Each type (expect type 0) will try to reflect and alter its decision for its own individual success. There is no kind of consciousness for the success of the group as a whole. These algorithms are again formed after the description of the limbic types by Häusel [6 S. 99-103, 199-202].

Table 3. Reflection algorithms, specific for each limbic type. This happens after an agent has polled its group members about their decision.

Type	Reflection algorithm
0	Like in lying, it is unpredictable and decides randomly.
1	As a “player” it likes to risk and speculate. Its reflection is based on the configured risk tolerance for the stimulant instruction in the simulation framework [7]. According to the risk it decides to alter its decision to the one of majority of its group. This is against the logic of a minority game, but it speculated on enough group members altering their decision, because of the poll.
2	Does not trust in its group members, but believes only in its calculations. It will never change its decision, because of the others. Indeed, it will try to manipulate if possible (see for type 2 in section 2.2).

Table 3. (*continued*)

3	Based on the configured risk tolerance for the stimulant instruction in the simulation framework [7]. According to the risk, it will eventually consider to alter its individual decision to the decision of the majority of its group, If it decides to consider, it will take a look at the visitor-quota of its group. If this quota is lower than the threshold to win the game, it will alter its decision to visits the bar, regardless it previous decision. Otherwise it will alter its decision to not visit the bar.
4	Tends to avoid risks and tries to play safe. So, it will take the obvious route and alter its decision to the minority. It takes a look at the visitor-quota in its group. If this quota is lower than the threshold to win the game, it will alter its decision to visit the bar, regardless its previous decision. Otherwise it will alter its decision to not visit the bar.
5	Will always stick with the majority of its group, regardless the chances of winning the game. When the majority of its group decides to visit the bar, it will alter its decision to that. When the majority of its group decides to not visit the bar, it will follow that either. The agent may have the idea that this is not a clever behaviour for a minority game, but as in lying, it does not dare to enforce its own way consequentially.
6	Full of stress, it tends to immediate counter-actions. If the previous game was won, it will keep its individual decision. If not, it acts like type 4.
7	When the majority of its group decides to visit the bar, it will alter its decision to not visit the bar. When the majority of its group decides to not visit the bar, it will alter its decision to visit the bar.

3 Results and Discussions

With the simulation framework established, we translate our questions into valid configurations. We define the scope of simulations in this paper (3.1) and determine the settings and configurations needed for those (3.2). Finally we look at the results and discuss the findings (3.3).

3.1 Introduction

The extended simulation framework was implemented in a configurable software-client. It allows the configuration of one or more groups of agents, composed of different limbic types. These groups play a defined number of games of the El-Farol-Bar-Problem. A game is divided into one or more rounds, where each round represents the decision-making. The minority (winners) of a round is defined by a configurable threshold of visitors.

The software allows analyzing the simulation results in different views by behavior, success, visitor-composition by round, etc. Finally the results are also exported as a structured text file for further analysis.

We focus on validating our simulation framework and the questions stated in the introduction. For this first time we limit ourselves to the study of one group, which is composed evenly of all limbic types. During the first run of simulations its members will be forced to say the truth during reflection. During the second run of simulations its members will be allowed to lie, so we may compare the differences in behavior and success of its members.

Both runs of simulation will increase the size of the group, if necessary to provide significant results, but with keeping the even composition of limbic types.

3.2 Environmental Settings of the Simulation

We start with one group of 400 players with 50 players of each limbic type. The specific settings of the limbic instructions were taken from the previous study and are explained there [7]:

Table 4. Configuration of the limbic instructions

Balance	
Visiting orientation	35%
Weighted value for other limbic instructions	60%
Change strategy after X rounds lost	3 rounds
Dominance	
Use prediction function for at least X rounds	3 rounds
Weighted value for other stimulant instructions	65%
Stimulant	
Chance of repeating a decision in the next round	45%
Risk tolerance	60%

With these settings, we run four simulations with configurations as shown in table 5. The first two configurations (A and B) test the reflection without the effect of lying. We increase the count of players in the second configuration, to confirm our results against a larger population. We basically repeat these configuration in C and D, but then with possible lying during reflection.

Table 5. Sets of configuration for the simulations in this paper

Config.	Players per limbic type	Games	Rounds/Game	Lying allowed?
A	50	100	500	no
B	100	100	500	no
C	50	100	500	yes
D	100	100	500	yes

3.3 Results

Reflection Only, No Lying Applied. The first simulation shows a reliable and significant pattern. An average of 30% of all players changes its opinion per round. It never exceeds the range of 20%-40%. Interestingly there is always a stable ratio of players that wins and has kept its decision during reflection. The ratio of those who win and has changed its decision previously during reflection was highly erratic in opposite to that.

The highest cluster of visitor-counts is around 50% of the population. The second highest cluster is nearly above 60%, missing the threshold of the visitors to win. So the group interaction leads to a maximizing the count of successful agents within the group. The average percentage of visitors never drops below 40% and also never exceeds 80%. The even composition of the group and therefore the even distribution of reflection-algorithms seem to balance each other out.

The aggregated ranking and success of the limbic types is nearly invariant through all games. Type 7 is by far the most successful one. This was expectable to some degree, since its reflection algorithm alters its decisions always against the majority. Obviously a good move in minority games in general.

Limbic type 2 is the by far the most unsuccessful one. It never changes its decision during reflection, making it predictable and inflexible.

The mainly stimulant types 1 and 5 are ranked below average. Their behavior to stick with the majority of a decision does not pay off within a group of this composition. Types 4 and 6 both accomplish to balance wins and losses, with type 4 being a bit more consistent.

Types 0 and 3 achieve both aggregated results above average. For type 0 this is surprising, as its random behavior would be expected creating purely average results. The result of type 3 is n total opposite to the other dominant type 2. The addition of stimulant instruction to the dominant behavior drastically increases its success.

These results scale up consistently in the simulation of configuration B. It shows similar patterns as in the previous simulation. This is in opposite to Redmondinos work [4]. The ratio of changed decisions does not increased with the count of links between the players. Reason for that may be the different communication protocol and the more complex characteristics of the players.

Both simulations showed, it is not per se good to change decision in minority games. But with a clever algorithm (e.g. type 7) and other group-members with a complementing "not-clever" algorithm (e.g. type 2*)*, it may become a huge factor of success.

Reflection with Lying Applied. In average between 20% and 40% of the agents apply lying per round. This is a very consistent pattern and nearly never exceeds this range. Up to 80% of the lies are applied successful, meaning an agent who lied won that round. The total number of liars that win a round is higher most of the times as the number of liars that lose a round.

In total, around 50% of the winners of a round are liars. Compared to the total amount of liars within the population (see above), the minority of liars is over-represented as winners. Therefore it is a viable strategy in this type of group composition.

Surprisingly the aggregated results for the limbic types do not change a lot compared to the simulations without applied lying. Despite a bit more variability, type 7 is still the most successful, type 2 still the most unsuccessful. The aggregated ranking of the limbic types by success over all games is the same.

Again the results scaled up consistently in configuration D, confirming the patterns observed. The ranking in success of the limbic types did not change significantly to these in the previous simulations.

There is no significant effect of lying in the resulting success of limbic types in this even composed configuration. Still, there is a significant influence of lying on the behavior of the agents during the simulation. The limbic algorithms balanced each other out in the end. So if all agents apply lying with their own respective strategies, they are able to retain their level of success. Lying does not better their results, but ensures that the distribution of success between the types stays persistent. This defines successful lying in our simulations.

4 Conclusions and Future Work

We extended the simulation framework of limbic types in the El-Farol-Bar-Problem by introducing group communication and the ability of lying by the agents. The group communication is implemented by polling the individual decisions of its group members by a player. The player looks at the results afterwards. Eventually it alters its decision to visit the bar according to the decisions of others. Additionally the players may lie about their own individual decision to each other during polling.

The developed software was used to test our simulation framework and reviewed the application on configuration with and without applied lying to compare the effects. The effects observed were significant and reproducible. The ratio of players changing their decision was within a stable range. There was no overall advantage of changing decisions by reflection. But with the right strategy and group composition the limbic type 7 could outperform the others by far.

If lying is allowed during communication*, the final results did not change* significantly. The ratio of changed decisions was nearly the same, as the ranking of the success of limbic types was the same. The direct effects of lying during communication and reflection were balanced out due to the even composition of the group. But to succeed and retain success, *an agent has to adapt to the lying* situation and eventually apply it, to retain its level of success.

Further studies will observe different group compositions and the possibility for competing groups with its members playing for success of their group, even if this results in losing individually. This collective style of player may require new algorithms and strategies.

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Identifying Limbic Characteristics on Twitter

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Abstract. An adaptive, intelligent system requires certain knowledge of its users. Patterns of behavior, preferences, and motives for decision making must be readily identifiable for the computer to react to. So far, typifying of users needed either a huge collection of empirical data via questionnaires or special hardware to track the user's behavior. We succeeded to categorize users by analyzing only a small amount of the data trace a user leaves while using the online social network (OSN) Twitter. Our approach can be adapted to other platforms easily. Thus, human behavior is made understandable for computer systems and will help to improve the engineering of human-computer-interactions.

Keywords: Limbic Characteristics, Twitter, Classification, Social Network.

1 Introduction

The behavior of people bears a lot of their personality. It gives evidence about their way of thinking, feeling, and deciding. An adaptive, intelligent system requires that knowledge of its users to be able to show specific reactions to each different user. Therefore, the automatic identification of different personalities is a challenge. So far, typifying of users needed either a huge collection of empirical data via questionnaires or special hardware to track the user's behavior. We succeeded to categorize users by analyzing only a small amount of the data trace a user leaves. Based on the model of limbic characteristics by Häusel [1][2], we deduced six hypotheses about the behavior of Twitter users conveying the specific limbic characteristics. The accuracy of Häusel's approach for predicting human behavior was proofed by empiric validation with more than 60,000 consumers as subjects [2]. Akinalp showed how this approach can be adapted for decision making processes in economic systems with limited resources [3]. By analyzing the huge mass of data a user produces while using online services the inference from behavior to characteristics can be done automatically by the system. That is the achievement of our work.

Related work on social networks presented methods for measuring social influence [4] and message propagation behaviors [5] in interpersonal relationships, but does not consider the personality of humans. The connection between Twitter users and

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personality traits based on the psychological model called "The Big Five" has been examined in [6]. In our work, we quantify user behavior using basic functionality of the platform. Thus, human behavior is made understandable for the system and will help to improve the engineering of human-computer-interactions.

2 Fundamentals of Limbic Type Identification

2.1 Functionality of Twitter and Its Potential for Data Analysis

One of the most popular online platforms has been chosen as the subject of our work because of the multiple possibilities for data mining. Quantitative studies about the user's personnel data, e.g. their origin, and their activities on the platform can be found in [7]. In [8], subject matter of analysis was mainly the network topology and the retweet tree, and a ranking of users as well as of topics.

Data for analysis can be sampled by querying the Twitter Search API [9] with random generated user-IDs. Not only the user's activities are documented but also information related to emotions, interests, personal opinions and so forth, conveyed by functions e.g. replies, retweets, hashtags. This opens up possibilities for several methods: text and sentiment analyzes, analyzes of the network structure as well as of personal data. We categorize the subject matter of a data analyzes on Twitter as follows:

1. Private user's profile data and user settings
2. Data, resulting from online activities of the user (connected to Twitter)
3. The user's position within the social network
4. Content analyzes of the user's tweets
5. Formal analytic interpretation of the user's tweets

All five categories include a great range of variables. In addition to parameters that can be directly extracted, measurements were proposed, e.g. the klout score for influence [10], which combine multiple parameters.

2.2 The Approach of Limbic Characteristics and Limbic Types

As an approach to model human characteristics, Häusel states in [1] that every person is influenced by three key motivational and emotional systems. The different magnitudes of influence of one person compared to another form the individual character and determine in this way behavior and decisions.

These three systems, called limbic instructions, are the following:

- **Stimulant:** The impulse responsible for curiosity, inventiveness, restlessness, communicativeness and the pursuit for amusement.
- **Dominance:** Influences human beings to fight, to strive for power, autonomy, leadership and to overtake responsibility.
- **Balance:** The wish for security, stability, home and social integration.