

*Center for the Study of Rationality
The Hebrew University of Jerusalem*

**Scientific Report
June 2008 – June 2009**

*Presented by
Eyal Winter
Center Director*

About the Center

Founded in 1991, the Hebrew University's Center for the Study of Rationality is a unique venture in which faculty, students, and guests join forces to explore the rational basis of decision-making. Coming from a broad sweep of departments—mathematics, economics, psychology, biology, education, computer science, philosophy, business, statistics, and law—its members apply game-theoretic tools to examine the processes by which individuals seeking the path of maximum benefit respond to real-world situations where individuals with different goals interact.

Largely inspired by the pioneering work of Professors Robert John Aumann (Nobel Laureate in Economics 2005) and Menahem Yaari (President of the Israel Academy of Sciences and Humanities), the range of the Center's scientific activity is unparalleled in the world. Most interdisciplinary centers aim to promote cooperation between researchers in two or three different fields, whereas the Center for Rationality is a truly multidisciplinary enterprise, drawing on the talents of outstanding scholars from ten different departments in four faculties of the University. The richness of perspective is a vital aspect of the Center's mission: to explore models that describe interactive decision-making as it occurs in every one of these disciplines, and beyond.

Through its workshops and conferences the Center challenges academics to break free from the governing rubrics of their individual specialties and, instead, to direct their gaze toward the wider horizon of interactive dynamics. As of the 2005–2006 academic year the Center opened a Ph.D. Program for Excellent Students: taking specially designed courses that are offered by the Center, the students accepted to the program are the best from all the institutions of higher learning in Israel and from all the disciplines represented by Center members.

The Center is a hub of activity: it holds workshops, conferences, seminars, and lectures, including the popular "Rationality on Friday" interdisciplinary colloquium; it hosts world-class guest scholars from around the world, and publishes a series of highly regarded Discussion Papers based on Center activities.

Mike Borns's and Elinor Notrika's help in the preparation of this report is gratefully acknowledged.

Acknowledgments

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- The President of the HU.
- Yad Hanadiv, for support of the academic activities of the Center, with special emphasis on innovative programming.
- Dr. Jozef Straus, Canada.
- Mr. Stanley Bogen, USA.
- The Horowitz Foundation, for providing grants to the Center's students, and for general support of the Center's Ph.D. program. (The fund was terminated in December 2008 due to the Madoff scam.)
- The Beracha Foundation, for supporting the Center's visiting scholars and special conferences, as well as the BeeHave laboratory.
- The Seidmann family, USA, for providing a donation toward upgrading the Center's library in memory of Rose & Moshe Seidmann.

This report was prepared for the annual meeting of the Academic Committee of the Center (June 22, 2009):

Sergiu Hart (Chair)
Kenneth Arrow
Hanoch Guttfreund
Gil Kalai
Yaakov Kareev
Eric Maskin
Abraham Neyman
Eytan Sheshinski
Hermona Soreq
Edna Ullmann-Margalit
Eyal Winter (Center Director)

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1. Visiting Scholars

During the 2008–2009 academic year, the Center hosted eighteen visitors from around the world. These scholars conduct joint work with Center members, lecture in its various colloquia, and meet with Center students. They include senior scientists as well as post-doctoral students and annual guests.

Short-Term Visitors

Robert Boehm, Max Planck Institute for Economics, Germany; April 19–June 10, 2009. Host: Gary Bornstein.

Markus Englerth, Max Planck Institute for Research of Collective Goods, Bonn; October 3–November 30, 2008. Host: Alon Harel.

Alex Gershkov, Economics, University of Bonn; July 21–August 11, 2008. Host: Motty Perry.

Serdar Gökhan Senol, Botanical Garden & Herbarium, Ege University; April 24–26, 2009. Host: Avi Shmida.

Konstantinos Hadjichristidis, Cognitive Sciences, University of Trento; March 15–April 16, 2009. Host: Ilana Ritov.

Penélope Hernández, Economics, Valencia; May 1–5, 2009. Host: Sergiu Hart.

Abram M. Kagan, Mathematics, University of Maryland; March 8–June 3, 2009. Host: Rinott Yossi

Bart Lipman, Economics, Boston University; May 28–June 6, 2008. February 13–23, 2009. Host: Elchanan Ben-Porath.

Andreu Mas-Colell, Economics, Universitat Pompeu Fabra; January 1–6, 2009. Host: Sergiu Hart.

Benny Moldovanu, Economics, University of Bonn; April 1–19, 2009. Host: Eyal Winter.

Phil Reny, Economics, University of Chicago; May 31–June 23, 2009. Host: Motty Perry.

Yuliy Sannikov, Economics, Princeton University; December 20–26, 2008. Host: Gil Kalai.

Farder Senol, Turkey, April 22–26, 2009. Host: Avi Shmida

Alexander P. Sukharukov, Biological Faculty, Moscow Lomonosiv State University; December 9–17, 2008. Host: Avi Shmida.

Nicolas Vieille, School of Management, HEC Paris; January 1–28, 2009. Host: Elchanan Ben-Porath.

Massimo Warglien, Business Economics and Management, University Ca' Foscari, Venice; January 21–28, 2009. Host: Yaakov Kareev.

Jorgen Weibull, Economics, Stockholm School of Economics; March 18–23, 2009. Host: Sergiu Hart.

Asher Wolinsky, Economics, Northwestern University; November 30–December 18, 2008. June 2–21, 2009. Host: Sergiu Hart.

Visiting Scholars

Itzhak Aharon, Ben Gurion University, Physics, all year. Host: Sergiu Hart.

Zur Shapira, NYU, Business/Psychology; a regular annual guest.

2. Seminars

This year the Center conducted three series of seminar meetings: “Rationality on Friday,” “Game Theory and Mathematical Economics,” and the “Students’ Seminar.” In addition to these formal weekly meetings there are also various occasional seminar meetings, often informal and sometimes during our regular “sandwich luncheon” meetings on Sundays.

“Rationality on Friday”

“Rationality on Friday,” coordinated by Center Members Alon Harel (first semester) and Ilana Ritov (second semester), is a forum to which the best Israeli and international researchers are invited to present state-of-the-art research topics. Open to the general public, this multidisciplinary colloquium has become a staple of the Center and has gained wide popularity. This year’s lectures:

1. **Shraga Biran**, S. Biran & Co., Law Firm (Nov. 21, 2008):
“Theory of Opportunities as an Interdisciplinary Science.”
2. **Ariel Porat**, Tel Aviv University (Nov. 28, 2008):
“Aggregating Probabilities across Offences in Criminal Law.”
3. **Daniel Attas**, The Hebrew University (Dec. 19, 2008):
“Terms of Trust.”
4. **Igal Kvart**, The Hebrew University (Jan. 2, 2009):
“Knowledge, Skepticism, Simulation Models, and Cognitive Explanations.”
5. **Eyal Benvenisti**, Tel Aviv University (Jan. 16, 2009):
“Reclaiming Democracy: The Strategic Uses of Foreign and International Law by National Courts.”
6. **Massimo Warglien**, University Ca’ Foscari, Venice (Jan. 23, 2009):
“Developing Language Structure in the Lab.”
7. **Tehila Kogut**, Ben Gurion University (Mar. 20, 2009):
“The Identifiable Victim Effect and When It Is Better to Stay Anonymous.”
8. **Matthew H. Kramer**, Cambridge University (Apr. 24, 2009):
“Why Consistency is Hardly Ever Enough: Reflections on Hillel Steiner’s Methodology.”
9. **Eliezer Rabinovici**, The Hebrew University (May 8, 2009):
“Dynamics of Prejudices and Legitimacy of Questions in Fundamental High-Energy Physics.”
10. **Nancy Cartwright**, LSE (May 22, 2009):
“Hunting Causes and Using Them: A Bridge Too Far.”

(For abstracts of the “Rationality on Friday” lectures, see Appendix 1.)

“Game Theory and Mathematical Economics”

This series of talks explores the connection between the fields of Mathematical Economics and Game Theory. Among the speakers this year were four students in the Ph.D. Program in Rationality, who were asked to present their research. Of the nineteen talks, five were given by

speakers from abroad, six by Hebrew University faculty, and four by lecturers from other Israeli universities:

1. **Eyal Winter**, The Hebrew University (Nov. 9, 2008):
"Mental Equilibrium and Rational Emotions."
2. **Abraham Neyman**, The Hebrew University (Nov. 16, 2008):
"Stationary Payoffs and Equilibrium."
3. **Silvio Micali**, MIT (Nov. 23, 2008):
"Resilient and Equilibrium-Free Mechanism Design."
4. **Ziv Gorodeisky**, The Hebrew University (Dec. 7, 2008):
"Stochastic Approximation of Discontinuous Dynamics."
5. **Yisrael Aumann**, The Hebrew University (Dec. 14, 2008):
"Rational Expectations in Games."
6. **Kobi Gal**, MIT and Harvard University (Dec. 21, 2008):
"Computer Agents for Reasoning about People's Beliefs and Preferences."
7. **Dov Samet**, Tel Aviv University (Jan. 4, 2009):
"The Sure-thing Principle and Independence of Irrelevant Knowledge."
8. **Sergiu Hart**, The Hebrew University (Jan. 11, 2009):
"Bargaining and Cooperation in Strategic Form Games."
9. **Ella Segev**, Ben Gurion University (Jan. 18, 2009):
"Efficiency Levels in Sequential Auctions with Dynamic Arrivals."
10. **Ro'i Zultan**, The Hebrew University (Jan. 25, 2009):
"Job Market Signaling and Job Search."
11. **Yan Dolinsky**, The Hebrew University (Feb. 1, 2009):
"Perfect and Partial Hedging for Swing Game Options in Discrete Time."
12. **Ziv Hellman**, The Hebrew University (Mar. 15, 2009):
"How Common are Common Priors."
13. **Jorgen Weibull**, Stockholm School of Economics (Mar. 22, 2009):
"Robust Set-valued Prediction in Games."
14. **Ron Holzman**, Technion (Mar. 29, 2009):
"Sharing the Cost of Capacity Network."
15. **Penélope Hernández**, University of Valencia (May 3, 2009):
"Bounded Memory Equilibrium."
16. **Yuval Heller**, Tel-Aviv University (May 10, 2009):
"Weaker Axiomatizations of Rational Choice."
17. **Yaakov Babichenko**, The Hebrew University (May 24, 2009):
"A Evolutionary Foundation of Rational Choice."
18. **Peter Stone**, The University of Texas at Austin (May 31, 2009):
"Teaching Teammates in Ad-hoc Teams."
19. **Abraham Neyman**, The Hebrew University (June 14, 2009):
"The Maximal Variation of Martingales of Probabilities and Repeated Games with Incomplete Information."

(For abstracts of the "Game Theory and Mathematical Economics" lectures, see Appendix 2.)

“Students’ Seminar”

The Students’ Seminar is an open, friendly, and informal venue in which students of the Center present and discuss their academic work. In addition to throwing light on what one’s fellow students are working on, the seminar promotes interdisciplinary cooperation and exchange. The seminar is not restricted to current work, but allows students to discuss any academic topic of interest, be it a past thesis, an article, or a lecture. The seminar is also open to outside lecturers whom the students find interesting and wish to invite.

This year’s seminar was coordinated by Ph.D. students Ro’i Zultan (first semester) and Ilan Nehama (second semester).

1. **Ron Peretz** (Nov. 16, 2008): “*Towards a Folk Theorem in Repeated Games with Bounded Recall.*”
2. **Moti Michaeli** (Nov. 30, 2008): “*Risk in Repeated Games with the Possibility of Bankruptcy.*”
3. **Omer Edhan** (Dec. 14, 2008): “*Utility and Dynamics: Is There a General Non-Equilibrium Theory?*”
4. **Ro’i Zultan** (Jan. 4, 2009): “*Job Market Signaling and Job Search.*”
5. **Sarit Weisburd** (Jan. 18, 2009): “*Moral Hazard in Car Insurance Contracts: A Study of the Effects of Company Provided Insurance on Car Accidents in Israel.*”
6. **Amnon Schreiber** (Feb. 1, 2009): “*A Dynamic Model of Asymmetric Information in an Order-driven Market.*”
7. **Ilan Nehama** (Mar. 24, 2009): “*Another Proof of the Gibbard–Satherthwaite Theorem and Implications for an Infinite Number of Voters.*”
8. **John Levy** (Apr. 21, 2009): “*Stochastic Games with Information Lag.*”
9. **Robert Böhm** (May 5, 2009): “*Social Categorization and the Interindividual-Intergroup Discontinuity Effect.*”
10. **Aviv Keren** (May 14, 2009): “*Random Sequences.*”
11. **Ron Peretz** (June 4, 2009): “*Learning the Length of a Cycle.*”
12. **Roi Zultan** (June 11, 2009): “*Cycles of Conditional Cooperation.*”
13. **Ori Weisel** (June 18, 2009): “*Punishment, cooperation, and cheater detection in “noisy” social exchange.*”

3. Conferences

The 19th Summer School in Economic Theory

The Summer School in Economics is hosted annually by the Center in collaboration with the Institute for Advanced Studies of the Hebrew University. Taught by renowned HU and guest scholars, it attracts an audience of advanced graduate and post-doctoral students from around the world. The School is headed by Nobel Laureate Eric Maskin from Princeton University, and is co-directed by Center Director Eyal Winter.

The 19th School, June 27–July 8, 2008, was dedicated to “*The Economics of Kenneth Arrow*” (87 participants).

The 18th Annual Rationality Conference

The 18th Annual Rationality Conference (“Retreat”) took place at the Ramot Resort Hotel in the Galilee on February 8–10, 2009. As always, the conference was an opportunity for Center faculty and advanced doctoral students to present and discuss their ongoing research.

The academic program of the 18th Conference, organized this year by Ph.D. student Ro’i Zultan, was attended by 66 participants; 7 faculty and 9 doctoral students gave lectures. Topics ranged over biology, cognitive psychology, theoretical economics, education, sociology, mathematics, and law. In addition to the lectures, two round tables entitled “*The Economic Crisis*” and “*What a Laboratory Experiment Can Teach Us about the World’s Behavior*” were organized.

As always, the lecture sessions were interspersed by nature tours, under the guidance of Center Member Avi Shmida.

(For the Hebrew titles of the papers presented at the retreat, see Appendix 3.)

4. Special Events

Workshop on Regret, Emotions, and Decision Making

The Workshop was jointly hosted by the Center on March 23, 2009, and by Ben Gurion University of the Negev on March 24, with the participation of 60 researchers. The Workshop brought together researchers from economics, psychology, and other fields with the dual aim of enabling the participants to discuss each other’s work as well as to explore new avenues for future interdisciplinary collaboration.

The workshop participants included: Itzhak Aharon (HU), Judith Avrahami (HU), Giorgio Coricelli (Université Lyon), Ido Erev (Technion), Tal Eyal (Ben-Gurion University), Urs Fischbacher (Universität Konstanz), Sacha Gironde (ENS), Vittorio Girotto (Università IUAV di Venezia), Sergiu Hart (HU), Yakir Levin (Ben-Gurion University), Ilana Ritov (HU), Ramzi Suleiman (Haifa University), Massimo Warglien (University Ca’ Foscari, Venice), Eyal Winter (HU), Eldad Yechiam (Technion), Dan Zakay (Interdisciplinary Center, Herzliya), Marcel Zeelenberg (Tilburg University).

(For the titles of the Workshop lectures, see Appendix 4.)

Contract Law: Interdisciplinary Perspectives

The Conference was jointly hosted by the Law Faculty on June 2, 2009, and by the Center on Wednesday 3, with the participation of 40 researchers. In recent decades, legal scholarship in the U.S. and Israel has undergone a process of fragmentation. To facilitate a fruitful exchange among scholars who analyze contract law from diverse perspectives and ultimately encourage integration of the various perspectives, this conference brought together leading American and Israeli researchers who study contract law from different angles. The papers presented at the conference discussed contract law from several theoretical view points, such as economics, psychology, and moral philosophy, and employed diverse methodologies (including formal modeling and qualitative and quantitative empirical studies).

(For the titles of the Conference lectures, see Appendix 5.)

Book Events

On December 18, 2008, the Center celebrated the publication of three new books by Center members:

1. Ein-ya Gura and Michael Maschler: *Insights into Game Theory*.
2. Shmuel Zamir, Michael Maschler, and Eilon Solan: *Game Theory*.
3. Eytan Sheshinski: *The Economic Theory of Annuities*.

The speakers were Yisrael Aumann, Elchanan Ben-Porath, Sergiu Hart, Shmuel Zamir, Efraym Zadka, and Hana Maschler.

Round Table on “The World Financial Crisis”

On November 25, 2008, the Center hosted a roundtable discussion on “The World Financial Crisis.” The round table discussed the rational drivers that contributed to the causes of the financial crisis, like corporate governance and managers’ incentives, and discussed the rationality (or irrationality) of the economic players—consumers, investors, and firms. The organizer was Abraham Neyman; the panel members were Profs. Assaf Hamdani, Sergiu Hart, Eugene Kandel, and Abraham Neyman.

Graduate Students’ Evening

On December 18, 2008, the Center organized a Graduate Students’ Evening to enable the old and the new students in its Ph.D. Program to become better acquainted. Center Director Eyal Winter and Course Coordinator Carl Posy began the evening by outlining the goals and activities of the Program as well as addressing the issue of student scholarships.

Special Lecture

On July 1, 2008, the Center hosted a special lecture, entitled “*The Situated Person: Building a Science of the Individual*,” by Walter Mischel of the department of psychology, Columbia University, President Elect-APS. Prof. Walter spoke on how can one identify and understand the psychological invariance, the basic coherence and organization, that distinctively characterizes an individual and that underlies the variations in the thoughts, feelings, and actions that occur across contexts and over time.

5. Center Laboratories

“BeeHave”: The Bee Behavior Laboratory

The Bee Behavior Laboratory (BeeHave) uses bumblebees foraging on artificial flowers as a model system to study interactive decision-making in animals. The BeeHave members are Prof. Dan Cohen, Prof. Uzi Motro, Prof. Avi Shmida, Dr. Tamar Keasar, and Noam Bar-Shai.

During 2008/9 we employed one Ph.D. research student (Noam Bar-Shai) and three undergraduate research assistants (Amiel Vasal, Ishai Weissman, and Rimon Cohen). We have been working on three research projects:

1. Pollination Ecology of the Red Anemone Guild

Using sampling and experiments to investigate the role of large red floral displays in attracting beetle visitors, we found that Glaphyrid beetles have a special receptor to see the color red. Indeed, Glaphyrids visited red artificial plastic bowls almost exclusively. Both male and female beetles prefer large red display flowers and bowls. No significant preference was shown by them for flowers with a black center. Female beetles feed on the flowers more often than males, while males shelter overnight in the flowers more often than females. Males also make frequent moves (“jumps”) between flowers, presumably to search for females. These jumps between flowers are very important in the pollination of Red Anemone Guild flowers. The various observations and experiments indicate that in the case of the Glaphyrid beetles flower size and color are the main preferences that drive flower selection. These findings serve to explain the extra large red flowers of Anemone, Ranunculus asiaticus, Tulipa, Glaucium, and Papaver in the Middle East.

Preliminary results were summarized in Discussion Paper 491 of the Center for the Study of Rationality.

2. The Evolution of Toothed Nectaries in the Genus Colchicum

Of the 81 different species of Colchicum, only five are known to have crested toothed appendages around their nectaries. Colchicums grow in the transitional belt and in the northern Negev in Israel and bloom between the end of autumn and the beginning of winter, when flowering is very rare. We studied two species of Colchicum in the field and showed that the toothed appendages serve to protect ants from nectar-robbing. Through manipulation by cutting the inner appendages of the petals we proved that ants avoid nectaries with long crested appendages. This may explain the evolution of the corona in many other genera of Angiosperms, e.g., Narcissus, Silene, and Scilla.

3. Can Bees Count to Two? Numerical Competence in Bees

The numerical competence of bees is the subject of ongoing research by Noam Bar-Shai of BeeHave. Bar-Shai uses naive bumblebees and computer-controlled artificial feeders, which can be programmed in terms of the conditions when a reward is to be supplied. In the experiment, feeders are arranged in two separate clusters (“patches”) and a bee can get a reward only a fixed number of times at each patch. The bee decides after each visit whether to stay at the same patch or to move on to the other patch. In two-rewards-per-patch experiments, the optimal strategy is to leave a patch after visiting two feeders, and most bees learned to adopt this as their major strategy. Further experiments are planned to test bees’ competence in using information about numbers greater than two, and also to test the

influence of factors such as distance between patches, and variability in the number of rewarding visits per patch.

Additional field studies are being carried out on Wild Mustard (*Sinapis alba*) and Bristly Hollyhock (*Alcea setosa*) in order to monitor the behavior of bees in the wild and compare it with that of the laboratory bees. Preliminary observations in nature indicate that wild bees can count to two and even up to five.

“RatioLab”: Interactive Decision Laboratory

The Laboratory for the Study of Interactive Decision-Making is devoted to the experimental study of human decision-making. This state-of-the-art computerized facility enables researchers to conduct interactive decision-making experiments with many participants while fully controlling the strategic aspects of the situation (payoffs, type and amount of information and feedback available to the players, and communication opportunities between players). The laboratory is shared by psychologists, economists, and game theorists who employ experimentation as a methodology for testing and refining theory. Below are the current research projects which take place in the laboratory.

1. “*Absolute and Relative Gain in Intergroup Conflict.*” Supported by Israel Science Foundation grant to G. Bornstein (Psychology).
2. “*Cross-Cultural Experiments on Strategic Decision Making.*” Supported by German Science Foundation (DFG) grant to E. Winter and R. Selten (Economics).
3. “*The Neurobiological Basis of Human Cooperation, Trust, and Altruistic Behaviors: Nexus between Molecular Genetics, Economics, Game Theory, and Neural Imaging.*” Supported by the Hebrew University Center for Converging Sciences to G. Bornstein (Psychology), R.P. Ebstein (Biomedicine & Social Sciences), A. Darvasi (Computing Sciences, Biotechnology & Biomedicine), A. Knafo (Psychology), and A. Maril (Cognitive Science).
4. “*Receiving Advice, Combining Opinions, and Making Decisions.*” Supported by Israel Science Foundation grant to I. Yaniv (Psychology).
5. “*The Weight of Impulses in Decision Making: Effects of Rejoicing, Regret, and Envy in a Repeated Competitive Situation.*” Supported by Israel Science Foundation grant to Y. Kareev and J. Avrahami (Education).
6. “*Order Effect in Games and Competitions with Imperfect Information.*” Supported by Israeli Foundation Trustees grant to R. Zultan (Education).

Nine different experiments with over 800 participants have been conducted so far this year.

The Lab wishes to acknowledge with gratitude the support received from the Center for the Study of Rationality this year, and relies on receiving similar support next year. The Center’s financial support is used to update equipment and software and help pay the Lab’s administrative staff. All research activity is paid for through research grants.

6. The Ph.D. Program in Rationality

The Center's graduate program opened in the 2005–2006 academic year. In its first year, 21 students were admitted. Now in its fourth year, the Program has grown to 38 students, all of them outstanding in their fields. We continue to attract first-rate students who come from the departments of Computer Science, Philosophy, Cognition, Education, Mathematics, Economics, Law, Statistics, Sociology, and Business Administration.

(See list of 2008–2009 students in Appendix 6.)

The Director of the Graduate Program is Center Member Prof. Carl Posy.

Candidates for the Center's Ph.D. program must be registered in a doctoral or a master's program of one of the HU departments. In addition to the requirements of their department, the students must also meet the additional criteria set by the Center.

(see words by the Ph.D. program Coordinator in Appendix 7a)

Courses for the Ph.D. Program in Rationality

The courses in the Ph.D. Program in Rationality are designed and given by the Center's faculty for the benefit of the doctoral students in the Program. Nine specially created courses were offered during the current 2008–2009 academic year:

1. *Game Theory: Theory and Application* (Prof. Elchanan Ben-Porath)
2. *Evolutionary Biology and Game Theory* (Prof. Sergiu Hart, Prof. Uzi Motro)
3. *Advanced Course in Game Theory* (Prof. Sergiu Hart)
4. *Advanced Topics in Game Theory* (Prof. Abraham Neyman)
5. *Topics in Rationality* (Prof. Eyal Winter)
6. *Computational Game Theory* (Dr. Michal Feldman)
7. *Games with Incomplete Information* (Prof. Shmuel Zamir)
8. *Psychology of Decision Making* (Prof. Judith Avrahami, Prof. Yaakov Kareev, Prof. Ilana Ritov, Prof. Ilan Yaniv)
9. *Students' Seminar*

(See course descriptions, in Hebrew, in Appendix 7b.)

Scholarships

The Center awarded 38 scholarships to students in its Program: five prestigious Kahneman stipends (generously donated by the Horowitz Foundation in honor of Nobel Laureate and Center Fellow Daniel Kahneman), nineteen to the Center's Ph.D. students, ten to its M.A. students, and one Jozef Straus scholarship. Subsequently, seven of our students were accorded special recognition by the Hebrew University: three received the President Prize, three received the Rector Prize, and one received the "Scholarship for Excellence in the

Converging Technologies Program.” In addition, two graduate students in the Program received scholarships through their advisors’ grant funds.

Recipients of *Kahneman Fellowships*:

Gil Ben-Zvi, M.A. Computer Science.

Nehama Ilan, M.A. Computer Science.

Elyashiv Wiedman, M.A. Economics.

Halbersberg Yoed, Ph.D. Law (supervised by Dr. Ehud Guttel).

Ron Peretz, Ph.D. Mathematics (supervised by Prof. Abraham Neyman).

Ph.D.s Conferred

Ziv Gorodeisky “*Stochastic Perturbations of Discontinuous Dynamics with Applications to Game Theory.*” Supervisor: Prof. Sergiu Hart.

Motti Amar “*When Marketing Actions Generate a Placebo Effect and Influence Product Efficacy.*” Supervisor: Prof. Maya Bar-Hillel.

Fulbright Scholars

This year, the Fulbright Program has provided funds for two students to undertake graduate research at the Center: Ronni Sadovsky and Hillel Bavli. Through the Fulbright Program, graduate students and professors from the U.S. undertake advanced research projects in over 155 different countries, while graduate students and professors from those countries are invited to take on research projects in U.S. universities.

Visiting Fellow

Zhigang Cao is a Ph.D. candidate of the Academy of Mathematics and Systems Science of the Chinese Academy of Science. He came to the Center on February 27, 2009, as a visiting student. He is working with Prof. S. Hart for one year. The fellowship is supported in part by the Chinese Academy of Science.

7. Center Publications

Discussion Papers

In 2008–2009, 21 Discussion Papers were added to the Center’s highly regarded DP Series, currently comprising 508 papers. The DP Series includes many articles by Center faculty and students subsequently published in prestigious journals (such as *Econometrica*, *Proceedings of the National Academy of Sciences (USA)*, *Games and Economic Behavior*, *Mathematics of Operations Research*, *Social Research*).

(See Appendix 8 for the list of this year’s DPs.)

Books by Center Members

Michael Maschler, Eilon Solan, and Shmuel Zamir, *Game Theory* (in Hebrew), Magnes Press, 2008.

Ein-ya Gura and Michael Maschler, *Insights into Game Theory: An Alternative Mathematical Experience*, Cambridge University Press, 2008.

Eytan Sheshinski, *The Economic Theory of Annuities*, Princeton University Press, 2007.

8. Distinctions and Promotions

Center Members and Staff are highly regarded in the scientific world and hold numerous honors and distinctions. The following were honored during the 2008–2009 period:

Center Editor Mike Borns awarded the Hebrew University Prize for Excellence in 2009.

Prof. Sergiu Hart elected President of the Game Theory Society 2008–2010.

Prof. Eva Illouz named “Influential Thinker of Tomorrow” by the German daily *Die Zeit*.

Prof. Ilana Ritov elected President of the European Association for Decision Making 2009–2011.

9. International Cooperation

- **MPI**

An International Max Planck Research School on Adapting Behavior to a Fundamentally Uncertain World was recently established. The Center is a joint venture of the following institutions:

- Max Planck Institute for Economics, Jena
- Max Planck Institute for Human Development, Berlin
- Max Planck Institute for Research on Collective Goods, Bonn
- Department of Psychology, University of Jena
- Department of Economics, University of Jena
- The Center for the Study of Rationality, The Hebrew University
- Cognitive Science, Indiana University, Bloomington

The first three institutes, focusing on research in economics, psychology, and law, have reached the conclusion that pooling the resources of researchers and students from all three areas can result in better insights into human behavior in uncertain environments, such as characterize many aspects of our daily activities. They mobilized the cooperation of the other four institutes, and applied to the Max Planck Society in a request to establish an international research school, which will focus on aspects of joint interest to people from all three fields.

The school, whose annual budget of approximately 750,000 Euros coming from the German participating members as well as the Max Planck Society, is planned to run for six years, with 10 new students, selected on the basis of an international competition, added to its student body each year. Students selected to be part of the program will be affiliated with one of the German institutions, and participate, in addition to their normal research activities, in an annual summer school to be held at MPI Jena, and two annual workshops, to be held, on a rotating basis, by the other participating institutes.

The invitation to our Center, via Center Member Prof. Yaakov Kareev, to be part of this initiative is a welcome recognition of our international standing. Members of the Center have been taking active part in the instruction at the School. This included Dr. Judith Avrahami and Prof. Yaakov Kareev (in 2007), Prof. Gary Bornstein (in 2008), and Prof. Ilan Yaniv (in 2009).

Appendix 1 – “Rationality on Friday” Lectures, 2008–2009: Abstracts

Shraga Biran, S. Biran & Co., Law Firm (Nov. 21, 2008):

“Theory of Opportunities as an Interdisciplinary Science”

And who are you? Opportunity, the All-conquering. Why do you stride on the tips of your toes? I am always running. Why do you have pairs of wings of your feet? I fly like the wind. Why do you carry a razor in your right hand? As a sign to man that my appearance is more abrupt than any blade. And your hair, why does it hang down over your face? So that he who encounters me may grab it. By Zeus, and why is the back of your head bald? Because nobody, once I have run past him with my winged feet, can ever catch me from behind, even though he yearns to.

Ariel Porat, Tel Aviv University (Nov. 28, 2008):

“Aggregating Probabilities across Offences in Criminal Law”

A defendant is charged with four offences, allegedly committed in four different times and places. The probability that he committed each one of the offences is 90%. Assume that the minimum threshold required for conviction is 95%. Under prevailing criminal law the defendant would be acquitted of all four charges since no offence can be attributed to him. However, a simple calculation reveals that the probability that the defendant committed no offence at all is .01% only! Consequently it seems that convicting the person for at least one offence without specifying what this offence is would be just and efficient. We argue that in such cases, and under certain conditions, efficient deterrence will be better achieved if courts would aggregate probabilities across different offences, and would be willing to convict defendants even for unspecified offences. We also show under what conditions aggregating probabilities will yield less, rather than more, convictions.

Daniel Attas, The Hebrew University (Dec. 19, 2008):

“Terms of Trust”

I present an analysis of the concept of trust, with particular emphasis on resolving conflict situations (e.g., peace process, labor relations, and support for public goods). The problem of trust can be tackled by facilitating genuine trust or by increasing the likelihood of cooperation by means of providing prudential reasons to cooperate (so-called confidence building measures). I analyze the terms of genuine trust and argue that confidence building measures on their own cannot solve the problem of trust, and can sometimes undermine genuine trust.

Igal Kwart, The Hebrew University (Jan. 2, 2009):

“Knowledge, Skepticism, Simulation Models, and Cognitive Explanations”

A central traditional problem of skepticism in philosophy is what an adequate response to a skeptical challenge is—i.e., a challenge about whether we know what we typically think we know. A conceding response to a skeptical challenge is to retract what one asserted or what one took oneself to know. In this talk I offer a treatment of a sub-kind of skepticism—perceptual skepticism, from a new perspective—in terms of a probabilistic account of perceptual knowledge. I argue that one can delineate the cases when retraction is in order and when it is not. I will consider such responses as cognitive phenomena, and offer a cognitive explanation for them. I also call attention to a specific, generally ignored, type of norms: cognitive, non-epistemic, norms of accountability, underlying linguistic competence, which govern cognitive processing of terms such as, in our case, “know’.” The underlying probabilistic account of knowledge, I suggest, like some other related semi-formal analyses, can be considered at least as a simulatory account of linguistic processing, displaying the methodology of simulatory modeling.

Eyal Benvenisti, Tel Aviv University (Jan. 16, 2009):

“Reclaiming Democracy: The Strategic Uses of Foreign and International Law by National Courts”

It wasn't so long ago that the overwhelming majority of courts in democratic countries shared a reluctance to refer to foreign and international law. These courts conformed to a policy of avoiding any application of foreign sources of law that would clash with the position of their domestic governments. But as we demonstrate, in recent years courts in several democracies have begun to show a change of heart, often engaging quite seriously in the interpretation and application of international law and heeding the constitutional jurisprudence of other national courts. We explain this emerging jurisprudence as part of a

reaction to the forces of globalization that are placing increasing pressure on governments, legislatures and courts to conform to global standards. The courts seek to expand the space for domestic deliberation and to strengthen the ability of national governments to withstand the pressure brought to bear by interest groups and powerful foreign governments. For this strategy to succeed, courts need to forge a united judicial front. This entails coordinating their policies with equally positioned courts in other countries, through the common language of international law and comparative constitutional law. The analysis also explains why the U.S. Supreme Court, which so far has not been required to protect domestic political process from external pressures, is still not a part of this collective effort. Finally, and based on this insight into the driving force behind reliance on foreign law, we assert that recourse to these sources is perfectly legitimate from a democratic theory perspective, as it aims to reclaim democracy from the debilitating grip of globalization.

Massimo Warglien, University Ca' Foscari, Venice (Jan. 23, 2009):

“Developing Language Structure in the Lab”

In recent years there has been a growing interest in recreating experimentally the conditions for the emergence of language and in particular of (proto)grammatical structures (e.g., Galantucci 2005; Garrod et al. 2007; Selten & Warglien 2007; Kirby et al. 2008) in coordination games. In this talk I summarize recent results in this research area and discuss more in detail my experimental work with R. Selten (PNAS 2007) and its implications, in particular concerning language compositionality and its adaptive value. I also briefly discuss a new experimental strategy that promises to deliver laboratory languages that are ecologically more valid and closer to natural language.

Tehila Kogut, Ben Gurion University (Mar. 20, 2009):

“The Identifiable Victim Effect and When It Is Better to Stay Anonymous”

People's willingness to contribute more resources to save the lives of identified victims (about whom they have some information) than to save anonymous or “statistical” victims is known as “The Identifiable Victim Effect.” In our previous research we suggested that this effect leads to an increase in helping behavior mostly when the victim is a single individual whom the perceiver regards as belonging to his or her own in-group. The emotional reaction to the victim appears to be a major source of the effect, such that the emotional arousal toward the victims (empathy and distress) is particularly intense when the victim is a single in-group member. However, the spontaneous emotional response to the single identified target may also strengthen negative emotions (anger and blame) in situations where the target is perceived responsible to his/her plight. Our current research shows that identification of a single target may decrease helping in such cases, especially when the perceiver holds strong beliefs in a just world (in which people get what they deserve).

Matthew H. Kramer, Cambridge University (Apr. 24, 2009):

“Why Consistency is Hardly Ever Enough: Reflections on Hillel Steiner's Methodology”

This talk will contest the aspiration of Hillel Steiner and many other Kantians to derive substantive moral and political conclusions from purely formal premises. Pace the Kantians, I argue that the constraint of logical consistency is so weak as to be satisfied by virtually every credible conception of justice. Hence, if we wish to select from among competing conceptions, we have to go beyond formal considerations

Eliezer Rabinovici, The Hebrew University (May 8, 2009):

“Dynamics of Prejudices and Legitimacy of Questions in Fundamental High-Energy Physics”

I will sketch recent ideas in the pursuit of the understanding of the basic laws of matter. This will be done from the point of view of challenging prejudices and legitimacy of questions.

Nancy Cartwright, LSE (May 22, 2009):

“Hunting Causes and Using Them: A Bridge Too Far”

We spend a lot of effort in trying to discover causal laws, in large part because we believe they can supply us with effective strategies for achieving targeted results. This paper argues that causal laws are after all not all that good at underwriting strategy, and invariance, which is now widely on offer as a prop, is no fix. It urges instead that we concentrate less on trying to test for invariance and more on understanding its sources, in which case we can even improve on our causal laws, not just use the ones we are stuck with.

Appendix 2 – “Game Theory and Mathematical Economics” Lectures, 2008–2009: Abstracts

Eyal Winter, The Hebrew University (Nov. 9, 2008):

“Mental Equilibrium and Rational Emotions.”

We introduce emotions into an equilibrium notion. In a mental equilibrium each player “selects” an emotional state which determines the players’ preferences over the outcomes of the game. These preferences typically differ from the players’ material preferences. The emotional states interact to play a Nash equilibrium and in addition each player’s emotional state must be a best response (with respect to material preferences) to the emotional states of the others. We first discuss the concept behind the definition of mental equilibrium and show that this behavioral equilibrium notion organizes quite well the results of some of the most popular experiments in the literature of experimental economics. We expose some attractive properties of mental equilibria that are useful for deriving the set of mental equilibria for specific games.

Abraham Neyman, The Hebrew University (Nov. 16, 2008):

“Stationary Payoffs and Equilibrium.”

The continuous and stationary cardinal utilities defined on infinite sequences $z(1), a(1), z(2), a(2), z(3), \dots$ of states $z(t)$ in S and activities/consumptions at in A are characterized. Such infinite sequences arise explicitly as plays of a stochastic game with state space S and set of action profiles A or as the feasible economy evolutions where $z(t)$ is a state variable describing the available technology and/or information and/or preference at stage t and $a(t)$ describes the economic activity at stage t . Such infinite sequences arise also implicitly in the study of non-stationary cardinal utilities over streams of consumptions/actions $a(1), a(2), \dots$, where $z(t)$ represents the implicit preference over the future given the past consumption/activity. It is proved that any stochastic game with finitely many states and actions and a continuous and stationary payoff function has a subgame perfect equilibrium consisting of stationary strategies.

Silvio Micali, MIT (Nov. 23, 2008):

“Resilient and Equilibrium-free Mechanism Design.”

Traditional mechanism design achieves a desired property “at equilibrium,” and is thus vulnerable to equilibrium selection and player collusion. We advocate that mechanisms should be designed in a new way, so as to achieve their desiderata without these vulnerabilities. We exemplify our notions and techniques for guaranteeing revenue in *unrestricted* combinatorial auctions—a problem about which very little is known—even assuming that all players are rational and independent. (Based on work with Paul Valiant and Jing Chen.)

Ziv Gorodeisky, The Hebrew University (Dec. 7, 2008):

“Stochastic Approximation of Discontinuous Dynamics.”

We consider stochastic dynamics whose expected (average) vector field is not necessarily continuous. We generalize the ordinary differential equation method for analyzing stochastic processes to this case, by introducing leading functions that “lead” the stochastic process across the discontinuities, which yields approximation results for the asymptotic behavior of the stochastic dynamic. We then apply the approximation results to the classical best-response dynamics used in game theory.

Yisrael Aumann, The Hebrew University (Dec. 14, 2008):

“Rational Expectation in Games.”

A player i ’s actions in a game are determined by her beliefs about other players; these depend on the game’s real-life context, not only its formal description. Define a game situation as a game together with such beliefs; call the beliefs—and i ’s resulting expectation—rational if there is common knowledge of rationality and a common prior. In two-person zero-sum games, i ’s only rational expectation is the game’s value. In an arbitrary game G , we characterize i ’s rational expectations in terms of the correlated equilibria of the doubled game $2G$, in which each of i ’s strategies in G appears twice.

Kobi Gal, MIT and Harvard University (Dec. 21, 2008):

“Computer Agents for Reasoning about People’s Beliefs and Preferences.”

Technological advancements have created opportunities for computers to interact with people in diverse settings, whether as autonomous actors or as proxies for individual people or organizations. The range and complexity of human decision-making raises significant challenges to the design of successful computer agents for these mixed human-computer settings. This talk will present work that addresses these challenges by synthesizing AI techniques with results from behavioral economics and psychology. I will present a language for representing the different mental models people may use to make their decisions, described as nodes in a graphical network. The language makes a distinction between agents’ optimal strategies and the way they actually behave in reality. I will show how this language facilitates the design of computer agents that represent and learn the social factors that affect people’s negotiation behavior. In empirical investigations, agents using this language to negotiate with other people were able to outperform traditional game-theoretic equilibria. Finally, I will present a new empirical framework for investigating decision-making in these mixed human-computer settings, and its potential contribution to social and computer scientists.

Dov Samet, Tel Aviv University (Jan. 4, 2009):

“The Sure-thing Principle and Independence of Irrelevant Knowledge.”

Savage introduced the sure-thing principle in terms of the dependence of decisions on knowledge, but gave up on formalizing it in epistemic terms for lack of a formal definition of knowledge. Using simple models of knowledge, we examine the sure-thing principle, presenting two ways to capture it. One is in terms of the union of future events, for which we reserve the original name—the sure-thing principle; the other is in terms of the intersection of kens—bodies of agents’ knowledge—which we call independence of irrelevant knowledge. We show that the two principles are equivalent and that the only property of knowledge required for this equivalence is the axiom of truth—the requirement that whatever is known is true. We present a symmetric version of the independence of irrelevant knowledge which is equivalent to the impossibility of agreeing to disagree on the decision made by agents, namely the impossibility of agents making different decisions being common knowledge.

Sergiu Hart, The Hebrew University (Jan. 11, 2009):

“Bargaining and Cooperation in Strategic Form Games.”

In this paper we view bargaining and cooperation as an interaction superimposed on a strategic form game. A multistage bargaining procedure for N players, the “proposer commitment” procedure, is presented. It is inspired by Nash’s two-player variable-threat model; a key feature is the commitment to “threats.” We establish links to classical cooperative game theory solutions, such as the Shapley value in the transferable utility case. However, we show that even in standard pure exchange economies the traditional coalitional function may not be adequate when utilities are not transferable.

Ella Segev, Ben Gurion University (Jan. 18, 2009):

“Efficiency Levels in Sequential Auctions with Dynamic Arrivals.”

In an environment with dynamic arrivals of players who wish to purchase only one of multiple identical objects for which they have a private value, we analyze a sequential auction mechanism with an activity rule. If the players play undominated strategies then we are able to bound the efficiency loss compared to an optimal mechanism that maximizes the total welfare. We have no assumptions on the underlying distribution from which the players’ arrival times and valuations for the object are drawn. Moreover we have no assumption of common prior on this distribution.

Ro’i Zultan, The Hebrew University (Jan. 25, 2009):

“Job Market Signaling and Job Search.”

The high cost of searching for employers borne by prospective employees increases friction in the labor market and inhibits formation of efficient employer-employee relationships. It is conventionally agreed that mechanisms that reduce the search costs (e.g., internet portals for job search) lower unemployment and improve overall welfare. We demonstrate that a reduction of the search costs may have the converse effect. We consider a labor market in which workers can either establish a long-term relationship with an employer by being productive, or shirk and move from one employer to the next. In addition, the workers can signal to a potential employer their intention to be productive. We show that lower search costs lead to fewer employees willing to exert effort and, in a separating equilibrium, to more individuals opting to

stay completely out of the job market and remain unemployed. Furthermore, we show that lower search costs not only deteriorate the market composition, but also impair efficiency by leading to more expensive signaling in a separating equilibrium.

Yan Dolinsky, The Hebrew University (Feb. 1, 2009):

“Perfect and Partial Hedging for Swing Game Options in Discrete Time.”

We introduce and study hedging for an (Israeli) game style extension of swing options considered as multiple exercise derivatives. Assuming that the underlying security can be traded without restrictions we derive a formula for valuation of multiple exercise options via classical hedging arguments. Introducing the notion of the shortfall risk for such options we study also partial hedging which leads to minimization of this risk.

Ziv Hellman, The Hebrew University (Mar.15, 2009):

“How Common are Common Priors?”

To answer the question in the title we consider a fixed state space with a profile of partitions that have a single common knowledge component and let the types, that is, the posterior probabilities, vary. How common is it for types to have a common prior? The answer depends on the partition profile. We say that a partition profile is tight if any refinement of its elements results in a profile that has more than one common knowledge component. If the partition profile is tight then every profile of types that is positive at least at one state has a common prior. If it is not tight, then the set of types that have a common prior is topologically thin: it is nowhere dense in the set of all types.

Ron Holzman, Technion (Mar. 29, 2009):

“Sharing the Cost of Capacity Network.”

We consider a communication network where each pair of users requests a connection guaranteeing a certain capacity. The cost of building capacity is identical across pairs. Efficiency is achieved by any maximal cost spanning tree. We construct cost sharing methods ensuring Stand Alone core stability, monotonicity of one’s cost share in one’s capacity requests and continuity in everyone’s requests. We define a solution for simple problems where each pairwise request is 0 or 1, and extend it piecewise-linearly to all problems. The Uniform solution obtains if we require one’s cost share to be weakly increasing in everyone’s capacity request. In the BHM solution, on the contrary, one’s cost share is weakly decreasing in other agents’ requests. The computational complexity of both solutions is polynomial in the number of users. The Uniform solution admits a closed form expression, and is the analog of a popular solution for the minimal cost spanning tree problem.

Penélope Hernández, University of Valencia (May 3, 2009):

“Bounded Memory Equilibrium.”

In the present paper we define a new solution concept for infinitely repeated games in which the players have bounded computational capacity, the automaton equilibrium payoff. We say that a payoff vector is an automaton equilibrium payoff if (1) it can be supported by a pair of strategies that can be implemented by automata, (2) no player has a smaller automaton that, on the equilibrium path, yields the same (or higher) long-run average payoff, and (3) to profit, a player has to switch to an automaton with significantly larger memory. The second condition reflects the intuition that players have a lexicographic utility (as Abreu and Rubinstein 1988): subject to maximizing their payoff they would like to minimize the size of the automaton that they use. An implication of this requirement is that the punishment phase must be part of the equilibrium path, since otherwise a player may reduce the number of states in its automaton while still being able to implement the equilibrium path. The third condition says that as soon as a player does not significantly increase its memory size, he cannot profit. This condition reflects the intuition that a significantly larger automaton is not feasible, so that players need not to worry about deviations to such automata. Alternatively, since memory size is costly, one may think of deviations to a significantly larger automaton as too costly to implement. Our main result is a folk theorem: every feasible and individually rational payoff vector is an automaton equilibrium payoff. Our construction suggests one way to implement a mixed automaton equilibrium. Any pure automaton which conforms to the mixed automaton equilibrium has the same complexity and implements the same equilibrium play but not in the same way. The play consists of three phases: a punishment phase, in which each player proves to the other that she can punish if necessary; a babbling phase, in which the players follow a pre-specified

sequence of action pairs, and a regular phase, in which the players play repeatedly a sequence of action pairs that implements the desired equilibrium payoff.

Yuval Heller, Tel Aviv University (May 10, 2009):

“Weaker Axiomatizations of Rational Choice.”

A DM (decision maker) has to choose an act under uncertainty. The subjective expected utility model assumes that his choices are derived from a transitive binary preference. This assumption is equivalent to the weak axiom of revealed preference. In this paper we demonstrate that rational choices may not follow the weak axiom, and we present two axiomatic models for rational choice that are not derived from binary preferences. The first one replaces the weak axiom with two weaker axioms: convex-paired comparisons and irrelevant acts invariance. The second model adds to the choice problem a frame: observable payoff-irrelevant information that may affect choice. Given a specific frame, the DM chooses a unique act. We assume that his choices satisfy monotonicity, independence, and the contraction property, and that the set of frames satisfies continuity requirements. We prove that both axiomatizations are equivalent to the following representation: the DM has a unique convex set of possible priors over the state of nature, and a vN-M utility function, such that an act is chosen if and only if it is the best act with respect to a possible prior.

Yakov Babichenko, The Hebrew University (May 24, 2009):

“Completely Uncoupled Dynamics and Nash Equilibrium.”

Completely uncoupled dynamic is a repeated play of a game, when in every given time the action of every player depends only on his own payoffs in the past. In this paper we try to formulate the minimal set of necessary conditions that guarantee a convergence to Nash equilibrium in a completely uncoupled model. The main results are: 1. The convergence to Nash equilibrium cannot be guaranteed with finite memory strategies, in a generic game. 2. A convergence to Nash equilibrium almost all the time can be guaranteed with finite memory strategies, in a generic game.

Peter Stone, The University of Texas at Austin (May 31, 2009):

“Teaching Teammates in Ad-hoc Teams.”

Teams of agents, defined as agents operating in the same environment with identical utility functions, are typically developed in a planned, coordinated fashion. However, such coordinated development is not always possible. Rather, as deployed agents become more common in robotics, e-commerce, and other settings, there are increasing opportunities for previously unacquainted agents to cooperate in ad-hoc team settings. In such scenarios, it is useful for individual agents to be able to collaborate with a wide variety of possible teammates under the philosophy that not all agents are fully rational. This talk considers an agent that is to interact repeatedly with a teammate that will adapt to this interaction in a particular suboptimal, but natural way. We formalize this “ad-hoc team” framework in two ways. First, in a fully cooperative normal form game-theoretic setting, we provide and analyze a fully implemented algorithm for finding optimal action sequences, prove some theoretical results pertaining to the lengths of these action sequences, and provide empirical results pertaining to the prevalence of our problem of interest in random interaction settings. Second, we consider a cooperative k-armed bandit in which cooperating agents have access to different actions (arms). In this setting we prove some theoretical results pertaining to which actions are potentially optimal, provide a fully-implemented algorithm for finding such optimal actions, and provide empirical results.

Abraham Neyman, The Hebrew University (June 14, 2009):

“The Maximal Variation of Martingales of Probabilities and Repeated Games with Incomplete Information.”

The variation of a martingale $m[k]$ of $k+1$ probability measures $p(0), \dots, p(k)$ on a finite (or countable) set X is the expectation of the sum of $\|p(t) - p(t-1)\|$ (the L_1 norm of the martingale differences $p(t) - p(t-1)$), and is denoted $V(m[k])$. It is shown that $V(m[k])$ is less than or equal to the square root of $2kH(p(0))$, where $H(p)$ is the entropy function (the sum over x in X of $p(x)\log p(x)$ and \log stands for the natural logarithm). Therefore, if d is the number of elements of X , then $V(m[k])$ is less than or equal to the square root of $2k(\log d)$. It is shown that the order of magnitude of this bound is tight for d less than or equal to 2 to the power k : there is $C > 0$ such that for every k and d less than or equal to 2 to the power of k there is a martingale $m[k] = p(0), \dots, p(k)$ of probability measures on a set X with d elements, and with variation $V(m[k])$ that is greater or equal to the square root of $Ck(\log d)$. It follows that the difference

between the value of the k -stage repeated game with incomplete information on one side and with d states, denoted $v(k)$, and the limit of $v(k)$, as k goes to infinity, is bounded by the maximal absolute value of a stage payoff times the square root of $2(\log d)/k$, and it is shown that the order of magnitude of this bound is tight.

Appendix 3 – The 18th Annual Rationality Conference: Paper Titles

1. אמנון שרייבר, "קבלת החלטות עם העדפות על מצבי ידיעה"
2. מורן אופיר, "בחינת ההשקעה במוצרים פיננסיים מובנים מנקודת מבט רציונלית"
3. אמיר באן, "מומחיות כנגד מוניטין"
4. עיטם בנגר, "שימושים יישומיים של תורת המשחקים עם שחקנים לא רציונליים: מקרה מצעד הגאווה"
5. מיה בר-הלל, "על הפסיכולוגיה של שנאת בזבוז"
6. עידית כצנלסון, "אסטרטגיות של ליקוט מזון בדרור הבית – נטייה מוקדמת או למידה?"
7. מיכל ארבילי, "קו-אבולוציה של כללי למידה ואסטרטגיות חברתיות במשחק היצן-נצלן"
8. יעקב ברגמן, "מדעי הרוח: בגדי המלך החדשים?"
9. אוריאל פרוקצ'יה, "כללים וסטנדרטים בספר הברית"
10. אילן נחמה, "יישום התאמת בחירה חברתית על ידי שיווי משקל Nash-k"
11. שמאל זמיר: "משפט המושבעים של קונדורסה"
12. דני כהן, "מודלים לאבולוציה ואדפטציות לזמן ארוך בתנאי סלקציה ואקולוגיה משתנים: בחינה מחודשת של ההנחות של שיווי משקל ואופטימליות"
13. עמרי אלוש, "מגוון מינים – מתהליך לדגם"
14. עמוס שור, "האם זו התשובה עליה חשבת? השפעת שיטת הבחירה על בחירת קושי המטלה, שביעות רצון ודיווח עצמי על טיב הביצוע"
15. איתן ששינסקי, יוג'ין קנדל, "המשבר הכלכלי"
16. ישראל אומן, מיה בר-הלל, סרג'יו הרט, גרי בורנשטיין, "מה ניתן ללמוד מניסויי מעבדה לגבי התנהגות בעולם?"

Appendix 4 – Workshop on Regret, Emotions and Decision Making: Paper Titles

1. Judith Avrahami, "Does Regret Shape Decisions?"
2. Sacha Bourgeois-Gironde, "What Makes Regret Rational?"
3. Giorgio Coricelli, "Reward-based Emotions: Affective Evaluation of Outcomes and Regret Learning."
4. Ido Erev, "Big Eyes and Regret in Decisions from Experience."
5. Tal Eyal, "Emotions and Psychological Distance."
6. Urs Fischbacher, "Processing Punishment Preferences: What We Learn from Reaction Time."
7. Vittorio Girotto, "Cognitive Empathy and Counterfactual Thinking."
8. Sergiu Hart, "Adaptive Heuristics, Regret Matching, and Correlated Equilibria."
9. Ilana Ritov, "Choice, Counterfactuals, and Conflict: Evaluation of Decision Outcomes over Time."
10. Ramzi Suleiman, "Emotions, Social Orientations, and Self-worth as Predictors of Responders Behavior in Simple Bargaining games."
11. Massimo Warglien, "Regret-Driven Neural Nets and Learning from Multiple Games."

12. Eyal Winter, “Mental Equilibrium and Rational Emotions.”
13. Eldad Yechiam, “The Trap of Risks with Rare Losses Is Made Deeper by Regret: Implications for Social Learning and Drug Abuse.”
14. Dan Zakay, “Can Prospect Theory Be Generalized to Non-Monetary Dimensions?”
15. Marcel Zeelenberg, “Counterfactual Thinking and the Amplification of Regret.”

Appendix 5 – Contract Law: Interdisciplinary Perspectives

1. Ariel Porat and David Gilo, Tel Aviv University Law Faculty, “A Market-Based Approach to Consumer Contracts.”
Comment: Uriel Procaccia, IDC Hertzliya Law School, Hebrew University of Jerusalem.
2. Kevin Davis, New York University Law School, “Interpreting Boilerplate.”
Comment: Assaf Hamdani, Hebrew University of Jerusalem Law Faculty.
3. Alon Harel, Hebrew University of Jerusalem Law Faculty, Yuval Procaccia, IDC Hertzliya Law School, “On the Optimal Regulation of Unread Contracts.”
Comment: Shmuel Becher, College of Management Academic Studies.
4. Florencia Marotta Wurgler, New York University Law School, “Does Anyone Read the Fine Print? A Test of the Informed Minority Hypothesis Using Clickstream Data.”
Comment: Asaf Zussman, Hebrew University of Jerusalem, Economics Department.
5. Gregory M. Klass, Georgetown Law Center, “Regulating Information in Contractual Relationships.”
Comment: Menny Mautner, Tel Aviv University Law Faculty.
6. Eyal Zamir and Barak Medina, Hebrew University of Jerusalem Law Faculty, “Incorporating Deontological Constraints into Economic Analysis of Contract Law.”
Comment: Ronit Donyets Kedar, Academic Center of Law and Business.
7. Jody S. Kraus, University of Virginia Law School, “The Correspondence of Contract and Promise.”
Comment: David Enoch, Hebrew University of Jerusalem Law Faculty and Department of Philosophy.
8. Roy Kreitner, Tel Aviv University Law Faculty, “On the New Pluralism in Contract Theory.”
Comment: Eyal Diskin, Tel Aviv University Law Faculty.
9. Ofer Grosskopf, Tel Aviv University Law Faculty, “Dividing the Surplus upon Termination: The Case of Long-term Contracts for Cooperation.”
Comment: Barak Medina, Hebrew University of Jerusalem Law Faculty.
10. Shmuel Leshem, University of South California Law School, “Rights of First Refusal.”
Comment: Yoed Halbersberg, Hebrew University of Jerusalem Law Faculty.
11. Hila Keren, Hebrew University of Jerusalem Law Faculty, “Giving is Receiving: The Emotions Which Make It Rational to Enforce Promises to Gift.”
Comment: Shahar Lifshitz, Bar-Ilan University Law Faculty.
12. Doron Teichman, Hebrew University of Jerusalem Law Faculty, “Old Habits are Hard to Change: Evidence from Israeli Real Estate Contracts.”
Comment: Avishalom Tor, Haifa University Law Faculty.

Appendix 6 – Students in the Ph.D. Program in Rationality (2008–2009)

Ran Aboodi – M.A Philosophy
Omri Allouche – Ph.D. Evolution, Systematics, and Ecology (Ronen Kadmon)
Itai Arieli – Ph.D. Mathematics (Robert J. Aumann)
Yaakov Babichenko – Ph.D. Mathematics (Sergiu Hart)
Amir Ban – Ph.D. Computer Science (Nati Linial)
Gilad Bavly – Ph.D. Mathematics (Abraham Neyman)
Etam Bengier – M.A. Mathematics
Ronny Ben-Porath – Ph.D. Economics (Motty Perry)
Gil Ben-Zvi – M.A. Computer Science
Shahar Dobinski – M.A. Computer Science (Noam Nissan)
Yonatan Fredland – M.A Economics
Yair Goldberg – Ph.D. Statistics (Yaakov Ritov)
Ziv Gorodeisky – Ph.D. Mathematics (Sergiu Hart)
Elad Green – M.A. Cognition
Yoed Halbersberg – Ph.D. Law (Ehud Guttel)
Einav Hart – M.A Cognition
Omer Idan – Ph.D. Mathematics (Abraham Neyman)
Uri Isserles – Ph.D. Statistics (Yosef Rinott)
Aviv Keren – Ph.D. Philosophy (Carl Posy)
Amir Konigsberg – Ph.D. Philosophy (Gabriel Mozkin)
Adi Koplovitz – M.A. Philosophy
Neta Krakover – M.A. Computer Science
Yehuda Levi – Ph.D. Mathematics (Abraham Neyman)
Yaakov Melinovski – Ph.D. Statistics (Yosef Rinott)
Moti Michaeli – Ph.D. Economics (Robert J. Aumann)
Ilan Nehama – M.A. Computer Science
Noa Nitzan – Ph.D. Mathematics (Robert J. Aumann)
Moran Ofir – Ph.D. Law (Uriel Procaccia)
Ron Peretz – M.A. Mathematics (Abraham Neyman)
Assaf Rom – M.A Economics
Orit Ronen – Ph.D. Economics (Eytan Sheshinski)
Amnon Schreiber – M.A. Economics
Shorer Ran – M.A Economics
Sarit Weisburd – Ph.D. Economics (Saul Lach)
Uri Weiss – Ph.D. Law (Robert J. Aumann)
Elyashiv Wiedman – M.A. Economics
Shifra Wine – Ph.D. Law (Alon Harel)
Ro'i Zultan – Ph.D. Education (Yaakov Kareev)

Appendix 7a – Words by the Ph.D. program Coordinator

The Graduate Program at the Center for the Study of Rationality:

In 2006 the Rationality Center established an educational program that is open to selected MA and Ph.D. students at the Hebrew University.

The program accepts students of exceptional intellectual ability and academic achievement, whose interests coincide with (or can be served by) the Center's focus on game theory and decision making. We require that the students be registered in one of the established MA or Ph.D. programs at the University.

Admission to the program is highly selective. Indeed, the applicant pool is at this point fairly self selecting: there are very few inquiries and almost no applications from students who have not already achieved a superior academic record. *This year saw 21 formal applications and an additional 10 -12 inquiries that were rejected out of hand. From this pool a total of eight new students were accepted.*

Each year the Center offers a selection of graduate courses in a variety of areas. These are very rigorous courses. The program requires its students (both MA and Ph.D students) to take 15 credit-hours of classes (selected from these course offerings) over and above the standard requirements of their home department.

In addition to their coursework, the students participate in a student-run seminar in which they present their work in progress. They also participate actively in the Center's annual retreat. Each year several of them present talks at the retreat.

The students are active participants in the day to day intellectual life of the Center. They use the two rooms and work stations that are provided for them for their own work and for many interdisciplinary conversations. Some indeed are collaborating in the active research of Center faculty members.

The program now has a total of 38 registered students. They are a cadre of future leaders in the academic, public and private spheres.

Students at the Center have achieved academic honors and recognition at the University – including a number of prestigious fellowships and awards.

Given the success of the Graduate Program up till now, we may assume that there will be a continued demand for places. At the moment two main issues face the Program:

- A. Financial Aid: In the past the Center has managed to support a large number of its students with grants of financial aid. We also are able to offer a small number of teaching and research assistantships. (This year 29 students had grants and two students had assistantships.)

However up through the first semester of 2008-9 the aid program was fully funded by the Horowitz Foundation, a fund that collapsed in the wake of this year's financial crisis. Given assistance from the University and contributions from Center members'

research grants, we were able to cobble together enough funds to continue this year's support.

We have applied to Yad HaNadiv for a grant that will allow continued support for the next five years. However if that does not come through we will need to consider other options.

- B. English Language Courses: Up until now all the courses at the Center have been offered in Hebrew. We have been asked by the University's authority for foreign students to offer a number of courses in English in order to accommodate a number of visiting students from Harvard. Several of our teachers have expressed willingness to offer their classes in English should there be demand. We must consider the pros and cons in principle of making this accommodation.

Appendix 7b – Ph.D. Program Course Descriptions

Game Theory: Theory and Application (Prof. Elchanan Ben-Porath)

נציג את תורת המשחקים כמסגרת מחשבה לניתוח אינטרקציות בין מקבלי החלטות רציונליים. נדון במושגי פתרון שונים ונשתמש במושגי הפתרון הללו לניתוח דוגמאות בעלות עניין. בפרט נדון במשחקי תחרות בין פירות, מכרזים, הצבעות ומשחקי מיקוח. בחלק השני של הקורס נדון בתיאוריה של עיצוב מכניזמים ואימפלמנטציה.

Topics in Rationality (Prof. Eyal Winter)

בקורס יסקרו מספר נושאים ברציונליות והקשרם לתחומי מחקר שונים בהם עוסקים חברי המרכז לרציונליות.

Computational Game Theory (Dr. Michal Feldman)

הקורס ידון בנושאים הנמצאים בממשק של מדעי המחשב, תורת המשחקים ומיקרו כלכלה, ויכלול מגוון רחב של תחומים אשר תופסים לאחרונה מקום משמעותי במסחר אלקטרוני באינטרנט. בין התחומים שיידונו: תכנון מנגנונים ומכרזים, מכרזים קומבינאטורים, סיבוכיות חישובית של מציאת שוויו משקל, משחקי רשת, משחקי פוטנציה (potential games), מחיר אנרכיה (price of anarchy), מחיר יציבות (price of stability), טובין דיגיטליים, ועוד.

Evolutionary Biology and Game Theory (Prof. Sergiu Hart, Prof. Uzi Motro)

הקורס ידון בנושאים המשלבים ביולוגיה אבולוציונית ותורת המשחקים בניהם: שיווי משקל ואסטרטגיות יציבות אבולוציוניות, דינמיקות אבולוציוניות, יציבות סטוכסטית, תקשורת ואיתות.

Psychology of Decision Making (Prof. Judith Avrahami, Prof. Yaakov Kareev, Prof. Ilana Ritov, Prof. Ilan Yaniv)

הקורס יכלול סדרת הרצאות שיינתנו על ידי ארבעה חברי מרכז העוסקים בפסיכולוגיה של קבלת החלטות. כל מרצה יתרכז בנושאים הקרובים למחקר בו הוא עוסק: אילנה ריטוב – תפקידים של חרטה

וחשיבה בבחירה, יעקב קריב – השלכות של שימוש במדגמים מוגבלים על תפיסת סדירויות וגילוי השתנות, אילן יניב – תהליכי שיפוט, יהודית אברהמי – דינמיקה של החלטות.

Games with Incomplete Information (Prof. Shmuel Zamir)

נעסוק בהרחבה מידול של משחקים עם אינפורמציה לא מלאה: היררכיות של אומנות, המודלים של הרסניי ואומן, מרחב האומנות האוניברסאלי והמבנה שלו. מושג הקונסיסטנטיות, של אומנות. מושג שיווי המשקל הביזאני.

Appendix 8 – 2008–2009 Discussion Papers

(These and all earlier DPs can be found on our website: www.ratio.huji.ac.il.)

488. **Andriy Zapechelnuk and Ro'i Zultan**, "Job Market Signaling and Job Search" (July 2008).
489. **Alon Harel and Tsvi Kahana**, "The Easy Core Case for Judicial Review" (September 2008).
490. **Sergiu Hart**, "Nash Equilibrium and Dynamics" (September 2008).
491. **Tamar Keasar, Avi Shmida and Asaph Zylbertal**, "Pollination Ecology of the Red *Anemone Coronaria* (Ranunculaceae): Honeybees May Select for Early Flowering" (November 2008).
492. **Ilan Yaniv, Shoham Choshen-Hillel and Maxim Milyavsky**, "Spurious Consensus and Opinion Revision: Why Might People Be More Confident in Their Less Accurate Judgments?" (November 2008). *Journal of Experimental Psychology: Learning, Memory, and Cognition* (forthcoming).
493. **Robert J. Aumann, Ein-Ya Gura, Sergiu Hart, Bezalel Peleg, Hana Shemesh and Shmuel Zamir**, "Michael Maschler: In Memoriam" (November 2008). *Games and Economic Behavior* 2, (2008) 351-392.
494. **Yehoram Leshem, Tamar Keasar and Avi Shmida**, "Female-biased nectar production in the protandrous, hermaphroditic shrub *Salvia hierosolymitana*: possible reasons and consequences" (December 2008).
495. **Itai Arieli**, "Rationalizability in Continuous Games" (December 2008).
496. **Ziv Gorodeisky**, "Stochastic Approximation of Discontinuous Dynamics" (December 2008).
497. **Robert J. Aumann**, "Rule-Rationality versus Act-Rationality" (December 2008).

498. **Theresa Lant and Zur Shapira**, “Managerial Reasoning about Aspirations and Expectations” (January 2009). *Journal of Economic Behavior and Organization* 66 (2008), 60-73.
499. **Yehuda (John) Levy**, “Stochastic Games with Information Lag” (January 2009).
500. **Gil Kalai**, “How Quantum Computers Can Fail” (January 2009).
501. **Aron Matskin and Daniel Lehmann**, “General Matching: Lattice Structure of the Set of Agreements” (January 2009).
502. **Abba M. Krieger and Ester Samuel-Cahn**, “The Secretary Problem of Minimizing Expected Rank: A Simple Suboptimal Approach with Generalizations” (January 2009).
503. **Ein-Ya Gura**, “Insights into Game Theory: An Alternative Mathematical Experience” (February 2009). *Quaderni di Ricerca in Didattica* 19 (2009), 172-183, G.R.I.M. Department of Mathematics, University of Palermo, Italy.
504. **Parimal Kanti Bag, Hamid Sabourian and Eyal Winter**, “Multi-Stage Voting, Sequential Elimination and Condorcet Consistency” (February 2009).
505. **Eyal Winter**, “Incentive Reversal” (February 2009).
506. **Eric D. Gould and Eyal Winter**, “Interactions Between Workers and the Technology of Production: Evidence from Professional Baseball” (February 2009). *The Review of Economics and Statistics* 91(1), 188–200.
507. **Amir Perelberg and Richard Schuster**, “Coordinated Breathing in Bottlenose Dolphins (*Tursiops truncatus*) as Cooperation: Integrating Proximate and Ultimate Explanations” (March 2009). *Journal of Comparative Psychology* (2008) 122 (2), 109–120.
508. **Amir Perelberg and Richard Schuster**, “Bottlenose Dolphins (*Tursiops truncatus*) Prefer to Cooperate When Petted: Integrating Proximate and Ultimate Explanations II” (March 2009). *Journal of Comparative Psychology* (2009) 123 (1), 45–55.
509. **Jay Bartroff, Larry Goldstein, Yosef Rinott and Ester Samuel-Cahn**, “The Spend-It-All Region and Small Time Results for the Continuous Bomber Problem” (April 2009).
510. **Abraham Neyman**, “The Maximal Variation of Martingales of Probabilities and Repeated Games with Incomplete Information” (April 2009).
511. **M. Vittoria Levati Ro'i Zultan**, “Cycles of Conditional Cooperation in a Real-Time Voluntary Contribution Mechanism” (May 2009).
512. **Abraham Neyman**, “The Value of Two-Person Zero-Sum Repeated Games with Incomplete Information and Uncertain Duration” (May 2009).
513. **Hillel Bavli**, “Rule-Rationality and the Evolutionary Foundations of Hyperbolic Discounting” (June 2009).

Appendix 9 – Members of the Center (2008–2009)

Aumann Robert J.	Mathematics
Avrahami Judith	Education
Bar-Hillel Maya	Psychology
Ben-Or Michael	Computer Science
Ben-Porat Elchanan	Economics
Bergman Yaacov Z.	Business School
Bornstein Gary	Psychology
Cohen Dan	Biology
Feldman Michal	Business School
Gavison Ruth	Law
Gura Ein-Ya	Science Teaching
Guttel Ehud	Law
Harel Alon	Law
Hart Sergiu	Mathematics, Economics
Illouz Eva	Sociology, Anthropology
Kahneman Daniel – Fellow	Psychology & Public Policy
Kalai Gil	Mathematics
Kandel Eugene	Economics, Business School
Kareev Yaakov	Education
Kvart Igal	Philosophy
Lehmann Daniel	Computer Science
Linial Nathan	Computer Science
Margalit Avishai	Philosophy
Motro Uzi	Biology, Statistics
Neyman Abraham	Mathematics
Nisan Noam	Computer Science
Peleg Bezalel	Mathematics
Perry Motty	Economics
Posy Carl	Philosophy
Procaccia Uriel	Law
Rinott Yossi	Statistics
Ritov Illana	Education
Ritov Ya'acov	Statistics
Samuel-Cahn Ester	Statistics
Sheshinski Eytan	Economics
Shmida Avi	Biology
Ullman-Margalit Edna	Philosophy, Education
Weiss Benjamin	Mathematics
Winter Eyal – Director	Economics
Yaari Menahem	Economics
Yaniv Ilan	Psychology
Zamir Shmuel	Statistics