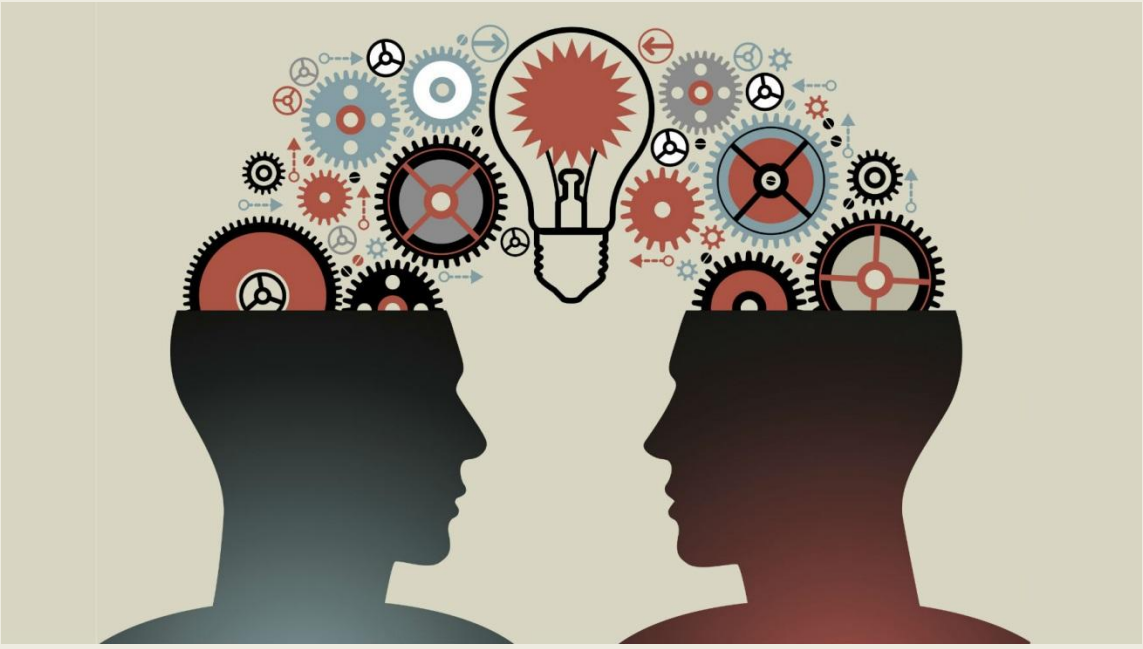
Neurobiology of Social Influence, August 30-31, 2015 Workshop

Keynote speakers: Keise Izuma (University of York), Ale Smidts (Erasmus University Rotterdam), Emily B. Falk (University of Pennsylvania), Micah Edelson (University of Zurich), Daniel Campbell-Meiklejohn (University of Sussex), Jan Engelmann (Radboud University Nijmegen), Vasily Klucharev (HSE), and other experts.

Workshop venue: Room 330, 9/11, Myasnitskaya Street, Higher School of Economics, Moscow.



nsi_2015.neurobiotech.ru

Moscow, Centre for Cognition & Decision Making - 2015

Program

Day 1. 30th of August (Room 330, 9/11, Myasnitskaya Street) Note: 10.00 – 14.00 – Informal program for invited speakers (meeting point will be announced)

14.00 - 15.00 – Emily B. Falk (University of Michigan): *Neural predictors of behavior change and idea propagation*
15.00 - 16.00 – Daniel Campbell-Meiklejohn (University of Sussex): *The "Value" of Social Learning*
16.00 - 16.20 – Coffee break
16.20 - 17.20 – Keise Izuma (University of York)*: The neural basis of cognitive consistency and attitude change*
17.20 - 18.20 – Vasily Klucharev (Higher School of Economics): *Reinforcement learning mechanisms of social influence*

19.00 – 22.00 – Informal evening program for speakers (meeting point will be announced)

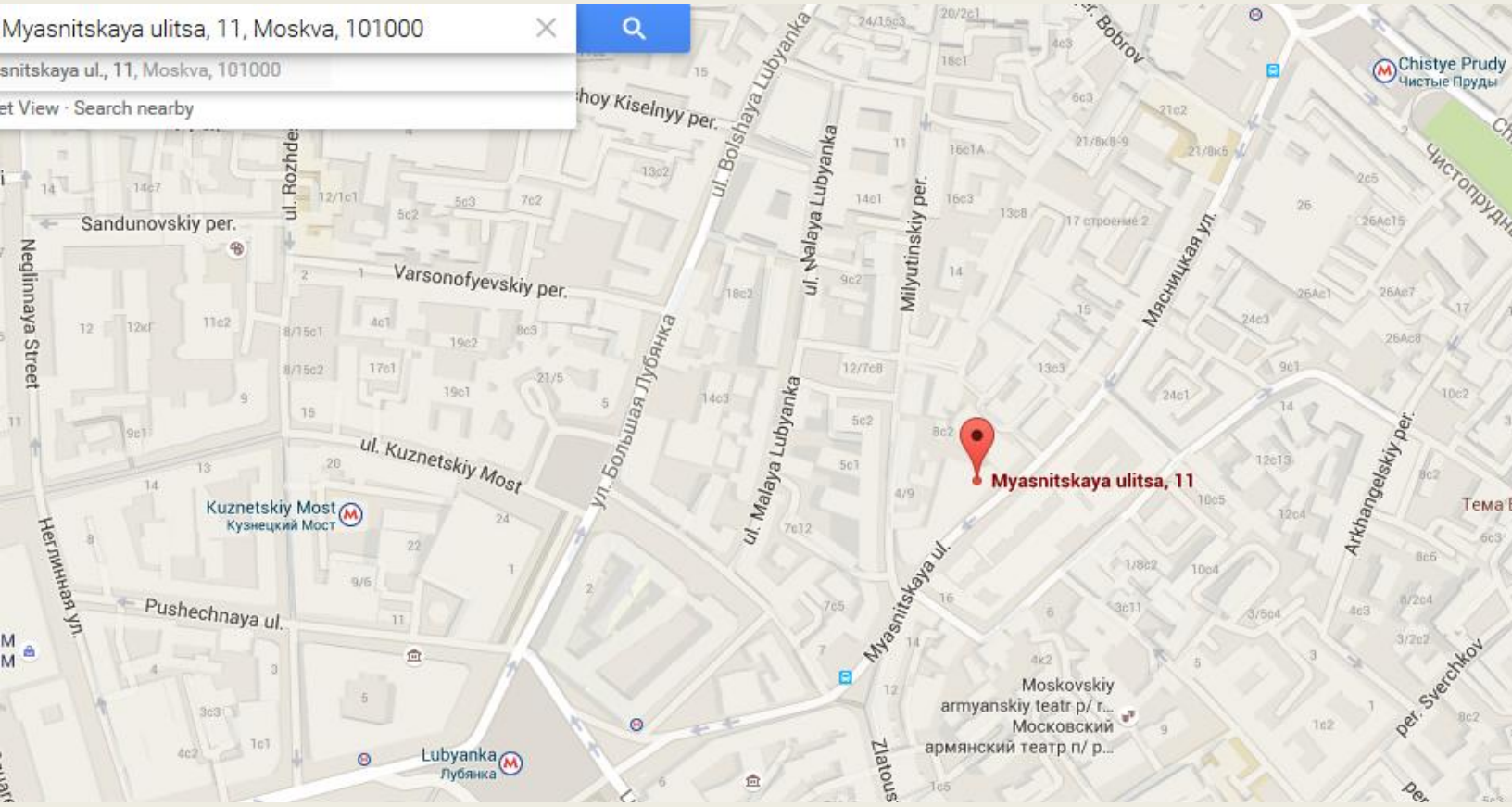
Day 2. 31st of August (Room 330, 9/11, Myasnitskaya Street)

10.00 – 11.00 – Micah Edelson (University of Zurich): *The Nature of Mnemonic Processing in Dynamic Social Environments*
11.00 – 12.00 – Jan Engelmann (Radboud University Nijmegen): *Emotional influences on social preferences*
12.00 - 13.00 – Ale Smids (Erasmus University Rotterdam): *Brain mechanisms of persuasive communication*
13.00 – 14.00 – Lunch
20-min presentations:
14.00 – 14.20 – Ivan Zubarev: C*orrelates of social conformity in spontaneous MEG: an exploratory analysis of the resting state data*
14.25 – 14.45 – Lei Zhang: *Modeling Social Influence on Human Decision-Making with Reinforcement Learning Theory*
14.50 – 15.10 – Yukihito Yomogida: *The Neural Basis of Changing Social Norms through Persuasion*
15.15 – 15.35 – Marco Colosio: *EEG signatures of cognitive dissonance*
15.40 – 16.00 – Martinez-Saito Mario*: The effect of social competition on the neural signatures of price-mechanism*
16.00 - 16.20 – Coffee break
16.20 - 18.00 – Round table discussion, closing of the workshop

Contacts
Workshop coordinator: **Anna Shpektor** [anna_shpektor@mail.ru]
When in Moscow, feel free to call **Anastasia Plotnikova** +7(963)767-60-70 with any questions about transportation, excursions, food etc. during your staying in Moscow.

Conference venue

The conference will take place in the historical city center, at the new HSE Campus (Room 330, 9/11, Myasnitskaya Street). Below You will find the more detailed explanation. The closest subway station is Lubyanka (Лубянка). It is on the #1 (Red) line, inside the circle of Koltsevaya (Circle) line. You need an exit to Myasnitskaya Street and Biblio-Globus (Мясницкая улица и "Библио-Глобус"). After you exit the metro, you need to go to the left before the first exit outside (from the underground) with a stairs. Go upstairs, then walk straight to the traffic light, cross the crosswalk and turn to the left. Then you need to go the next traffic light and turn to the left (by crossing the crosswalk). You'll come straght to the HSE Campus. A walk from Lubyanka metro station to the campus is about 3-4 minutes. For taxi drivers, just name the address and mention the Higher School of Economics.



Room 330, 9/11, Myasnitskaya Street

Abstracts

Keynote speakers

Emily B. Falk (University of Michigan) ***"Neural predictors of behavior change and idea propagation"***

Human social behaviours are influenced by a variety of social motivations. In this talk, I will present social neuroscience studies investigating the neural bases of how uniquely human social motivations affect our attitude and behaviours. I particularly focus on the two following social motivations; 1) the motivation to obtain social reward (e.g., good reputation or social approval from others), 2) the motivation to reduce cognitive inconsistency (e.g., cognitive dissonance). Social reward is an important incentive for pro-social behaviours, such as making donations. The motivation to reduce cognitive inconsistency can explain a wide variety of human behaviour or attitude change, such as why we are influenced by others' opinion, and why our past behaviours influence our preference or attitude. Our fMRI/TMS studies revealed that the ventral striatum and posterior medial frontal cortex (pMFC) play key roles in social reward based decision making and attitude change following cognitive inconsistency, respectively.
Title: The Neural Basis of Changing Social Norms through Persuasion

Daniel Campbell-Meiklejohn (University of Sussex) ***The "Value" of Social Learning***

How is value that is derived by social means, represented in the brain? Is it special? Goal-directed decisions are theorised to be determined by the expected satisfaction from one's options. The computation of these expectations require different sets of processes, depending on the context. It is my opinion that the differential reliance on particular combinations of processes to compute expected value is what will come to define 'social' value in the human brain, what makes it special, and what makes it not. I will discuss a framework, backed by experimental evidence and for exploring socially derived value. Time allowing, I may also delve into some clinical and psychopharmacological effects on social influence.

Keise Izuma (University of York) "The neural basis of cognitive consistency and attitude change"

Human social behaviours are influenced by a variety of social motivations. In this talk, I will present social neuroscience studies investigating the neural bases of how uniquely human social motivations affect our attitude and behaviours. I particularly focus on the two following social motivations; 1) the motivation to obtain social reward (e.g., good reputation or social approval from others), 2) the motivation to reduce cognitive inconsistency (e.g., cognitive dissonance). Social reward is an important incentive for pro-social behaviours, such as making donations. The motivation to reduce cognitive inconsistency can explain a wide variety of human behaviour or attitude change, such as why we are influenced by others' opinion, and why our past behaviours influence our preference or attitude. Our fMRI/TMS studies revealed that the ventral striatum and posterior medial frontal cortex (pMFC) play key roles in social reward based decision making and attitude change following cognitive inconsistency, respectively.

Vasily Klucharev (Higher School of Economics) ***"Reinforcement learning mechanisms of social influence"***

Defined as a tendency to align one's attitudes, beliefs and behaviors to match group norms, social conformity is a well-documented phenomenon in psychology. Yet, neuroscience research has only recently focused on the neurobiological mechanisms underlying conformity to group norms. A number of functional magnetic resonance imaging (fMRI) studies demonstrated that being exposed to a group opinion conflicting with one's own opinion triggered activity in the medial prefrontal cortex (MPFC) and ventral striatum. Interestingly, the MPFC has been also implicated in the generation of a so-called "reward prediction error" signal when the outcome of an action differs from the expected one. This signal presumably guides future action selection by updating predictions of action values. These findings suggest that social conformity may be based on general action-monitoring and reinforcement-learning mechanisms.

Micah Edelson (University of Zurich) ***"The Nature of Mnemonic Processing in Dynamic Social Environments"***

Human memory can be strongly influenced by the social environment, yet the underlying mechanisms of this process are not yet understood. We studied how the memory of individuals was affected by exposure to contradictory recollections of others using a combination of behavioral, pharmacological and neuroimaging techniques. We find evidence that a) the social milieu influences memory via medial temporal circuits and b) the ability to overcome this information, measured at the level of response and confidence, is mediated by specific prefrontal circuits. Our results suggest that the interplay of these two brain systems subserves the balance between memory change and overt compliance and may be influenced by the administration of pharmacological agents.

Jan Engelmann (Radboud University Nijmegen) ***"Emotional influences on social preferences"***

Much progress has been made in outlining the neural underpinnings of emotional processes on the one hand and of decision-making on the other. However, the effects of emotions on social preferences have received relatively little attention to date. I will discuss two experiments that underline the important role of emotions in social preferences. In the first experiment, we show that aversive emotions distort trust decisions and cause significant changes in the associated neural circuitry. They reduce trust and suppress trust-specific activity in left temporoparietal junction (TPJ), as well as functional connectivity between TPJ and emotion-related regions such as the amygdala. We also find that the posterior superior temporal sulcus (pSTS) plays a key role in mediating the impact of aversive emotions on brain-behavior relationships. Functional connectivity of right pSTS with left TPJ not only predicts mean trust taking in the absence of negative emotions, but aversive emotions also remove this association between TPJ-pSTS connectivity and behavioral trust. In the second experiment, we show that a simple intervention can enhance empathy for disliked outgroup members by enhancing positive emotions. During the learning intervention participants experienced help from an outgroup member. Our results show that this intervention successfully increased empathy-related brain responses towards the outgroup. The update of empathy-related brain responses through learning is implemented in the anterior insula, a region

that was found to track the learning signal ("prediction error"), as well as changes in empathy. Moreover, mediation analysis identified positive emotions towards an outgroup member as a significant mediator of the relationship between the neural prediction error signal and the intervention-based change in empathy-related neural signals in anterior insula. Together, our results emphasize the importance of emotions in trust decisions and learning empathy towards outgroup members and reveal the neural circuitry through which emotions influence social preferences.

Ale Smids (Erasmus University Rotterdam) ***"Brain mechanisms of persuasive communication"***

In marketing, advertising is an important means to influence and persuade consumers. Here we study the neural processing of effective advertising. First, we obtained both stated preference and neural measures (EEG and fMRI) in response to advertisements for movies (i.e., movie-trailers), to probe their potential to predict individual preferences of our subjects, as well as movie sales for the population at large. Results show that neural measures are significant predictors of individual and population-wide preference, above and beyond stated preference measures. Second, a follow-up fMRI study provides novel insight into the neural processes evoked by functional and experiential executional elements in television advertisements, and demonstrates how these processes relate to advertisement effectiveness. Comparing a unique set of different commercials for the same brand enabled examination of the influence of differences in ad appeal on brain responses and subsequent advertisement effectiveness. Findings show that ads which engage brain processes related to both the processing of the utility of the advertised product as well as to creative thought and emotional engagement are most effective on the population-level, and that a combination of functional and experiential executional elements successfully elicited these particular processes. In sum, our findings show that EEG and fMRI measures can be used as a neural markers for commercial success. Further research will be focused on analysing the dynamic pattern of the neural response in order to detect which ad execution patterns or scenes are particularly predictive of the success of an ad.

Presentations

Zubarev I.[1,2], Ossadtchi A.[1,3], Klucharev V [1], and Shestakova A. [1,]

"MEG signature of social conformity: evidence from evoked and induced response."

[1]National Research University, Higher School of Economics, Moscow, Russia
[2]Department of Biomedical Engineering and Computational Science, Aalto University, Espoo Finland
[3]Department of Higher Nervous Activity and Psychophysiology, Saint-Petersburg State University, Russia

Humans often adjust their behavior to match the group norms. In this study, we used magnetoencephalographic (MEG) source imaging to investigate the electromagnetic responses to the perceived mismatch between individual and group opinions. Group opinions conflicting with individual opinions evoked activity in the orbitofrontal and cingulate cortices occurring between 200 and 300 ms. The observed conflict-related activity corresponded to a MEG signature of the feedback-related negativity, that is typically elicited by feedback stimuli associated with unfavorable outcomes and learning.. This evoked brain activity was accompanied by an increase in power of theta oscillations (4-8 Hz) over a number of frontal cortical sites including the medial prefrontal

cortex. Based on these results, we argue that normative conflicts trigger neural activity underling error detection and subsequent behavioral adjustments.

Lei Zhang, Jan Gläscher (Institute of Systems Neuroscience, University Medical Center Hamburg Eppendorf, Hamburg, Germany) ***"Modeling Social Influence on Human Decision-Making with Reinforcement Learning Theory"***

Background and objective Most human decision-making takes place in a social context which influences individual decisions. In addition to making choices according to the action-outcome association, humans tend to align themselves with others, even without any direct social interaction. A long tradition of economic and social psychological studies has demonstrated a robust effect of social influence and conformity on perceptual decision-making. However, little is known about how the human brain computes value-based decisions when social influence is present. To fill this gap, we developed a novel experimental paradigm that allows for real-time interaction between multiple players.
Method In the present study, groups of five participants were asked to perform a probabilistic reversal learning task, in which the reward probability switched after a certain number of trials. Following their initial choice, they were also required to place a post-decision wager between 1 and 3 (i.e., 1, 2 or 3) affecting their final payoff. After each participant had seen the choices from other four co-players via intranet, they were able to adjust both their choice and wager. In the end, monetary reward was displayed depending on the reward probability, and participants' goal was to maximize their payoff.
Results and conclusion Behaviorally, we observe an increased switch probability of choices as a function of group coherence levels (i.e., 2:2, 3:1 or 4:0) when their initial choice was in inconsistent with the collective decision of the others and an increased change in post-decision wagering along the group coherence when the initial choice was in agreement with the others. Using reinforcement learning, we built two "social" variants, in which the other players' choices could influence the subject's 2nd choice, and two "non-social" variants, in which subjects' 2nd choices were not affected by others. We employed Bayesian hierarchical estimation to fit these models to the behavioral data and used the deviance information criterion for model selection. The social models outperformed the non-social models. Between the social models, a variant that updates interim expected values by the weighted group coherence prior to the 2nd choice outperformed another model, in which the individual cumulative reward history was taken into account. Comparing the winning model with actual data revealed that this model indeed provides robust prediction. These preliminary findings suggest that participants parse social information simply in terms of number of players (dis)agreeing with their initial choice rather than maintaining individual models of the others' decision-making process.
Support: BMBF Grant 01GQ1006, DFG Grant GRK1247

Yukihito Yomogida[1], Madoka Matsumoto[1], Ryuta Aoki[1], Ayaka Sugiura[2,3], Adam N. Phillips[1], and Kenji Matsumoto[1]
"The Neural Basis of Changing Social Norms through Persuasion"
[1]Brain Science Institute, Tamagawa University, Tokyo, 194-8610 , Japan
[2]Japan Society for the Promotion of Science, Tokyo, 102-0083, Japan
[3]Dept Life Sci, GSAS, Univ of Tokyo, Tokyo, 153-8902, Japan

Social norms regulate behavior, and changes in norms have a great impact on society. In most modern societies, norms change through interpersonal communication and persuasive messages found in media. Here, we examined the neural basis of persuasion-induced changes in attitude toward and away from norms using fMRI. We measured brain activity while 27 participants were exposed to persuasive messages directed toward specific norms. Before and after this persuasion task, the participants were asked to indicate how much they agreed with each of a large set of norms, including the norms that were targeted in the persuasion task. Brain activity during this attitude-rating task was also measured. Persuasion directed toward social norms specifically activated a set of brain regions including temporal poles, temporo-parietal junctions, and medial prefrontal cortex. Beyond these regions, when successful, persuasion away from an accepted norm specifically recruited the left middle temporal gyrus. Actually, this region's activity during the persuasion was positively correlated with the degree of attitude changes. Such an attitude change-related activity was also observed in the left supramarginal gyrus. Finally, in combination with fMRI data from the attitude-rating tasks, we determined that the left supramarginal gyrus tracked the degree of disagreement with accepted norms, suggesting that its role in the norm-changing process may be to represent how opposed we are to a given social norm.

Marco Colosio[1], Anna Shpektor[1], Anna Shestakova[1], Vadim Nikulin[1,2], Eugeny Blagovechensky [1]
Vasily Klucharev V[1]

"Neural mechanisms of post-decisional spreading of alternatives: EEG study."

[1]National Research University, Higher School of Economics, Moscow, Russia
[2] Charité - Universitätsmedizin Berlin

Objective: Cognitive Dissonance (CD) theories state that preferences can be modulated by the mere act of choosing (Festinger, 1957). Some neuroimaging studies (see Izuma 2013, for a review) suggested that activity of the medial prefrontal cortex (mPFC) underlies post-decisional spreading of alternatives, nevertheless the exact mechanism of CD remains unclear.
Methods: right-handed hungry participants performed a free-choice paradigm (Izuma at al., 2010), in which participants were initially asked to rate their preference for food items (snack food) using 8-point Likert scale. Next, subjects made choices between pairs of foods (Self trials in the Choice task) which varied systematically so that choices were sometimes made between two equally liked items (Self-Difficult trials), and other times between one liked item and one disliked item (Self-Easy trial). In still other trials, choices were made randomly by a computer between two equally liked items (Computer trials, control condition). Next, participants were asked to rate the original set of food items again to detect post-decisional spreading.
Results: Our behavioral result clearly show post-decisional spreading of alternatives, i.e. items that were rejected during Self-Difficult trials were rated significantly more negative than those rejected during Self-Easy trials. Interestingly, decisions during Self-Difficult trials were accompanied by a stronger negative fronto-central ERP similar to the Error-Related Negativity (ERN).
Conclusion: Overall, our results could suggest that CD can be mediated by the activity of the mPFC as a part of the general performance-monitoring circuitry.
Acknowledgments: The work was supported by RSCF grant no: 14-18-02522.

Mario Martinez-Saito[1], Boris Gutkin[1,2], Anna Shestakova[1], Vasily Klucharev[1]

"The effect of social competition on the neural mechanisms of decision-making"

[1]Center for Cognition and Decision Making, Higher School of Economics, Moscow, Russian
[2]Ecole Normale Superieure, Paris, France

Objective: Behavioural economics has extensively studied how people make economic decisions in environments with different levels of supply and demand (i.e. with different levels of economic completition). However, the neural mechanisms underpinning such decisions remain unidentified. Here we study the neural mechanisms underlying decisions in different conditions of economic competition. Additionally, we aim to investigate the learning processes that lead to adaptive bargaining strategies, and how these are modulated by the degree of economic competition.
Methods: subjects played the role of buyers in simultaneous games against different numbers of prerecorded buyers and sellers. We used a modified Ultimatum Game (double auctions) in 50-minute 3T functional magnetic resonance imaging (fMRI) scanning sessions. Overall, the game allowed us to identify the effects of competition (number of sellers and buyers) on subjects' willingness to pay (the size of bids).

Results: Behavioural results demonstrated that subjects adjusted their trading price during the game based on the perceived competitiveness of the environment. We observed a progressive, yet incomplete convergence towards the optimal strategy predicted by a game-theoretic analysis. Intriguingly, the data hint at two separable learning processes involved: the subjects' overall scales of bid values are mainly influenced by the market environment, whereas subjects' trial-by-trial adjustment of bid values instead display a skewed distribution modulated by the outcome of the previous trial. Preliminary fMRI data analysis showed significant differential activations and differential dynamics of the activity in the basal ganglia in the different competitive conditions.
Conclusion: The results of the pilot study indicate that people learn to alter trading price based on the perceived competitiveness of the environment and suggest a profound role of the dopaminergic system in behavioural adaptations during economic competition.
Acknowledgements: This work was done within the framework of a subsidy granted to the HSE by the Government of the Russian Federation for the implementation of the Global Competitiveness Program.