

# PokerMapper - Final report

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Media Partner: Asiweb, Il Giornale del Poker and Riccardo Reina

Poker experts: Gabriele Lepore (Italy); Per Vallander and Alex Jacobsson (Sweden)

## Researchers and affiliations

Schiavella M<sup>1</sup>, Pelagatti MM<sup>2</sup>, Lepore G<sup>1,3</sup>, Westin J<sup>1</sup>, Cherubini P<sup>4</sup>

<sup>1</sup>School of Technology and Business Studies, Computer Engineering, Dalarna University, Falun SE-791 88, Sweden

<sup>2</sup>Department of Economics, Management and Statistics, University of Milan-Bicocca, 20126 Milano, Italy

<sup>3</sup>SISAL Poker Team Pro

<sup>4</sup>Department of Psychology, University of Milan-Bicocca, 20126 Milano, Italy

## Activities

**September 2014.** Kick-start of the project. We study the Italian law and European agreement concerning the experimentation on humans and prepare the application for the Ethical Committee of the University of Milano-Bicocca (<http://www.unimib.it/go/218413488/Home/Italiano/Ateneo/Organi/Comitato-Etico>), which we submitted on October 13<sup>th</sup>.

**October 2014.** We prepare the official web site (<http://www.pokermapper.it>) of the project, where we describe the project both in a schematic way and in depth. We provide the instructions to take part in the study and provide all the legal information about the rights of the participating volunteers. On the 23<sup>th</sup> the Ethical Committee approves our experimentation conditionally on the integration of the documentation we sent (<http://www.unimib.it/upload/pag/218413488/in/infoce271014.pdf>).

**November 2014.** We amend the application to the Ethical Committee and submit the requested information on November 10<sup>th</sup>. In collaboration with Nordforce Technology AB (<http://www.nordforce.se>), we work on the secure site through which the volunteers provide their data on age and schooling, answer to a questionnaire for problem gambling risk and upload their hand history files.

**December 2014.** On December 1<sup>st</sup> the Ethical Committee finally approves our experimentation (<http://www.unimib.it/upload/pag/218413488/0/in/infoce011214.pdf>). We prepare the texts for the secure site and do extensive beta-testing. It takes some time to fix all bugs.

**January 2015.** On January the 15<sup>th</sup> the safe site is finally online (<https://poker.clinsheet.com>). We start advertising the project to recruit volunteers through Facebook (<https://www.facebook.com/ricerca.pokermapper>) with messages directed to people in the Milan area interested in poker. At the same time we inform the most relevant online poker forums that we are looking for volunteers.

**February 2015.** Since the recruiting of volunteer is proceeding slower than what we expected, we enrol an editor (Riccardo Reina) of *Il Giornale del Poker* (The Poker Journal) and of a press agency (AsiWeb) to help us with the advertising. He works *pro bono* provided that we write ten 600-words articles on science and poker for his journal/agency. Through Riccardo Reina we enrol also a high ranking Italian poker player (Gabriele Lepore) who, though his fame in the field and his network of players, help us with recruiting and consult us on the Italian online poker scene, which under many aspects is different from the Swedish one, which our Swedish poker experts know the best. Gabriele is also working *pro bono*. The recruiting improves.

**March 2015.** The recruiting goes on and the Swedish poker experts begin to send us contacts of volunteers that should enter the second step of the experimentation. We solve bureaucratic problems to give the promised reimbursement to the volunteers and Mauro Schiavella starts testing the volunteers. Each battery of tests lasts between 3 and 5 hours, the time depending on the speed of reaction of each volunteer and on the fact that some tests do not impose any time limit to be completed (e.g.: Raven's Standard Progressive Matrices and Wisconsin Card Sorting Test).

**April 2015.** Thanks to the good relations of Riccardo Reina with the Campione d'Italia Casino, our research team is hosted 4 days in the Casino during the IPO18 event (<http://www.italianpokeropen.it>), which is a famous live poker competition. Gabriele Lepore and Mauro Schiavella recruit more volunteers and Mauro tests some players there and fix meetings for later tests. Mauro is also interviewed about PokerMapper by the press attending the event.

**May - June 2015.** The online recruitment and the administration of the test battery at Bicocca go on at the same time. On the 24<sup>th</sup> of June we close the secure website, used for online recruitment. 46 players are enrolled and invited to participate in the second part of the research.

**July 2015.** On the 2<sup>nd</sup> of July the last battery is administered. We count 36 complete batteries and 10 dropouts. We begin the test scoring and a long data-entry phase (511 variables per 36 complete batteries). In late July we are able to begin some data analysis. We decide to participate to a call for poster abstracts made by the National Center for Responsible Gaming for their 16<sup>th</sup> annual conference.

**August 2015.** In early August we are notified that our poster abstract was accepted for the poster session and at least one author is invited to attend the conference in Las Vegas, Nevada. We decide that Mauro Schiavella, Jerker Westin and Gabriele Lepore will attend the conference.

**September 2015.** Data analysis goes on. We begin to design the poster. We attend the NCRG conference in Las Vegas (27-29/09). We are awarded an Honorable Mention at the Poster Session.

**October 2015.** Two of us (Westin and Schiavella) attend the Svenska Spel Research Council's research day in Stockholm on the 7<sup>th</sup> of October. Westin makes an oral presentation on the research. The news of the award is communicated to our Media Partner and to Bicocca's Press Office. Tens of articles are written in few days in local and national web journals (among them Corriere.it and Wallstreet Italia.it). We begin to provide each volunteer with both a report on the results of the neuropsychological battery and a report on the poker ability.

Since the 23<sup>rd</sup> of January to date some 35 articles about PokerMapper have been published on local and national journals in Italy and abroad, showing interest of the press in the research project and its future developments. See details in the separate appendix, PokerMapper Press Review.

## Research objectives

Poker and responsible gambling both entail the use of the executive functions (EF), which are higher-level cognitive abilities. The main objective of this work was to assess if online poker players of different ability show different performances in their EF and if so, which functions are the most discriminating ones. The secondary objective was to assess if the EF performance can predict the quality of gambling, according to the Gambling Related Cognition Scale (GRCS), the South Oaks Gambling Screen (SOGS) and the Problem Gambling Severity Index (PGSI).

## Sample and methods

The study design consisted of two stages: 46 Italian active players (41m, 5f; age  $32 \pm 7,1$ ys; education  $14,8 \pm 3$ ys) fulfilled the PGSI (8% no problem; 22% low risk; 63% medium risk; 7% problem gambling) in a secure IT web system and uploaded their own hand history files, which were anonymized and then evaluated by two poker experts. 36 of these players (31m, 5f; age  $33 \pm 7,3$ ys; education  $15 \pm 3$ ys) accepted to take part in the second stage: the administration of an extensive neuropsychological test battery by a blinded trained professional. To answer the main research question we collected all final and intermediate scores of the EF tests on each player together with the scoring on the playing ability. To answer the secondary research question, we referred to GRCS, PGSI and SOGS (50% no problem; 36% problem; 14% probable pathological) scores. We determined which variables that are good predictors of the playing ability score using statistical techniques able to deal with many regressors and few observations (LASSO, best subset algorithms and CART). In this context information criteria and cross-validation errors play a key role for the selection of the relevant regressors, while significance testing and goodness-of-fit measures can lead to wrong conclusions.

## Correlations

Since the response variables are scores and the predictors either scores or binary (0-1) variables, the correlations are well defined and for most variables we have clear expectations about the right sign of the correlation. Our strategy to assess the statistical significance of the observed correlations was the following:

1. We selected the correlations that in absolute were larger than 0.33 which for a sample of 36 observations are significant at the 5% level. Notice that since we tested many correlations for significance, we expected that under the null hypothesis of absence of correlation some 5% of them can be larger than 0.33 in absolute value. The problem is that with 36 observations the power of the test is relatively low; 2. Since we have expected signs for almost each correlations, we compute the probability of having a number of sign matches equal or larger than the one observed on correlations in modulus larger than 0.33.

For the poker ability the strongest 7 correlations (on 17) have all the expected sign and this event is associated to a probability of 0.008 under the null of zero correlation, and thus, random sign. If we take into account all the correlations stronger than 0.33, then the probability of having a number of matches equal to or greater than the one observed (under the null of zero correlations) is 0.025. In both cases these p-values are smaller than 5% and so we reject the hypothesis that these correlations are different from zero only because of the action of chance.

For the problem gambling scores, all signs of the 28 correlations of the PGSI are matched. The probability of having this or a better results in guessing a random sign has probability  $1.1E-07$  (virtually zero). All but one sign of the 21 correlations of the SOGS are matched. The probability of having this or a better results in guessing random signs has probability 0.0001. Furthermore, all 37 correlations signs of the GRCS are matched. The probability of this event under the null of random signs is  $5.1E-08$  (virtually zero).

## CARTs

Using CARTs, we found that some variables of the administered tests are able to separate the players in base of their ability and in their quality of gambling.

In particular the poker ability tree shows that three variables are able to separate our sample: EQIS\_SM\_EQ\_RQW, the raw score of the Stress Management Scale of the Emotional Quotient Inventory Short version; FLUS\_ALLER\_RIP\_ the score of the sum of a kind of error (Repetitions) made in all parts of the Semantic Verbal Fluency Test; DIGIT\_FW\_ER\_0\_9, a score of the errors made in the most difficult series (9 digits) of the forward part of the Digit Span. Considering the classes of the poker ability (poor=10; fair=16; good=10), we have a tree composed by STR\_EFF\_T\_SEC, the time in seconds of the Stroop Effect, one of the most famous executive functioning indices; FLUF\_P\_ER\_VAR, a kind of error made during the Phonemic part of the Verbal Fluency Test; again DIGIT\_FW\_ER\_0\_9 (see above). With this second tree we are able to separate the sample in base of the poker ability classes with an accuracy of 0.83. Then we eliminated the fair class and proceeded with a tree with only 2 classes: 10 poor and 10 good players. This tree is composed by only one variable: FLUF\_P\_ER\_VAR (see above). This variable is able to separate the two classes with a Specificity of 0.70, Sensitivity 0.90 and Accuracy 0.80.

We used this kind of technique to test if we were able to separate the sample in base of the quality of gambling. EF variables allowed us to well separate the two classes of PGSI score we had in our sample of the 36 (Low=17; Medium=19). The tree on the PGSI risk groups separates the two classes with a Specificity of 0.88, Sensitivity 1.00, Accuracy 0.94. Three variables are involved: EQIS\_TOT\_EQ\_RAW, the raw score of the total Emotional

Quotient of the subjects, as evaluated by the Emotional Quotient Inventory Short; IBQ\_TOT\_T\_SEC, the total time to answer Shane Frederick's Intertemporal Behavior Questionnaire, a questionnaire assessing the tendency to make a patient versus an immediate choice; TOL\_9\_TOT\_T\_SEC\_DEC, the total decision time of the 9<sup>th</sup> configuration of the Tower of London.

SOGS risk groups are separated with a lower accuracy (0.72) by these variables: WCST\_%\_NONPERS\_ER (note that the "%" symbol was not recognized by the software we used for the statistical analysis), the percentage of non perseverative errors made in the Wisconsin Card Sorting Test; EQIS\_INTRA\_EQ\_STD\_50\_150, the standardized Emotional Quotient of the IntraPersonal Scale (possible scores between 50 and 150). This scale is about self-awareness and self-expression and it is composed by the subscales Self-Regard, Emotional Self-Awareness; Assertiveness; Independence; Self-Actualization; SPM\_B\_TSEC, the time needed to complete the second series of Raven's Standard Progressive Matrices.

GRCS final scores are not classes of risk related to gambling, but an evaluation of the amount of cognitive distortions related to gambling (the lower score, the better). In the GRCS tree, we find 3 variables, which separate the sample in 4 classes of cognitive distortions related to gambling (lowest=8, low=13, medium=8, high=7): FDCT\_N\_COR\_POS\_0\_1, which tells if the examinee was able to correctly position the numbers in the Free Drawn Clock Test; TOT\_10\_TOT\_MOVE\_5, the total moves made to complete the 10<sup>th</sup> configuration of the Tower of London (best is 5); DIGIT\_BK\_MAXSEQ\_0\_6, the maximum sequence of digits in the correct order remembered at the most difficult series of the Digit Span Back (6 digits is the best).

## Preliminary findings

### Poker ability

We found significant predictors of the poker ability score in various tests. In particular, there are good predictors 1) in some Raven's Standard Progressive Matrices variables that measure the fluid intelligence, which is the ability to think logically and solve problems in novel situations (independent of acquired knowledge) and sustained attention, the ability to focus the attention on a task over time, 2) in those Cognitive Estimates Test variables related to deductive reasoning, evaluation accuracy, problem solving, development of an appropriate strategy and self-monitoring, 3) in the Emotional Quotient Inventory Short (EQ-i:S) Stress Management score, composed by the Stress Tolerance and Impulse Control scores, and in the Interpersonal score (Empathy, Social Responsibility, Interpersonal Relationship) and Adaptability, 4) in those Tower of London variables related to goal setting (Initiating, Planning, Problem Solving and Strategic Behavior); 5) in the Raven's Standard Progressive Matrices scores related with fluid intelligence and sustained attention; 6) in the Intertemporal Behavior Questionnaire variables related to the ability to inhibit responses.

### The profile of the strong online poker player

- Fluid Intelligence: Able to think logically and solve problems in novel situations. Independent of acquired knowledge;
- Sustained Attention: Able to focus attention on a task over time;
- Strategic Behavior: Able to select a more profitable strategy;
- Problem solving: Able to move from a given state to a desired goal;
- Planning: Able to think about and to organizing the activities required to achieve a desired goal;

- Stress Management: Able to tolerate stress and control impulses;
- Social Skills: Able to interact and communicate with others;
- Adaptability: Able to change management;
- Response Inhibition: Able to inhibit impulsive/inappropriate responses;
- Deductive reasoning: Able to reason from one or more statements to reach a logically certain conclusion;
- Evaluation Accuracy: Able to provide measurements of a quantity, that are close to the true value;
- Self-Monitoring: aware of what he knows and able to make accurate assessment of his knowledge and/or skill.

## Quality of gambling

As for the quality of gambling, some EQ-i:S scales scores provide the best predictors: General Mood (Happiness and Optimism scales); Intrapersonal (Self-Regard; Emotional Self-Awareness, Assertiveness, Independence, Self-Actualization) and the total Emotional Quotient score, which is about the ability to effectively understand and express himself, understand others and relate with them and cope with daily demands. Furthermore we found good predictors in the Tower of London variables assessing Goal Setting (Initiating, Planning, Problem Solving and Strategic Behavior), which is one of the two executive processes overlapping with the profile of the strong online poker player (the other one is the Stress Management as evaluated by the EQIS). We also found that the ability to delay gratification (Shane Frederick's Intertemporal Behavior Questionnaire) and the preference for certain gain rather than higher expected value gains are good predictors of the gambling quality. Also the part of the Frontal Assessment Battery on Motor Programming and the ability to generate appropriate searching strategy as assessed by the Semantic Verbal Fluency Test are good predictors.

The Gambling Related Cognition Scale and a higher level of education provide two more predictors.

The presence of anxiety (but not of depression), seems to be a predictor of the gambling quality. We need to verify this data with further investigation, maybe on larger samples. Our data suggest that a responsible player is anxious.

## The profile of the responsible online poker player.

- Emotional Intelligence: able to effectively understand and express himself, understand other and relate with them, and cope with daily demands;
- Emotional Self-Awareness: aware and able to understand his own emotions;
- Good general mood (Happiness and Optimism): feels content with himself, other and life in general; positive and looking the brighter side of life;
- Able to delay gratification: prefers patient choices instead of immediate gratifications;
- Higher level of education;
- Lower cognitive distortions related to gambling;
- Presence of anxiety;
- Generating appropriate searching strategy: less perseverative and non-perseverative errors in a fast verbal searching task;
- Motor Programming: able to program and control motor actions;

- Certain gain rather than higher expected value gain: less risk seeking when facing higher expected value gains;
- Stress Management (see the profile of the strong online poker player);
- Goal Setting (see the profile of the strong online poker player)

## Conclusions

EF test results can discriminate between strong and weak players. They can also separate responsible and non-responsible players.

We found no correlations between ability to play poker and responsible gambling and between ability to play poker and depression and anxiety. The strong player and the responsible player both have the ability to manage stress (impulse control and stress tolerance) and to set goals (initiating, planning, problem solving, strategic behavior).

Through this preliminary study we gathered useful information to develop the next stage of our project: the construction of short cognitive tasks using card games in online poker environments.

## Implications for the field

Through PokerMapper we gathered knowledge and evaluated the feasibility of the construction of short tasks/card games in online poker environments for profiling users' executive functions. These card games will be part of an IT system able to dynamically profile EF and provide players with a feedback on their expected performance and ability to gamble responsibly in that particular moment. The implementation of such system in existing gambling platforms could lead to an effective proactive tool for supporting responsible gambling.

## Budget

Please see the enclosed excel file appendix.