Satisfaction and Learning: an experimental game to measure happiness[1]

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Introduction

It is well known that the "satisficing behaviour" developed and described by Herbert Simon is the core of a decision-making model which is alternative to the one used in standard economics. According to the standard economics model, economic agents, in their actions, exclusively apply criteria aimed at maximizing their own utility or, with reference to firms, their own profit. Maximization behaviour is at the basis of the idea that a system can, in this way, reach an efficient and optimum allocation of the available resources, an allocation which guarantees the maximum level of satisfaction for all the agents, and is compatible with the system's resources.

Yet, according to the severe criticism that has been levelled to its foundations by an extensive literature (Egidi-Rizzello 2003), this approach is on the whole unrealistic, and it is not consistent with any feed-back arising from the sciences studying human behaviour. Such criticism has disputed the maximization approach, in favour of a more realistic approach, consistent which these sciences: the satisficing approach. According to this approach, in Simon's view, human behaviour, in decision-making and problem-solving processes, aims at satisfying individual levels of aspiration, which - on the one hand - arise from individual psycho-neurobiological characteristics, and - on the other- adjust to the individual experience. Since experience is ever-changing the individual levels of aspiration become dynamic and inter-individual levels of aspiration variable.

It is evident that this kind of perspective radically changes the standard approach, which is based on the idea that maximization, efficiency, individual satisfaction and social coordination are directly and automatically linked to each other. Thus, economics tends to focus attention on the necessary means to "reach the efficiency" rather than on the ends. On the contrary, the satisficing approach describes a world where agents act in a situation of uncertainty, with limited information, they develop partially unstable routines, make (sometimes systematic) errors, but reach effective solutions. The agents' ends cannot be precisely predetermined, and they are often unexpected and undefined, since they are directly interrelated to the behaviour and choices of other agents, who act in a situation of uncertainty and limited Information, make systematic errors, and may have differentiated levels of aspiration. Nevertheless, a relevant aspect of this approach is that the relationship means-ends is overturned, and ends become more important than means.

In the space of five decades, the remarkable developments of Simon's studies and of the extensive literature which directly draws on his contributions on decision making have combined into the procedural rationality model, which synthesizes individual and organizational decision making. In the last decade, a new discipline known as cognitive economics has emerged (Egidi-Rizzello 2003); besides a very recent branch of experimental economics has developed, which deals with the experimental analysis of differentiated learning processes, of the processes of coordination in conditions of uncertainty, and of the emergence of shared rules (Novarese-Rizzello 2003, Novarese 2003a and 2003b, Egidi-Narduzzo 1997). Thus the research based on Simon's work is focusing on a few very specific but relevant aspects of decision making: it has highlighted the partially dynamic and partially stable nature of the individual levels of aspiration, and is now trying to verify whether it is possible to gather empirical data on the level of satisfaction reached by individuals in decision-making processes.

This aspect has not been sufficiently researched into, and one of the main purposes of this paper is suggesting a possible - though fraught with difficulties - path of experimental research. As to the dynamics

[1] The experiment presented in the paper was carried out at the Alex Laboratory in Alessandria. We wish to thank Guido Ortona and Marie Edith Bissey for their cooperation The software used, Swiee, was developed by Riccardo Boero. Other people participated in the organization of the experiment: Paolo Parodi, Maria Teresa Servello, Alessandra Sterpone, Cesare Tibaldeschi.
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and the stability of the levels of aspiration, on the contrary, the literature offers interesting contributions (Tversky and Kahneman 1974, Kahneman and Tversky 1979, and 1984; Tversky and Kahneman 1986; Kahneman, Slovic and Tversky, 1982, Witt 1993, Posch, Pichler and Sigmund 1999; Selten 1999, Gigerenzer 2003). In order to explain the partially stable nature of the levels of aspiration, we may assume that two different processes occur, which are both connected to the human perceptive characteristics. The first process is a typical path-dependent mechanism. As stated elsewhere (Rizzello 1997 and 1999), and on the basis of the tradition of Hayek's contributions on perception and on the nature and role of knowledge – contributions which are complementary to Simon's works on rationality and decision making – individual perceptive mechanisms are typically path-dependent, and depend on both individual experience and mental and neurobiological characteristics with a highly innate component. The second mechanism, concerning the partially stable nature of the individual levels of aspiration, was developed above all by Kahneman and Tversky (1974), through the anchoring effect (the first alternative deeply affects the decision-making process; here the affinity to path-dependence is evident), and by Tietz (1997), who highlighted the adaptation mechanism of the levels of aspiration, following Selten's contributions on the aspiration adaptation theory, which was developed in the 1960s and only recently translated into English (Selten 1998).

As regards the partially dynamic dimension, the recent literature offers extremely interesting contributions. Among them we wish to underline the model based on the win-stay, lose-shift principle, developed by Nowak-Sigmund (1993). They draw on Thorndike's behavioural tradition (1911), according to which an individual (or an animal in the behavioural tradition) is likely to repeat an action if it has proved successful, and to change it if it has not. Although this theory is mainly applied in the game theory, it explicitly stresses the problem of the change which has been discussed with interesting results also by the cognitive theory (Witt 1993). On the basis of this theory, the following assumption is taking shape: in a decision-making dimension, where alternative actions are assessed, the levels of aspirations may actually lower or rise within a given range; but if the individual went beyond it, his/her actions would turn into an innovative behaviour, arising from possibly incoherent high levels of dissatisfaction, which can be explained by means of the theory of the cognitive dissonance (Festinger 1957; Akerlof and Dickens 1982).

In this analytical framework, this paper aims at indicating a path of research that may offer a contribution for measuring the levels of satisfaction in decision-making processes. To this end, within an experiment designed to reach other results, we decided to try and analyze the levels of satisfaction and their evolution for the subjects involved, their connection with the shaping and the stability of the levels of aspiration or their tendency towards change. As mentioned this was carried out *a latere* of another experiment, whose main goal was to analyze the learning processes and the processes of coordination of individuals who were asked to decide in conditions of uncertainty and limited information. We deemed that it was important to extend the analysis to the levels of satisfaction, not only because it is a central aspect in Simon's model, but also because this could be a relevant element *per se*. In fact, the subject might carry out a given action just because it is satisfying *per se*, independently of the economic pay-off in the strict sense of the word.

Finally, it is necessary to underline that a survey of the literature in this field showed that this is one of the first experiments aimed at measuring satisfaction[2]. Therefore, a number of methodological issues arise (one of the few similar experiments available in literature is Charness and Haruvy, 2000). One of the purposes of this papers is stirring a methodological discussion on these aspects.

In the next section we will first briefly illustrate the experiment, and then discuss the results in detail. We hope that we can show you clearly enough that the results concerning the analysis of the levels of satisfaction and their evolution are neither definitive nor consolidated, still significant. We are aware of these limits, nevertheless we hope that we pointed out a promising path which will allow us to reach more robust results in the near future, by means of the tools of cognitive economics and of experimental economics.

Experimental analysis

In this section we illustrate the results of an experimental analysis in which – along with organizational coordination – the participants' level of satisfaction was measured by explicitly asking them. This is the same method used to measure individual happiness with reference to one's own standards of living: by means of surveys, the subjects are asked to give a mark to their "life satisfaction" (see, for instance, Hayo and Seifert, 2002 or Ferrer-i-Carbonell and Frijters, 2002).

[2] The survey we are referring to is based upon the archives JSTOR and NEP - NEW ECONOMIC PAPERS (thus covering the consolidated literature and new or recent articles) and on a number of on-line economic journals.

As to the experiment described here, it is necessary to take some aspects into account and to explain a few points in detail.
This analysis was carried out within a broader research project aimed at studying, from a cognitive perspective, individual and organizational learning processes and the emergence of shared institutions and behaviours. In the experimental analyses based on this approach, the environment and the game proposed do not usually refer to standard situations or models of Economics, since the situations are usually more complex (with reference to the kind of variables or possible choices, rather than to the task to be performed). The purpose of the research program is understanding how organizational or individual learning and decision-making processes actually work, rather than simply analyzing the results. To do so, we need to enter the "black box" of decision-making processes and understanding their mechanisms. This purpose has a strong influence on the experimental approach used, as described in details in Novarese 2003b.
As yet recalled the analysis of satisfaction is not the specific purpose of the experiment. In fact, it is an additional analysis in an environment set up with broader purposes. This brings about a few problems and constraints concerning variables we can observe (besides it does not comply with experimentalists' usual methods). Still, it allows us to assess the subjects in a less limited environment, it guarantees economies of scale with other analyses, and provides interesting - though preliminary - results, which are well worth studying also because it is a new kind of data.
The main purpose of this chapter is to focus on what emerges in terms of the levels of satisfaction. We will present tables that need confirmation from other studies, but that suggest important ideas, which in the future might be compared to data of other similar experiments.

The sum 10 experiment
Team of three players are anonymously and randomly built among participants. The game has 36 rounds.
Each of the players has a set of numbers. This set remains unchanged in every round and is composed of the values: 0, 1, 3, 4, 10.
In every round each player has to declare one of the numbers in his set.
The numbers of the three people playing together are then summed.

According to the sum, each player receives a payoff, following this rule:

* if S(i) = 10, I(i)=40 - D(i)
* if S(i) > 10, I(i)=30 - D(i)
* if S(i) < 10, individual payoff=0 minus declared number

where
S(i)= sum of the team I, of which player i is a member
I(i)= player i: individual payoff
D(i): number declared by player i
The game is divided into two parts. In the first part (rounds 1-26) the players are coupled with artificial agents. In the second one, the groups consist in permanently coupled human beings.
The players do not know that they are playing with artificial agents. They are told that in the first part they will be coupled with two players, and in the second one to two new ones. The players do not know the number of rounds.

There are the following three kinds of artificial agents:
1) Group 1
- one agent always plays 3;
- one agent always plays 3 (first choice) and repeats this number if in the preceding round the human player chooses 4; otherwise it plays 0.
Thus, in order to obtain always 10, the human player should choose 4.

2) Group 2
- one agent always plays 4;
- one agent plays 3 (first choice) and repeats this number if in the preceding turn the human player chooses 3, otherwise it chooses the necessary number to reach 10 (e.g. if the player chooses 2, this agent chooses 10-2-3=5; if the player chooses 4, this agent chooses 3).

This way, the human player is presumably urged to choose always 3.

3) Group 3
Both artificial agents always choose 0 (only in round 1, for technical reason, they play a different number: 3 or 4). Therefore, in order to obtain sum 10 the players should play 10.

The experiment was carried out by means of the specific software Swiee (Boero 2001). In the appendix you can find the instructions received by the participants and the computer pages.
In each round the players are asked to: choose the number, state what sum they expect to obtain in the following rounds; estimating (with a number from 0 to 10) the level of satisfaction for the result obtained in the preceding round (in round 36 the satisfaction is missing, therefore it will be excluded from the analysis)

The experiment was carried out in November 2002 at the *Centro Alex Laboratory of the Università del Piemonte Orientale in Alessandria* and it was organized by the Centre for Cognitive Economics. Twenty-four first-year law students, who were attending an introductory course on economics, participated in this experiment. On the basis of the score obtained they were granted credits for their exam.
At the end of the game the participants were asked to fill in a questionnaire commenting upon the game.

A note on terminology is here useful. "Total score", below, refers to the sum of the scores obtained in the first or in the second part or in the whole game. "Score", instead, refers to the sum obtained in each round.

Correlation between points and satisfaction at an individual level
The reliability and the meaning of the data on the satisfaction expressed by the players is the first aspects we need to understand. On the one hand – with reference to the experiment we are describing – the participants had no concrete motivation to disclose their actual satisfaction. Therefore, they might declare values at random. Moreover, generally speaking, a person might find it difficult to express his/her own level of satisfaction with a number, as there may be several aspects affecting that level.
As a matter of fact, in order to verify the data reliability, it would be necessary to know the actual model of each player's answers or, at least, we should decide to verify a given model. In other words, data reliability might depend upon the variables we choose to verify it. But this work's aims are mainly descriptive. Therefore the analysis does not follow strong assumptions concerning the players' behaviour. Certainly, satisfaction depends upon the evolution of the game, but the variables to be taken into account may vary (and might be different for different players).

The hypothesis most likely to prove true is that the subjects take first of all the scores into account. Nevertheless, it is also possible that other aspects are taken into consideration along with, or as an alternative to, the scores. Moreover, the relation between result and satisfaction might be not homogeneous.

The indicators proposed (table 1) are:
- the correlation coefficient between score obtained and satisfaction expressed in a given round, reckoned on the basis of each player's individual data[3];
- the correlation coefficient between satisfaction expressed and one variable in a given round, reckoned on the basis of each player's individual data;

This is certainly an imperfect indicator (the relation between scores and satisfaction might not be linear; a player, for example, might find it different to gain score 36 declaring 4, thus paying more than the other two team members, or 37), still it is significant and offers a preliminary view.

Table 1 presents the joined distribution of the values of the correlation coefficients:
- between individual scores and satisfaction,
- between team's mean score and individual satisfaction.

The two values are generally quite close to each other. In most cases (20 out of 24) the highest value is the first one. Thus, satisfaction seems to be more strictly connected to the individual than to the team's score (the two values are not necessarily coincident).

[3] It is also possible to reckon the correlation coefficient on all players in a given round (or in a given set of rounds). The results, not shown, are coherent with those proposed here.

For three players both coefficients are not significantly different from 0 (according to Pearson's test at a level of confidence of 99%). In one case both coefficients are negative; in another case they both equal exactly to 1.
This is a first index of the data reliability, since data are correlated with two significant indicators of the evolution of the game. The table also highlights a sharp heterogeneity among players.
In the table we present the most significant correlations[4].

Table 1. Distribution of individual values of the correlation between scores and satisfaction in each turn

		correlation on team score						
		<0	**0**	**0-0.5**	**0.5-0.8**	**0.8-1**	**1**	**total**
correlation on individual score	**<0**	1						*1*
	0		3					*2*
	0-0.5			5				*5*
	0.5-0.8			3				*3*
	0.8-1				5	6		*11*
	1						1	*1*
	total	*1*	*2*	*8*	*7*	*6*	*1*	*24*

Significance: 99%

Table 2 allows us to assess, in a different perspective, the connection between sum obtained by the team, individual score and mean satisfaction stated: the sums obtained by the team and the possible individual score are associated. For example: player 1 obtains sum 10 in three different ways (i.e. by means of three combinations of his/her own choices or other partners' choices), thus gaining three different (for him/her) scores. In other words, a player may obtain 10 by stating different numbers:10, 3, 4, 2 or 0 (depending on what the other team members declare).
Therefore, we can understand the extent to which individual satisfaction is associated with the scores, rather that with the sum obtained by the team (considered as an indicator of the ability to obtain 10, which might be perceived as the game's main goal, but also as an indicator of the team's rather that the individual's interests).

Let us take into account, for example, player 2. He obtains sum 10 in three different ways (or, in other words, he obtains different scores associated with the sum 10). The mean satisfaction is always the same (equal to 9). It seems, than, that satisfaction is independent of the scores. Player 18's values are similar; player 10 is even more satisfied with 36 than with 37, and with 20 than with 26).
Apparently, for other participants, player 3 for example, the score deeply affects satisfaction, more or less independently of the team performance (at any rate, the two values are strictly connected): he gives value 8 to score 36, while he attributes a higher level of satisfaction to 37.
On the basis of this table, most players seem to consider their individual scores more important than the team performance, but some of them seems to have different ideas.
From table 2 we can also infer that a few players (1, 11, 14, 17) attribute a high level of satisfaction – sometimes even higher than the one stated for their highest scores – to 0 and negative values[5]. This seems to be a paradoxical result, but it is consistent with what has emerged in other experiments: players punish their partners when they behave opportunistically, even when this means losing or not obtaining marks. Such behaviour produces a very high level of satisfaction, which might compensate for the loss of points. Thus table 2 further justifies such kind of behaviour; it is not only strategic choice aimed at inducing the others to behave in a more unselfish way.

[4] The correlations among other variables were tested, but are not presented here because resulted less interesting.
[5] That can lead to have individual correlation coefficient with negative or null values.

Table 2. Mean individual satisfaction attributed by players to different sums and scores in the whole game.

	sum < 10				sum = 10					sum > 10				
player	**-4**	**-3**	**-2**	**0**	**30**	**36**	**37**	**38**	**40**	**20**	**26**	**27**	**28**	**30**
1		9.00	8.60	7.17		5.00	8.50	6.00			8.00	8.50	6.75	9.00
2	3.75	2.50	7.00	5.57		9.00	9.00	9.00		5.00	9.00	9.00		
3	0.00	0.00	0.00			8.00	9.00				6.58	7.00		
4		0.00	4.00	5.25					8.00			7.00	8.00	7.00
5	0.00	3.33			5.00		10.00			5.00				
6	4.40	2.20	2.00	4.33					10.00	8.00			9.00	10.00
7			0.00				10.00				6.33	10.00		
8	2.50	3.33	5.00	4.14		7.00				7.25				
9							10.00					1.00		
10	4.25	3.67	1.00			8.75	8.00			7.13	5.50			
11		0.00	10.00				10.00				9.00	8.33		
12		3.00	3.00	5.81		8.00				7.50	8.00			
13		2.00	2.00	3.17	6.20		8.00		10.00					7.00
14			6.50	7.00	4.08					0.00				
15	1.67	3.00		2.00	5.31				8.80	5.50	8.00			
16	0.00	0.00		0.00	1.86	9.13					8.00			
17	0.00	0.00		10.00	4.29		10.00	8.50						
18	4.00		0.00	7.50	10.00	10.00	10.00							
19	1.00	10.00		1.00			9.23							1.00
20	5.33	6.50	8.00	4.00		9.55				5.67	5.00	6.00		
21	2.67	3.50	0.00	1.20	5.32		8.00			2.25				
22			2.50	3.00			8.00	8.00	10.00			8.33	6.00	
23	3.00	3.00	3.00	6.18					9.00	4.50				8.00
24	0.00	0.00	0.00	0.20	1.00					2.00	7.00			

Table 1 and 2 refer to the whole game, therefore they do not distinguish between the two parts. Therefore, we cannot analyze an aspect which might be important (especially in a cognitive perspective): the possible evolution of the relation between result and satisfaction. Next section deals with this aspect.
Nevertheless, it is necessary to distinguish the existence of possible trends from other kinds of behaviour, which bring about variable coupling between levels of satisfaction and scores but not a well-defined trend. A player might attribute different levels of satisfaction to the same score for different reasons. It might depend on reactions due to that specific moment of the game. Or the player might not attribute significance to different (and close to each other) levels of satisfaction, which, in his opinion, are identical: thus he/she might randomly choose one or the other. At the top end we find the player who always chooses random values.
On the contrary, the evolution of the level of satisfaction implies that there is a certain stability in close rounds and that the variations should take place as rounds go by[6].

The evolution of satisfaction

Performance and satisfaction in the first part of the experiment

As stressed before in the first part of the experiment, players are "trained" in different ways, trough the interaction with different kind of artificial agents[7].
Three treatments have been tested.

[6] With reference to the tables we have just observed, it is necessary to point out that a possible evolution of the satisfaction associated to given scores would bring about less significant values of the individual correlation coefficient.
[7] As said they don't know that they are playing with artificial agent and are not told of being undertaking a "training period".

The first one is built to force players to chose "4". The second treatment aims to train players to chose 3. The third treatment is based on agents whose aims is to force human players to declare 10, choosing always 0.

The first aspect to be analysed here is the effect of this treatment on the behaviour of the players in the first part and the reflex on their satisfaction. For this reason we take into account different values as measure of performance and behaviour.

The mean individual total score[8] of the treatments differs in a statistically highly significant way (two kind tests were carried out: the analysis of the variance and the Wilcoxon Rank sum non-parametric test; they give very similar result in all cases). Group 2 has the highest score, as expected. The lowest score is, a little unexpected, that of group 1.
Consider also the following findings:
- the percentage of 4 played in treatment 1 is higher than in the other groups, but the difference is not statistically significant;
- the percentage of 4 in treatment 1 is lower than those of 3 and of 10 in treatment 2 and 3 respectively;
- group 1 declare an higher percentage of 0 than group 3.
- group 1 has the lower mean number of sum equal to 10, but the highest of sum higher than 10.

The game at the basis of the experiment, has two dimension: at least one of the players should accept to "pay" more then the others, but the team should also succeed in coordinating.
Coordination is easier in treatment 3, as the other two players choose always the same numbers.
In treatment 1, there is an artificial agent that changes it behaviour, so making more difficult for the human players to understand the right number to choose, before having to decide if accept it.
The lower score and the lower percentage of sum equal to 10 in treatment 1 is then probably related partly also to this coordination problem, as it seems strange that players accept to play 10 but not 4 (and as treatment 1 has an higher percentage of sum higher than 10).
As said, choosing 0 can be a way to punish partners' free-riding, but -looking at this data- it can also be considered a kind of self-protecting behaviour ("as I'm not able to make a positive score, I save points, declaring 0") or a way to punish partners for not being clear in their strategies.

As expected, treatment 2 has the highest mean satisfaction. Group 1 has a mean satisfaction a little higher than group 3 (the difference is not significant: the P-value of the F test of the ANOVA is 0.36; the p-value of the Kruscal Wallis test is 0.34), even if its score is significantly lower (P-value F test ANOVA=0.04; p-value Kruscal Wallis test 0.04).

Table 3. Mean value of many indicators in the first part of the experiment by treatment

	group 1	group 2	group 3	p value t test	Wilcoxon test on difference between group 1 and 2
mean of total score	205.5	854.6	407.7	0.0001	0.0001
mean of satisfaction	5.5	8.9	4.5	0.0001	0.0001
mean of rounds in which sum =10	3.2	20	13.2	0.0001	0.000
mean of rounds in which sum > 10	5.5	3.9	0.0	0.0001	0.03
mean of rounds in which sum < 10	17.7	2.3	12.3	0.0001	0.000
mean number of 0 declared	11.0	0.9	9.0	0.01	0.00
mean number of 3 declared	2.3	22.0	1.4	0.0001	0.00
mean number of 4 declared	6.4	1.8	2.3	0.14	0.23
mean number of 10 declared	5.5	0.0	13.3	0.001	0.00
mean of disp1	-1.4	0.78	-5.1	0.001	0.0004

[8] Evidently the score is always highly correlated with the other possible indicators (like the sum of the team …).

The comparisons of the levels of satisfaction, scores being equals, can be carried out using a regression of the mean satisfaction on the individual total score obtained in the same period (first or second) with a dummy indicating the training treatment. The regression is showed in table 3.

The dependent variable is the mean individual satisfaction in the first part of the experiment.
The independent variables are:

- the total individual score in the first part (TOTAL SCORE 1);
- a dummy variable for those who underwent training in group 1 (DUM_1),
- a dummy variable for those who underwent training in group 2 (DUM_2),
- the mean differences, in all rounds of the first part, between player's score and the score of the other players in the same team (DISP1); a positive value means that he got an higher score, 0 mean that the score is equal, a negative value means that he get a lower score; individuals in treatment 3 can make points only with negative values of DISP1; the variable can be equal to 0 only if the sum is 0; for group 1 the situation is similar, but human players can get more then the other, when playing 0 (in this case, the other get a mean negative score); for group 2 the index can assume more values (positive or negative), because there are different possible solutions; players can, in fact, get more or less of the artificial agents.

The regression, first of all confirm that, given the score, the training in treatment 3 lead to a lower satisfaction (about 2 points) while there are no significant differences between the other treatments. In fact, when we add the dummies for the treatments, the fit of the model improves, and the variables are significantly different from 0 (if we consider only the first two treatment, on the contrary, the dummy is not significant and doesn't improve the fit).
This fact, related to the previous findings, suggest that opportunism could cause more dissatisfaction than problems of coordination. Players of treatment 3 are relatively less satisfied because they should face opportunistic agents. Players in group 1 face a difficult environment, beyond the opportunism of the partners. This result can be explained with a reference to the theory of procedural rationality, according to which players reduce their levels of aspiration if the environment faced is seen as difficult. But in treatment 3 the environment is simple, players see the others making points and should accept an unfair result[9].

Table 4. Main results of a series of regressions with mean satisfaction in the first part as dependent variable, all treatments and treatments 1 and 2

TOTAL SCORE_1	DUM_1	DUM_2	DISP1	R^2	P value F test
all treatment (n=24)					
0.006 (p.v.=0.00)	-	-	-	0.52	0.0001
0.005 (p.v.=0.02)	2.14 (p.v.=0.09)	1.94 (p.v.=0.04)	-	0.66	0.0001
0.005 (p.v.=0.00)	-	-	0.29 (p.v.=0.02)	0.63	0.0001
0.006 (p.v.=0.06)	(1.45) (p.v.=0.24)	(0.19) (p.v.=0.95)	(0.21) (p.v.=0.55)	0.67	0.0002
only treatment 1 and 2 (n=16)					
0.005 (p.v.=0.0001)	-	-	-	0.89	0.0001
0.005 (p.v.=0.0001)	(-0.12) (p.v.=0.87)	-	-	0.89	0.0001

1) -: variable not included in the estimation
2)between parentheses you can find the parameters that are not significant at a 90% level
3) "p.v." is the p-value

Evolution of satisfaction and effects of the training period
In this section we try to understand to what extent players' mean satisfaction change as a result of the experience in the first part of the game, where the kind of partners, and consequently choices and results, are quite different.

[9] This hypothesis will be tested again, in another experiment, comparing these results with those of a sum 10 experiment in which the score is equal for all members of a team (and then there is no room for opportunism).

Another paper analyse in more detail the possible effects of the training period on players' behaviour in the second part of the game (see Novarese, 2003a). In this paper, instead, the attention is focused on the satisfaction and on its relation with score[10].

Table 5 compares many mean values[11] of the three groups. Among the treatments there are no significant differences in mean total score. There are some differences in the number of sum equal to 10, but they are not very significant. Players in treatment 2 play more 3 than the others[12].

Table 5. Mean value of many indicators in the second part of the experiment by treatment

	treatment 1	treatment 2	treatment 3	P- Value F test ANOVA	p-value Kruskal-Wallis Test
mean of total score	140.8	177.8	225.9	0.23	0.41
mean of satisfaction	6.9	5.8	5.6	0.68	0.84
mean of rounds in which sum =10	1.9	2.9	5.0	0.12	0.20
mean of rounds in which sum > 10	2.9	2.5	1.8	0.41	0.29
mean of rounds in which sum > 10	3.3	2.6	1.3	0.16	0.16
mean number of 0 declared	3	1.6	2.6	0.69	0.48
mean number of 3 declared	1.5	4.3	0.3	0.01	0.02
mean number of 4 declared	6.4	1.8	2.3	0.14	0.76
mean number of 10 declared	0.9	0.9	2.4	0.32	0.39
disp2	0.70	0.13	-0.83	0.64	0.64

Table 6. Main results of a series of regressions with mean satisfaction as dependent variable, considering treatment 1 and 2

TOTAL SCORE_2	DUM_1	DISP2	SCORE1	SATIS1	R^2	P value F test
0.02 (p.v.=0.00)	-	-	-	-	0.41	0.0069
0.02 (p.v.=0.00)	1.74 (p.v.=0.04)	-	-	-	0.57	0.0044
0.02 (p.v.=0.00)	-	-	-	-0.40 (p.v.=0.07)	0.54	0.0058
0.02 (p.v.=0.00)	-	-	-0.003 (p.v.=0.01)	-	0.64	0.008
0.02 (p.v.=0.00)	-	(0.09) (p.v.=0.66)	-	-	0.43	0.02
0.02 (p.v.=0.00)	-	(-0.04) (p.v.=0.80)	- 0.002 (p.v.=0.02)	-	0.64	0.00
0.02 (p.v.=0.00)	1.72 (p.v.=0.06)	(-0.04) (p.v.=0.80)	-	-	0.57	0.00

1) -: variable not included in the estimation
2)between parentheses you can find the parameters that are not significant at a 90% level
3) "p.v." is the p-value

[10] As said score is the variables which is more correlated to satisfaction. Nevertheless, the score is highly correlated to the other values (sum of the team…) which might be relevant, and therefore the analysis has a general valence.

[11] While in the first part of the experiment each individual represents an independent observation from the others, now the situation is changed and many individual variables of the members of each team are strongly related to those of his/her partners. The score, for example, is highly related among team members (even if within the group there is a negative correlation) , as the number of rounds in which the sum is equal to ten. Other values, like the distribution of the numbers declared by a player, can be or not related to the other; a player may be willing to impose its strategies or can try to adapt his behaviour to the others.
The analysis of this aspects here is yet focused on the levels of satisfaction, and the other aspects are seen only in this perspective and then we could avoid to face this problem of dependence.

[12] At an individual level there is a significant correlation among the number declared in the first and second part. See also Novarese 2003.

To compare the levels of satisfaction of the treatments, scores being equals, a new series of OLS regression were performed, using the individual mean satisfaction in the second part as dependent variable.
The independent variables are:

- the total individual score in the second part (TOTAL SCORE 2),
- dummy variable for those, who underwent training in group 1 (DUM_1),
- dummy variable for those, who underwent training in group 2 (DUM_2),
- the mean individual differences between the player's score and their partners in the second part (DISP2, built as DISP1 but with the data of the second part),
- total score obtained in the first part of the experiment (SCORE1),
- mean satisfaction obtained in the first part of the experiment (SATIS1).

Different specifications has been estimated on different sub-samples.
Table 6 and 7 show the main results.

Table 7. Main results of a series of regressions with mean satisfaction as dependent variable, considering all treatments

TOTAL SCORE	DUM_1	DUM_2	SCORE_1	DISP2	SODD1	R^2	P value F test
0.02 (p.v.=0.00)	-	-	-	--	-	0.40	0.0009
0.02 (p.v.=0.00)	3.26 (p.v.=0.00)	(1.32) (p.v.=0.21)	-	-	-	0.59	0.0004
0.02 (p.v.=0.00)	-	-	-	0.37 (p.v.=0.01)	-	0.56	0.0002
0.02 (p.v.=0.00)	2.59 (p.v.=0.02)	0.28 (p.v.=0.03)	-	0.28 (p.v.=0.03)	-	0.67	0.0002
0.02 (p.v.=0.00)	-	-	(-0.001) (p.v.=0.42)	-	-	0.42	0.003
0.02 (p.v.=0.00)	-	-	(-0.0009) (p.v.=0.48)	0.37 (p.v.=0.01)	-	0.57	0.0002
0.02 (p.v.=0.00)	-	-	-	-	(0.03) (p.v.=0.89)	0.40	0.0002

1) -: variable not included in the estimation
2)between parentheses you can find the parameters that are not significant at a 90% level
3) "p.v." is the p-value

Treatment 1 and 2

Take into account, first of all, group 1 and 2 in table 7. They can be more easily compared in terms of distribution of the score in the second part and showed the more clear differences in the first one.
As seen, in fact, in the first part of the experiment, groups' scores are quite different, because of the different behaviours of the artificial agents faced. Given the score, there are no differences in satisfaction.
On the contrary, yet, as shown in table 8, in the second part, score being equal, group 1 has a higher mean score. Group 2 has almost all its highest mean values of satisfaction for high scores.

As regards the first part of the experiment, we saw that by adding the dummy referring to the treatment we did not improve the fit of the base model (that include only the score as independent variable), and therefore it does not look significant.
In the second part, instead, by adding that variable – which is fully significant and has a positive value- we improved the fit of the estimate.
Thus, it seems that in the first part, for these treatments, there are no significant effects specifically due to training. On the contrary, in the second part the total score is less explicative of the variance of satisfaction. By adding the information on training we understand in a better way the mean satisfaction. Those who underwent training in group 1 have significantly lower satisfaction values (at a 95% trust level), given the score.

If instead of the dummy on the training we introduce into the estimate the mean satisfaction obtained in the first part of the experiment (i.e. a value which is certainly linked to the kind of agents faced in the previous part) the capacity to foresee and the significance of the model decrease. Satisfaction in the first part has a negative sign: those who obtained a higher mean satisfaction in the training period have a tendency to be less satisfied in the second part.

On the contrary, if we introduce the variable referring to the score in the first part, the model's explaining capacity increases. The variable has a negative sign: higher score corresponds to a lower level of satisfaction in the second part. This might indicate that the effect of training is here mainly linked to the score obtained.

Treatment 3

Now we consider also treatment 3, compared with the others.
The regression proposed in table 7, shows that between group 2 and 3 there are no differences (while group 1 maintain its higher intercept).
The variable DISP2 seems to be more relevant for this group. In fact, it become significant in table 7, when we add the data of this treatment. Also in the regression on individual groups, DISP2 has the strongest relevance (and significance) for this players. This strongest sensibility to the differences in score with the partners have probably been acquired in the first part of the game (in the second part treatment 3 has no different mean values of DISP2, as shown in table 5).

The score of the first part, lose here its significance, probably because of the differences meaning between the low score in group 1 and 3. As seen in the first part, in fact, in one case there are (also) problem of coordination, while in the other, players should accept low score because of the opportunism of artificial agents. This difference seem to have dissimilar effect on the satisfaction in the first part, and it' s then also a possible source of these new divergences.

Table 8 shows the results of a series of estimations on the data of the second part for each treatment. With the usual problem of the small dimension of the samples, what emerges here confirms and expands some previous findings.
Treatment 1 has the lower elasticity to score and the highest value of the intercept. The score get in the first part result the more significant variable able to explain the satisfaction.
Treatment 2 has the sharpest inclination, an intercept higher than group 3 and is influenced only by the score.
Treatment 3 has the lowest intercept and is strongly influenced by the variable DISP2.

Summary of the main empirical findings and concluding remarks

The analysis proposed here suggests a series of ideas and research hypothesis that should be further tested and investigated but that are plausible and in some cases can be related to other empirical or theoretical works.

The first result, which is not necessarily obvious *a priori*, is that it is possible to measure satisfaction in an experiment, despite a few problems and limits, which might be better understood or even solved in new experiments.
Apparently, satisfaction is mainly affected by the score. Given this value, there are, nevertheless, other elements affecting satisfaction. The more important is the need of not being subject to others' opportunism. At least a few subjects might be influenced also by the ability of succeeding in carrying out their task within the experiment, and as a consequence, also by the general team performance, rather that only by their own score.

Experience and learning seem to play a relevant role in affecting the mean satisfaction levels.
The empirical evidence here seems to suggest that a training in a situation in which coordination is difficult, improve the mean levels of satisfaction in the next period. A training in a situation in which players have to interact with strongly opportunistic partners, make players' satisfaction more penalized by the opportunism of the others.
These seem to be important results with manifold valences. On the one hand, this might affect subjects' behaviour during the experiments, and it is therefore to be taken into due consideration at a methodological level. More generally, this is a further demonstration of the relevance of learning processes in the way how subjects perceive the environment. Finally, this result appears also to be coherent with Simon's model, linking satisfaction, levels of aspirations(which were not measured here) and performance.

The available data doesn't allow here to test directly the eventual effect of satisfaction on individual behaviour. This also happened because this kind of analysis is not simple and it would be necessary to know the levels of aspiration and the expectations, that are yet very difficult to be measured[13]. We hope this Chapter could draw a useful line for further researches.

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[13] In the experiment proposed, we tried to measure level of aspiration by mean of the expected sum, but no significant results emerged, probably because of many measure problems.

Appendix 1: Instructions for the experiments distributed among the participants

Game sum 10

The game is divided into two parts. Each part is subdivided into a number of rounds.

The computer randomly and anonymously couple 3 players.

In each turn you have number 0, 2, 3, 4, 10 (included) at your disposal and you have to declare one of them.

Your number will be added to that of the two players coupled with you.

On the basis of the sum obtained, the score will be determined by this rule, identical for the three players:

- if the sum is 10,

score= 40 – the number declared

for example: if you declared 4, the first player coupled with you declared three and so did the second player, the sum is 10; you gain a score of 40-4=36, the other two players gain 40-3=37.

- if the sum is higher than 10

score = 30 – declared number

for example, if you declared 4, the first player coupled with you declared 4, and the second declared 3, the sum is 11; your score is 30-4=26; the second one gains 30-4=26, the third one gains 30-3=27.

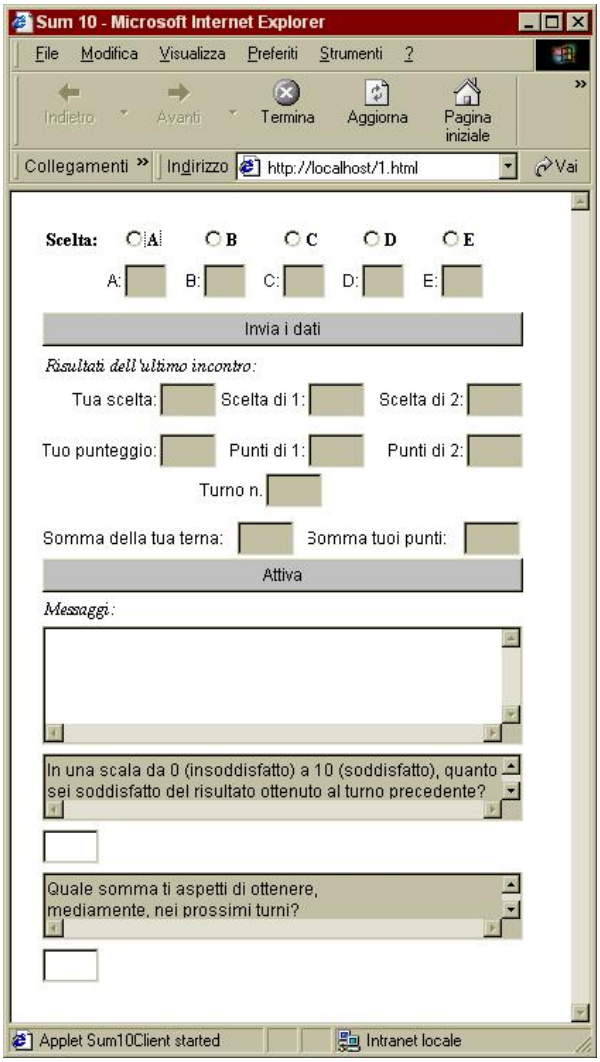
- if the sum is lower than 10,

score = 0 – declared number

for example: if you declared 4, the first player coupled with you declared 0, the second declared 3, the sum is 7; you gain 0-4=-4 (you lose 4); the second player gains 0-0=0; the third one 0-3=0 (he/she loses 3)

All through the first part you will be coupled to the same two players.
In the second part (your computer will inform you when the second part starts) you will be coupled to two other players, who will be the same until the end of the game.

This is the page you will see on your computer.



At each round, you will be asked to answer to the following question:

- in a 0 (unsatisfied) to 10 (satisfied) scale, what is your level of satisfaction for the results you obtained in the preceding round?
- What is the mean sum you expect to gain in the following rounds?

Before going on to the next round it is necessary to wait until all players (not only the ones coupled with you) have answered. You might have to wait. Be patient!

The computer will pass to the new page automatically, as soon as it is possible to continue.