A TYPOLOGY OF PLAYERS: BETWEEN INSTINCTIVE AND CONTEMPLATIVE[*]

ARIEL RUBINSTEIN

A new typology of players is proposed based on the classification of actions as either instinctive or contemplative. A person's type is the probability of him choosing a contemplative action. To test the typology, results of 10 games are analyzed. Actions in each game were classified depending on whether their response time was more or less, respectively, than the median response time of all subjects who played the game. It is argued that fast actions are more instinctive and slow actions are more contemplative. A subject's contemplative index (CI) is defined as the proportion of games in which he chose a contemplative action. It is found that for 8 of the 10 games, the CI in the other 9 games is positively correlated with a player's choice of a contemplative action in that game (average Spearman correlation of 9%). The CI is used to shed light on the nature of choice in five additional games. *JEL* Codes: C72, C91.

I. INTRODUCTION

We often differentiate between people who make decisions instinctively and those who reason things out. In particular, in strategic settings we distinguish between people who use strategic reasoning in making a choice and those who go by their gut feeling. The goal of the article is to suggest a natural typology along these lines and examine its usefulness in predicting behavior and interpreting behavior in games. A major merit of the typology is that it resembles the way we classify people in real life.

The proposed typology will be based on the classification of actions as either instinctive or contemplative. A person's type will be determined by the probability of him choosing a contemplative action. A player of type p is one who chooses a contemplative action with probability p.

One of the main merits of the typology is its ability to capture the way we tend to classify people in real life. It is often said of a

person that "his decisions are based on emotion" or that "his behavior demonstrates thoroughness." Such statements are based on the individual's observed behavior rather than the nature of his deliberation process. I would advocate that typologies in economics should be judged not only by their predictive power but also by their descriptive power. Thus, even if one could make better predictions of behavior based on some other kind of information about a subject (and I imagine that measures with better predictive power will be found sooner or later) the typology suggested here will nonetheless be of value.

Following a description of the data (Section II) the article is structured as follows: Section III provides the groundwork for defining the typology. It spells out the experimental results of 10 games (most of them familiar ones) that are included in the set of problems at my website (gametheory.tau.ac.il; see Section II for details) and for which a large amount of data has been collected. Strategies were classified in one of two classes depending on whether their median response time (MRT) was more or less, respectively, than the median response time of all subjects who played the game. Note that the partition is based solely on an objective criterion.

Section IV argues for the interpretation of the fast actions as (more) instinctive and the slow actions as (more) contemplative. This interpretation is, in my opinion, quite intuitive in most cases; nonetheless, support for the interpretation was obtained by means of a mini-experiment in which graduate students labeled the two classes of actions for each game.

Section V presents the main innovation: the contemplative type is defined as the probability that a subject will choose a contemplative action. Section VI presents a test for the typology. For each of the basic 10 games, an agent's "contemplative index" (CI) is calculated, that is, the proportion of the other 9 games in which he plays a contemplative action. It appears that in most cases the CI based on the other nine games is positively correlated with whether the agent plays contemplatively in the tenth.

Section VII presents an analysis of five additional games in light of the new typology. It is claimed that the CI (calculated on the basis of the 10 games) illuminates the nature of the play in those games and is informative for interpreting behavior. Section VIII discusses another typology (a version of the typology suggested in Rubinstein (2013)): agents are characterized by their relative speed in responding to a problem. This method captures a

real-life characterization of people as fast or slow responders independently of their choices. A type of a person is estimated using an agent's GI index, which is the median of the agent's RT positions relative to other players in each game. It appears that GI is also positively correlated with the choice of more contemplative actions (though probably less so than CI).

Initially, I was looking for correlations between specific actions taken by a player in pairs of games. The average Spearman correlation between the 45 pairs of basic games was only about 0.040. I would speculate that it is rare to find correlations much higher than that between the behavior of a subject in two different games, unless the games are highly similar (Georganas, Healy, and Weber 2014 reach a similar conclusion). Note that the correlations reported between the CI and the contemplative action differ from these correlations in two ways. First, the correlation is calculated on the instinctive/contemplative level and does not relate to specific choices. Second, the correlation is calculated between the proportion of contemplative actions in a series of independent games and choosing a contemplative action in another game. The average correlation for 45 pairs of games was also only 0.039. In the case of correlations between the CI in a series of games and a contemplative action in a different game, the average Spearman correlation jumps to 0.089. Obviously, this is an important issue in itself that requires elaboration and, as one referee suggested, justifies a paper on its own.

I.A. *Comments on the Use of Response Time*

The use of response time to open the black box of decision making is well established in psychology and goes back 150 years to the work of Franciscus Cornelis Donders (see Donders 1969). The pioneering studies of choice reaction times include Stone (1960), Luce (1986), and Busemeyer and Townsend (1993).

The current paper follows Rubinstein (2006, 2007), where I argued that response time is useful as a simple, cheap, and attractive indicator of the nature of a choice in games. The interpretation of response time as an indication of whether a choice is instinctive or contemplative (cognitive) is in some sense consistent with Kahneman (2011), who classified quick and instinctive responses as being the product of a system I decision process and slower contemplative responses as being the product of a system II decision process (for a critique of the two-systems approach, see

Keren and Schul 2009). Note, however, that psychologists typically study response time in contexts where it is measured in fractions of a second (for an exception see Ratcliff 1978, a study of memory retrieval tests). In the context of the game situations studied here, response time measures the time spent thinking about a decision and is typically within the range of 30–240 seconds.

I.B.   Comments on the Literature

For reasons beyond my understanding, economists were hostile to the use of response time until recently, when it became a legitimate and popular tool. Currently, response time is used in the literature for a number of purposes, which were classified recently by Spiliopoulos and Ortmann (2014). In this study, response time plays the following roles:

Interpreting the meaning of choice in single games. Previous works in economics that used RT in this way include Rubinstein (2007) (for a variety of games), Lotito, Migheli, Ortona (2013) (a public goods game), Agranov, Caplin, and Tergiman (2013) (guessing games), Arad and Rubinstein (2012) (General Blotto Tournament), and Brañas-Garza, Meloso, and Miller (2012) and Hertwig, Fischbacher, and Bruhin (2013) (the ultimatum game).

"Predicting" the behavior of players in a game. See Clithero and Rangel (2013), Rubinstein (2013), and Schotter and Trevino (2014).

Defining a typology of players. See Rubinstein (2008, 2013).

A number of previous papers have attempted to find between-game correlations of strategies. Following are some examples that made use of a typology based on level-k reasoning: Costa-Gomes and Crawford (2006) observe the correlation between players' k-level type within a family of guessing games; Fragiadakis, Knoepfle, and Niederle (2013) suggest an original way to determine whether subjects indeed follow any rule within a family of guessing games; Burchardi and Penczynski (2014) identify one-third of the subjects as nonstrategic for a group of games; Georganas, Healy, and Weber (2014) find that k-levels are fairly consistent within a family of games but not between them; and finally, Arad and Rubinstein (2012) take a somewhat

different approach by comparing the behavior of a large population of subjects in the Blotto Tournament and the 11–20 request game and find correlations when subjects are partitioned into three groups: level 0, levels 1-2-3, and the rest.

II. THE DATA

Experiments that study response time require a large number of subjects. For the current study, this was accomplished using the data accumulated on my didactic website http://gametheory.tau.ac.il. The subjects were students in game theory courses from around the world. As of the beginning of 2014, the site had 50,000 users from 40 countries (some as "marginal" as China and India). More than half were from the United States, Switzerland, United Kingdom, Colombia, Argentina, and the Slovak Republic. In this respect, the pool of subjects was more diverse than the standard ones in game theory experiments, although obviously the sample is not representative of the "world" in any serious way.

The site contains a bank of game-theoretic and decision-theoretic problems. Teachers, most of whom teach game theory courses, register on the site, assemble sets of problems, and assign them to their students. Problems on a particular topic are recommended to be assigned before the material is studied in class. Students respond to the problems anonymously. Teachers have access to statistics summarizing the choices of their students as well as those of all other respondents. The website records both the students' answers and their response times.

A "problem" in this article is a description of a hypothetical game. A subject responds to the problem by specifying his anticipated behavior in the role of one of the players. For each problem, the responses of the quickest 5% of subjects were removed (clearly, many of them chose an answer without even reading the question). Each problem is given two identifiers: a name and a serial number in the system (indicated by #). The serial numbers are included in the article to make the database easier to use.

Response time (RT) is measured as the number of seconds from the moment a problem is sent to a subject until his response is sent back and recorded by the server in Tel Aviv. Given the speed of communication, we can treat this as the time the problem is on the subject's screen.

A commonly used graphic tool is the response time cdf. For any set of strategies C, define $F_C(t)$ to be the proportion of subjects that chose an alternative in C and who responded within t seconds. Rubinstein (2007, 2013) found that the graphs of the response time cdfs display two remarkable regularities. (i) They have a common shape that resembles an inverse Gaussian or log-normal distribution. (ii) The response time cdfs (for a particular problem) are almost always ordered by the "first-order stochastic domination" relation. When $F_C(t) \geq F_D(t)$ for all t, for two exclusive sets of strategies C and D, we say that the C-choosers respond faster than the D-choosers.

II.A. Comment

I am aware of three criticisms of this type of research and following are my responses to them (the first two already essentially appeared in Rubinstein 2013, p. 541).

1. The Lack of Monetary Incentives. I have never understood the source of the myth that paying a few dollars (with some probability) will keep the subjects (who come to the lab on their own volition and are paid a certain amount no matter how they perform in the experiment) as focused on the task as they would be in real life. The opposite would seem to be the case. Human beings have good imaginations and framing a question using the phrase "imagine that" achieves a degree of focus equal at least to that created by a small monetary incentive. Exceptions might include very boring tasks, for which incentives are necessary to ensure that subjects are not just answering arbitrarily. In any case, I cannot see how the incentive provided by the small amount of money involved can be compared to the advantage of quick and easy access to a large number of subjects from a variety of countries. (For a detailed discussion of the monetary incentive issue, see Camerer and Hogarth 1999 and Read 2005 as well as the references therein.)

2. The Use of a Nonlaboratory Setting. The use of web-based experiments does not provide control over what participants are doing. This is indeed true, but do researchers know whether the subject in a laboratory setting is thinking about the experiment or about his troubled love life? Are decisions more natural in a

"sterile environment" or when a subject is sitting at home eating pizza?

3. The Pool of Subjects. The subjects are students in game theory courses, and they may have viewed the problems as a homework assignment rather than imagining that they are playing a game. However, the results obtained for this data set are quite similar to those normally obtained by researchers. The one systematic difference involves a small proportion of subjects (the "victims of game theory") who chose the Nash equilibrium action even in games where it made no sense to do so and would result in a low expected payoff. Also, note that teachers are asked to assign the problems to their students before they talk about them in class. Finally, there isn't much variation in the results within large groups who answered the same problem. Overall, it is hard to find evidence that the subjects in this study are more biased than any standard pool of subjects; furthermore, as mentioned earlier, the geographical distribution of the students is much more diverse than what we usually see in experiments.

III. The Basic Collection of Games

The basic collection of games consists of 10 games (results for some of the games were reported in Rubinstein 2007 for much smaller samples). There were four criteria for including a game in the collection: (i) It had received a very large number of responses. (ii) The distributions of response time for the various actions were significantly different (unlike in the Chicken Game or in the case of the responder in the Ultimatum Game discussed in Section VII). (iii) The strategies in each game could be labeled clearly as being either above or below the MRT of the entire population of responders in the game. This was not the case in, for example, the Trust Game and the Public Contribution Game discussed in Section VII, in which a significant proportion of participants chose actions with an MRT very close to that of the entire population of responders for that game. Including these games might have added another degree of arbitrariness to the process. (iv) I had a clear personal intuition about how to classify the strategies as either instinctive or contemplative. This

subjective classification does not play any role in the discussion that follows.

The description of each game is accompanied by the distribution of responses, the MRT of the different actions and the RT cdfs. In games where the number of strategies is large, some similar actions were consolidated. The responses in each game are divided into two groups: those with MRT above the overall median and those with MRT below the overall median. (Recall that the RT cdfs are ordered by the first-order stochastic domination relation.) The discussion of each game ends with a brief description of the intuition behind the slow/fast partition.

III.A.   *Zero-Sum Game (#15)*

The simple zero-sum game shown in Figure I was presented to students (like some other games which will follow) in the form of a bi-matrix in which payoffs were presented as numbers, without specifying their interpretation (students in game theory courses are, of course, familiar with this kind of presentation).

The 4,715 subjects "played" the game in the role of the row player. Whether one interprets the payoffs as monetary payoffs or vNM utilities, Nash equilibrium predicts that more players will play B than T. However, the action T was in fact the more popular choice (62%). Its MRT (41 s) is much lower than that of B (57 s).

The RT findings are consistent with the intuition that a player who does not use strategic considerations will choose T (which is associated with the highest payoff). Choosing B must be an outcome of reasoning, according to which the subject puts himself in the shoes of the column player, whom he believes is likely to play R. This makes B his best response. This interpretation is supported by results from two other versions of the game that appear on the site. In one, subjects were asked to play the game in the role of the column player, and in the other the column and row roles were reversed and subjects were asked to play the game as the row player (facing the negative payoffs of the original column player). In both versions, between 84% and 87% of the subjects (who did not also play #15) chose the action associated with the payoff of -1.

III.B.   *Hoteling's Main Street Game (#68)*

Figure II is a three-player discrete variant of Hoteling (1929)'s Main Street Game with seven locations ordered on a line.

$n = 4{,}715$	Percent	MRT
T	62	41 s
B	38	57 s

MRT = 47 s
Fast: T
Slow: B

You are Player 1 in the following game:

		Player 2	
		L	R
Player 1	T	2,–2	0,0
	B	0,0	1,–1

Imagine that Player 2 is an anonymous
player. What will you play?
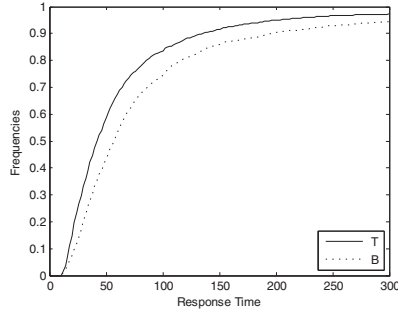
FIGURE I

A Zero-Sum Game

$n = 8{,}329$	Percent	MRT
1+7	10	45 s
2+3+5+6	46	70 s
4	43	42 s

MRT = 53 s
Fast: 1,4,7
Slow: 2,3,5,6
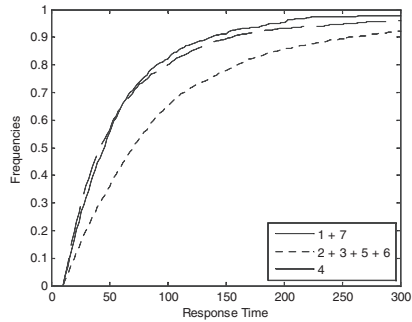
Imagine you are the manager of a chain of cafés competing with two other similar chains. Each
of you is about to rent a shop in one of the seven new identical huge apartment buildings standing
along a beach strip. Once each of you knows exactly where the other two competitors locate, it
will be too late to move to another location. You expect that the customers (the residents in the
seven buildings) will not distinguish between the three cafés and will pick the one which is closest
to their home. In which building (a number between 1 and 7) will you locate your café?

FIGURE II

Hotelling's Main Street Game

The game's unique symmetric Nash equilibrium strategy assigns probabilities (0.4, 0.2, 0.4) to positions 3, 4, and 5, respectively. Of 8,329 subjects, 43% chose the middle position, which is double what is expected in equilibrium. (In the two-player version of the game, which appears on the site (#71), 69% of the 10,336 subjects chose the middle position.) Only 10% of the subjects chose the dominated actions 1 and 7. The MRTs of the center position (4) and the edges (1,7) were below the median, whereas the MRTs of the actions 2,3,5,6 were above it. This is consistent with the intuition that choosing the center position is instinctive while locating a bit off-center is an outcome of strategic reasoning.

III.C. The Two-Contests Game (#66)

As in Huberman and Rubinstein (2000), subjects were asked to choose one of two contests: "coin" or "die" (see Figure III). The subjects compete by guessing, as closely as possible, the outcome of 20 tosses of a coin or die depending on what they chose. The winner in each contest is the best guesser.

Of the 1,901 subjects, 68% chose "coin," and their MRT was much lower than for those who chose "die" (71 s versus 88 s). This must be an outcome of a misconception that it is "easier" to guess the coin tosses and a failure to understand that the difficulty of the task has nothing to do with the chances of winning. A rational

$n = 1,901$	Percent	MRT
Coin	68	71 s
Die	32	88 s

MRT = 77 s
Fast: Coin
Slow: Die
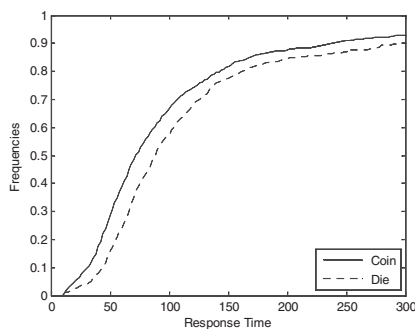
Imagine you are the manager of a chain of cafés competing with two other similar chains. Each of you is about to rent a shop in one of the seven new identical huge apartment buildings standing along a beach strip. Once each of you knows exactly where the other two competitors locate, it will be too late to move to another location. You expect that the customers (the residents in the seven buildings) will not distinguish between the three cafés and will pick the one which is closest to their home. In which building (a number between 1 and 7) will you locate your café?

FIGURE III

The Two-Contests Game

strategic player should try to choose the contest he believes will attract fewer subjects.

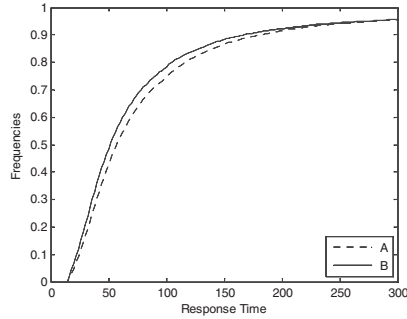### III.D.   Relying on the Other Player's Rationality (#3)

Relying on the other player's rationality is described in Figure IV. There is a common interest for the players to reach the outcome (A, A). However, player 1 will suffer a large loss if player 2 does not play the dominating action and thus playing A is based on the belief that the other player will play rationally. Among 13,524 subjects, the 60% who chose option A had a higher MRT than those who chose the play-it-safe option B (56 s versus 51 s).

III.E.   Successive Elimination (#4)

This game is described in Figure V. Only 27% of the 13,399 subjects chose B, the survivor of the successive elimination of dominated strategies, and their MRT is extremely high (153 s). The actions C and D have the potential to yield relatively high payoffs, and thus they attract the attention of subjects. The MRT

$n = 13{,}524$	Percent	MRT
A	60	56 s
B	40	51 s

MRT = 54 s
Fast: B
Slow: A

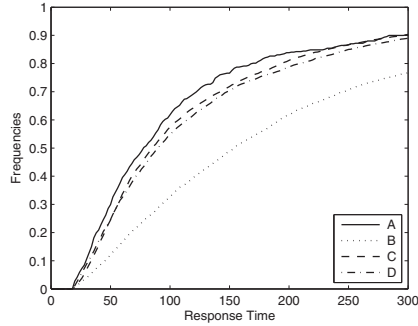You are player 1 in a two-person game with the following monetary payoff matrix:

Player 2

		A	B
Player 1	A	5,5	-100,4
	B	0,1	0,0

What will you play?

FIGURE IV

Relying on the Rationality of the Other Player

n = 13,399	Percent	MRT
A	4	77 s
B	27	153 s
C	39	85 s
D	30	89 s

MRT = 99 s
Fast: A,C,D
Slow: B

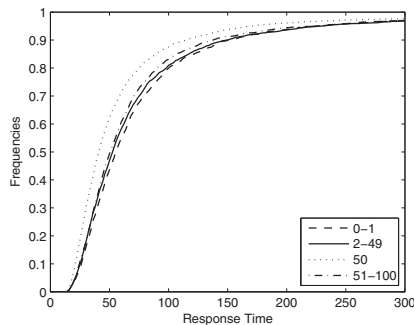You are player 1 in a two-person game with the following payoff matrix:

Player 2

Player 1		A	B	C	D
	A	5,2	2,6	1,4	0,4
	B	0,0	3,2	2,1	1,1
	C	7,0	2,2	1,5	5,1
	D	9,5	1,3	0,2	4,8

What will you play?

FIGURE V

Successive Elimination

n = 13,957	Percent	MRT
0–1	11	55 s
2–39	13	53 s
40–49	9	50 s
50	49	40 s
51–60	10	52 s
61–100	7	47 s

MRT = 46 s
Fast: 50
Slow: the rest

Imagine that you and another person (who you do not know) are to share $100. You must make an offer as to how to split the $100 between the two of you and he must either accept or reject your offer. In the case that he rejects the offer, neither of you will get anything. What will your offer be? I offer the following amount to the other person (and if he agrees I will get the remainder):

FIGURE VI

The Ultimatum Game

of those who chose C or D was below that of all subjects. The 4% of subjects who chose the action A (which is a mistake since it is dominated by C) have the lowest response time.

III.F. *The Ultimatum Game (#23)*

The ultimatum game is described in Figure VI. Of 13,957 subjects, 49% chose the equal division and their response time (40 s) was clearly the lowest. In fact, it is the only choice to make it into the fast group. The MRT of the 11% of subjects who chose 0 or 1 (the "victims of game theory") is much higher (55 s), as is the MRT of those who chose a number within the range 2–49. Interestingly, 17% of the subjects chose a number above 50 (which might be the result of a desire to be generous or the outcome of confusion between giving and taking).

III.G. *The One-Shot Chain Store Game (#28)*

Subjects were asked to play the role of the entrant in a variant of Selten (1978)'s one-shot chain store game (see Figure VII). The MRT of the 53% of subjects who chose the safe "no entry" action (68 s) was dramatically lower than that of the 47% of subjects who chose the risky "Entry" action (84 s).

$n = 7,148$	Percent	MRT
Enter	47	84 s
Not	53	68 s

MRT = 75 s
Fast: Not to enter
Slow: Enter
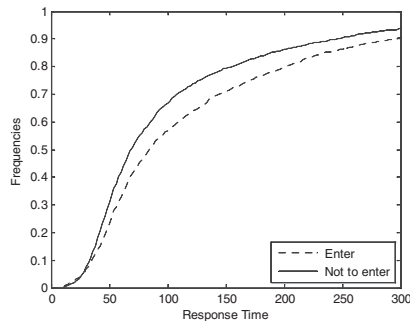
In your neighborhood, there is one grocery store and one tailor. At the moment, the profits of the grocery store owner are around $10K per month while the tailor's profits are only $4K per month. The tailor asks your advice about whether to change his shop into a grocery store. He figures that if the grocer does not respond aggressively to the new competition, each of them will earn about $6K per month. On the other hand, if the grocer does respond aggressively and starts a price war, then the earnings of each store will be reduced to about $2K per month. What is your advice to the tailor?

FIGURE VII

The One-Shot Chain Store Game

III.H.   The Centipede Game (#33)

Subjects were asked to play the role of the leading player in Rosenthal (1981)'s Centipede Game with 100 turns, presented as a strategic game (namely, a player has to choose the turn in which he intends to stop the game; the number 101 stands for "never stop") (see Figure VIII). The slow group chose the actions in the range 96–100 (probably reflecting k-level reasoning) or the Nash equilibrium choice of 1. The fast group chose to never stop the game (58% of the 7,111 subjects) or one of the seemingly random choices in the range of 2–95 (10%).

III.I.   The Stop or Pass Game (#34)

In this game, each of 20 players in turn can either stop the game and receive $10, in which case the others get nothing, or pass. If all 20 players pass, each receives $11. Subjects were asked to imagine that they are the player who starts the game (see Figure IX). Among 6,267 subjects, the safe action of "Stop" was the most popular and had the lowest MRT.

III.J.   The Traveler's Dilemma (#53)

In this version of Basu (1994)'s Traveler's Dilemma game, players announce a demand in the range of 180–300. If one player asks for a strictly lower amount than the other, he receives an additional $5 at the expense of the other player (see Figure X). The slow group chose within the range of 295–299 (16%), which is usually interpreted as the range of outcomes of k-level reasoning, or the Nash equilibrium choice of 180 (21%). The prominent choice in the fast group was 300, which attracted 44% of the subjects.

IV. Instinctive and Contemplative Actions

The choices in each problem (game) were classified into two categories: fast and slow. The dividing line was the MRT of all the subjects who responded to the problem. All actions for which the MRT of its choosers was below the dividing line went to the fast group and any other action went to the slow group. Note that the criterion is totally objective. (The only sense in which my personal judgment entered in was in the three games in which the number

| n = 7,111	Percent	MRT
1	11	167 s
2–95	10	108 s
96–98	2	209 s
99	9	174 s
100	10	167 s
101	58	139 s
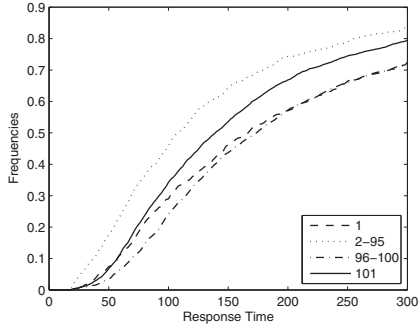
MRT: 145 s
Fast: 2–95, 101
Slow: 1, 96–100

You are playing the following "game" with an anonymous person. Each of the players has an "account" with an initial balance of $0. At each stage, one of the players (in alternating order—you start) has the right to stop the game. If it is your turn to stop the game and you choose not to, your account is debited by $1 and your opponent's is credited by $3. Each time your opponent has the opportunity to stop the game and chooses not to, your account is credited by $3 and his is debited by $1. The game lasts for 200 stages. If both players choose not to stop the game for 100 turns, the game ends and each player receives the balance in his account (which is $200; check this in order to verify that you understand the game). At which turn (between 1 and 100) do you plan to stop the game? (If you plan not to stop the game at any point, write 101).

FIGURE VIII

The Centipede Game

n = 6,267	Percent	MRT
Stop	61	44 s
Pass	39	49 s
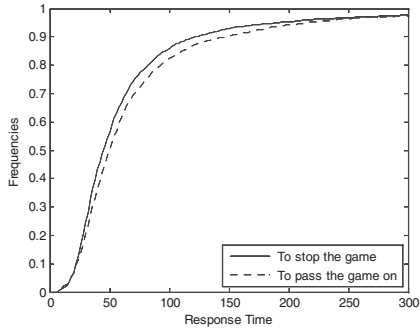
MRT: 46 s
Fast: Stop
Slow: Pass

You are player number 1 among a group of 20 players participating in a 20-stage game. At stage t, player t has to decide whether to stop the game or pass the game on to player t+1. If he stops the game, he receives $10 while all other players receive nothing. If none of the 20 players stop the game, then they all receive $11 each. Your choice is:
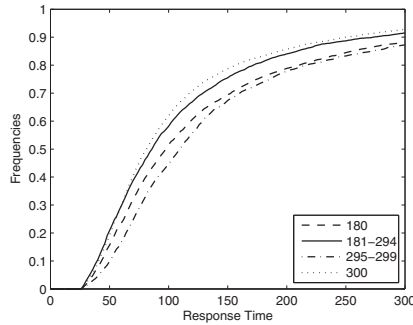
FIGURE IX

The Stop or Pass Game

n = 15,215	Percent	MRT
180	21	97 s
181–294	19	85 s
295	5	116 s
296–298	3	118 s
299	8	102 s
300	44	81 s

MRT = 88 s
Fast: 300, 181–294
Slow: 180, 295–299

Imagine you are one of the players in the following two-player game. Each of the players chooses an amount between \$180 and \$300. Both players receive the lower amount. Five dollars are transferred from the player who chose the larger amount to the player who chose the smaller one. In the case that the same amount is chosen by both players, each receives that amount and no transfer is made. What amount would you choose?

FIGURE X

The Traveler's Dilemma

of strategies was more than 100, which was too large to relate to each action separately.)

We could continue the discussion without giving the fast and slow categories any further interpretation. However, economics is about interpretation, and there seem to be some attractive features common to the actions in each category. The actions of the fast group seem to be more instinctive, whereas those of the slow group seem to be more contemplative. By "instinctive" we mean that the subject follows a gut feeling without applying any strategic analysis. By "contemplative," we mean that the subject analyzes the strategic aspects of the game and bases his choice on what he expects the other players will do.

I don't pretend to be able to provide a theory to explain what makes an action instinctive or contemplative. There are various intuitive explanations for the classification that depend on the particular game. For example, in the ultimatum game (Section III.F) the instinctive action is identified as 50, since it is associated with an action that is associated with salience and appeals to a sense of fairness. In the zero-sum game (Section III.A), the

instinctive action is the one with the highest payoff. High payoffs also attract subjects to the instinctive actions of C and D in the successive elimination game (Section III.E). In "relying on the other player's rationality" (Section III.D) and "stop or pass" (Section III.I), the instinctive actions are associated with avoiding a very low payoff. In the traveler's dilemma (Section III.J), the instinctive choice of 300 seems to reflect level-0 reasoning. In contrast and as explained in Section III, contemplative actions seem to be a best response based on a reasonable belief about what the other player will do.

As mentioned, the choice of games in this collection was not arbitrary. These were games in which some actions seem intuitively to be more instinctive than the others. However, my personal intuition is not essential to the analysis (since the classification is based solely on an objective criterion) and is used only to suggest that the fast group makes instinctive decisions and the slow group makes contemplative ones. To provide support for my interpretation of the classes of actions in each game, the following mini-experiment was carried out (at the suggestion of Ayala Arad and the journal's referees).

Seventeen graduate students in economics at Tel Aviv University were recruited (and paid a flat fee of about $12). All were familiar with basic game theory concepts and had not been exposed to my previous work on the subject. They were approached in small groups of between two and five and participated in a session that lasted about 45 minutes. Each rater received a booklet containing the games discussed in Section III, each on a separate page. The various strategies in the game were presented below the game's description in two groups (fast and slow) without attaching any labels to the groups and in a random order. Raters were asked to circle the group which, in their opinion, contains the more instinctive actions (which were defined in the instructions as "intuitive, immediate, an outcome of activating gut feeling and not of deliberation and activation of cognitive power"). Raters were told that if in their opinion there is only one instinctive action, they should circle the group in which it appears. At the end of each session, the raters discussed their answers with me in order for me to understand whether there were cases in which they had difficulty deciding. Table I summarizes the results.

In 7 of the 10 games, the judgment of the overwhelming majority of the raters assigned the term "instinctive" to the "fast"

TABLE I

THE RATERS' AGREEMENT RATES

Section	The Game	Instinctive Actions	Contemplative Actions	Agreement Rate
III.A	Zero-sum game	T	B	16:1
III.B	Hoteling	1, 4, 7	2, 3, 5, 6	13:4
III.C	Two contests	Coin	Die	15:2
III.D	Relying on other's rationality	A	B	8:9
III.E	Successive elimination	A, C, D	B	15:2
III.F	Ultimatum	50	Other	13:4
III.G	One-shot chain store	Don't change	Change	11:5
III.H	Centipede	2–95, 101	1, 96–100	9:8
III.I	Stop or pass	Stop	Pass	13:4
III.J	Traveler's dilemma	181–294, 300	180, 295–299	10:7

group (namely, the set of strategies with RT below the MRT of the entire population of responders). In the other three cases, the raters were split evenly in their judgments. Furthermore, in the discussion following the experiment, it appears that in those three cases some raters considered actions that are the outcome of "simple strategic reasoning" to be instinctive as well. For example, in relying on the other player's rationality, some raters felt it was obvious that action B is dominated for the other player and thus classified action A as instinctive for the row player. In the centipede game and the traveler's dilemma, some raters felt it is instinctive to stop the game a bit before the end and to ask for a little bit less than the upper limit of 300.

Thus, overall the raters' judgments supported labeling the categories as instinctive or contemplative.

V. A NEW TYPOLOGY: ON THE SPECTRUM BETWEEN INSTINCTIVE AND CONTEMPLATIVE

We reach the core idea of the article—a proposed new typology of players. The typology is relevant in games, like those discussed in Section III, where an intuitive distinction is possible between actions chosen on the basis of contemplative considerations and those that are the outcome of instinctive reasoning. The player's type is determined according to his tendency to choose a contemplative action. In a formal model, an agent

would be characterized by the probability of him choosing a contemplative action whenever he makes a decision.

A major merit of the typology is its resemblance to the way we tend to classify people in real life. It is often said of a person that "his decisions are based on emotions" or that he "his behavior demonstrates thoroughness." Such statements are based on the individual's observed behavior, rather than the nature of his deliberation process. Even if one could make better predictions of behavior based on some other kind of information about a subject (and I bet one would find measures with better predictive power sooner or later), the typology suggested here will still likely provide added value.

Note that according to this suggestion a player's type specifies only the probability that he will choose a particular type of action (i.e., instinctive or contemplative) rather than predicting with certainty which action he will choose. This is in line with Arad and Rubinstein (2012) who found a correlation between the behavior of a player in the Colonel Blotto game and his behavior in the 11–20 money request game only after the strategies were grouped together according to the k-level reasoning so that all level-1-2-3 strategies were put together rather than the level of the strategies. In a sense, this is also consistent with the position taken by psychologists who argue that a basic criterion for explaining behavior in decision situations is the extent to which an individual uses System 2 reasoning (see Stanovich and West 2000).

A comment on the concept of type: A "type" is a category of individuals with common characteristics. In both the theoretical and experimental literature, these common characteristics constitute a mode of behavior that is often described using a distinct preference relation or a deterministic procedure of choice. Thus, for example, an agent is type 1 in the k-level literature if he always maximizes his expected payoff as a best response to what he perceives as level-0 behavior. The "crazy" type in the repeated chain store paradox game is an individual who seeks confrontation and does so in all circumstances. The impatient type in bargaining is an individual who uses a low discount factor.

In contrast, consider, for example, the way we classify people as "good" or "bad" in real life. In fairy tales, a good person is always good and a bad person is always bad. In life, a good person does not always choose a good action and an evil person does not always choose an evil action. A good person is one who chooses a good deed significantly more often than an evil person

does and vice versa. Accordingly, a type in this article is some range on the spectrum between instinctive and contemplative, rather than being located only at one of its endpoints.

Other typologies come to mind, and in Section VIII I discuss one of them. A referee suggested a typology based on the distinction between random and contemplative players. Such a typology is very different from the one suggested here since behavior, which is noncontemplative is often not random (for example, the very popular choice of 50 in the ultimatum game is clearly not random). Also in real life, we often use different typologies simultaneously in the same context, believing (rightly or wrongly) that each has some predictive power.

As mentioned in the introduction, I take the position that the importance of a typology in the social sciences is due not just to its predictive power but also to its ability to capture the intuitive classifications we often use. I am not attempting to arrive at the best measure to which to fit the data but to suggest a typology that seems to reflect appealing classifications.

VI. Testing the New Typology

Given a set of games and the contemplative/instinctive classification of strategies for each game, a subject's type is estimated by his contemplative index (CI), which is defined as the proportion of games in which he has chosen a contemplative action. A CI of 1 means that he has always chosen a contemplative action and a CI of 0 means that he has always chosen an instinctive strategy. One possible improvement of the measure would be to weight an action by the degree to which it is contemplative rather than classifying it as either contemplative and instinctive in a binary manner.

The typology is tested using the results for the 10 games described in Section III. Only subjects who played at least 7 of the 10 games are included. For each game, the CI of each subject is calculated on the basis of the results for the other nine (or less) games he played. Ideally, the correlation would be calculated between CI and the probability that the player will play contemplatively in the 10th game. However, each player is observed playing any single game only once, and thus this probability can only be estimated using the frequency with which contemplative actions are chosen by subjects with similar CI.

Figure XI presents 10 graphs, each containing 10 points. The diamonds above the point $x + 0.05$ on the horizontal axis indicate the proportion of subjects whose CI is between x and $x + 0.1$ and who chose a contemplative action. The bars indicate the proportion of subjects whose CI is within this range. To emphasize the relationship, each of the graphs includes a linear regression line for the 10 points where each point is weighted by the proportion of subjects in the corresponding range. Also reported are the results of a logistic regression to estimate the coefficients, *p*-values, and odds ratio. In the regression, the CI for each subject is used as a predictor variable with 0 or 1 as the dependent variable, where 1 indicates that he played contemplatively and 0 otherwise. Incidentally, the odds ratios calculated from the
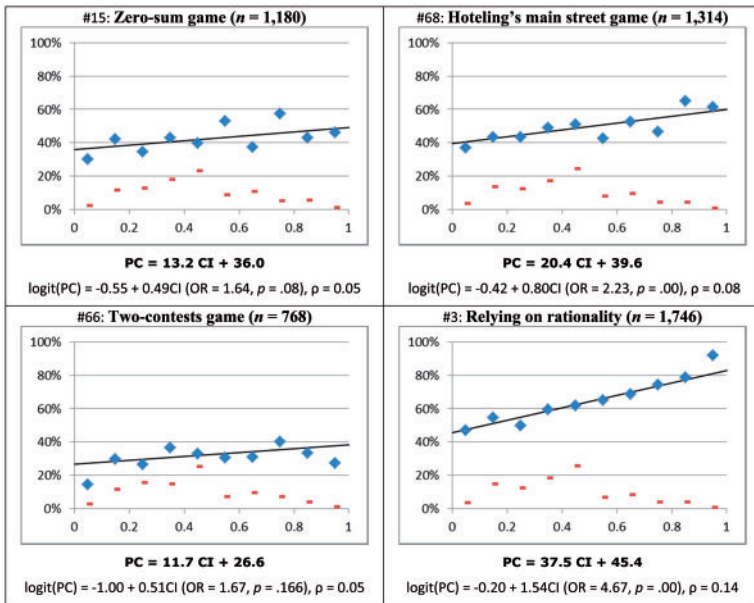
FIGURE XI

The Proportion of Contemplative Choices (PC) as a Function of the Contemplative Index (CI) in the Basic Set of Games.

The diamonds above $x + 0.05$ on the horizontal axis indicate the proportion of subjects whose CI is between x and $x + 0.1$ and who chose a contemplative action. The bars indicate the proportion of subjects whose CI is within this range. OR = odds ratio, ρ = Spearman correlation.
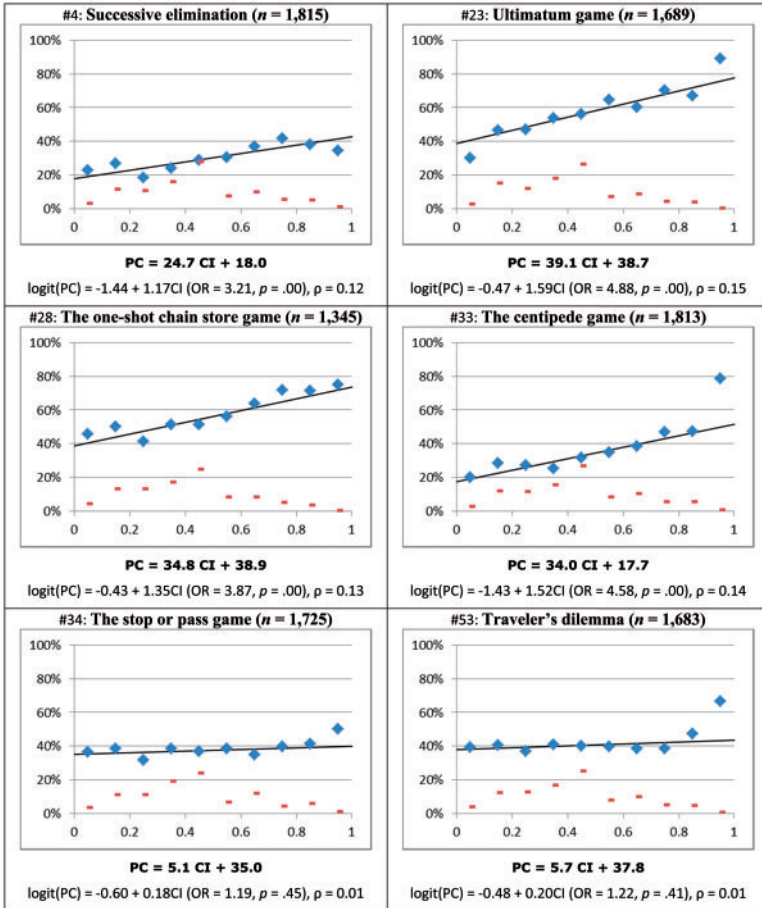
FIGURE XI

Continued

logistic regression are very close to those calculated from the above weighted linear approximation (i.e., given the regression line PC = a + bCI, the odds ratio is the ratio between $\frac{(a+b)}{(1-a-b)}$ and $\frac{a}{(1-a)}$).

That CI has some predictive power is quite clear from the graphs, although in two of the games (the stop or pass game and the traveler's dilemma), the correlation between CI and the proportion of contemplative choices is not significant. In these two games, the Spearman correlation (denoted by ρ) is very low

(a little over 1%). In all of the other eight games, the Spearman correlation is in the range of 5–15%.

VII. APPLYING THE TYPOLOGY TO ADDITIONAL GAMES

This section discusses five additional games that were not included in the basic set and in which it is unclear (at least to me) which is the more instinctive response. The CI, calculated on the basis of the 10 basic games, is used to provide an interpretation of the actions in these games.

VII.A. *Responders in the Ultimatum Game (#25 and #86)*

Subjects were asked to play the ultimatum game in the role of responder. They were randomly assigned to respond to an offer of either $10 or $5 (out of $100) (see Figure XII).
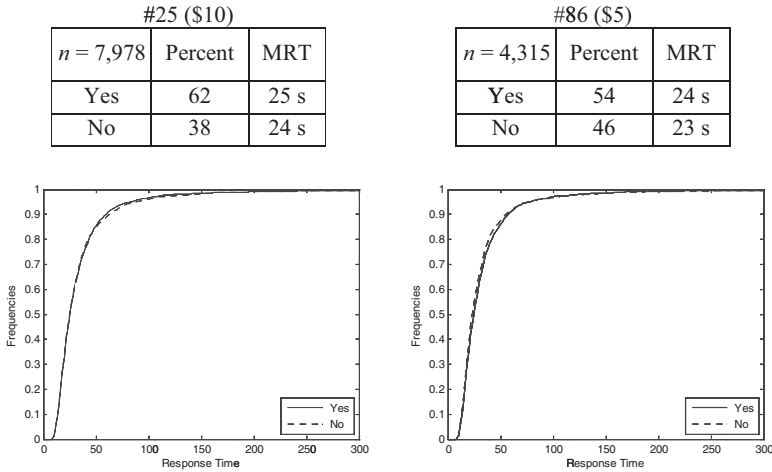
About 62% of the 7,978 subjects who received an offer of $10 said that they would accept such an offer, whereas 54% of 4,315 subjects who received an offer of $5 said that they would accept such an offer. In both cases, there is no difference between the RT cdfs of those who accepted the offer and those who rejected it. Thus, the response time results are unable to provide an indication of whether acceptance or rejection is the more instinctive choice.

Nevertheless, the graphs in Figure XI do show that CI is correlated with the rate of acceptance. The Spearman correlation between the CI and accepting the offer of $10 is 0.17 and between the CI and accepting the offer of $5 is 0.093. The acceptance rate for the offer of $10 is 49% for CI up to 0.4 as compared with 68% for CI above 0.4. Similarly, the acceptance rate for the offer of $5 is 47% among the subjects with CI of up to 0.4 and 59% for CI of greater than 0.4 (see Figure XIII).

VII.B. *The Contribution Game (#79)*

This is a standard five-player contribution game (see Ockenfeks and Weimann 1999). Each player decides how to allocate 10 tokens between a private fund (where a token is worth $4 to the player himself and nothing to the others) and a public fund (where a token is worth $2 to each of the five players) (see Figure XIV).

"No contribution to the public fund" is the most popular choice (38% of 8,531 subjects). The response time of the 15%

#25 ($10)

n = 7,978	Percent	MRT
Yes	62	25 s
No	38	24 s

#86 ($5)

n = 4,315	Percent	MRT
Yes	54	24 s
No	46	23 s

You and someone you do not know are to share $100. He makes you an offer and you can either accept it or reject it. If you reject it, neither of you will get anything.
#25: He offers you $10 (if you accept, he will get $90).
#86: He offers you $5 (if you accept, he will get $95).
Do you accept the offer?

FIGURE XII

Ultimatum Game: A Responder

who contributed all their tokens to the public fund is exceptionally high. The middle option ($5 to the public fund) attracts a sizable proportion of the subjects (13%) and as expected its MRT is the lowest.

The correlation between CI and the choices made in the game reveals that CI seems to be correlated with the proportion of subjects who chose an extreme value (either 0 or 10). The Spearman correlation between the CI and taking a decisive action is 0.13 (see Figure XV). In other words, having a higher CI makes it more likely that the subject will choose one of the two extreme alternatives. Thus, players who are more contemplative appear to be more decisive, one way or the other, about whether to contribute.

VII.C. The Trust Game (#133)

In this version of the trust game (Berg, Dickhaut, and McCabe 1995), player A can transfer up to $10 to player B. The amount transferred is then tripled, and player B then decides
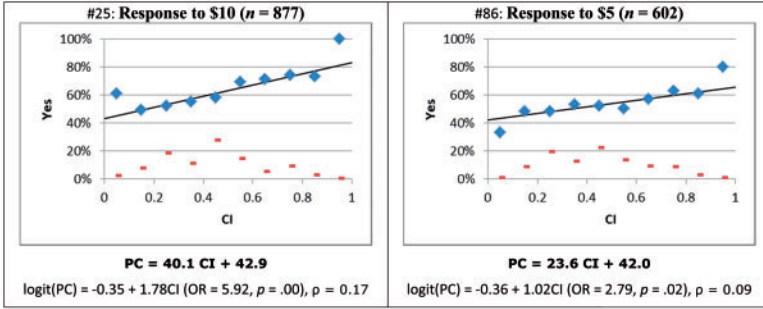
FIGURE XIII

The Ultimatum Game (Responder): The Rate of Acceptance as a Function of CI

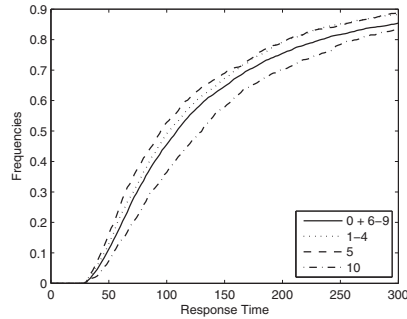| $n = 8{,}531$	Percent	MRT
0	38	108 s
1–4	27	101 s
5	13	94 s
6–9	8	109 s
10	15	130 s

You are participating in a game with four other players. In the game, each player gets 10 tokens. You have to decide how to allocate the 10 tokens between two different funds: (1) Your personal fund: for each token you invest in your personal fund, you (and only you) will receive $4. (2) The group fund: for each token any player invests in the group fund, each of the five players receives $2 (regardless of how much they themselvees invested in this fund). Your decision is how to divide the 10 tokens between the 2 funds. You may mix up the investment of your 10 tokens in any way you wish.

I allocate the following amount of tokens to the group fund:

FIGURE XIV

The Contribution Game

how much to give back to player A. Subjects were asked to play the game in the role of player A (see Figure XVI).

Once again, the middle choice ($5) is quite popular (18% of the 6,879 subjects) and the MRT of those subjects who chose it is the lowest (81 s). The MRT of those who chose to transfer less than $5 (59% of the subjects) is much higher than for those who transferred more than $5 (97 s versus 83 s). Thus, thinking about a choice for a longer time apparently makes the subject less trustful.
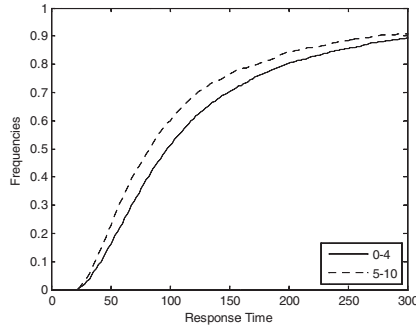
#79: **The contribution game (*n* = 1,165)**
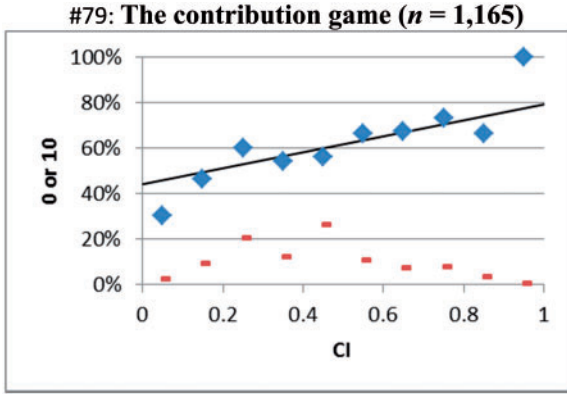
PC = 35.3 CI + 43.8

logit(PC) = -0.28 + 1.49CI (OR = 4.42, *p* = .00), ρ = 0.13

FIGURE XV

The Contribution Game: The Proportion of the Choice 0 or 10 as a
Function of CI

n = 6,879	Percent	MRT
0	28	96 s
1	13	107 s
2–4	18	93 s
5	18	81 s
6–9	9	84 s
10	13	83 s

Player A is given \$10 and must decide how much to transfer to Player B (\$x) and how much to keep (\$10-x).
The two players don't know one another and will not meet. After Player A has made his decision, Player B is
informed of x. The amount x is then tripled, and Player B must decide how much (out of 3x) to keep and how
much to give to Player A. The amount Player B gives willl be added to what Player A kept to himself from the
original \$10. If you were Player A, how much of the \$10 would you give to Player B?

FIGURE XVI

The Trust Game

The CI analysis yields even stronger results (see
Figure XVII). Transferring at least \$5 becomes less popular
as CI increases (negative Spearman correlation of 0.082)
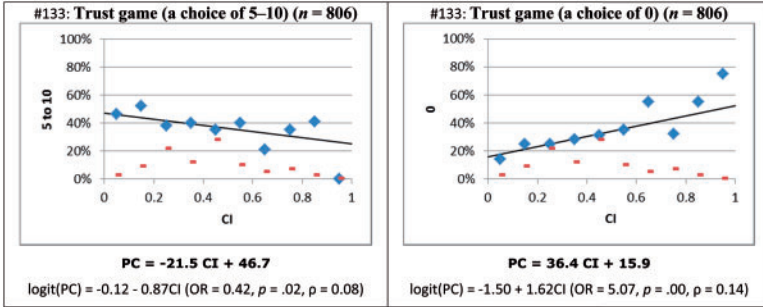and the proportion of subjects who express complete mistrust

FIGURE XVII

The Trust Game: The Proportion of Subjects Who Chose 5–10 and 0 as a
Function of CI

(transferring 0) increases with CI (Spearman correlation of
0.137).

VII.D. *Chicken (#77)*

Chicken is a clear example of a game with no discernible
correlations between behavior and either response time or CI.
The game was presented to subjects as a 2×2 matrix game, with-
out any background story. The population of 8,837 subjects was
split evenly between the two actions (see Figure XVIII). The
RT cdfs are very similar, and CI is not correlated with the
choices made in the game (Spearman correlation of 0.004)
(see Figure XIX).

VIII. THE G-TYPOLOGY

Rubinstein (2013) proposed an alternative typology of choices
that will be referred to as the G-topology to distinguish it from the
typology discussed here, which will be referred to in this section
as the C-typology. The G-typology classifies people as fast or slow
independently of the content of their actions. It is appropriate in
contexts where we are unable to observe their choices and, even if
we were able to observe them, are unable to determine whether
they are consistent with the agent's goals. The G-typology corre-
sponds to statements like "He is a hasty decision maker" or "He
deliberates for a long time before making a decision." In contrast,
the C-typology presented earlier is appropriate in a context where
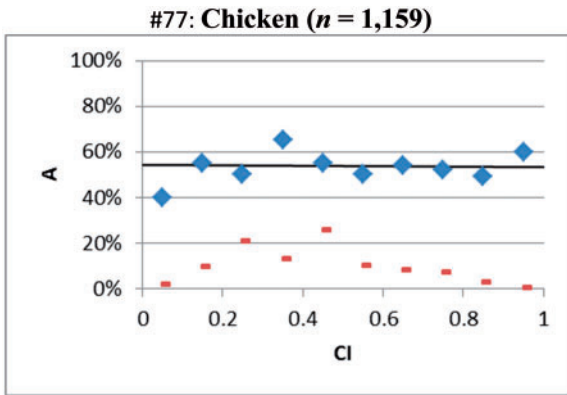
$n = 8,837$	Percent	MRT
A	51	51 s
B	49	48 s
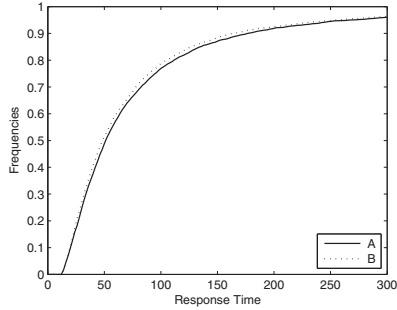
You are player 1 in a two-person game with the following monetary payoff matrix:

| | | Player 2 | |
		A	B
Player 1	A	3,3	2,4
	B	4,2	1,1

What will you play?

FIGURE XVIII

#77: **Chicken ($n = 1,159$)**

PC = -1.0 CI + 54.5

logit(PC) = 0.17 + -0.01CI (OR = 0.99, $p = .98$, $\rho = 0.004$)

FIGURE XIX

The Chicken Game: Proportion of Subjects Who Chose A as a Function as CI

we know the nature of an agent's choices. For example, consider a bright individual who is also a very quick thinker. The G-typology might classify him as fast although he consistently chooses actions that are considered contemplative, while the C-typology would correct for this problem. Alternatively, consider an individual who bases his decisions on gut feelings but is slow to make them. He might be classified as contemplative according to the G-typology although his choices are instinctive. Again, the C-typology is able to correct for this kind of "mistake" in classifying decision makers.

Here is how the G-typology is estimated. A subject's "local rank" is defined as the proportion of subjects who answered the problem faster than he did, whereas his "global index" (GI) is the median of his local rankings in the games he has played. As in the calculation of CI, GI is calculated using the data for subjects who "played" at least 7 of the 10 basic games. For each game, a subject's GI is calculated on the basis of his RT in the other games. Figure XX illustrates the connection between GI and the tendency to choose contemplative actions. Each graph presents one of the 10 games and each diamond-shaped point corresponds to a GI decile. Thus, the kth point relates to the subjects in the kth decile (from the bottom) and indicates the proportion of subjects in the decile who chose a contemplative action.

Overall, the positive relationship between GI and contemplative behavior is evident from the graphs. Judging by the Spearman correlations, the CI is probably a somewhat better predictor of a contemplative action than the GI (the average correlation is 7% for GI as compared to 9% for CI).

IX. Final Comments

A novel typology is used to classify players in games in which a distinction can be made between instinctive and contemplative strategies. Response time data was used to establish the partition of actions into contemplative (long response time) and instinctive (short response time). The typology characterizes a player according to his tendency to choose contemplative actions (as opposed to instinctive ones). According to this typology, one agent is more contemplative than another if he tends to choose contemplative actions more often.
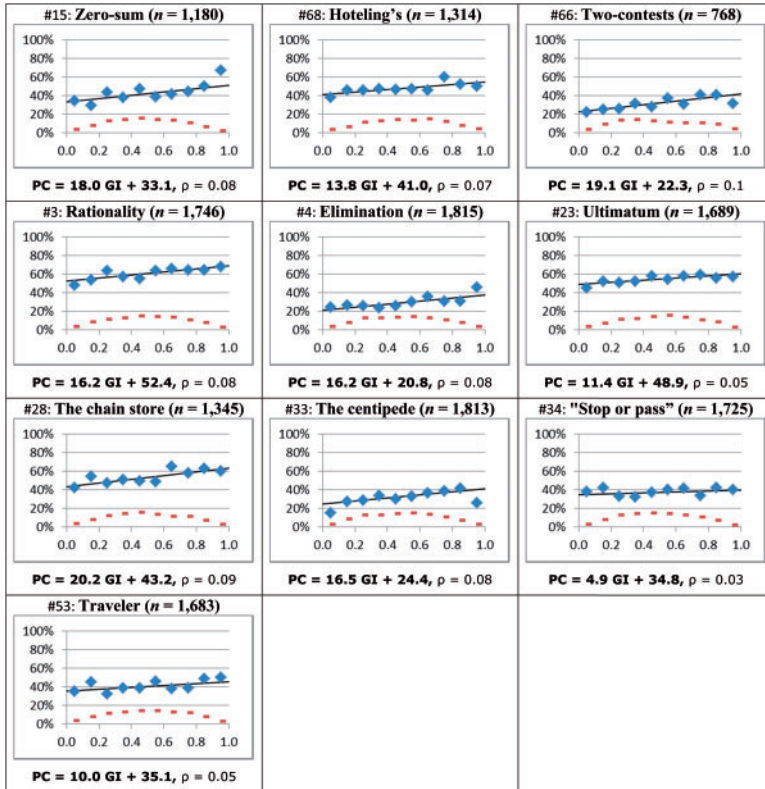
FIGURE XX

The Proportion of Contemplative Choices as a Function of GI in the Basic 10 Games

The kth diamond-shaped point represents the subjects in the kth decile (from the bottom) and indicates the median GI in the corresponding decile and the proportion of subjects in the decile who chose a contemplative action.

My goal is to introduce a typology that resembles the way we classify individuals into types in real life. Based on observed behavior, and given our perception of instinctive versus contemplative actions, we often classify a person as either instinctive or contemplative. The suggested typology is meant to capture this intuitively appealing classification and not necessarily to achieve the "highest" predictive power. The experimental data is brought mainly to show that the suggested typology has some predictive power and that on average the correlations between the CI and a

contemplative action are of a higher order than those observed between contemplative actions in two different games.

Some readers of the article were curious as to whether highly contemplative types are more successful at playing games. In the four games in which the observed expected payoff can be calculated, the optimal strategies are indeed contemplative although when there are more than two actions to choose from not all contemplative actions do better than all instinctive actions. In the zero-sum game (Section III.A), the experiment was also carried out for the role of the column player, and in that case 85% of the subjects chose R and therefore the contemplative action B is clearly the best choice. In the coin and die contests game (Section III.C), the die choice is indeed the wise one. In the three-player Hoteling Game (Section III.B), the vector of expected payoffs is (1.66, 2.13, 2.43, 2.39, 2.44, 2.13, 1.65) and the contemplative actions 3 and 5 are indeed the best choices; however, the instinctive choice of 4 is more profitable than positions 2 and 6. In the traveler's dilemma (Section III.J), the contemplative action of 299 yields the highest expected payoff, but the other contemplative actions are not as profitable as the instinctive action of 300, not to mention the Nash equilibrium action of 180 which yields a disaster.

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