The focal point in the Traveller's Dilemma: An Experimental Study

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The focal point in the Traveller's Dilemma:

An Experimental Study[♣]

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Abstract: This paper provides an experimental test of the traveller's dilemma. Our investigation aims to address the research hypothesis that introducing a reference point *à la* Schelling (set equal to the Pareto optimal solution) might drive people away from rationality even when the size of the penalty/reward is high. Experimental findings reported in this paper provide answers to this question showing that the reference point did not encourage coordination around the Pareto optimal choice.

Keywords: traveller's dilemma, focal point, individual decision

JEL codes: C91, C92, D81, D70

♣ The experiment was conducted at the ESSE laboratory at the University of Bari and financed by the same University. The paper was written up while Piergiuseppe Morone was visiting the University of Castellón, for whose hospitality he is grateful.

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1. Introduction

There is an abundant literature relating to the traveller's dilemma (henceforth TD) (Basu, 1994). This game, together with the p-beauty contest game (Keynes, 1936; Moulin, 1986; Nagel, 1995) is often used to demonstrate the tension between clear-cut game-theoretic analysis based on serial inductive thinking and the vagaries of actual behaviour.

Interest in the TD is related to the fact that the optimal strategy depends on what the other player is expected to do. It is interesting since the unique game-theoretic prediction for both players' payoff is much worse than their cooperative behaviour payoff.

Basu (1994) proposed a nice and simple story:[1] two travellers spend their holiday on a tropical island, where they purchase identical and expensive items; on the return trip the airline loses their luggage containing the purchased items. In order to reimburse the two travellers for their loss, the airline representative asks each traveller separately to fill out a claim, with the understanding that claims must be at least x and no greater than X (with $x < X$). Claims will be fully reimbursed if they are equal. But if they are different, both travellers will receive the lower claim. Additionally, the lower claimant will receive a small reward, and the higher claimant will incur a small penalty deducted from the reimbursement. Obviously, each person has an incentive to "undercut" the other, so no common claim above x can constitute a Nash equilibrium.

Basu proposed this game in order to demonstrate the conflict between intuition and game-theoretic reasoning in a one-shot game, where backward induction occurs at an introspective level. As it seems, game theoretic reasoning gives a clear-cut answer to what should be expected in the TD. However, "all intuitions seem to militate against all formal reasoning in the traveller's dilemma. Hence the traveller's dilemma seems to be one of the purest embodiments of the paradox of rationality in game theory because it eschews all unnecessary features, like play over time or the nonstrictness of the equilibrium" (Basu, 1994: 391).

Many authors tested through laboratory experiments the TD theoretical predictions, consistently finding that behaviour conforms closely to the Nash equilibrium when the penalty/reward is high, and when the penalty/reward parameter approaches 0, subjects' behaviour steers towards the Pareto optimal solution where both travellers claim X (e.g. Capra et al. 1999, Brañas-Garza et al. 2011, Morone et al. 2014). What we aim to do in this paper is to investigate how the introduction of a clear reference point *à la* Schelling[2] might affect subjects' behaviour

[1] The story was first told by Basu at the American Economic Association annual conference in January 1994, and subsequently published in the Association Journal.

[2] A reference (or focal) point (also called Schelling's point) is a solution that people will tend to use in the absence of communication, because it seems natural, special or relevant to them. Schelling himself illustrated this concept with the

under different penalty/rewards size; an issue that, to the best of our knowledge, has never been addressed within a TD framework. This question relates to existing evidence showing that the presence of a reference point may play a role in similar games, such as beauty contest (see for instance Morone and Morone 2008 and 2010).

Specifically, we want to test the research hypothesis that introducing a reference point *à la* Schelling (set equal to the Pareto optimal solution) might drive people away from rationality even when the size of the penalty/reward is high.

The relevance of this research hypothesis stem from the observation that the TD game typically conducted in the laboratory differs from Basu's story since it omits to mention the actual value of the lost items (an information known to the travellers in the original story). We believe the items' value represents a reference point *à la* Schelling, i.e. a solution that people might tend to use in the absence of communication, because it seems natural, special or relevant to them. Hence, introducing a reference point should help integrating experimental results with the travellers' original story and might encourage coordination around the Pareto optimal choice even with a high penalty/reward. If this would not be the case, we will then have a further confirmation of earlier findings - i.e. that a small penalty/reward lead to a Pareto optimal solution whereas larger penalty/reward results lead to the Nash equilibrium.

In the following section we briefly review the literature on experimental tests of the TD as well as on the reference point *à la* Schelling. Experimental design is discussed in section 3. Section 4 presents our results and section 5 concludes.

2. Literature review

Whenever the TD game has been tested in the lab, experiments confirmed the intuition that claims may be higher than the Nash equilibrium, which predicts the lowest possible claim no matter how small the penalty/reward is. Capra et al. (1999), for instance, ran a repeated TD experiment, and showed that the size of the penalty/reward matters. Specifically, the Nash equilibrium strategy solution proved to be a bad predictor of people's behaviour in a TD with small penalty/reward and a rather good predictor if the penalty/reward parameter was big.

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following problem. Tomorrow you have to meet a stranger in New York City. However there is no means of communication between you. So, where and when do you meet them? This is a coordination game where any place in the city at any time tomorrow is an equilibrium solution. Schelling asked a group of students this question and found the most common answer was "noon at (the information booth at) Grand Central Station." There is nothing that makes "Grand Central Station" a location with a higher payoff (you could just as easily meet someone at a bar, or in the public library reading room), but its tradition as a meeting place raises its salience, and therefore makes it a natural "focal point" (from *Wikipedia* - mildly edited).

Becker et al. (2005) proposed an experimental adjustment on the TD: testing it on participants who were experts in game theory. The fact that their results confirm the general findings, namely that the behaviour in experiments is far from the Nash equilibrium prediction, indicates that these findings should not be attributed to any lack of understanding of the game, but rather represent a robust pattern of behaviour.

Rubinstein (2006) reported on an unconventional experiment conducted during the years 2002 and 2003. He collected large amounts of data from audiences in a public lecture that he delivered at several universities. People who were invited to attend the lecture (mainly students and faculty) were asked to respond (on the website *gametheory.tau.ac.il*) to several questions before attending the lecture. The on-line questionnaire included one question that was a simplified version of the TD. As stated by the author, only 13% of respondents reported an answer in line with the game theoretical prediction. Moreover, on average, they would do poorly playing against a player chosen randomly from the respondents. As put by Rubinstein, "these players can claim to be the 'victims' of game theory" (2006: 875).

Chakravarty et al. 2010 conducted a laboratory experiment with pre-play communication, finding that pre-play communication does not help raise claims.

Finally, Basu et al. (2011) isolated deviations from the Nash behaviour caused by differences in welfare perceptions and strategic miscalculations. Their experimental findings suggest the dominance of the change in one's own reward/penalty over the change in the other player's reward/penalty. They also found that expected claims are inconsistent with actual claims in the asymmetric treatments. Moreover, focusing on reported strategies, they documented that changes in choices across treatments are, to a large extent, explained by risk aversion.

In spite the growing body of studies investigating the TD game in the lab, none of these experimental tests has ever dealt with the effect of introducing a reference point in the game, a task which we shall address in the reminder of this paper.

3. Experimental design

The experiment presented here was conducted at the ESSE laboratory of experimental economics at the University of Bari. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007). Participants were undergraduate students from different disciplines, enrolled at the University of Bari.

Students played a repeated TD game; in total, six experimental treatments were run, each involving 20 participants. Written instructions on the experiment were distributed prior to its commencement.[3] In all treatments, amounts were denoted by *ECU* (Experimental Currency Unit), where 100*ECU* = 1€. The average payoff was 9€ (including a participation fee of 3€)[4].

As mentioned, the experiment consists of six treatments, grouped into two blocks: *control* (T1, T2, and T3) and *reference* (T4, T5, T6). Each treatment was carried out once. In the first period of each control treatment (T1, T2 and T3), players were randomly paired and were allowed to interact for 10 periods in a 'partner design'. During each period subjects were asked to report a number between 40 and 200. If both subjects in a couple reported the same number, then their payoff would have been the reported number. If they reported different numbers, then they would get different payoffs. More precisely, the subject who reported the smallest figure received the minimum reported figure plus a reward, and the subject who reported the largest figure received the minimum reported figure minus a penalty. In T1 the reward/penalty was set equal to 2*ECU*; in T2 the reward/penalty was set equal to 25*ECU*; in T3 the reward/penalty was set equal to 40*ECU*.

Reference treatments (T4, T5 and T6) were identical to the control treatments, but in this case participants were selected in a more sophisticated way. In order to induce a reference point, we initially recruited 40 subjects and let them participate in a task completely unconnected[5] with the TD experiment. At the end of this task, half of the subjects earned 200*ECU* and the other half earned 40*ECU*. Subsequently, those players who earned 40*ECU* were paid and let go, whereas those 20 subjects that gained 200*ECU* were publicly informed that they gained 200*ECU* and sent to a different laboratory where they found two research assistants that conducted the second part of the experiment being unaware of how much money each subjects had gained in the previous task.[6] Now, these subjects, in order to get paid, were paired and asked to claim their payoff in the usual Basu's setup, i.e. knowing that if they claimed the same amount their payoff would have been the reported number; however, if they claimed different numbers they would get different payoffs (the claimed amount minus/plus a penalty/reward).[7]

In all treatments, decisions were referred to as "claims" and the earnings calculations were explained without reference to the context, (i.e. without mentioning the luggage travellers'

[3] An English translation of the Italian instructions for the experiment are reported in the appendix.
[4] Treatments in the group block and in the reference block lasted, on average 32 minutes; the control treatments lasted on average 13 minutes.
[5] They played a "mine" and the 20 subjects who completed the game first got 200 ECU, all the others 40 ECU.
[6] We decided to introduce a reference point in this way since, as well-established experimental literature shows (Guth and Ortman, 2006; Bosman and van Winden, 2002; Cherry et al., 2002; Bosman, et al., 2005), people behave, *ceteris paribus*, differently if their own earnings are at stake (effort experiment) than they would if a budget was provided to them like a sort of manna from heaven (no-effort experiment).
[7] The entire procedure was common knowledge.

scenario); hence, all treatments were designed to be context free. A summary of the structure of the experiment is reported in Table 1.

Table 1. Treatments' parameterisation

Penalty/Reward	***Treatments***	
	Control	***Reference***
2*ECU*	T1	T4
25*ECU*	T2	T5
40*ECU*	T3	T6

4. Results

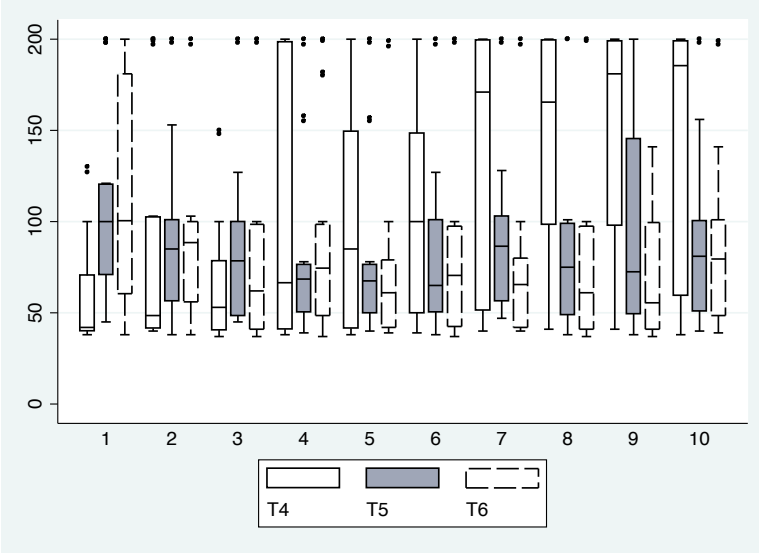
Results associated with the control treatments have already been published in a recent paper (Morone et al. 2014) showing that small penalty/reward lead to a Pareto optimal solution whereas larger penalty/reward results lead to the Nash equilibrium. This finding is in line with earlier results in the literature (Capra et al. 1999) and serve as a control against our hypothesis that a the introduction of a focal point *à la* Schelling might affect subjects' behaviour under different penalty/rewards size.

In order to address this hypothesis, we report in Figure 1 the period-by-period average claim for treatments 4, 5 and 6. As explained earlier, in these treatments all subjects earned a payoff of 200*ECU* in a previous task, and this is common knowledge to all subjects participating to the experiment (but it was unknown to the research assistants conducting the experiment in the second lab); as we believe, this provided them with a clear reference point, since they were asked to claim the pay-off earned in the first part of the experiment. The first-period median in T4 is 42, in T5 it is 100, and it is equal to 100.5 in T6.[8] Also in this case, these first-period group claims are systematically lower and statistically different (at the 1% significance level) from those observed in the first-period of the control treatments.

For the sake of clarity, we report a summary of the first-period claims across all six treatments in Table 2. Hence, contrary to our expectations, providing subjects with a reference point equal to the upper bound does not increase the number of subjects playing at (close to) the Pareto end of the spectrum. Apparently, in the first period of the game the reference point does not encourage coordination around the Pareto optimal choice, but rather it stimulates strategic behaviours, pushing individual choices towards the Nash equilibrium.

[8] Also in this case, we tested and found that deviations from the equilibrium in the first-period claims are not statistically different at the 1% significance level across T7, T8 and T9.

Figure 1: Period-by-period claims in treatments 4, 5 and 6



An overall look at the repeated game basically confirms our earlier findings. Figure 2 reports a two-by-two comparison of the six treatments. Specifically, each thin line connects the period-by-period median claim for treatments 1, 2 and 3; each thick line connects the period-by-period median claim for treatments 4, 5 and 6. Data are bounded by two horizontal dashed lines showing maximum and minimum claims. It can be seen that the reference session is (almost) always below the control session, suggesting that providing a reference point improves subject rationality rather then pushing them to play (closer to) the Pareto end of the spectrum.

Table 2. First-period median claims

Penalty/Reward	***Treatments***	
	Control	***Reference***
2*ECU* (T1 and T4)	99.5	42.0
25*ECU* (T2 and T5)	124.5	100.0
40*ECU* (T3 and T6)	118.5	100.5

In order to statistically corroborate these results we performed a random effect panel regression model with a random effect for each individual pooling together all six treatments. Specifically, we estimate the following model: $Y = \alpha + \beta_1 Period + \beta_2 D_{Treatment}(T2) + \beta_3 D_{Period}(T2) + \beta_4 D_{Treatment}(T3) + \beta_5 D_{Period}(T3) + \beta_6 D_{Treatment}(T4) + \beta_7 D_{Period}(T4) + \beta_8 D_{Treatment}(T5) + \beta_9 D_{Period}(T5) + \beta_{10} D_{Treatment}(T6) + \beta_{11} D_{Period}(T6),$ where *Period* is the trend (periods 1 to 10), $D_{Treatment}(T2)$ is the

Treatment 2 intercept dummy, $D_{Period}(T2)$ is the Treatment 2 slope dummy obtained by interacting the Treatment 2 intercept dummy with the trend. All other period and treatment dummies are constructed in the same way as $D_{Treatment}(T2)$ and $D_{Period}(T2)$ differing only for the treatment considered.

Figure 2. Median Claims for Control Session and Reference Session

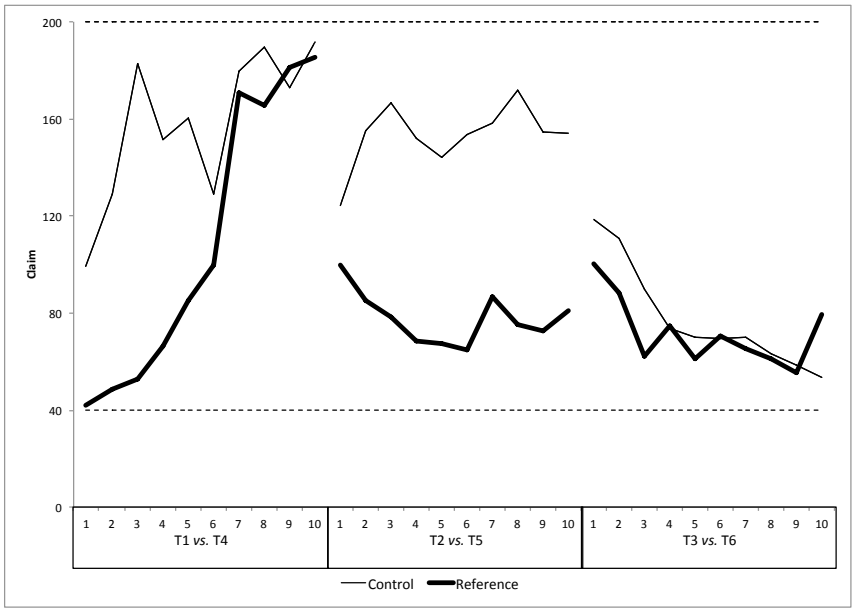


Table 3. Generalized linear mixed-effects regressions

Individual contributions on periods 1 to 10 in the reference treatments

Independent variable	**Coefficient**	**Std, Err,**	***z***	***P>|z|***
Constant	130.713	7.721	14.080	0.000
Period	3.833	1.092	4.470	0.000
$D_{Treatment}(T2)$	0.364	8.241	0.040	0.965
$D_{Period}(T2)$	-2.186	1.544	-1.420	0.157
$D_{Treatment}(T3)$	-23.769	8.241	-2.880	0.004
$D_{Period}(T3)$	-8.809	1.544	-5.710	0.000
$D_{Treatment}(T4)$	-67.133	8.241	-8.150	0.000
$D_{Period}(T4)$	6.064	1.544	3.930	0.000
$D_{Treatment}(T5)$	-36.803	8.241	-4.470	0.000
$D_{Period}(T5)$	-4.599	1.544	-2.980	0.003

$D_{Treatment}(T6)$	-37.258	8.241	-4.520	0.000
$D_{Period}(T6)$	-6.155	1.544	-3.990	0.000

In the regression results reported in Table 3, the constant term provides information on the intercept of treatment T1 and the coefficient of *Period* provides information on the trend of the same treatment. Information on other treatments (T2 to T6) is obtained by adding the coefficients of the treatment dummies – $D_{Treatment}$ (T2) to (T6) – and the period dummies – D_{Period} (T2) to (T6) – respectively to the constant and the coefficient of the trend (*Period*).

We calculate these values and reported them in a synoptic table (see Table 4) where we make also a two-by-two comparison across different treatments.

Table 4. Generalized linear mixed-effects regressions
Individual contributions on periods 1 to 10 in the reference treatments

		Intercept		Slope	
(a)	**T1-T2**	130.713	131.077	3.833	1.647
	T1-T3	130.713	106.944	3.833	-4.976
	T2-T3	131.077	106.944	1.647	-4.976
(b)	**T4-T5**	63.580	93.910	9.897	-0.766
	T4-T6	63.580	93.455	9.897	-2.322
	T5-T6	93.910	93.455	-0.766	-2.322
(c)	**T1-T4**	130.713	63.580	3.833	9.897
	T2-T5	131.077	93.910	1.647	-0.766
	T3-T6	106.944	93.455	-4.976	-2.322

In panel (b), we report results obtained for the reference treatments.[9] When comparing T4

[9] We shall not comment on results reported in panel (a) of Table 4 since, as already mentioned, the control treatments' findings were published in Morone et al. 2014.

and T5 we observe that the two treatments are statistically different in the interception and in the slope, additionally in T4 we observe an upward slope contrary to T5, that present a downward slope.[10] Identical results are obtained comparing T4 with T6. These results suggest that the increase in the penalty rewards does produce a change in subjects' behaviour, which is a common trait with the existing literature. Comparing T5 with T6 it is interesting to observe that there are no difference in the intercept, but rising the penalty/reward produce a, statistically significant, faster convergence to the Nash equilibrium.

We shall now turn to analyse results reported in panel (c) of Table 4. Here we compare the control treatment with the reference treatment. When looking at T1-T4 and T3-T6, we can confirm that a small penalty/reward (2ECU) is associated with a positive slope – i.e. suggesting a convergence towards Pareto. Conversely, a larger penalty/reward (40ECU) is associated with a negative slope – i.e. suggesting a convergence towards Nash. For an intermediate penalty/reward (25ECU) the two treatments (T2-T5) show opposite signed slopes, with the control treatment showing a positive slope and the reference treatment showing a negative slope (note that the difference is statistically significant).

Overall, these econometric results confirm our earlier findings suggesting that introducing a clear reference point *à la* Schelling does not encourage coordination around the Pareto optimal choice, but rather it stimulates strategic behaviours, pushing individual choices towards the Nash equilibrium.

5. Conclusion

In this paper we reported on a laboratory experiment on the traveller's dilemma conducted at the ESSE laboratory (Bari University, Italy). The aim of this experiment was to investigate whether in a traveller's dilemma individual claims are affected by the induction of a focal point *à la* Schelling. Experimental findings reported in this paper provide an answer to this research questions showing that, contrary to our expectations, the reference point did not encourage coordination around the Pareto optimal choice, but rather it stimulated strategic behaviours, pushing individual choices towards the Nash equilibrium.

[10] Statistical significance is obtained from Table 3, for both intercept and slope we cannot accept the hypothesis that, in the two treatments, they are equal at any significance level.

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Appendix

This appendix reports an English translation of the instructions distributed on paper to the subjects.

Instructions (All)

- Welcome to the ESSE laboratory and thanks for participating in this experiment.
- During the experiment you are not allowed to talk or communicate in any way with other participants.
- If at any time you have any questions, please raise your hand and one of the assistants will come to you to answer it.
- By following the instructions carefully, you can earn an amount of money that will depend on your choices and on the choices of other participants.
- At the end of the experiment, the money (expressed in ECU) that you have earned will be converted in euros at the exchange rate of 10 ECU = 1 euro. The resulting amount will be paid to you in cash.

General rules (Control)

- There are 20 subjects participating in this experiment.
- Instructions will be distributed at the beginning of the experiment.
- The experiment will be repeated for 10 periods. At the beginning of the first period 10 couples of two participants will be formed randomly and anonymously.
- In each period the choices that you and the other subject will make will determine the amount earned.
- The choices that you and the other subject will make, and the corresponding results, will be communicated to you at the end of each period.
- At the end of the experiment, the earnings of each participants will be determined as the sum of the earnings of the 10 periods.

General rules (Reference)

- There are 40 subjects participating in this experiment.
- The experiment will take place in 2 independent phases. At the beginning of each phase, instructions for that phase will be distributed.
- In phase 1 you will be asked a simple task where you can earn either 200 ECU or 40 ECU.
- At the end of phase 1 all subjects that earned 200 ECU will go to phase 2; for the other subjects, the experiment ends and they will be paid accordingly to their earning.
- At the beginning of the phase 2 instructions will be distributed.
- The phase will be repeated for 10 periods. At the beginning of the first period 10, couples of two participants will be formed randomly and anonymously.
- In each period the choices that you and the other subject will make will determine the amount earned.
- The choices that you and the other subject will make, and the corresponding results, will be communicated to you at the end of each period.
- At the end of the experiment, the earnings of each participant will be determined as the sum of the earnings of the 10 periods.

Specific rules (Control, Phase 2 Reference)

- In this phase you have to choose an integer between 40 and 200.
- At the same time, the subject with whom you have been paired has to choose an integer between 40 and 200.
- If the numbers chosen are the same, you will both earn a number of ECU equal to the number selected.
- If the numbers chosen are different, you will both earn a number of ECU equal to the lower of the chosen numbers, plus a bonus or penalty determined as follows:

[T1, T7]

- If the number you have chosen is smaller than the number chosen by the other subject, you will have a bonus of 2 ECU and the other subject will have a penalty of 2 ECU.

- If the number you have chosen is larger than the number chosen by the other subject, you will have a penalty of 2 ECU and the other subject will have a bonus of 2 ECU.

[T2, T8]

- If the number you have chosen is smaller than the number chosen by the other subject, you will have a bonus of 25 ECU and the other subject will have a penalty of 25 ECU.
- If the number you have chosen is larger than the number chosen by the other subject, you will have a penalty of 25 ECU and the other subject will have a bonus of 25 ECU.

[T3, T9]

- If the number you have chosen is smaller than the number chosen by the other subject, you will have a bonus of 40 ECU and the other subject will have a penalty of 40 ECU.
- If the number you have chosen is larger than the number chosen by the other subject, you will have a penalty of 40 ECU and the other subject will have a bonus of 40 ECU.