FOCAL POINTS

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Abstract. This paper gives an overview of the literature on focal points. It starts with reviewing Schelling's seminal book *The Strategy of Conflict*.I then discuss the problems that have to be faced when incorporating the notion of focal points in theory of games. Two recent approaches are discussed that deal with focal points. The eductive approach is static and concentrates on how players can use aymmetries in the descriptions of strategies. The evolutive approach is dynamic and focuses in the adaptive behaviour of players.

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In his modern classic *The Strategy of Conflict* Thomas Schelling (1960) introduced the concept of a focal point and laid the foundations for much of the later work on the subject. His point of departure was the state of game theory at that time, which centred on the minimax solution to zero-sum games. In zero-sum games there is no scope for mutual collaboration. The main point of his book was to argue that the theory developed for zero-sum games is not an appropriate starting-point for analysing nonzero-sum games: Being unpredictable is the main guide for rational behaviour in zero-sum games, whereas the reverse may very well be true in other types of games, in particular in games with common interests.

Schelling tried out nine examples of coordination games on what he termed "an unscientific sample of respondents" (1960, 55); two of these examples will be discussed in some detail below. It turned out that in all nine examples, players were often very well able to coordinate their actions. He observed that, not only do people in everyday life use symbolic details (the labels of strategies) in order to coordinate their activities, but also that game theory loses some of its relevance if it does not take this empirical evidence into account. He also argued that, from a normative point of view, a theory of rational play should take the symbolic details into account. In his own words: "A normative theory must produce strategies that are at least as good as what people can do without them. More, it must not deny or expunge details of the game that can demonstrably benefit two or more players and that the players, consequently, should not expunge or ignore in their mutual interest" (Schelling 1960, 98).

Schelling's theoretical remarks about focal points have two distinct elements: imagination and logic. A clear example in which logic seems to be the dominant factor explaining individuals' choices is a coordination game in which individuals are asked to write down a positive integer. If they coordinate on the same integer they get a positive reward; if not, nothing. Schelling reports that in this game two-fifths of all people chose the number 1, whereas if they were asked just to write down an integer (without the necessity of coordinating with somebody else) they wrote down a large variety of numbers. Schelling explains:

> And there seems to be good logic in this: there is no unique "favored number"; the variety of candidates like 3, 7 and so forth is embarrassingly large, and there is no good way of picking the "most favorite" or most conspicuous. If one then asks what number, among all positive numbers, is most clearly unique, or *what rule of selection would lead to unambiguous results*, one may be struck with the fact that the universe of all positive numbers has a "first" or "smallest" number. (Schelling 1960, 94).

In other examples, it seems that logic plays a less important role. When people are asked to coordinate on "heads" or "tails", the majority chooses "heads" even though there does not seem to be an argument that makes "heads" logically superior to "tails". In examples like this "prominence" or "conspicuousness" seems to play a key role. In other examples, prominence is a consequence of precedence: the reason for choosing a certain alternative now is that it has been chosen successfully in the past. In most cases, both imagination and

logic have to be used, however: “Logic helps … but usually not until imagination has selected some clue to work on from among the concrete details of the situation” (Schelling 1960, 58).

Subsequent work on focal points has taken various routes. I first discuss some of the experimental work that has been done, and then in Sections 2 and 3 go into some of the aspects of incorporating focal points into a theory of rational play in games. Section 4 discusses boundedly rational behaviour and the evolution of focal points, and Section 5 concludes with some general observations on the relevance of focal points outside situations of pure coordination, and on the applicability of the different theories on focal points discussed in the preceding sections.

1. Some Experiments

Schelling (1960) reported the results of many informal experiments which he had performed to show that people actually do use focal points. Apart from the nine coordination games mentioned above, he also carried out eight informal experiments on tacit bargaining. In a series of articles Mehta, Starmer and Sugden (1992, 1994a, 1994b) were, however, the first to do *controlled* experiments on whether agents employ focal points in deciding what to choose in pure coordination games. Other experiments on coordination games such as Van Huyck et al. (1990), concentrate on coordination games with Pareto-ranked equilibria and do not study the impact of the labels of strategies on the choices that

are made. The experiments of Mehta et al. were not really meant to test any formal theory and can, therefore, be discussed before actual theories about focal points. They consisted of two parts. Part I was an attempt to replicate Schelling-type results, asking questions such as "name a car manufacturer", "name a mountain", "name a year" and so on; Part II consisted of ten so-called assignment games.

The authors' main hypothesis is based on Schelling's work: before deciding what to choose players first inquire into the rules of selection that could be used as a base for one's decision, and players then choose from this set a rule that, if followed by both players, is most likely to result in coordination. They call this form of salience, Schelling salience. Apart from Schelling salience, the authors distinguish primary and secondary salience. According to primary salience, players just choose what first comes to their mind. According to secondary salience, players expect their opponents to play the option that is primarily salient for them and maximize expected pay-offs given this belief. If players have a common culture, all forms of salience may explain that players are able to coordinate their actions. Mehta et al. (1994a) test which of these forms of salience is best able to explain the experimental results. On the other hand, Mehta et al. (1994b) inquire into the actual rules of selection that people use. The latter are important in order to develop an explanatory theory of focal points, because as the authors rightly observe "when one explains coordination in terms of `salience', there is a danger that one is providing nothing more than an *ex post* rationalization" (Mehta et al. 1994b: 167). On the other hand, were we to possess some rules of selection that people actually use, we would be able to predict the decisions they

will make. Accordingly, for the ten assignment games three hypotheses were proposed and tested.

Mehta et al. (1994a, 1994b) define a *coordination index* which measures the probability that two individuals chosen at random from the population of participants give the same answer. If players were simply to randomize in a coordination game with n actions each, the coordination index would equal 1/n. In the three examples from Part I mentioned above, the coordination indexes were 0.80, 0.79 and 0.51, respectively. This indicates that, indeed, people are well able to coordinate their answers. Moreover, when players do not play a coordination game, but instead are just asked to give an answer, they do much worse. This indicates that in pure coordination games players are guided by Schelling (or secondary) salience, but not by primary salience.

It turns out that the three proposed hypotheses did fairly well in explaining most of the responses given by the participants. In all the games (apart from one) in which the hypotheses made predictions about which outcomes were to be expected, the predicted outcomes were also those most frequently observed in the sample. However, taking the coordination index as a measure of how successful participants are in coordinating their answers, it turned out that the players were almost as successful in the two games in which the hypotheses did *not* make a prediction about which outcome to expect as in the eight games in which they did. Apparently, also in the games for which the hypotheses are silent about what to expect, the participants are able to find rules of selection that helps them coordinating their answers.

Of course, in none of the games of the experiment did all the participants coordinate on the same answer, i.e., the coordination index never equalled 1. This implies that a theory which explains that players of coordination games have a higher chance of coordinating their actions than they would have if they simply randomised over all possible choices, should also explain that there are quite a few cases in which players do not manage to coordinate.

2. On the Difficulties of Incorporating Focal Points into a Theory of Rational Play in Games

Even though Schelling (1960) argued that rational players should take the symbolic details of strategies into account, he did not attempt to incorporate his analysis of focal points into a more formal theory of games. The first attempt to do so was by Gauthier (1975). The example he used is a coordination game in which meeting at one of two railway stations in London, Marylebone and St Pancras, is at stake. Suppose the matrix below specifies the pay-offs for the two players.

Table 1.

	Marylebone	St Pancras
Marylebone	5,5	0,0
St Pancras	0,0	5,5

As one of the persons is travelling from Leicester and as there are more trains running from Leicester to St Pancras, Gauthier argued that going to St Pancras is the salient option. Given this evidence, he goes about analysing the game in the following way. First, he argues that the way the players describe the game to themselves is different from the one provided above. According to Gauthier, the players consider two options, namely "seeking salience" and "ignoring salience". In the latter option the players randomise between going to any one of the two stations. The transformed game with expected pay-offs in the cells of the matrix is as follows.

Table 2.

	Seeking	Ignoring
Seeking	5,5	2.5,2.5
Ignoring	2.5,2.5	2.5,2.5

Given this transformed game, Gauthier argues that the only rational choice for both players is to seek salience and go to St Pancras station. In order to arrive at this conclusion he introduces a *Principle of Coordination* according to which rational players should play their part of a unique Pareto-efficient equilibrium, if there is one. Note that applying the criterion of risk-dominance to this transformed game yields the same conclusion.

Looking at Gauthier's analysis more closely, it is clear that the two key elements are: (i) a transformation of the game and (ii) the Principle of Coordination. In the next section it will

turn out that both elements are also present in later attempts to incorporate an analysis of focal points into a theory of games. Here, I would like to concentrate for a moment on the *particular way* Gauthier has transformed the original game. As Gilbert (1989) has argued quite convincingly, Gauthier does not seem to have a good reason to restrict the options of the transformed game to two. More specifically, if we stick to Gauthier's interpretation of "ignoring salience" as choosing each of the two options with probability 1/2, there seems to be at least one other alternative, namely "seeking the non-salient", i.e., if a player thinks about the possibility of "seeking salience", then it seems natural to assume that the possibility "seeking the non-salient" also comes to his mind. Allowing for this third option, however, destroys Gauthier's analysis. To see this note that the new transformed pay-off matrix is as below and that there are (again) two Pareto-efficient equilibria. Accordingly, the Principle of Coordination cannot operate successfully in this case.

Table 3.

	Seeking	Ignoring	Seeking NonS
Seeking	5,5	2.5,2.5	0,0
Ignoring	2.5,2.5	2.5,2.5	2.5,2.5
Seeking NonS	0,0	2.5,2.5	5,5

As pointed out by Goyal and Janssen (1996), a similar problem occurs in the analysis of Crawford and Haller (1990), which tried to explain how rational players can use past play to coordinate their actions in the future. Their analysis was based on precedence: once players have successfully coordinated their actions in one period (suppose, in the example

above, coordination on St Pancras railway station), they will do so ever after, because they can repeat the action combination that yielded a coordinated outcome. However, in 2x2 games players could also guarantee a coordinated outcome by both switching to the action that was not chosen in the first period in which a coordinated outcome was reached (in the example above, the players could also try to coordinate on Marylebone in the period after they coordinated on St Pancras). Hence, after a coordinated outcome has been reached there are two equally efficient ways (namely, meeting at St Pancras *and* meeting at Marylebone) to guarantee a coordinated outcome in the next period; and there is no way that rational players can individually distinguish between them. Accordingly, something much stronger than Gauthier's principle of coordination is needed to choose between the two equilibria. A similar argument can be made with respect to Kramarz (1996). It deserves mention, however, that Crawford and Haller's analysis is not vulnerable to the same criticism in 3x3 coordination games, because an asymmetry between the one action combination that resulted in coordination and the other two ones is created once players have coordinated the first time.

Thus, one of the difficulties of incorporating focal points in a theory of rational play in games is to create an asymmetry between the option that is considered to be salient and those that are not. In 2x2 games, Gauthier's analysis fails because if one action is salient (by some criterion), the other is in some sense also salient, because it is the only action that is not salient according to the first criterion. Hence, there is no asymmetry between the two actions. The same applies to several of the games analysed in Crawford and Haller (1990),

as there is no asymmetry between continuing playing the action that yielded a coordinated outcome and switching to the other action.

3. Rationalising Focal Points

Recently, Bacharach (1993), Janssen (1995) and Sugden (1995) have made some progress in circumventing the problems outlined above. The present discussion focuses mainly on Bacharach's contribution. The main ideas of his analysis are best understood by means of an example. Suppose two players are asked to choose one out of 10 wooden blocks. Of the blocks, 2 are yellow and 8 are red and those who look at the blocks carefully will see that one of the red blocks has a wavy grain, whereas the grain of each of the other nine blocks is straight. If the two players each choose the same block, Bacharach is ready to give each a prize of £100. If they choose different blocks they get nothing. What would constitute a rational choice in this case?

Bacharach first introduces the notion of *availability*, which is the likelihood that a particular way of conceiving the coordination problem comes to the mind of a player. In the above example, there are two clues available: colour and grain patterns. The availability of colour is the likelihood that a player sees that the blocks have a colour and that he considers basing his choice on the colour of the object. Similarly, the availability of grain is the likelihood that a player sees that the blocks have a grain and that he considers basing his choice on the grain of the object. For simplicity, we will assume that the colours are very distinct so that

the availability of colour is 1. The availability of grain is denoted by v, where it is assumed that $v < 1$. Accordingly, it may be that (i) each player conceives of both ways to partition the blocks; (ii) only one player thinks about both ways while the other thinks only about colours; and (iii) each player thinks only about colours. It is assumed that availability v also measures the conditional probability that the grain structure comes to the mind of the opponent, given that it has come to the mind of a particular player.

The next step in the argument is to transform the game. In particular, Bacharach argues that given the different ways that come to the mind of a player, she only has a limited number of options. For example, if both grain structure and colour come to mind, she can (i) ignore all characteristics and randomise with probability 1/10 over all objects, (ii) choose a yellow block, (iii) choose a red block, (iv) choose the block with the wavy grain or (v) choose a block with a straight grain. As she does not have any reason to distinguish, for example, the two yellow objects from one another, she cannot decide to choose a *particular* yellow object. Therefore, the Principle of Insufficient Reason tells us that the player's choice should be such that it gives both yellow blocks the same probability. The same holds true, *mutatis mutandis*, for the red objects and the blocks with the straight grain. The transformation of the game described above is different from Gauthier's transformation, because in Bacharach's analysis all potentially possible ways to describe the game have been incorporated; in particular, the notion of salience has *not* been used in transforming the game.

Finally, Bacharach uses a Principle of Coordination that is similar to Gauthier's. It says basically that players choose one of the Pareto-dominant equilibria of the transformed game. Applying the Principle in the example discussed here gives the following result: if $v > ½$, players who observe both ways to partition the objects choose the block with the wavy grain, and if $v < ½$, they choose each of the yellow objects with probability ½. Players who do not observe the grain of the blocks choose each of the yellow objects with probability ½.

Bacharach's analysis formalizes the two elements of Schelling's theoretical remarks on focal points: conspicuousness and logic (unicity). The notion of availability formalizes how conspicuous an aspect of the objects is. The Principle of Insufficient Reason and the Principle of Coordination together formalize the logical (or uniqueness) aspect of focal points: if the availability of all characteristics is the same, then rational players should randomly choose blocks that are rarest, because this gives the highest chance of coordination. In the example above, there is a trade-off between rarity and availability. Hence, the result: if (and only if) the availability is large enough the rarity aspect dominates.

Janssen (1995) generalizes and modifies Bacharach's analysis. He allows for objects to have an arbitrary number of attributes and he shows that in all generic cases, players receive a higher pay-off following the procedure outlined above than they would receive if they neglect the information contained in the labels of the strategies and randomise over all objects. He obtains his result by using a more strict version of the Principle of

Coordination, which says that rational players will choose their part of the *unique* Pareto-efficient equilibrium if there is one.

Sugden (1995) stays closer to the conventional game theoretic framework. His basic game is essentially the game in normal form. Players play this basic game, however, under a certain private description. This description is assigned to players by a random labelling procedure. Sugden shows that depending on whether the labelling procedure is perfectly correlated, uncorrelated or somewhere in between, the principle of coordination (what he terms the principle of collective rationality) may or may not assure coordination.

The approaches taken by Bacharach (1993) and Janssen (1995) have the following general structure in common. Each player observes a certain number of attributes of the strategies. How many attributes one player observes is beyond conscious control. The attributes she observes are potential clues for solving the coordination problem. The analysis shows how people choose one out of the set of potential clues and choose an action according to the clue that is used. The analysis may also be used to show why coordination may fail as it does in some circumstances (as we all know from daily experiences and from the evidence reported in Section 1 and in Schelling (1960)). One reason for this offered by the analysis above is that if some attributes come to the mind of one player and she thinks it likely that they will also come to the mind of the other player, she may decide on a particular action. However, the particular attribute which lies at the basis of her decision may not have come to the mind of the other player at all. To illustrate with the example used above: a player who observes both attributes of the wooden blocks chooses the block with the wavy grain if

$v > ½$. The other player may, however, fail to notice the grain of the blocks altogether. Hence, a coordination failure occurs. A second reason may lie in the fact that even if the same attributes come to the mind of different players, they may have assigned different probabilities to the event that an attribute also comes to the mind of the other player, i.e., the availabilities may be subjective and differ across players.

What the analysis achieves is that it establishes a way players may reason about what to choose in coordination games. If after the game is played you are asked by the other player why did you choose that particular option, then you have an answer: Given your assessment of the probabilities that the other player did in fact observe what you did, you maximised the chance of coordination. Of course, this analysis does not rationalise the assessment of availabilities. In this sense, the analyses discussed here still assume the existence of some kind of (primary) salience, because successful coordination is only guaranteed if the probabilities which players assign to the other player observing what you did are sufficiently similar.

Another point that deserves attention is the falsifiability of the theory. If availability cannot be measured independently of the choice which individual players make, then from the above it follows that almost any choices can be rationalised. Indeed, in their experimental paper testing the theory outlined above, Bernasconi and Bacharach (1997) try to measure the value of subjective availabilities in a certain experiment, on the basis of earlier experiments with the same subjects and from the subjects' written reports. It turns out that the joint

hypotheses that the theory is correct *and* that availabilities can be measured in the proposed way do quite well in explaining the experimental results.

A final question is the extent to which the Principle of Coordination is reasonable in the present context. Two versions of the Principle have to be distinguished. The version Bacharach (1993) employs, which is also implicitly used by Crawford and Haller (1990), should be criticised on the grounds that it assumes too much coordination capacity on the part of the individual players: how can players, each of them deciding individually, guarantee themselves an equilibrium pay-off if the equilibria are pay-off symmetric? The second version employed by Gauthier (1975), Janssen (1995) and Sugden (1995) does not suffer from this criticism. Their solution concept is only applicable if there is a unique Pareto-efficient equilibrium. Of course, one may argue that the second version of the Principle of Coordination is also an equilibrium selection device and that it goes beyond the standard notion of individual rationality usually employed in game theory. I think this potential criticism is too conservative in the present context. I have two arguments. First, other arguments that have been used for equilibrium selection purposes such as risk dominance (Harsanyi and Selten 1988) and its generalisation ½-dominance (Morris, Rob and Shin 1995) yield the same results if applicable in many pure coordination games. Second, and more substantively, arguments have been made in favour of the principle of coordination. Sugden (1991), among others, argues that in pure coordination games rational players should consider themselves as being member of a team. Being a member of a team, they should think about a rule of behaviour that if followed by both is best for both players, i.e. it is Pareto-efficient. If such a rule exists and is unique, each player *reasoning*

individually will discover the rule and is sure that the other player will discover the same rule. Hence, individual rational players have a reason to use the Principle of Coordination. (For completeness, note that the Principle of Coordination does not prescribe that rational players should choose to cooperate in one-shot Prisoner's Dilemma games, because in such game there are three Pareto-efficient allocations). Along different lines, Colman (1997) also argues in favour of the Principle of Coordination.

4. Evolution and Focal Points Based on Precedence

Schelling (1960) already argued that precedence is one of the ways in which focal points come about. Above, it was argued that the notion of precedence is inherently difficult to incorporate into a theory of games that is based on common knowledge of rational behaviour. The reason is that rationality is essentially forward looking: a strategy is rational at a certain moment in time if it maximises the player's expected pay-off *from that moment onwards*. On the other hand, precedent is, by definition, something based on the past. The reason why precedent may work to establish a focal point is that it helps players to coordinate their expectations on one out of many conceivable choices. However, if rationality is common knowledge, players' expectations about other players' future behaviour is based on their supposed rationality. Any equilibrium configuration, and not just the one that has been played before, is consistent with common knowledge of rationality. Hence, when common knowledge is assumed structural characteristics of the game are what matters and not historical accident.

A framework in which the way that precedence helps to shape focal points can be better understood is one in which the behaviour of individuals is boundedly (instead of fully) rational. Such an evolutionary game theoretic framework has recently been developed by Kandori, Mailath and Rob (1993) and Young (1993), among others. The basic model has players randomly drawn from a population playing a certain game. Players do not know with whom they are playing the game, but they have some (partial) observations on how the game has been played in the recent past. Players assume that past play is a good indicator of what their opponent will play in the game they play. Hence, expectations about opponent's play are not based on the supposition that they are rational. It is here that the assumption of boundedly rational behaviour is used most intensively. Given these adaptive expectations, players (gradually) adjust their behaviour towards the strategies that perform best. A final element that is important in the basic model is that at any moment in time people may behave in some unexplainable way. This is modelled by allowing any action to be chosen in any period with some (very small) probability.

The above mentioned articles show that if the random deviations have sufficiently low probability and if interaction is uniform, i.e., all players meet each other with the same probability, then most of the time most of the population will play according to one of the equilibria. The reason is twofold. First, because of the chance element eventually one particular way of solving the coordination problem will always be used more frequently than the other(s). Second, once a particular way of solving the coordination problem gains an edge, it is likely that more people hear about it and that they expect more people to use it. Hence, it becomes best to join the majority. For any positive probability of random

deviations, there is a chance, however, that there is a sequence of random events by which one convention replaces another. When this probability is small, a convention is stable for a long time, but will be replaced eventually.

Young (1996) has shown how evolutionary game theory can be used to analyse the origin of two different types of conventions: (i) the historical development that eventually led every country in continental Europe to drive on the right side of the road, and (ii) the widely used norm in distributive bargaining to split the surplus in two equal parts.

5. Concluding Remarks

Schelling (1960) argued that focal points are important not only in pure coordination games, but also that they seem to play a key role in many other economically relevant areas such as tacit and explicit bargaining. This is confirmed by Young (1996). At first sight one may expect focal points to be irrelevant in bargaining situations as there is an element of pure conflict: the larger share of the surplus one party gets, the less does the other. On closer inspection, however, the importance of focal points may be revealed. Especially when the stakes are high, it is important for both parties to reach an agreement no matter what its exact content is, if the alternative outcome may be that no agreement is reached at all. Hence, as Schelling (1960, 70) observed "most bargaining situations ultimately involve some range of possible outcomes within which each party would rather make a concession than fail to reach agreement at all.… and very often the other party knows it". Focal points

are important in social life, because they help stabilise mutual expectations in case many conceivable choices exist.

There are basically two alternative stories to tell about how focal points come about. One story is based on the way players make rational use of the observed labels (attributes) of strategies and their beliefs about the labels their opponent observes. The second story is based on precedence governing the (adaptive) expectation about future play of the opponent. The stories have different domains of applications and are, therefore, not inconsistent with one another. The rationality story based on the unicity of certain attributes of strategies is best used in case people have to coordinate in situations they have not encountered before. The precedence story applies to recurrent situations in which a focal point gradually emerges out of the historical process which is partly governed by chance.

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