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A Theory of Strategy and the Role of Leaders in it

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Abstract

This paper formally defines a (project or business) strategy as the '*minimum set of decisions (sufficient) to guide all other decisions*' and derives it as the equilibrium outcome of a game where a person can look ahead, do an overall optimization, and announce or fix decisions at a cost. Strategy is thus like a sufficient statistic for an optimal plan of action, the minimum set of actions you need to fix in order to trigger a target equilibrium, or the minimum unifying thought behind an optimal plan. It serves as an organizational tool to efficiently guide a whole organization towards an optimal outcome.

The paper then analyzes when and how strategy creates value (including when an uninformed strategy can create value), what characteristics make a decision 'strategic', why different people may consider different decisions 'strategic', why important decision makers should be involved in strategy development, and why leaders with strong vision are more likely to propose a strategy and their strategies are more likely to be implemented. It also shows how understanding the structure of strategy may enable a strategist to develop the optimal strategy without doing a comprehensive optimization.

1 Introduction

A company's success depends critically on its strategy. But strategy – in its everyday meaning – matters far beyond business: health organizations need a strategy to deal with an epidemic; the military needs a strategy to win a war; and an economic zone needs a strategy to deal with a financial crisis.[1] The etymological origin of strategy reinforces its importance: derived from the Greek word for general (στρατηγος), it comprises the issues that are specifically under the authority of the army's general or overall commander. As such, strategy becomes a defining responsibility for the leader or CEO, which makes it a popular topic in management education and publications. But what is 'a strategy' (in this everyday sense)? Is it simply a set of important decisions or should

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[1] In the body of the paper, I will use the term 'strategy' always in its everyday sense, rather than its game-theoretic sense. Whereas the proofs will use the term in both meanings, it will always be clear from the context which meaning is intended.

it be characterized differently? What is its role or why does it matter? Moreover, apart from being important, strategy also tends to be contentious. It is often a major point of disagreement in organizations, especially when in trouble; and new managers often propose new strategies, as if strategy is something personal; in fact, a person's background often gives clues to the strategy they are likely to develop. How or why would it matter who develops the strategy?

This paper develops an economic theory of strategy – in its everyday meaning as 'project strategy' or 'business strategy' – and uses it to answer questions such as : Which decisions are 'strategic'? What is the value of strategy? Can a 'blind' strategy be useful? How does it matter who develops the strategy?

In developing this theory, I explicitly take a broad perspective on strategy, going beyond business. In order to study strategy in this broad sense – as a general tool that organizations use to tackle complex problems with no known solution – I will analyze a generic decision setting. Beyond widening the paper's applications, this also distinguishes which aspects of 'business strategy' are driven by 'strategy' and which by the specific context of 'business'. That, on its turn, is critical to find the boundary conditions for specific strategy prescriptions and whether they extend to, say, non-profits or government organizations.

One powerful way to see what strategy means is to look at settings where strategy is missing, i.e., to look at what typifies an 'absence of strategy'. The typical setting where people say that 'this company lacks a strategy', and a common starting point for a strategy course, is one where an organization took a series of actions that each made sense on their own but that do not make sense together.[2] The most telltale symptom of a lack of strategy is thus a lack of consistency. It follows that strategy must be some statement of the organization's course so that, when people take the strategy into account when choosing their own actions, all the actions end up fitting together. But strategy must be more concise than a full plan of action; it is the most concise way to achieve that goal. To capture that, I formally define strategy as the '*minimum set of decisions (sufficient) to guide all other decisions*'. Strategy is thus like a sufficient statistic for the overall plan of action of the organization, the minimum unifying thought behind its series of actions. And it is an organizational tool to efficiently guide a whole organization towards an optimal outcome. This definition of strategy differs from most definitions in the literature by focusing on the functionality of strategy instead of on descriptive characteristics.

Rather than simply positing this formal definition, I start the paper by showing that it is in fact the equilibrium outcome of a game that captures a typical ('planned') strategy process, as we commonly see it in a consulting team, in a firm, or in the classroom. In such process, people take a step back, collect information, and then devise a 'grand plan' for the project or firm. I therefore study a formal setting where a group of people are engaged in a common project and each person must make a decision that affects the project's outcome. Each person has 'local' information about her own decision and how it interacts with others, but knows little or nothing about the others' decisions. If left to their own devices, the piecemeal or trivial outcome results: each decision is optimal on a standalone basis but there is a lack of alignment across decisions. And people would say that 'this firm doesn't have a strategy.' I then allow one person, the strategist, to collect information about any decisions and any interactions that may be relevant and to then announce or fix decisions, at a cost. In equilibrium, this person will announce exactly an optimal 'strategy' as defined above: the minimum set of decisions sufficient to guide all other decisions to the overall optimum. This model thus provides a transparent logic for 'strategy', which is useful to explain and to analyze the concept. Whereas the focus of this paper is thus on intentional, planned strategy, I

[2] See for example Ghemawat (1987), Collis and Conrad (1996), or Rivkin (2000).

will discuss in how far the ideas carry over to strategy as a description for a course of action that evolved or emerged (Mintzberg 1990). In essence, strategy as defined here is also, in a very specific sense, the most concise description of an organization's complete course of action.

I then start the further analysis by looking at the *value* of strategy, both to understand when 'strategic' organizations will outperform 'myopic' ones and to get insight in the role of strategy. Note, by the way, that this particular analysis considers a very general question: when should a group of people plan ahead? I first show that strategy is most valuable when decisions interact and when they are irreversible. Moreover, irreversibility and interaction are complements: each by itself is not sufficient; you need both at the same time. The value of strategy also decreases in the standalone importance of subordinate decisions. This shows the fundamental effect of strategy: create alignment across decisions, but at the cost of compromising some decisions on a standalone basis. In fact, even an uninformed or 'random' strategy – when the strategist does not know either the optimal decisions or the interactions – can create value. Such uninformed strategy generates a focal point through common knowledge about some decisions – which improves alignment but on a potentially suboptimal course of action – and is more valuable when interactions and irreversibility are important relative to standalone decisions. The result fits the observation that high-tech firms, which face high uncertainty, often think of strategy as 'bets'. I then turn to the role of initial public information and show that the value of strategy increases in initial or public uncertainty, with uncertainty a complement to the degree of interaction. The complementarity shows that initial uncertainty matters in this context *not* because it makes it difficult to find the right decision, but because it makes it difficult to predict what others will do and thus to align with them. This is related to the effect of an uninformed strategy, though public information generates a better, since more informed, focal point. A final result on the value of strategy is that strategy creates more value when the interactions are all complements than when they are (irreducibly) a mixture of complements and substitutes. The reason is that in a (supermodular) environment with all complements, strategy can create full alignment, whereas an irreducible mix of substitutes and complements will require at least some compromise. This result suggests some caution on how to interpret the informal finding that successful strategies tend to be very well aligned: a high degree of alignment is often due not only to skill (developing a great strategy) but also to luck (being in a supermodular environment).

The development of strategy, as derived in this paper, generates *endogenously* a hierarchy of decisions, with more 'strategic' decisions guiding subordinate decisions. This obviously raises the question which decisions will in equilibrium be most likely to be 'strategic', in the sense of being part of the optimal strategy. The purpose of this analysis is not only to provide formal guidance on which decisions are strategic but also to give a clear rationale for *why* they are strategic. The first result is that more important decisions (on a standalone basis) are more 'strategic', but only if they interact sufficiently with other decisions. The first part of this result – that important decisions are strategic – confirms a general intuition (which is a good thing for the definition) but the second part – on the simultaneous need for interaction – refines this and immediately indicates that the underlying mechanism is different from what one would think at first sight. Important decisions are more strategic *not* because they affect the performance more but because they will be decided on their own terms so that other decisions will have to adjust to them and will thus be guided by them. It is this 'guiding' intuition that explains why important decision are strategic *only if* they also interact sufficiently with other decisions: a decision can't guide others when there is no link. For example, the decision to hedge gas prices or currency risks may have a tremendous impact on airlines' bottom line, but that does not make them strategic decisions. The same result holds for the degree of eventual confidence in the optimal choice: decisions about which the participants are eventually confident are more strategic because they are more likely to be taken on their own terms and thus to guide other decisions. Remarkably, irreversibility per se does *not* make a decision strategic in this setting, unlike what has been argued by some: being irreversible does not, by itself, make a decision 'guiding' for other decisions. (But I will argue later that implementation problems may create a need for commitment, which can then make irreversible decisions more strategic.) I finally also show that more central decisions – in a network sense – are more strategic because they are more effective at guiding other decisions through their high number of interactions.

An indirect but really important insight from this analysis is that understanding the structure of strategy may enable a strategist to find the optimal strategy more efficiently, without a comprehensive optimization. It leads to the surprising result that even though creating alignment is one of the main effects of strategy, detailed information about the interactions may not always be necessary to find the right strategy.

I finally turn to the question how and why it matters *who* develops the strategy. A first result here is that different people may systematically consider different decisions to be strategic. Marketing people will consider marketing decisions as more strategic and are more likely than average to define a strategy in marketing terms. The reason here, unlike the biased perception explanation in the literature, is that different people often have different levels of confidence across decisions – based on their experience and expertise – and this leads them to rationally consider different decision as being strategic: it makes more sense to guide the organization via decisions about which you are very confident than via decisions about which you have lots of doubts. This also generates two other interesting results. First, it will look as if a strategist with a background in marketing *favors* the marketing department, since she chooses marketing decisions optimally and then adjusts the rest to it. Second, even when two people agree on every individual decision, they may come up with very different strategies that lead to very different outcomes.

A second important result is that when decisions are controversial – when people may disagree on the optimal course of action – a strategy developed by an outsider (or by a principal who is not involved in day to day decision making) may lack credibility and fail to be implemented. In fact, I show that such outsider – when developing a strategy – may purposely choose a strategy that is suboptimal (in her own eyes) because it is built around less controversial, and thus more credible, choices than the optimal strategy. Moreover, when both an outsider-principal and an insider-decision maker each develop a strategy, the outsider's strategy is often disregarded. Strategy formulation and execution are thus closely linked, and the key decision makers should be deeply involved in the development of strategy. These results are relevant, for example, for the division of work between a board and a CEO and for the optimal use of consultants and staff functions in strategy.

I finally turn to the relationship between strategy and leadership, as both provide direction to an organization. I show that leaders with a clear vision, in the sense of a strong conviction about the right course of action, are more likely to propose a strategy and that their strategy is more likely to be implemented because it has higher credibility. I argue that strong leadership can be both a complement and a substitute for strategy.

This paper is by necessity limited in scope: it focuses on simple static settings with a transparent information structure and disregards, among other things, many agency and dynamic issues. This initial focus is meant as a useful starting point and the left-out issues suggest important directions for future research. Moreover, as a simple formal model, the analysis also cannot capture all the possible meanings and roles of strategy in all its complexities. Instead, the analysis is intentionally focused on these specific aspects that seem to provide most insight, through formal analysis, on the practical effects and functions of strategy. Finally, the models themselves are for transparency reasons very simple, often even consisting of just two decisions. The logic here is that any robust result on strategy should also hold in a two-decision setting, which is therefore the best context for formal analysis. Moreover, the mechanisms and intuition – which are very transparent and easy to see in such simple settings – seem to carry over completely to more complex settings. But this suggests some interesting questions for further research.

Literature The management literature on the nature and role of strategy is simultaneously extensive and limited. On the one hand, nearly every serious textbook or management book on strategy discusses the definition and role of strategy. Porter (1980 p.xvi), for example, defined strategy as 'a broad formula for how a business is going to compete, what its goals should be, and what policies will be needed to carry out those goals' whereas Chandler (1969 p.13) defined it as 'the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals.' The purpose of these definitions is not to serve as an in-depth analysis of the nature and role of strategy, but rather as a stepping stone towards specific recommendations for good or bad strategies. Given this purpose, these definitions describe in general terms what strategy means in the specific context of business, but they do not provide the detail and the criteria on what strategy is and what it is not, that is necessary for an in-depth study of the phenomenon 'strategy'. (They do not allow, for example, to discriminate between strategy and a comprehensive plan or just some set of important decisions.) But the lack of a crisp definition also hinders, at times, its use by managers. Authors such as Collis and Rukstad (2008) and Saloner, Shepard, and Podolny (2001) have addressed this issue in a very pragmatic way by providing an experience-based list of decisions that a strategy must specify, but without providing a clear rationale for why specific decisions are included or excluded. While such list is extremely useful in practice, the lack of rationale makes it difficult to think about and adapt the rule to specific or changing circumstances. That requires a more detailed and unambiguous definition of strategy and an explicit understanding of its role.

The management literature *specifically* focused on the nature and role of strategy, on the other hand, is much more limited. Apart from early writers such as Chandler (1969) or Andrews (1987), who essentially introduced the idea of strategy, this literature has mainly focused on the process by which strategy takes shape in organizations. Bower (1970) and Burgelman (1994) studied in detail how resource allocation decisions are made in organizations and how this shapes strategy, pointing out important ways in which the process differs from an analytical optimization exercise. Mintzberg (1990) stressed the importance of emergent (as opposed to planned) strategy and the different challenges that this presents to management. The 'upper echelons theory' of Hambrick and Mason (1984) looked at the effects of top management teams' background and beliefs on strategy. The 'rugged landscape' literature (Levinthal 1997, Rivkin and Siggelkow 2003) considered, among other things, how organizational structure and processes affect the search process for an optimal position. Overall, this literature has by and large focused on the non-planned and non-analytical aspects of strategy and has developed important insights in this process. The current paper takes the opposite path, and thus complements that literature. Instead of researching how the actual processes deviate from 'strategy as deliberate planning and execution', it takes that ideal definition and fleshes it out, making the definition very precise and exploring its implications. This yields different, complementary, insights for strategy.

There are a few papers that are more closely related to the ideas in this paper. While very different in both approach and logic, the discussion of strategy in Ghemawat (1991) and Casadesus-

Masanell and Ricart (2010) raised many of the questions that I studied in this research. The insights of Ghemawat (1991) on irreversibility and commitment were especially influential and will be discussed at different points in the analysis. The arguments of Montgomery (2008) for taking the role of people in strategy seriously provides additional motivation for the analysis in Sections 6 and 7. The current paper differs from these not only through its use of formal tools and its formal definition of strategy, but also through its different logic and focus.

The economics literature on strategy is similarly both extensive and limited. On the one hand, many parts of economics are directly or indirectly related to strategy. Most of the theory of industrial organization, for example, is directly relevant to strategy development, whereas international economics and organizational economics are important for global and corporate strategy. But literature specifically focused on strategy is much more limited. Starting with Brandenburger and Stuart (1996), there is a small but growing literature on 'competitive advantage,' which is a central concept for strategy since it provides a systematic link between a company's choices and its long-term profitability (MacDonald and Ryall 2004). Closer to the current work is the literature that looks at the organizational effects of specific strategy choices. Rotemberg and Saloner (1994, 1995), for example, (implicitly) equate strategy with a choice of scope or focus – a choice *not* to undertake a particular project or a choice to favor one department over another – and show that such a narrow scope or focus can improve the incentives for effort and can reduce the negative effects of conflict. Mailath, Nocke, and Postlewaite (2004) (implicitly) equate business strategy with a firm's choice of business and show that the existence of strategy-specific human capital may, for example, make mergers unattractive. Milgrom and Roberts (1992) have a very insightful, though informal, discussion of how coordination through strategy and coordination through prices differ, and their discussion of the Hurwicz criterion (Hurwicz 1973) is related to some of the ideas in this paper. But this literature does not provide an explicit formal definition of strategy – that would distinguish, for example, among a simple project choice, a strategy, or a full plan – or study its fundamental nature and role.

From a more structural perspective, the analysis in this paper is closely related to team theory (Marschak and Radner 1972). Team theory studies the effect of information and decision structures – who gets what information and who makes which decisions – when a group of people pursue a common goal but have different local information, as at time 0 of the model in Sections 2 to 5 of this paper.[3] This team theory literature has studied the role and form of hierarchies (Geanakoplos and Milgrom 1991, Radner and Van Zandt 1992, Garicano 2000, Van Zandt 2003), the role of shared knowledge (Crémer 1993, Prat 2002), and the grouping of tasks into units (Crémer 1980, Dessein and Santos 2006), and how these are affected by parameters such as communication costs. Unlike team theory models such as Bolton and Dewatripont (1994) or Garicano (2000) – where the organization is faced with a series of independent 'problems'; where solving problems is a matter of spending resources (e.g., time in combination with some measure of knowledge or ability); and where performance is measured by the number of problems solved – this paper is part of the team theory literature where organizational performance depends on the specific content of decisions and on decision interactions, and where players need to make inferences about state variables in order to make good decisions. From a team theory perspective, this paper introduces an alternative solution to such team theory problems: strategy.

Given this focus on a new solution, the setting in this paper differs structurally from existing team theory models along a number of dimensions. The most important difference is that the information

[3] Sections 6 and 7 differ from the team theory literature as differing priors introduce agency concerns. These sections also show that many of the earlier results are a limit case of this more agency-like setting.

and decision structure is now partially a choice variable of one of the players – the strategist – and thus part of the equilibrium outcome: the strategist chooses which states to investigate and which decisions to fix, and these equilibrium choices may depend on the realized state and the signals and may even depend on the strategist's identity, as in Sections 6 and 7. This is very different from the existing literature where the information structure and allocation of decisions is fixed at the start of the game, either endogenously as part of the research question – as in Geanakoplos and Milgrom (1991), Van Zandt (2003), Dessein and Santos (2006), and many others – or exogenously as part of the context. These differences reflect a deeper difference in focus: team theory has been focused on ongoing decision making processes – where organization structure and other structural measures are the appropriate response – whereas the current paper focuses on a *one-off* decision point, for which a less structural solution is optimal. For example, Dessein and Santos (2006) (henceforth DS) study task allocation and investments in communication technology (which are very structural solutions) whereas this paper studies which decisions the strategist will announce in equilibrium (which is more ad hoc). Similarly, papers like Garicano (2000) and Van Zandt (2003) derive optimal hierarchical structures, which is again a very structural and enduring response that is appropriate for repeated decision making, unlike the one-off decision in this paper.

Some further typical differences – that reflect this focus on strategy as a new solution to team theory problems – are the mode of communication (publicly fixing decisions), the implicit objective (minimizing the number of investigations and of decisions to fix), the possibility of reverting decisions, and the discrete nature of decisions. That discrete nature of decisions captures the stark choices in one-off decision points and leads to very different coordination issues than the more common continuous variables with quadratic costs.

There are also a few points on which the paper may seem similar to some of the existing team theory papers but is in fact different. For example, the role of a strategist may be interpreted as an organizational hierarchy. But that interpretation differs considerably from the hierarchies of Geanakoplos and Milgrom (1991) or Van Zandt (2003). For one thing, the cheap talk results suggest an alternative interpretation of the strategist as advisor rather than as a superior in a hierarchy. Second, the strategist does not aggregate information or refine decisions, but fixes some of the decisions to guide the remaining decisions. Moreover, the hierarchy here, if interpreted as such, always has exactly two layers. Another seeming similarity is between this model's decision structure and that of Dessein and Santos (2006). Coordination problems in DS, however, only exist when there is limited communication, unlike here where alignment conflicts are inherent and often unavoidable. Likewise, many of the results of this paper cannot be derived in DS because of DS's assumption that if two decisions interact then at most one of them also needs to adjust to an external state.

But despite these differences, the current paper's results on the 'value of strategy' do apply more broadly to team theory models with decentralized decisions. The reason is that the value analysis compares the optimal outcome, independent of the method by which it is achieved, with the piecemeal outcome. As a consequence, the results of Section 4 on irreversibility, on the complementarity among interactions, uncertainty, and irreversibility, and on the role of supermodularity are new insights that apply broadly to team theory settings with decentralized decisions. The existing literature has either not investigated the value of achieving the optimal solution, as in Crémer (1993), Prat (2002), or Dessein and Santos (2006),[4] or stayed on a much more general level without such specific comparative statics, as in the case of Marschak and Radner (1972).

There are also some economics papers that relate to specific sections or aspects of this paper.

[4]Given their purpose and setup, the question is less salient in their contexts.

Section 7, for example, is related to the (limited) economic literature on managerial vision – in the sense of a strong belief about the right course of action. In particular, building on Rotemberg and Saloner (2000)'s insight that a manager's vision can improve effort incentives (when employees are locked into fixed projects), Van den Steen (2005) showed that vision can provide a firm with direction and coordination through 3 mechanisms (as I will discuss later). Relative to this work, Section 7 adds strategy as a fourth mechanism through which a manager with vision can give a firm direction and generate coordination. Some papers, such as Crémer (1993), Prat (2002), and Siggelkow (2002), that relate to very specific results, will be discussed later in the paper.

The main contribution of this paper is to provide a formal definition of strategy that clearly distinguishes between a strategy and either a full plan or just a set of important decisions, and then to use that to study the value and role of strategy, the nature of strategic decisions, and the relationship between strategy and leadership. Apart from formally confirming existing informal insights, the paper often refines these insights, provides new intuition, and derives completely new results.

The next section describes the paper's model, whereas Section 3 formally defines 'strategy', shows that it is the equilibrium outcome of that model, and discusses how it relates to other decisions and related concepts. Sections 4 and 5 study respectively the value of strategy (including the value of uninformed strategy) and what decisions are strategic. Sections 6 and 7 consider the role of people and the link with leadership. Section 8 discusses the link to business strategy and Section 9 concludes. Some of the longer proofs are in Appendix A whereas Appendix B discusses a possible equilibrium refinement.

2 Model

This paper studies a setting in which a group of people are engaged in a common project and these people must make (simultaneous or sequential) decisions that affect the project's outcome.[5] The basic research question is the form and value of 'strategy' (in the everyday sense of the word) and how it matters who develops that strategy.

Formally, consider a project that generates revenue R, which depends on a set of K decisions with typical element D_k. Each decision D_k is a choice between two alternative courses of action, $D_k \in \{A, B\}$. The project revenue R will depend *both* on whether the decisions are correct on a standalone basis *and* on whether the decisions align correctly. In terms of being correct on a standalone basis, one and only one of the choices (A versus B) will be correct, as captured by the decision state variable $T_k \in \{A, B\}$: decision D_k is correct if and only if $D_k = T_k$ and it is wrong otherwise. In terms of interactions, two decisions D_k and D_l can be either complements, in which case they should be the same (AA or BB), or substitutes, in which cases they should be opposites (AB or BA).[6] This will be captured by an interaction state variable $T_{k,l} \in \{C, S\}$ for complements (C) or substitutes (S). The revenue R is then an increasing function of the decisions being correct and of the decisions interacting correctly. In particular, I will assume that the project revenue has

[5]I will discuss later how the setting can also be used to understand the role of strategy when one person makes decisions sequentially over time (but may forget the outcome of earlier optimizations).

[6]With an ordering on the actions, say that $A > B$, this indeed corresponds to the formal definition of complements and substitutes in the sense of Milgrom and Roberts (1990) and Topkis (1998) for the revenue function defined later.

the following parametric form:

$$R = \sum_{k=1}^{K} \alpha_k I_k + \sum_{k=1}^{K} \sum_{l=1}^{k-1} \gamma_{k,l} J_{k,l}$$

where $\alpha_k, \gamma_{k,l} \geq 0$, $I_k = I_{D_k = T_k}$ is the indicator function that decision D_k is correct, and $J_{k,l} = +1$ or -1 depending on whether the decisions D_k and D_l are aligned correctly or not. In other words, if $T_{k,l} = C$ then $J_{k,l} = +1$ if the decisions are AA or BB and $J_{k,l} = -1$ if the decisions are AB or BA, and the other way around for when $T_{k,l} = S$.[7] For much of the paper, I will work with a two-decision model ($K = 2$) and will simplify the revenue function to $R = \alpha_1 I_1 + \alpha_2 I_2 + \gamma J$ where $\gamma = \gamma_{1,2}$ and $J = J_{1,2}$. With 2 discrete decisions, this parametric form is in fact without any loss of generality up to a constant.[8]

Players know the parameters α_k and $\gamma_{k,l}$, but have (initially) no knowledge of the states T_k or $T_{k,l}$. In particular, each player starts with a prior belief about each T_k that states A and B are equally likely and with a prior belief about each $T_{k,l}$ that states C and S are equally likely. In other words, all players believe that $T_k = A$ with probability .5 and that $T_{k,l} = C$ with probability .5, with all T_k and $T_{k,l}$ being independent random variables. (Section 4 will study the effect of public/initial information by introducing an up-front public signal about one of the decision states.) The empirical probability distribution of the states and interactions is also that A and B are equally likely and that C and S are equally likely. The players in this case thus happen to have a common prior belief that moreover happens to be the true empirical distribution. I will later – when studying the role of people in strategy in Sections 6 and 7 – consider how the results would be affected by differing priors, which seems appropriate for settings where strategy really matters.

For each decision D_k there is a project participant P_k who will make that decision, with each participant making one and only one decision. Apart from the K project participants, there will also (sometimes) be an outsider O and/or a principal P, whose roles will be discussed later. The only formal difference between O or P and the project participants P_k is that O and P do not make any project decisions.

One of these $K + 2$ people will be able to investigate, at the start of the game, the (decision and/or interaction) states and then fix and announce a set of decisions. For reasons that will become clear from the equilibrium, I will call that person the 'strategist', i.e., the person who develops the strategy. For most of the analysis, I will assume that the strategist is an outsider, i.e., someone who is not assigned to any of the project decisions. Later in the paper, I will consider the effect of choosing different people as the strategist.

The timing of the game is indicated in figure 1. At the start of the game, the strategist decides – if she want to do a comprehensive optimization – whether to investigate any decision and/or interaction states. If the strategist investigates some decision state T_k (resp. some interaction state $T_{k,l}$), she gets a signal $\theta_k \in \{A, B\}$ (resp. $\theta_{k,l} \in \{C, S\}$) about the true state that is correct with commonly known probability $p_k \in (.5, 1)$ (resp. $p_{k,l} \in (.5, 1)$). After receiving the signal, she can decide whether to investigate another state or to continue. Let $\theta = (\theta_k; \theta_{k,l})_{k,l \in K, l<k}$ denote the vector of all potential signals. To keep the analysis transparent, I will assume that there is no cost to investigating a state, but everyone has a lexicographic preference for less investigations: when otherwise indifferent, everyone prefers less states to be investigated. This is equivalent to assuming

[7] This choice of $J_{k,l} \in \{-1, 1\}$, as opposed to $I_{k,l} \in \{0, 1\}$, is made to ensure that the effects of complements or substitutes do not depend on the naming of the states.

[8] Note that the interaction states capture what is often called 'internal alignment' while the decision states capture 'external alignment.' (e.g. Bower, Bartlett, Uyterhoeven, and Walton (1995).)

1 Strategy making

a The strategist decides which states T_k and $T_{k,l}$ to investigate.

b When she investigates a state T_k or $T_{k,l}$, the strategist receives a signal θ_k or $\theta_{k,l}$ that is correct with probability respectively p_k and $p_{k,l}$. She can then either return to 1a or continue to 1c.

c The strategist can fix and announce one or more decisions D_k.

2 Signals and Decisions

a Each participant P_k receives signals θ_k and $\theta_{k,l}$ about her decision state T_k and about the interaction states $T_{k,l}$ of her decision with any adjacent decisions. These signals are correct with respective probabilities p_k and $p_{k,l}$.

b All participants make their decisions (either simultaneously or sequentially without observing each others' decisions).

3 Potential Reversion

a All signals and decisions are revealed to all players.

b Each player P_k can decide (in ascending order) whether to reverse his decision D_k at a cost c_k to the project.

Figure 1: Timing

an infinitesimal cost of investigating a state.[9] Based on the signals from all investigations, the strategist can then fix and announce one or more decisions. (The equilibrium set of announced decisions will turn out to be the optimal strategy, as defined later). I will again assume that there is no cost from fixing and announcing decisions but that everyone has a lexicographic preference for fixing and announcing less: when otherwise indifferent, everyone prefers less decisions to be fixed and announced. This is again equivalent to assuming an infinitesimal cost of fixing and announcing a decision. With respect to investigating *versus* announcing/fixing, I will assume that players have a lexicographic preference for announcing over investigating: when otherwise indifferent, players prefer to first minimize the number of state investigations and to then minimize the number of decisions announced. This captures the considerable cost involved in collecting comprehensive information for state investigations.

The assumption that the strategist can directly fix the decisions obviously side-steps some critical issues involving strategy implementation. In Sections 6 and 7, I will make strategy a cheap talk announcement in order to investigate some of these implementation issues. Whereas almost all earlier results go through with cheap talk announcements, the combination of cheap talk and open disagreement will introduce some interesting new perspectives.

In stage 2a of the game, each participant P_k gets information about his own decision state T_k, in the form of a signal θ_k that is correct with commonly known probability p_k, and about each interaction $T_{k,l}$ between his own decision and any adjacent decision, in the form of a set of signals $\theta_{k,l}$ (one for each interacting decision) that are correct with respective probabilities $p_{k,l}$. The content and informativeness of these signals are thus (for simplicity) identical to those of the strategist, i.e., it is as if the participants see the same information as the strategist saw (or would have seen if she had investigated that state), which seems like the most neutral assumption. Allowing these signals to differ is an interesting topic for further research. In stage 2b, all participants then make their decisions either simultaneously or sequentially but without observing each others' decisions, to capture the setting of a large organization.[10] (Almost all of the analysis would also go through for a model with sequential decisions that are observed by all. In that case, strategy would also ensure consistency of decisions over time. This is an interesting variation for further research.)

In stage 3, all signals and decisions are revealed. Each participant P_k (sequentially in ascending order) can reverse her decision D_k at cost c_k. This possibility of reversion is introduced to study the effect of decisions being more or less reversible. Except for Sections 4 and 5, though, I will assume

[9] The effect of such costs (and of different costs for different decisions) are important topics for further research.

[10] Simultaneous decisions are mathematically equivalent to sequential decisions where people are not aware of others' decisions when they make their own decision.

that all $c_k = \infty$, so that decisions are completely irreversible.

The simultaneous moves in stage 2b introduce the possibility of multiple equilibria. The equilibrium selection criterium that I will apply is that of symmetric belief-based learning or fictitious play (Fudenberg and Levine 1998), which seems most appropriate to capture the setting of a large organization where people have difficulty coordinating. In symmetric belief-based learning, each player starts with the naive prior belief that all other players will randomly and independently choose between A and B, with both actions equally likely. Each player chooses her own action as a best response to these (naive) beliefs, given the payoff structure of the game. Each player then observes all others' actions and updates her beliefs accordingly. And so on. If there are multiple equilibria, I will select the equilibrium to which this learning process converges.

Let $\tilde{c}$ denote the sum of all reversion costs c_k that are actually incurred. The players' objective is to maximize the expected value of $\Pi = R - \tilde{c}$. This is equivalent to assuming that all players' utility is a strictly increasing function of Π and that players are risk neutral. I thus assume here that all players are cooperating on the same project and share (to some degree) the same objective. Extending the model by introducing competitors or independent players – who have different objectives and whose decisions may affect the focal organization – is an important direction for further research but beyond the scope of this paper.

I will focus on pure strategy equilibria that are symmetric in the sense that switching A and B in all signals also switches A and B in all announcements in 1c and in all action choices in stage 2. The rationale for imposing such symmetry is that any asymmetric equilibrium requires sophisticated and precise coordination on the particular equilibrium that is being played, which is clearly unrealistic in the context of an organization that struggles with the much simpler task of coordinating its decisions.[11]

I will use some recurring notation throughout the paper. Let $\beta_k = \alpha_k(p_k - .5)$ and $\eta_{k,l} = \gamma_{k,l}(2p_{k,l} - 1)$ combine, for respectively the decision and the interaction state, the importance with the eventual confidence. Let Z_k denote the piecemeal choice for D_k, i.e., the choice that maximizes I_k. Define the 'piecemeal outcome' or 'trivial outcome' as the outcome where each player chooses Z_k. For any variable denoting a decision choice, say $X \in \{A, B\}$, let $\overline{X}$ denote the complement, i.e., $\overline{X} \in \{A, B\} \setminus X$.

3 Business Strategy as an Equilibrium Outcome

I start now by formally defining (project or business) strategy and by showing that such strategy is indeed the equilibrium outcome of the game described in Section 2.

Note first that a strategy as the minimum set of decisions sufficient to guide all other decisions is only meaningfully defined relative to a target outcome, and relative to the audience and the available information. The need to specify the target outcome is obvious. The need to specify the audience and available information comes from the fact that 'minimum sufficient' always depends on what the relevant participants know and what the strategist knows. For example, if it is common knowledge among the participants that $Z_2 = A$ then there is usually no need to specify $D_2 = A$ in the strategy. But for an audience that does not know that $Z_2 = A$, the information in the strategy must

[11] An example of such an excluded equilibrium is an equilibrium where, whenever the optimum is for all players to choose A, the strategist announces no decisions at all. Given common knowledge of the equilibrium, all participants know that they should choose A, and will thus coordinate on the right outcome, whenever no strategy is announced. Such equilibrium is not very realistic for any setting where strategy matters since it requires a high degree of coordination on the (unusual) meaning of 'no strategy'. The symmetry condition excludes such equilibria.

compensate for that more limited shared knowledge. For another example, if the strategist, through the investigation, knows that the piecemeal outcome happens to coincide with the optimal outcome then the optimal strategy – with insiders as the audience and with this particular shared information – is empty. For a different audience with garblings of these signals (say outsiders), the optimal strategy will likely not be empty. Generally, I conjecture optimal strategies for insider audiences to be simpler and more sparse than for outsider audiences, especially when the organization has shared beliefs (Van den Steen 2010a). It is also important to note that the definition implicitly assumes an organizational context within which the strategy will guide other decisions. For example, the ability of the strategist to collect information and fix decisions and the assignment of employees to decisions are part of the organizational context in this model.[12]

With these considerations in mind, the definition of strategy as the 'minimum set of decisions to guide all other decisions' can then be reformulated in the context of the model of Section 2: a strategy – given the target outcome and given the beliefs – is the minimum set of decisions to fix so that the equilibrium of the subgame starting in stage 2 implements the target outcome.

To completely formalize this definition, I need to introduce some notations. Let the target outcome, which may depend on the vector of signals θ, be denoted $\tilde{\mathbf{D}}(\theta) = (\tilde{D}_1(\theta), \ldots, \tilde{D}_K(\theta))$. One target outcome of particular importance is the optimal outcome, denoted as $\hat{\mathbf{D}}(\theta)$: for each θ, $\hat{\mathbf{D}}(\theta)$ maximizes R. Denote the subset of signals that the strategist has investigated as τ. This subset of signals is chosen by the strategist and may thus change depending on the context. Let $\tilde{\tau}$ denote a particular realization of that subvector τ, and $\mathcal{T}$ the set of all possible realizations for τ, i.e., the set of all possible $\tilde{\tau}$. It will be convenient to also have some notation for the subvector of signals that are in θ but not in τ. I will denote this by τ' and use $\tilde{\tau}'$ and $\mathcal{T}'$ as the analogous symbols for $\tilde{\tau}$ and $\mathcal{T}$, so that $\theta = (\tau, \tau')$. I will, finally, use $K_{\mathcal{S}} \subset K$ to denote the indices of the subset of decisions that are part of the strategy $\mathcal{S}$.

Definition 1 *A strategy $\mathcal{S}$ (for target outcome $\tilde{\mathbf{D}}(\theta)$, revealed signals $\tilde{\tau}$, and for given players' beliefs) is a set of decision choices $(D_k = \tilde{d}_k)_{k \in K_{\mathcal{S}}}$ for a subset of decisions $K_{\mathcal{S}} \subset K$ such that*

1. *$\tilde{d}_k = \tilde{D}_k(\tilde{\tau}, \tilde{\tau}')$ for all $k \in K_{\mathcal{S}}$ and for all $\tilde{\tau}' \in \mathcal{T}'$,*
2. *for any $\tilde{\tau}' \in \mathcal{T}'$, the outcome $\tilde{\mathbf{D}}(\tilde{\tau}, \tilde{\tau}')$ is an equilibrium outcome of the subgame starting in stage 2 – with no reversions in stage 3 – when $\tau = \tilde{\tau}$ and $\tau' = \tilde{\tau}'$ and when the decisions $D_k = \tilde{d}_k$ are fixed and common knowledge for all $k \in K_{\mathcal{S}}$, and*
3. *there does not exist a set of decision choices $\check{d}_k$ for a subset of decisions $K_{\check{\mathcal{S}}} \subset K$ such that the two previous conditions are satisfied and $K_{\check{\mathcal{S}}} < K_{\mathcal{S}}$.*

An optimal strategy for $\tilde{\tau}$ is a strategy that implements the optimal outcome $\hat{\mathbf{D}}(\tilde{\tau}, \tilde{\tau}'), \forall \tilde{\tau}'$.

A strategy does not necessarily exist for every $\tilde{\tau}$ and $\tilde{\mathbf{D}}$, however. If, for example, τ is empty and the desired outcome $\tilde{\mathbf{D}}$ is neither the trivial outcome nor a constant, then no strategy exists. But when τ is the full vector of signals, a strategy always exists for any $\tilde{\mathbf{D}}$: setting $D_k = \tilde{d}_k = \tilde{D}_k(\tau), \forall k$ is a candidate strategy that satisfies the first two conditions of the definition, so that condition 3 then minimizes over a finite non-empty set and a strategy always exists. This ensures that the overall problem of finding an optimal strategy is well behaved.

This definition does not restrict the participants' (and thus the audience's) beliefs at the start of stage 2. In particular, it allows the strategy to influence the beliefs. In some instances, such

[12]The strategy may, on its turn, specify or imply certain organizational choices, such as the level of incentives or the degree of delegation of operational decisions.

inferences are a realistic feature of strategic settings. For example, it is not unusual to hear someone defend their company's strategy against an alternative suggestion by saying "I'm sure our management knew about that option and the fact that they didn't follow it means that they must have information that shows it's no good." I therefore did not want to immediately restrict the beliefs but instead state the beliefs explicitly in the proposition. Whereas more research is needed to understand this better, the equilibrium refinement in Appendix B corresponds to a restriction that 'for all decisions that are not part of the strategy, the beliefs at the start of stage 2 equal the prior beliefs,' which is the most logical and most intuitive restriction. All results would go through under this refinement (and the corresponding refinement to the definition of strategy).

The following proposition then says that the strategist will in equilibrium announce exactly an optimal strategy.

Proposition 1 *In any equilibrium, the set of decisions fixed by the strategist in stage 1c is exactly an optimal strategy (for the signals observed in stage 1b and the beliefs at the start of stage 2).*

Proof : As neither the investigation of states nor the announcement of decisions have a monetary cost (because they affect only lexicographic preferences), the equilibrium of the game must generate the maximum payoff (given the signals θ), i.e., the outcome must be the optimal outcome $\hat{\mathbf{D}}$. It further follows that, in equilibrium, the strategist will fix in stage 1c a set of decisions such that the equilibrium of the subgame starting in stage 2 implements the optimal outcome for any realization of signals. Moreover, among all sets of decisions that so implement the optimal outcome, the strategist will choose the one with the smallest number of decisions (given her lexicographic preference for fixing less decisions). That set of decisions is thus an optimal strategy (for the states investigated in stage 1b and the beliefs at the start of stage 2). This proves the proposition. ■

While the proof of this proposition is almost automatic, the result is important because it connects the definition of strategy as the 'minimum set of decisions to guide all other decisions' with the important practice of 'looking ahead to the overall problem when making one particular decision'. This provides a clear rationale for the use of strategy in practice and a reference point to think about the concept.

This does not mean, however, that the strategy concept derived here is only relevant in the context of 'a planned strategy for an organization'. In particular, the definition can also be interpreted as 'the minimum set of decisions sufficient to pin down all other decisions' where the 'pinning down' can use only local information. As such, the general ideas of this paper may be useful to study 'strategy as description' when the course of action emerged or evolved (Mintzberg 1990). This is an interesting direction for further research. The definition can even be used in the context of an individual decision maker, when that decision maker may forget the outcome of previous optimizations: if such individual decision maker is more likely to remember a small set of decisions (i.e., a strategy) than a full course of action, then strategy as defined here eliminates the need to recalculate the overall solution every time a new decision comes up while ensuring consistency over time.

An obvious question is how this definition of strategy relates to the definitions in the management literature. Although some interpretation is necessary, definitions such as those by Chandler (1969), Andrews (1987), or Porter (1980) seem to refer essentially to the core decisions of a company to help everyone understand where the company is going. In that interpretation, they are completely consistent with the definition in this paper. This is also true not only for the definitions that Mintzberg (1987, 2007) suggests as the consensus view among dictionaries, managers, and other sources, but also for some of the other definitions he and Hax and Majluf (1996) list.

Furthermore, the list of decisions by Collis and Rukstad (2008) can also be interpreted as an average experience-based 'minimum set of decisions sufficient to guide all other decisions' for the most common situations. The theory in this paper is complementary to such experience-based approach by providing a rationale for such list, by providing an evaluation criterium to potentially further refine the list, and by providing a logic for adjusting the list to specific settings, circumstances, or evolutions.

There are a few points that deserve clarification. A first point is that strategy is often defined as a 'pattern'. I will return to this issue below. The essence of my argument on this issue is that strategy is about ensuring that there is a pattern in the decisions – as I will show, for example, that a strategy is valuable only when there are interactions – but that strategy is itself distinct from that pattern: strategy can be one single decision, such as 'being low-cost', that guides all other decisions to form a pattern. Strategy is the unifying thought behind the pattern. A second point is the frequent mention of 'goals' as part of a strategy in these definitions, for example in Collis and Rukstad (2008) or Chandler (1969). Such 'goals' as part of a strategy do not refer to overall goals such as 'shareholder value maximization' but to more subordinate goals such as 'grow to 17,000 financial advisers by 2012.' But such goal is in essence a decision on a targeted aggregate variable – in this case firm size – that is used to guide many other decisions. This is similar to a decision to 'be low cost': you don't become low cost 'by decision'; it is a decision on an objective that guides other decisions. The inclusion of such 'objectives' is thus consistent with the definition that I proposed here. A third point is the view that strategy is about being 'consistent over time'. The model in this paper is consistent with that – as long as one does not exclude that strategy is *also* about being consistent at one point in time – because the model in this paper can be interpreted as having sequential decisions (that are not observed by others) and can easily be reformulated as having sequential decisions that are observed by all.

It is also important to point out that an agent in this model may be interpreted as a unit of the firm, such as the production or marketing function or a product division. The CEO's strategy then specifies the minimum set of decisions to guide all decisions of functions. Each function, such as marketing or production, on its turn then translates that to a marketing or production strategy. An organization will thus often have a cascade of strategies, from an overall strategy to functional strategies, and sometimes even further down to product strategies or the strategy of a particular marketing campaign.

A final useful question is how this definition of strategy differs from the job description of a manager. Isn't 'choosing the set of decisions sufficient to guide all other decisions in her unit' exactly what a unit's manager should do? The answer is 'not necessarily', for a number of reasons. First of all, a manager will often do more than that. For example, managers may make decisions that don't necessarily guide any other decisions. Managers motivate and represent their unit to the rest of the organization, etc. But second, and more importantly, the task of developing a unit's strategy is not automatically part of the manager's job description and may sometimes be allocated to someone other than its manager, for example a consultant or a staff unit. Fundamentally, this is an organization design question on how to allocate authority and control: should a unit's manager choose the unit's strategy? I will argue in Section 6 that such an allocation has important advantages, but that does not imply that it is either always optimal or always true. For example, the manager's capacity for decision making may fall short of what is required or there may be scale benefits in grouping strategic decision making in one unit. In the end, whether each manager should be responsible for the strategy of her unit is a normative question. And a precise definition of strategy combined with an understanding of its role are important to study this question.

4 The Value of Strategy

When thinking about strategy, at least three questions immediately come up: Why does strategy matter? What does it look like? And how do you find one? The following sections will study each of these questions – on a relatively general level. Section 6 and 7 will also consider the question whether and how it matters who develops the strategy, which was one of the original motivations for this work.

While the content and the optimal development of strategy have more practical relevance than the value of strategy, the latter is a better starting point for the analysis. The reason is that studying the value of strategy gives insight into what strategy 'does', i.e., how it changes decision-making and how it affects the ultimate outcome. That, in turn, is an important building block for understanding the content and the development process of an optimal strategy.

In this section, I therefore start the analysis with this first line of questions: Why does strategy matter? When is it more useful or more important to consider the overall problem before making any particular decisions? This question has both a quantitative and a qualitative component: how much will the solution improve by developing a strategy – and what may that depend on – and in what qualitative way does the outcome or solution differ by having a strategy, i.e., what is it that strategy 'does'? Empirically, this question identifies settings where where 'strategic' companies are more likely to outperform 'myopic' companies and settings where companies will spend more on strategy development.

I start this analysis with some results that mainly confirm general intuitions about strategy. Such intuition-confirming results are important for a formal theory because they show that the definition indeed captures (at least part of) the essence of strategy. Moreover, the results also give useful insight into the role of strategy.

For this formal analysis, I will study the model of section 2 with two decisions ($K = 2$) and with all $c_k = c$ for some exogenously given c. (Allowing different c_k does not seem to generate extra results that are particularly interesting.) The analysis compares the game with and without stage 1. I will use the expression 'developing a strategy' to refer to the combination of the investigations and decision announcements in stage 1. Proposition 2a then shows that the benefit of developing a strategy is higher when there are stronger interactions among the decisions, when eventual confidence about these interactions is higher, and when decisions are more difficult to reverse. Moreover, interactions and irreversibility are complements: the degree to which strong interactions make strategy more valuable is higher when decisions are also more difficult to reverse, and the other way around. *Simultaneous* interaction and irreversibility are thus necessary for strategy to be valuable.

Proposition 2a *The value of developing a strategy increases in the degree of decision interaction (γ), in the eventual confidence in the interaction ($p_{1,2}$), and in the degree to which decisions are difficult to reverse (c). Decision interaction, eventual confidence in the interactions, and irreversibility are all complements with respect to the value of strategy.*

Proof : Remember that Z_k denotes the choice for D_k that maximizes I_k and that $\eta_{k,l} = \gamma_{k,l}(2p_{k,l} - 1)$, $\eta = \eta_{1,2}$, and $\gamma = \gamma_{1,2}$. I will also define $\overline{k} = \text{argmax}_k\, \alpha_k(2p_k - 1)$ and $\underline{k} = \text{argmin}_k\, \alpha_k(2p_k - 1)$.
Given the assumption that there is no monetary cost (beyond lexicographic preferences) for announcing/fixing decisions, the strategist can always implement what she believes is best (since she can in principle fix *all* decisions). Moreover, absent a monetary cost of investigating decisions (beyond lexicographic preferences), the equilibrium expected payoff will be as if she investigated all states and thus knew all signals (since she will investigate any signal that may potentially affect the expected payoff). The value of strategy

thus equals the difference between, on the one hand, the maximum expected payoff when all signals θ are revealed (and one person can choose all decisions) and, on the other hand, the expected equilibrium payoff if stage 1 did not exist.

Consider now first the optimal choices, denoted $\hat{D}_k$, when all signals are known. By renaming the decision choices, I can assume here wlog. that $\theta_{1,2} = C$. If now $Z_1 = Z_2$, then $\hat{D}_1 = \hat{D}_2 = Z_1 = Z_2$, and the payoff is $\alpha_1 p_1 + \alpha_2 p_2 + \eta$. If $Z_1 \neq Z_2$, then there are 3 candidates for the optimal outcome:

1. $D_1 = Z_1$ and $D_2 = Z_2$ with payoff $\alpha_1 p_1 + \alpha_2 p_2 - \eta$.
2. $D_1 = Z_1$ and $D_2 = \overline{Z}_2$ with payoff $\alpha_1 p_1 + \alpha_2 (1 - p_2) + \eta$.
3. $D_1 = \overline{Z}_1$ and $D_2 = Z_2$ with payoff $\alpha_1 (1 - p_1) + \alpha_2 p_2 + \eta$.

If $\overline{k} = 1$ and $\underline{k} = 2$ then $\alpha_1 p_1 + \alpha_2 (1 - p_2) + \eta \geq \alpha_1 (1 - p_1) + \alpha_2 p_2 + \eta$ and only candidates 1 and 2 are left, and analogously for $\overline{k} = 2$ and $\underline{k} = 1$. It follows that the optimal solution is to always set $D_{\overline{k}} = Z_{\overline{k}}$ and to set $D_{\underline{k}} = Z_{\overline{k}}$ if $\eta \geq \alpha_{\underline{k}}(p_{\underline{k}} - 1/2)$ and $D_{\underline{k}} = Z_{\underline{k}}$ if $\eta \leq \alpha_{\underline{k}}(p_{\underline{k}} - 1/2)$. The expected payoff is $\alpha_{\overline{k}} p_{\overline{k}} + \frac{\alpha_{\underline{k}}}{2} + \eta$ if $\eta \geq \alpha_{\underline{k}}(p_{\underline{k}} - 1/2)$ and $\alpha_{\overline{k}} p_{\overline{k}} + \alpha_{\underline{k}} p_{\underline{k}}$ if $\eta \leq \alpha_{\underline{k}}(p_{\underline{k}} - 1/2)$.

Consider next the equilibrium outcome in the case without any announcement/fixing in stage 1c and without reversing any decisions ex-post. The equilibrium in this case is that $D_k = Z_k, \forall k$. Since the choices will be aligned half the time, the expected payoff from this equilibrium equals $\alpha_1 p_1 + \alpha_2 p_2 = \alpha_{\overline{k}} p_{\overline{k}} + \alpha_{\underline{k}} p_{\underline{k}}$.

Consider finally the equilibrium outcome in the case without announcing/fixing in stage 1c but *with* reversing. Consider now the gain for each player from changing his decision from the original piecemeal solution. If $Z_1 = Z_2$, there is obviously no gain from reversing any decision, so assume that $Z_1 \neq Z_2$. In that case – since the cost of reversing is the same for all decisions and each player tries to maximize overall profits Π – the decision with the lowest $\alpha_k(2p_k - 1) + c$ will reverse as long as that $\alpha_k(2p_k - 1) + c$ is smaller than 2η.

Taking the last two cases together, the expected payoff from the equilibrium without strategy equals $\alpha_{\overline{k}} p_{\overline{k}} + \alpha_{\underline{k}} p_{\underline{k}}$ if $\eta \leq \alpha_{\underline{k}}(p_{\underline{k}} - .5) + c/2$ and $\alpha_{\overline{k}} p_{\overline{k}} + \frac{\alpha_{\underline{k}}}{2} + \eta - c/2$ if $\eta \geq \alpha_{\underline{k}}(p_{\underline{k}} - .5) + c/2$.

I can now calculate the gain from strategy. When $\eta \leq \alpha_{\underline{k}}(p_{\underline{k}} - \frac{1}{2})$, the gain from strategy is zero (since the payoff always equals the piecemeal payoff $\alpha_{\overline{k}} p_{\overline{k}} + \alpha_{\underline{k}} p_{\underline{k}}$).

When $\eta > \alpha_{\underline{k}}(p_{\underline{k}} - \frac{1}{2})$, the gain from strategy equals

$$\min\left(\eta - \alpha_{\underline{k}}(p_{\underline{k}} - \frac{1}{2}), c/2\right) = \min\left(\gamma(2p_{1,2} - 1) - \alpha_{\underline{k}}(p_{\underline{k}} - \frac{1}{2}), c/2\right) \tag{1}$$

The comparative statics on γ, $p_{1,2}$, and c follow immediately. So does the fact that γ and $p_{1,2}$ are complements with respect to the value of strategy. For the complementarity between γ and c, consider c having values $\overline{c} > \underline{c}$ and γ having values $\overline{\gamma} > \underline{\gamma}$. Let $\overline{A} = 2[\overline{\gamma}(2p_{1,2} - 1) - \alpha_{\underline{k}}(p_{\underline{k}} - .5)]$ and $\underline{A}$ analogous. Complementarity between γ and c then requires that $\min(\overline{A}, \overline{c}) - \min(\underline{A}, \overline{c}) - \min(\overline{A}, \underline{c}) + \min(\underline{A}, \underline{c}) \geq 0$. Since the expression is completely symmetric in A and c, it suffices to consider the case that $\overline{A} \geq \overline{c}$ (since the case $\overline{c} \geq \overline{A}$ is completely analogous by symmetry). Now if $\underline{A} \geq \overline{c}$, then the expression equals zero, so we can henceforth assume that $\overline{c} > \underline{A}$. So there are only two possibilities left:

$$\overline{A} \geq \overline{c} > \underline{A} \geq \underline{c} \qquad \overline{A} \geq \overline{c} \geq \underline{c} \geq \underline{A}$$

In the first case, the expression equals $\overline{c} - \underline{A} - \underline{c} + \underline{c} = \overline{c} - \underline{A} > 0$. In the second case, the expression equals $\overline{c} - \underline{A} - \underline{c} + \underline{A} = \overline{c} - \underline{c} > 0$. This proves that they are complements. The proof for complementarity between c and $p_{1,2}$ is completely analogous. This proves the proposition. ■

The intuition for the role of interaction is that when there is little interaction (or when there is a lot of uncertainty about the exact form of the interaction), then there is little to gain from aligning with other decisions, so that each decision should be made on its own terms. There is then no gain from an overall 'strategy' to guide decisions. Similarly, when all decisions are reversible, interactions can be resolved through ex-post adjustment and there is no need for the anticipation and planning inherent in strategy (Ghemawat 1991). This also makes clear why you need *both* interactions and irreversibility. One practical implication of this result is that a business that is all about getting a few decisions correct with no interaction or where the optimal decisions are widely known, will have very little value from strategy.

The role of interaction here is also interesting from a different perspective. Strategy is often defined as a 'pattern of decisions'. Proposition 2a suggests a different interpretation: strategy is not necessarily a pattern, but its key role is to *generate* a pattern. In other words, strategy only matters when there should be a pattern in the decisions and strategy makes sure that that pattern is realized. But the strategy itself can be one single decision (instead of a pattern of multiple decisions).

In Proposition 2a, the importance of an interaction and the eventual confidence in that interaction have essentially the same effect. This will be a recurring pattern in this analysis. The reason is that both factors work through the same channel: they both affect the importance of getting that particular decision or interaction right. If the participants aren't very confident about the right decision or interaction, then it is also less important to make sure that the decision or interaction follows whatever they think is right.

Before continuing, it is useful to introduce some terminology and notation. The proof of Proposition 2a shows that one decision – the one with the higher $\alpha_k(p_k - .5)$ – will be taken on its own terms while the other decision will adjust to it (or be guided by it). I will refer to the first as the 'dominant' decision and to the latter as the 'subordinate' decision and I will use $\overline{k} = \operatorname{argmax}_k \alpha_k(2p_k - 1)$ and $\underline{k} = \operatorname{argmin}_k \alpha_k(2p_k - 1)$ as the respective indices.

An obvious question at this point is how the value of strategy depends on the importance of (and confidence in) individual (standalone) decisions. Whereas it is obvious, and straightforward to show, that the value of strategy increases when there is a *proportional* increase in the importance of all interactions ($\gamma_{k,l}$) *and* of all individual decisions (α_k), the value of strategy does *not* increase with the importance of one individual decision (α_k) by itself. In fact, the opposite is true: as Proposition 2b below shows, the value of strategy *decreases* in both the importance ($\alpha_{\underline{k}}$) and the eventual confidence ($p_{\underline{k}}$) of the subordinate decision. The reason is that the only way for strategy to achieve coordination and direction is by compromising on individual (subordinate) decisions. As standalone decisions are more important, the compromises and trade-offs get tougher. This reduces the value that strategy can create. The following proposition captures that result formally.

Proposition 2b *The value of developing a strategy* decreases *in the importance ($\alpha_{\underline{k}}$) of the subordinate decision and the eventual confidence ($p_{\underline{k}}$) in it.*

Proof : This follows directly from equation 1 in the proof of Proposition 2a. ■

To see this result in action, consider the following example from Ryanair (Rivkin 2000). All Ryanair's routes are short distance flights. For a fixed turnaround time at the gate, short distance flights spend a larger share of their time on the ground, relative to long distance flights. Turnaround time at the gate thus becomes an important cost driver. One way to speed up the turnaround time is to eliminate food service. That, on its turn, is feasible for Ryanair, precisely because customers care little about food service on short distance flights. In other words, compromising on food service is inconsequential for an airline with only short distance flights. The fact that the subordinate decision (food service) is relatively unimportant to customers makes it feasible for Ryanair to align its decisions around a fast turnaround time. This alignment allows the low-cost strategy to create a lot of value. If, instead, customers cared highly about food service, then alignment would be more costly and strategy would create less value.

These two propositions also capture nicely the fact that strategy deals with the trade-off between the often conflicting objectives of external and internal alignment. 'External alignment' means ensuring that the organization's decisions are appropriate given the challenges and opportunities presented by the organization's environment, and is captured here by the standalone effect of the decisions α_k and p_k. 'Internal alignment' means ensuring that the organization's decisions fit together, and is captured here by the interactions $\gamma_{k,l}$ and $p_{k,l}$. In the setting of this paper, an organization without strategy will do relatively well in terms of pure external alignment, since each decision maker will fully consider his or her local challenges and opportunities. But it will do badly in terms of internal alignment. Strategy improves the organization's internal alignment at the cost of some loss in external alignment. In casu, the subordinate decision will sometimes be piecemeal *sub*optimal in order to improve the alignment with the dominant decision. It should be noted, though, that, unlike in the current setup, internal and external alignment may interact. In that case, it is entirely possible that strategy improves *both* internal and external alignment, although there will typically still be a trade-off at the margin. This is an interesting issue for further research.

Before continuing with comparative statics on the value of strategy, it is useful to explore somewhat further the role of strategy by considering whether and how an uninformed strategy can add value and how that compares to the optimal strategy. I therefore turn to that issue now, and then return to some more comparative statics on the value of strategy.

The value of an *uninformed* strategy It is sometimes said that it is more important to just choose *some* direction than to delay (or to invest more) in order to find the *optimal* direction. A related observation is that managers of high-tech start-ups often talk in terms of 'bets' rather than strategy, reflecting a sense that they are forced to make important and far-reaching choices without having much information to base these choices on. Does it make sense to make such 'bets'? Both of these observations raise the question what the gain from *some* strategy is even when it may be uninformed and thus potentially suboptimal.

To analyze this formally, I will consider a modified version of the model of Section 2 where the strategist cannot investigate any states at all but can still announce (and implement) a strategy, i.e., can announce/fix decisions in stage 1c.[13] What is the value from such 'uninformed' strategy (or strategy 'bet') and what would such strategy look like? For this analysis, I continue to assume that $K = 2$ and that all decisions carry the same cost of reversal, i.e., $c_k = c$ for all k. The following proposition then shows that strategy can add value without information about the optimal decisions and even without knowing whether decisions are substitutes or complements.

Proposition 3 *There is value from developing an optimal* uninformed *strategy when γ, $p_{1,2}$, and c are large relative to α_k and p_k, in particular when $\gamma(2p_{1,2} - 1) > \alpha_{\overline{k}}(p_{\overline{k}} - .5) + \alpha_{\underline{k}}(p_{\underline{k}} - .5)$ and $c > \alpha_{\overline{k}}(2p_{\overline{k}} - 1)$. The value increases in γ, $p_{1,2}$, and c, and decreases in α_k and p_k. The γ, $p_{1,2}$, and c are again all complements with respect to the value of uninformed strategy.*

When an uninformed strategy adds value, any *one-decision strategy (i.e., either $\mathcal{S} = (D_1 = A)$, or $\mathcal{S} = (D_1 = B)$, or $\mathcal{S} = (D_2 = A)$, or $\mathcal{S} = (D_2 = B)$) is optimal (within the set of uninformed strategies).*

Proof : As before, there is no gain from any strategy possible when $\eta \leq \beta_{\underline{k}}$. So assume henceforth that $\eta > \beta_{\underline{k}}$. Absent any decision state signal, the optimal non-trivial outcome is to ensure that the two decisions are aligned correctly (assuming that it is indeed possible to get such alignment, an issue to which I return

[13] This is obviously equivalent to assuming that the cost of investigation is prohibitive. The question what happens at intermediate cost of investigation is an interesting issue for further research but beyond the scope of this paper.

below). The expected payoff such optimal uninformed strategy (if it can be implemented and does better than the piecemeal outcome) equals $\frac{1}{2}(\alpha_1 + \alpha_2) + \eta = \eta + \frac{\alpha_{\overline{k}}}{2} + \frac{\alpha_{\underline{k}}}{2}$.
Remember from Proposition 2a that the expected payoff from *not* having a strategy equals

$$\max\left(\alpha_{\overline{k}}p_{\overline{k}} + \alpha_{\underline{k}}p_{\underline{k}}, \alpha_{\overline{k}}p_{\overline{k}} + \frac{1}{2}\alpha_{\underline{k}} + \eta - c/2\right)$$

It follows that the gain from having the optimal uninformed strategy, equals

$$\min\left(\eta - \alpha_{\underline{k}}(p_{\underline{k}} - \frac{1}{2}) - \alpha_{\overline{k}}(p_{\overline{k}} - \frac{1}{2}), c/2 - \alpha_{\overline{k}}(p_{\overline{k}} - \frac{1}{2})\right)$$

Moreover, when this value is strictly positive, then each player is willing to compromise his decision to ensure that the interaction is correct. It follows that this can be achieved by choosing as strategy $\mathcal{S} \in \{(D_1 = A), (D_1 = B), (D_2 = A), (D_2 = B)\}$. Moreover, all these strategies have the same expected payoff. In other words, *any* of the one-decision strategies is optimal. ■

A first obvious question is how strategy can add value without the strategist even knowing whether the decisions are complements or substitutes. The reason why strategy 'works' here is because people *want* to align their decisions with others when γ is large, but they can only do so if they know what others will do. When γ is sufficiently large relative to α_k and p_k, it becomes optimal to blindly commit one decision, in order to allow others to align with that.[14]

But since the strategy is uninformed, the internal alignment comes at the cost of a near complete loss of external alignment. In particular, under the optimal uninformed strategy, the external alignment – whether decisions are correct on a standalone basis – is no better than random. It is therefore also intuitive that the optimal uninformed strategy is most valuable at high γ and $p_{1,2}$ and at low α_k and p_k.

This benchmark thus clarifies the role of strategy from a different angle: Without *any* strategy, the organization does relatively well on external alignment, but no better than random on internal alignment. With the optimal *uninformed* strategy, things switch to the other extreme: the organization does well on internal alignment, but no better than random on external alignment. The optimal *informed* strategy, finally, optimally combines and trades off internal and external alignment.

An important challenge for such 'strategy as a bet' is implementation: employees may doubt that managers will follow-through on the announced (blind) strategy. This issue is mitigated at low α_k and p_k since participants have less reason to focus on standalone payoffs. But still, the optimal uninformed strategy derived here ceases to be an equilibrium once the strategy is a cheap talk announcement: the equilibrium selection criterium used in this paper will select the piecemeal equilibrium over the announced strategy. Giving direction then requires a commitment device, which can be a reputation of managers to follow-through on an announced strategy, a strategist-leader with strong views, or an irreversible decision. Section 6 and 7 will bring some more formal perspective on this issue.

I now return to the comparative statics on the value of strategy. For the remainder of this section, I will assume that $c_k = \infty, \forall k$, i.e., that all decisions are completely irreversible.

Uncertainty Apart from the factors derived above, intuition also suggests that strategy will be more valuable when there is more initial (or public) uncertainty about what course of action is

[14] Puranam and Swamy (2011) suggest a very different reason why even a wrong 'map' can be useful: when there is a risk of 'superstitious learning', a faulty starting point may sometimes avoid the erroneous learning and lead the firm to the right answer.

optimal. Absent initial/public uncertainty, everyone knows the optimal decisions, which makes it easy to coordinate.[15] To see this another way, the presence of initial/public uncertainty not only makes it more difficult to make the right decision but also makes it more difficult to predict what others will do and thus to coordinate with them.

To investigate the effects of initial uncertainty, I will consider here a 2-decision ($K = 2$) setting where – at the start of the game – all players get a common public signal about one of the states.[16] The question is how this reduction in initial uncertainty affects the value and role of strategy. Formally, let everyone observe a public signal $\sigma_2 \in \{A, B\}$ that $T_2 = \sigma_2$ with probability μ_2. The signal σ_2 is a garbling of θ_2: σ_2 equals θ_2 with probability q, and equals A and B with equal probability otherwise, so that $\mu_2 = .5 + q(p_2 - .5)$ and $.5 < \mu_2 < p_2 < 1$. Initial uncertainty about D_2 can then be measured by the variance $U_2 = \mu_2(1 - \mu_2) \in (0, .25)$.

The following proposition not only shows that the value of strategy increases with initial uncertainty but also that the increase is larger when the degree of decision interaction and the eventual confidence about the interaction are larger.

Proposition 4 *The value of developing a strategy increases in the initial (public) uncertainty U_2 about the decision state T_2. Uncertainty is (with respect to the value of strategy) a complement to the degree of interaction and to the eventual confidence in the interaction.*

Proof : The proof is in Appendix A. ■

The complementarity is key to understanding the role of uncertainty: uncertainty by itself (i.e., at low levels of decision interaction or high reversibility) does not affect the value of strategy; instead, it is the combination of uncertainty and interaction that makes strategy more valuable. In other words, uncertainty makes strategy more valuable, *not* because it makes it more difficult to choose the right decision, but because it makes it more difficult to anticipate what others will do and thus to align.

The role of strategy in the face of uncertainty can again be interpreted in terms of internal and external alignment. The public signal reduces the initial/public uncertainty, allowing participants to anticipate better what others will do and to align with these expected actions. Whereas this improves internal alignment (at the cost of some external alignment), it still underperforms optimal strategy for 3 reasons. First, because the players respond to an imperfect prior signal about the other's likely action, they trust that signal less than they trust a strategy, and are thus less likely to align with it. This reduces internal alignment. Second, because the prior information is less precise than the final signal, the participants more often coordinate on a suboptimal action. This reduces external alignment. Third, because of the latter, the participant in charge of the dominant decision may decide not to adhere to the public signal when it contradicts her private (and more precise) signal, which then negatively affects internal alignment but improves external alignment. Initial/public information, like an uninformed strategy, provides a focal point that helps the participants to align their decisions. But it does better than an uninformed strategy on external alignment because its focal point is more informed – though worse on internal alignment because it is less committed.

[15] In the presence of multiple equilibria, there may still be a role for strategy even in settings with complete information since strategy can potentially play a role in equilibrium selection by making one equilibrium more salient than others. This is not the case in this particular setting, because all players have identical payoffs, but may be important with a different structure of payoffs and is an interesting topic for further research.

[16] The reason for considering a public rather than private signal is that the results for public signals are both more interesting and more tractable. Private signals would have similar but less effects.

Note further that public/initial information may make a player *knowingly* coordinate on the wrong action. In fact, in a modified version of this game it may even happen that each player knows for sure that the strategy coordinates on the wrong action, but players nevertheless follow the (known to be suboptimal) strategy.[17] This gives another useful way to interpret the role of strategy. Relative to such an outcome, the role of strategy is to create *common knowledge* of the optimal action, which then becomes a focal point for more responsive coordination. This perspective is most relevant in the context of change from a suboptimal status quo: strategy can help to create change by creating common knowledge of an alternative optimum. This enables participants to align on a new course of action.

Complements, Substitutes, and Supermodularity Whereas the critical role of interactions was already highlighted, it turns out that not only the strength and confidence of individual interactions matter but also their overall pattern. Companies that are known for their great strategy typically don't have just two or three decisions that are aligned but a large number. Take again the example of Ryanair. Its focus on short flights is aligned with its objective to reduce turnaround times at the gate. Its decision to offer no food service is aligned with both the short flights (which enable that) and the fast turnaround times (which it enables). Both the lack of food service and the fast gate turnarounds are aligned with the overall low-cost objective. What I will show now is that the specific pattern of such interactions directly affects the value of strategy. I will show, in particular, that strategy is more valuable in a (supermodular) setting with all complements than in a (non-supermodular) setting with both complements and substitutes.

Before getting to the formal result, I need to discuss a technical point that is important for both the results and the analysis here: if (exactly) two decisions are substitutes and we rename the decision choices for one of these – i.e., we switch the A and B labels for one of the decisions – then these two decisions become complements (and the other way around). Technically, if x and y are complements then x and $-y$ are substitutes and the other way around. It follows that no general results for complements versus substitutes can be derived with only two decisions (and one interaction) because any result for complements is also a result for substitutes after inverting the sign on one decision. But this only holds for two decisions and not for 3 decisions. In particular, in a setting with 3 decisions and 3 interactions, every time you try to switch an interaction from complement to substitute (or the other way around), you necessarily also switch another one. This places restrictions on the patterns that can be achieved and leads to a number of 'canonical' patterns that cannot be reduced to each other, creating a partition with equivalence classes. In the case of 3 decisions, the two canonical forms are, on the one hand, a setting with all complements and, on the other hand, a setting with 2 complements and one substitute. All other patterns can be reduced to one of these two, but these two cannot be reduced to each other. Following the literature on complementarities (Milgrom and Roberts 1990, Topkis 1998), a setting with all complements is called 'supermodular'. I will therefore denote these two cases as 'supermodular' and 'non-supermodular'. I will now study a setting with 3 decisions ($K = 3$) and 3 interactions and compare the supermodular and non-supermodular cases. I will assume, for simplicity, that all interactions have the same combined importance/confidence: for some fixed η, $\gamma_{k,l}(2p_{k,l} - 1) = \eta$ for all k, l. The following proposition then captures the result.

[17] Formally, if each player privately and independently could learn the dominant participant's preferred action $Z_{\overline{k}}$ with sufficiently small probability, then the lack of common knowledge would imply that the participants would coordinate on an action that both know is suboptimal. In fact, both players may know that the other knows, but the lack of common knowledge prevents them from coordinating on that knowledge.

Proposition 5 *For given α_k, p_k, and η, both the likelihood that there is a gain from strategy and the expected gain from strategy are larger in the supermodular case than in the non-supermodular case.*

Proof : The proof is in Appendix A. ■

Strategic companies will thus outperform myopic ones most in settings that are rich in complements. Conversely, the most perfect strategy creates only mediocre alignment and performance in a setting with both substitutes and complements. As a consequence, picking companies with great performance will result in companies that happen to be in industries or segments with lots of potential complements. Selecting on the dependent variable may thus mislead into thinking that strategy *creates* complements in settings where it only takes advantage of existing ones. (For example, the fact that fast turnarounds are beneficial to companies with short distance flights is a physical fact and not something 'invented' by Ryanair through its strategy.) Moreover, companies that are aware of the structure of interactions are more likely to invest in developing a strategy when that structure is supermodular than when it is not, leading to inverse causality from complements to strategy. Overall, even though alignment is one of the key objectives of strategy, one has to be careful when interpreting the degree of alignment as a measure for the quality of strategy.

Proposition 5 is somewhat related to the results of Crémer (1993), Prat (2002), and Siggelkow (2002). In particular, Crémer (1993) showed that two decision makers who face a team-theoretic setting with an unknown state variable, are better off getting identical signals about that state when their decisions are complements but independent signals when their decisions are substitutes. These results are related to, but quite different from, the current paper: Proposition 5 is about how much value gets generated from implementing the optimal outcome through strategy, whereas Crémer (1993) is about the particular pattern of decisions that realizes (or approximates) that optimum. Also related is Siggelkow's (2002) result that when two (positive) choice variables interact, misperceptions of the interaction are more costly under complements than under substitutes. This result is driven by whether errors (caused by the misperception of the interaction) are being amplified versus attenuated through the interaction. This is very different than irreducible trade-offs among the interactions that lower the benefit of getting to the optimum, which is the mechanism behind Proposition 5. Prat (2002) considerably generalized the most important parts of Crémer (1993) to supermodular and submodular settings, and independently derived the main result of Siggelkow (2002) for this more general setting. But the earlier differences with the current paper thus also apply. The difference between Proposition 5 and these earlier contributions should also be clear from the fact that an analogue of Proposition 5 simply does not hold for a 2 decision setting as studied by Crémer (1993) or Siggelkow (2002) (because getting the alignment right is as valuable under complements as under substitutes). The current result is fundamentally about a *pattern of multiple interactions* as opposed to the type of one single interaction.

5 The Nature of Strategic Decisions and the Strategy Process

Deciding what decisions are 'strategic', i.e., what decisions should be included in strategy, is a challenge for managers, students, and scholars alike. When asked about Walmart, for example, most people tend to say that Walmart's strategy is to be 'low-cost'. But the strategy of KMart was also to be 'low-cost'. And these two competitors had very different strategies, with very different results. Clearly 'low-cost' is thus not sufficient to characterize either Walmart's or Kmart's strategy. It has in fact proved hard to pin down what makes a decisions strategic and why. But it is an essential question for anyone who needs to develops a strategy: it is difficult to find a strategy if you don't know what you're looking for. The importance of these issues is reflected in the fact that Collis and Rukstad (2008) received one of the most coveted awards in the business press for an article on exactly this issue. In the article, they provided an experience-based list of generic decisions that make up a strategy. But such lists lack a rationale or explicit criterium, which makes it difficult to adapt it to specific or changing circumstances.

This paper's approach to strategy has the benefit that its definition implies a clear rationale and general principles for which decisions are 'strategic' and which aren't. That is the focus of this section. This analysis also leads to another important insight: it shows how understanding the structure of strategy may make the strategy development process more efficient by enabling the strategist to find the optimal strategy without doing a comprehensive optimization.

For this analysis, I first need to formalize the definition of being 'strategic'. The criterium I use here is the likelihood that the decision is part of the strategy.[18]

Definition 2 *The degree to which a decision is 'strategic' equals the probability that it is, in equilibrium, part of the optimal strategy (weighing multiple equilibria equally).*

This definition is stated in probabilistic terms because the content of strategy may depend on the state realizations.

To now derive general principles on what makes a decision 'strategic', I will focus again on the $K = 2$ setting, but I will allow the cost of reversal to differ by decision ($c_1 \neq c_2$) in order to study how a decision's reversibility affects it being strategic or not. The following proposition then shows that important decisions are strategic, though only if they also interact sufficiently. Moreover, irreversibility does *not* make a decision strategic.

Proposition 6 *A decision is more strategic when its standalone importance α_k and eventual confidence p_k increase and when the importance $\gamma_{k,l}$ and eventual confidence $p_{k,l}$ of its interactions increase, with standalone importance and confidence being a complement to interaction importance and confidence.*

The level of irreversibility c_k does not *affect whether a decision is strategic.*

Proof : If $\gamma(2p_{1,2} - 1) \leq \alpha_{\underline{k}}(p_{\underline{k}} - .5)$ then the piecemeal outcome is always optimal so that any optimal strategy is an empty set. It follows that, in that case, no decision is strategic.
When $\alpha_{\underline{k}}(p_{\underline{k}} - .5) < \gamma(2p_{1,2} - 1)$, then the optimal outcome has $D_{\underline{k}} = D_{\overline{k}} = \theta_{\overline{k}} = Z_{\overline{k}}$ when $\theta_{1,2} = C$ and $D_{\overline{k}} = \theta_{\overline{k}} \neq D_{\underline{k}}$ when $\theta_{1,2} = S$. This will in equilibrium be implemented with the following (optimal) investigation and announcement: investigate $T_{\overline{k}}$ in stage 1b and fix and announce $D_{\overline{k}} = Z_{\overline{k}}$ in stage 1c. This indeed implements the optimal outcome, given the payoff function and the fact that each P_k observes $\theta_{k,l}$, $\forall l$ in stage 2a. To see that this is the equilibrium, and the only possible one, note the following:

1. As the piecemeal outcome may differ from the optimal outcome (which is the case, for example, when $\theta_{\overline{k}} \neq \theta_{\underline{k}}$ and $\theta_{k,l} = C$), the optimal outcome can only be implemented for sure by investigating at least one state in stage 1b. The only condition under which the optimal outcome can be implemented with less than one announcement is when the piecemeal outcome is optimal (in which case an empty strategy can implement the optimal outcome). But coming to that conclusion requires 3 state investigations, so the lexicographic preference for announcement over investigation implies that everyone prefers 1 investigation and 1 announcement. It follows that any equilibrium must have exactly one investigation and one announcement.

[18] An alternative would be to take the likelihood of being investigated as (part of) the criterium. At least in this paper, these two alternatives give identical results.

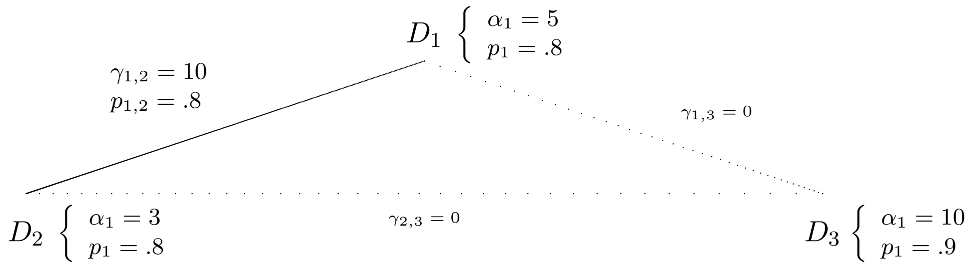

Figure 2: An example of an important decision that is not strategic

2. To see that it is the only equilibrium, note that the only alternative that fixes only one decision would be to fix $D_{\underline{k}}$ (or to alternate fixing $D_{\overline{k}}$ and $D_{\underline{k}}$). But finding the right value for $D_{\underline{k}}$ requires investigating $T_{\overline{k}}$, $T_{\underline{k}}$, and $T_{1,2}$. So this can't be optimal.

This completes the proof. ■

Whereas most people would agree that important decisions are more strategic, it is not immediately clear *why* that is the case. The result here not only provides a clear intuition but also modifies the principle itself as shown in the following corollary.

Corollary 1 *An important decision is not strategic unless it interacts sufficiently: for any α_k and p_k, there exist $\gamma_{k,l}$ (or $p_{k,l}$) such that D_k is not strategic.*

Proof : When either $\gamma_{k,l} = 0$ for all l or $p_{k,l} = .5$ for all l, then no other decision will depend on the choice for D_k, so that D_k will never be part of any strategy. ■

Figure 2 provides an example: whereas decision D_3 is more important (and with more confidence) than either D_1 or D_2, it is not strategic. The strategist will not investigate it or announce it and let P_3 use her local information to make that decision. Decision D_1 on the other hand, is strategic: the principal will investigate it and announce is, so that it can guide D_2. A practical example of an important decision that is most often not strategic is an airline's decision to hedge currency or commodity contracts: whereas such decisions have a tremendous impact on the bottom line, they usually do not affect other decisions and are therefore not strategic. Similarly, a technological choice buried deeply in a product design may critically affect a company's success or failure, but that does not – by itself – make the decision strategic.

The result here also gives a precise intuition: more important decisions are more strategic *not* because they have more impact on the project payoff, but because they are made on their own terms, i.e., without regard to what is optimal for other decisions. The other decisions thus have to adapt to them and be guided by them *if* there is sufficient interaction. To make that possible, the important decisions must be fixed and made public, i.e., be part of the strategy. The intuition for eventual confidence (or residual uncertainty) is again similar.

The most surprising result here is the result that irreversibility does not make a decision strategic, despite the fact that Ghemawat (1991, p42-46) singled out 'irreversibility' as a critical factor in making a decision strategic. Whereas Proposition 2a confirmed Ghemawat's (1991, p29-31) argument that irreversibility makes strategy more important – since you can't align ex post, alignment has to come through strategy – irreversibility does not make a decision strategic: it does not affect the decision's ability to guide other decisions. The irreversible decision may instead be guided by other decisions. Consider the following example. The need to purchase expensive customized equipment for a target market segment increases the importance of developing a strategy in order to avoid incurring this sunk cost and then changing the decision. But that doesn't make the purchase decision itself strategic: the strategic decision, which guides the purchasing decision, is the choice of market segment. That strategic decision is, by itself, rather easy to reverse (in contrast to some of the decisions that depend on it). This was the situation of Coors (Ghemawat 1987): Coors needed to decide on the construction of a large brewery which only made sense if it pursued a national (versus regional) strategy. Whereas the construction decision would be difficult to reverse, the strategic decision here was the choice of geographic scope which should drive decisions such as the brewery construction. Letting the irreversible decision – the brewery construction – dictate the choice of geography would put the cart before the horse. In conclusion, the presence of an irreversible decision may make it vital to develop a strategy but that does not mean that the decision itself will be part of the strategy.

Ghemawat (1991) also suggested a dynamics-based argument for the strategicness of irreversible decisions: as more information arrives over time, the organization may want to change decisions, but irreversible decisions cannot be changed. It thus seems that such decisions will by necessity guide other decisions. But it is important to distinguish here between decisions to which an organization *wants* to commit to provide guidance, which are strategic decisions in a planned sense, and those which it simply can't change by nature. In the basic setting of this model, these are formally shown to be different and unrelated. While this requires more research, Section 6 will suggest a different rationale for why irreversible decisions may be strategic: irreversibility can provide a much-needed commitment in the face of implementation issues. And it may then make sense to build a strategy around an irreversible decision. But in this case, the causal chain is reversed: the strategist needs commitment and therefore picks irreversible decisions as the strategic decisions.

Strategy Process The above result is also important from a very different perspective: it shows that the optimal strategy does not necessarily require a full investigation of all states. In particular, the following corollary shows that for $K = 2$ it suffices to investigate and announce the dominant decision. The strategist does not even investigate the type of interaction (substitute or complement) between the decisions.

Corollary 2 *When $K = 2$, it suffices to investigate the state of the dominant decision $T_{\overline{k}}$ in order to determine the optimal strategy. The optimal strategy is either $S = (D_{\overline{k}} = T_{\overline{k}})$ or the empty set.*

Proof : This follows directly from the proof of Proposition 6 ■

This result implies that understanding the structure of strategy may enable a strategist to be more efficient at finding it. Strategy is thus not only an organizational device to guide the organization towards an optimal outcome but also a problem-solving device to find that optimal outcome in a more efficient way.

It is, moreover, remarkable that even though creating alignment is a key effect of strategy, the strategist does not need to investigate any interaction to get that alignment. While this extreme result is specific to $K = 2$ (and indeed optimal strategies for $K > 2$ will often require the investigation of at least some interactions), it does capture a general and very important result: whereas strategy is about *creating* a pattern in the decisions, strategy itself *is* not necessarily a pattern. An optimal strategy can consist of one single decision (which then triggers the intended pattern). This insight is particularly important as many definitions of strategy have defined it as a pattern of decisions.

Network Centrality Returning now to the question of what makes decisions strategic, it is again important to look – beyond individual decisions – at interaction patterns. An obvious dimension to explore here is centrality: if the role of strategic decisions is to guide other decisions, then one would expect more central decisions – which affect more decisions – to be more strategic. I will measure centrality here by the weighted sum of adjacent links divided by the weighted sum of all links, with a link's weight being its combined importance and eventual confidence $\eta_{k,l}$.

To study this formally, I will consider a setting with 3 decisions ($K = 3$) and 2 interactions, so that one decision is by construction more central than the other two. To focus on the effect of the interactions, I will assume furthermore that all decisions have the same importance: for some given β, $\alpha_k(p_k - .5) = \beta$ for all k. The following proposition confirms that network-central decisions are more strategic because they can guide many decisions at once.

Proposition 7 *The more central decision is (weakly and for a non-empty parameter range strictly) more strategic.*

Proof : The proof is in Appendix A. ■

6 The Role of the Strategist and of CEO Involvement

The way most people think of strategy – and the way that strategy is usually taught – takes strategy as a very objective and analytical issue. Underlying this approach is an implicit assumption that there exists some unique optimal strategy and that that unique optimal strategy can (and will) be discovered through careful analysis and data collection. Strategy is seen as a problem-solving exercise. This view implies that the smartest analyst with the most information will come up with the best strategy and that rational people should agree on the optimal strategy. There is no reason for the nature of the optimal strategy to depend on the strategist; no reason for the optimal strategy to depend on the CEO's world view; and no reason for strategy formulation and execution to be done by the same people. It is this 'objective' view of strategy that was captured in this paper up to this point.

This 'objective' view of strategy, however, stands in contrast to the fairly messy and almost personal or subjective nature of strategy development. It is common to see deep and persistent disagreements among otherwise very smart and rational people about a company's strategy – especially when a company is doing badly. In fact, it would be rare to find a company in trouble with unanimity on its optimal strategy.[19] This observation is closely related to the widely held view (among managers) that strategy is the CEO's job and not that of some smart outside analyst. It is almost as if a strategy is something personal and strategy formulation and execution are deeply linked. New CEOs are almost *expected* to propose new strategies, while a CEO's background can give important clues as to the kind of strategy she may develop. But why would it matter who develops the strategy, if it's just a matter of getting it 'right'? Why not hold, for example, a vote? And even when strategy is not fully objective, why would the CEO's view – rather than, say, the view of a very smart analyst – somehow be the 'right' one?

Such partially personal nature of strategy and a deep link between strategy formulation and execution has important implications. If the optimal strategy is CEO-dependent, then that affects what boards and shareholders should consider when appointing a new CEO. It also throws a very

[19] Or, looking more broadly, unanimity on how to solve challenges like famine or climate change.

different light on CEO turnover. If the optimal strategy is CEO-dependent, then it may be optimal for a new CEO to propose a new strategy and this should be more likely when core decisions are more controversial. And if CEO involvement in strategy is critical, then that should affect the division of work between a CEO and a board.

Deep and persistent disagreement about strategy is in fact quite natural. Strategy, as I showed earlier, deals with the fundamental uncertainties a company faces: which technologies will succeed, how competitors will respond, how customers and markets will evolve, etc. With little or no data and often no way to completely resolve uncertainty except waiting for the outcome, this is where people need to rely on intuition and judgement. But intuition and judgment are almost by definition personal and thus different across people. As Knight (1921) observed, such 'business decisions [...] deal with situations which are far too unique [...] for any sort of statistical tabulation to have any value for guidance. The conception of an objectively measurable probability or chance is simply inapplicable.' People thus almost unavoidably have personal or subjective views about a firm's optimal strategy.

To formally study the role of 'subjectivity,' I will assume that players have differing prior beliefs. In a model with differing priors, players may openly and persistently disagree in their beliefs even though they do not (necessarily) have private information. This assumption of (unbiased) differing priors captures the fact that people may have different 'intuition,' 'mental models,' or 'belief systems,' which may lead people with identical data to draw different conclusions. Although not (yet) fully mainstream in economics, the differing priors assumption does have a long tradition in economics, including articles such as Arrow (1964), Wilson (1968), Harrison and Kreps (1978), Varian (1989), Harris and Raviv (1993), Morris (1994), Yildiz (2003), Van den Steen (2005, 2010), Bolton, Scheinkman, and Xiong (2006), Boot, Gopalan, and Thakor (2006), and Geanakoplos (2009), and has recently been on the rise. Hong and Stein (2007) argue that 'disagreement models (...) represent the best horse on which to bet [as the future consensus model for behavioral finance].' There is also a burgeoning empirical literature such as Chen, Hong, and Stein (2002) or Landier and Thesmar (2009). The differing priors assumption fits an analysis of strategy particularly well, as the fundamental role of 'belief systems' has been stressed by academic studies of managers and managerial decision making (Donaldson and Lorsch 1983, Schein 1985). A more in-depth discussion of differing priors can be found in Morris (1995) or Van den Steen (2010a,b).[20]

For the analysis, I will focus on differing priors about decision states – as opposed to disagreement about interactions – because informal observation suggests that strategic disagreement usually reflects disagreement about optimal standalone decisions (due to disagreement about the state of

[20]People having differing beliefs raises the question which beliefs to use in the analysis. Since people believe that they are right but know that others may disagree (and that these others believe that they are right), each person will act on his or her own personal beliefs but is also aware that others will act on their beliefs.
An important question is why – if the decision is important – players don't simply discuss until they reach agreement. The answer is twofold. First, many of these beliefs – and the worldview they derive from – are deeply engrained and difficult to change. Second, the decision on persuasion is a time and cost trade-off, and in many cases persuasion is just not the right option as further data collection may be very costly and time consuming.
Another question is where such differing priors would come from in a Bayesian framework. There are three ways to think about this. As the prior for this game is a posterior from earlier updating, (unconscious) bounded rationality will often lead to differing priors, even when starting from a common prior. Unconsciously forgetting some of the data used to update beliefs, for example, would do. A second – more philosophical and more controversial – argument is that people may be born with differing priors: in the absence of information there is no reason to agree. From that perspective, differing priors are perfectly consistent with a fully rational Bayesian paradigm: priors are just primitives of a model. A third is to see the Bayesian model as a good local approximation of human thinking but not necessarily as a good global approximation.

the outside world) rather than disagreement about interactions, which are more often an internal and better understood issue. In particular, assume that people start, as before, with no knowledge of the relevant states and thus with 50/50 beliefs about the state. There is no change compared to before for beliefs and signals about interaction states ($T_{k,l}$), i.e., players will never openly disagree about the interactions. There is, however, potential disagreement on decision states (T_k). When someone gets a signal about a decision state – either by investigating that state in stage 1b or by learning about the state in stage 2a – they learn their subjective beliefs about that state. The interpretation here is that all players observe the same signal but disagree in their interpretation of that signal. (Like two people reading the same economic indicators but disagreeing what it means for the optimal economic policy.) I will use θ_k^i to denote the signal *as subjectively perceived* by P_i. When P_i and P_j both learn the signal for T_k and $\theta_k^i \neq \theta_k^j$ then this means that they observed the identical same signal but interpreted it differently. Each player thinks her own interpretation is correct and the other is wrong, so that when P_i has observed θ_k^i and then learns that $\theta_k^j \neq \theta_k^i$, she will not update her beliefs about T_k but she will simply think that P_j misinterpreted the signal.[21] Let Z_k^i denote the decision that player i believes maximizes I_k and let $p_k^i \geq .5$ denote i's confidence in that state upon observing θ_k^i, i.e., p_k^i is i's belief that $T_k = Z_k^i$ after observing θ_k^i. I will assume that the beliefs are drawn randomly such that any two players i and j agree on the optimal decision for D_k with probability $\lambda_k^{ij} \geq .5$, where λ_k^{ij} is an exogenously given parameter, i.e., $P[Z_k^i = Z_k^j] = \lambda_k^{ij}$. Agreement or disagreement will be conditionally independent events across both players and states.

To summarize, consider two players i and j who both observe the signal for T_k. These two players will disagree on the optimal standalone decision for D_k ($Z_k^i \neq Z_k^j$) with probability $1 - \lambda_k^{ij}$. Moreover, players i and j each believe that they are correct with probability p_k^i and p_k^j respectively. Since these are all subjective beliefs, there is no necessary connection among p_k^i, p_k^j, and/or λ_k^{ij}. The fact that any two players may disagree, the confidence levels p_k^i, and the disagreement probability λ_k^{ij} are all common knowledge.

6.1 Personal View on Which Decisions are Strategic

I now start by considering the question how strategies would differ when they are developed by different people. A simple answer is that if people disagree sufficiently about where things are headed, then they will also disagree on the optimal outcome and thus on the optimal strategy.[22] But can we say something more systematic about how disagreement will affect strategy?

The key result and insight of this subsection is that a person is more likely to consider a decision strategic when she has strong beliefs about that decision. People will thus differ systematically in which decisions they consider strategic and therefore in the *kind* of strategies they develop.

To study this formally, consider two $K = 2$ firms with identical α_k, $\gamma_{k,l}$ and identical true states T_k, $T_{k,l}$. Each firm has a strategist, denoted i and j. To focus completely on the role of the strategist's beliefs, I will assume that in each of the two firms, all participants always interpret signals in the same way as the firm's strategist. So for each firm and strategist, the situation is completely as before, but the two strategists (and by extension any two employees of the two firms) may disagree. Let $\overline{k}^i$ denote the dominant decision according to strategist i.

[21] If the model would also include private information – which is more realistic but less tractable – then there would be some updating after observing disagreement, but disagreement would persist.

[22] Consider, for example, a $K = 2$ setting with $\alpha_1 = \alpha_2 = \gamma_{k,l} = 1$. Let both participants's confidence be identical (though they may disagree on the optimal decisions) with $p_1^1 = p_1^2 = .9$, $p_2^1 = p_2^2 = .6$ and $p_{1,2} = .6$. Both players now consider D_1 to be the strategic decision so that player i will set as strategy $\mathcal{S} = (D_1 = Z_1^i)$. But if the players disagree on T_1, i.e., $Z_1^i \neq Z_1^j$ then they will effectively announce different strategies.

Proposition 8 *If i and j's level of eventual confidence, p_k^i and p_k^j, differ in such a way that $\overline{k}^i \neq \overline{k}^j$ then i and j will disagree on which decision is strategic. Each strategist will consider the decision about which she is most confident as more strategic.*

Proof : This follows directly from Proposition 6. ■

The importance of this result comes from the fact that it provides an explanation for the widely observed phenomenon that different CEO's indeed develop different strategies and that, moreover, these strategies tend to be driven by the CEO's past experience (Hambrick and Mason 1984). A CEO with a background in marketing, for example, will tend to develop a marketing-oriented strategy, whereas a CEO with a background in production will tend to develop a production-oriented strategy. A common interpretation is that this is driven by a bias in perception: marketing people think that everything is eventually a marketing problem (Dearborn and Simon 1958, Walsh 1988). The result here suggests a different, and quite rational, explanation: marketing people are very confident about marketing decisions and it is thus subjectively optimal for them to center their strategy around decisions about which they are most confident.

But there is more to this. Under a CEO who has a background in marketing and is very confident about marketing, the strategy will also *favor* marketing in the sense that the marketing decision is more likely to be optimal on a standalone basis than any other decision. It may therefore look as if the CEO is playing favorites with her own people. That is captured in the following corollary.

Corollary 3 *On average, the participants in strategist i's firm believe that the decision about which the strategist feels most confident is also most likely to be correct on a standalone basis: $P[I_{\overline{k}^i}] \geq P[I_k]$ for all k, with strict inequality for a non-empty set of the parameter space.*

Proof : This follows directly from Proposition 6. ■

Remarkably, the result of Proposition 8 also leads to the following rather surprising outcome: even if i and j agree for each decision on the optimal choice ($Z_k^i = Z_k^j, \forall k$), they may *still* develop very different strategies with very different outcomes. Consider, for example, a setting with $K = 2$, $\alpha_1 = \alpha_2 = \gamma_{k,l} = 1$, and where i and j agree that the interaction $\theta_{1,2} = C$ with confidence $p_{1,2} = .9$. Let both players agree for each of the standalone decisions, $Z_1^i = Z_1^j = A$ and $Z_2^i = Z_2^j = B$, but have different levels of confidence $p_1^i = p_2^j = .9$, $p_2^i = p_1^j = .6$. Then i will announce as strategy $D_1 = A$, with the intention of implementing $A - A$ while j will announce as strategy $D_2 = B$, with the intention of implementing $B - B$. This thus proves the following proposition.

Proposition 9 *Even if $Z_k^i = Z_k^j, \forall k$, strategists i and j may develop different strategies leading to different outcomes.*

Whereas the analysis here focused on disagreement on the p_k's (and the α_k's were supposed to be common knowledge), disagreement about the α_k's would have a very similar and very intuitive effect: a strategist is more likely to consider a decision D_k to be strategic when she believes α_k to be high.[23]

Personal Influence on Strategy under Agreement It may seem, at first, that Proposition 8 is similar to the idea that identity may matter because different people may have access to different

[23]I thank Bob Gibbons for pointing this out.

information. It turns out, however, that the effects of differences in information access are very different from the results derived here.

To see this, consider the following variation on the model of Section 2 with differential access to information (but common priors): assume that each P_k learns her θ_k and $\theta_{k,l}$ at the start of the game (instead of in stage 2a). For all other states, each P_k has uninformative priors, as before. Different people may now come up with different strategies (even under common priors) because they start with different information, which affects their cost of developing specific strategies. For example, P_1 prefers to develop a D_1-based strategy since he does not incur the (lexicographic) cost of investigating T_1. But these are real knife edge cases and lead to quite different predictions from the differing priors model of personal influence. The mechanism in this case is that when $\alpha_1(p_1-.5)=\alpha_2(p_2-.5)<\gamma(2p_{1,2}-1)$, both decisions can be either dominant or subordinate. If P_1 is the strategist, then she will make her decision D_1 dominant and thus strategic (since that saves her the cost of investigating a decision, as she already knows θ_1). This can lead to two different strategies with different outcomes. For example, if $Z_1=A\neq Z_2$ then the firm will implement $A-A$ with P_1 as the strategist and $B-B$ with P_2 as the strategist.

But this differs from the differing priors setting in important ways. First, everyone agrees ex post on what the expected payoffs from the two strategies are. Second, the expected payoffs are identical so that each participant is indifferent (ex-post) between her own strategy and the other's strategy. So no one would spend financial or political capital to be the strategist, unlike in the differing priors case (Van den Steen 2008). Moreover, this can only happen in the knife edge case that $\alpha_1(p_1-.5)=\alpha_2(p_2-.5)$ which limits the relevance of this result in practice.

6.2 Personal Involvement in Strategy Development

The insight why different people (both systematically and randomly) come up with different strategies is important but does not really answer the question why it matters that it is the *CEO* who develops the strategy rather than some smart outsider or a committee of internal experts. Why would the CEO's view be of particular importance in strategy?

I will show here that, when strategy is cheap talk, involvement of the CEO – and of others who control strategic decisions – lends a credibility to the strategy that improves the likelihood of implementation. For one thing, these people are likely to do their part of the implementation and to use their authority and influence to make others do their part. As a consequence, the proclaimed strategy – despite being cheap talk – becomes a credible indicator for the strategic decisions and will affect the expectation of others about these decisions and thus guide their decisions. That, on its turn, becomes self-reinforcing since others acting according to the strategy makes it more attractive for the CEO to also stick to the announced strategy. Strategy as a public announcement thus becomes a commitment device. In summary, CEO involvement in strategy formulation provides a commitment that she will act on the (cheap-talk) strategy, which makes it an effective means to guide the others' decisions and thus for strategy implementation. As strategy implementation is a well-known challenge, with estimates that up to 70 to 90% of strategies fail to get implemented (Kaplan and Norton 2000), this is a very important consideration.

To formally analyze this issue of credibility and implementation, I will thus assume that the strategy announcement in stage 1c is just a cheap talk announcement that does not (directly) bind or fix any decisions. But unrestricted cheap talk equilibria can generate unrealistic predictions. For example, in an unrestricted cheap talk equilibrium, the strategist may announce '$D_2=B$' whenever she means '$D_1=A$': in equilibrium, the participants will make the right inferences and understand that the strategist meant in fact '$D_1=A$' and follow that recommendation. Such equilibria, however, require a sophisticated up-front coordination on the meaning of the message, i.e., on the equilibrium that is being played, which is not realistic in a setting where even coordination on decisions is hard. To eliminate that possibility, I will impose the following equilibrium selection rule: If there exists an equilibrium with truthful cheap talk – in the sense that the announced decisions are part of the intended outcome by the strategist – then players will play that equilibrium.

I also need to adjust the definition of strategy to reflect that strategy is now cheap talk.

Definition 1' *A strategy $\mathcal{S}$ (for target outcome $\tilde{\mathbf{D}}(\theta)$, revealed signals $\tilde{\tau}$, and for given players' beliefs) is a set of decision choices $(D_k = \tilde{d}_k)_{k \in K_{\mathcal{S}}}$ for a subset of decisions $K_{\mathcal{S}} \subset K$ such that*

1. *$\tilde{d}_k = \tilde{D}_k(\tilde{\tau}, \tilde{\tau}')$ for all $k \in K_{\mathcal{S}}$ and for all $\tilde{\tau}' \in \mathcal{T}'$,*
2. *for any $\tilde{\tau}' \in \mathcal{T}'$, the outcome $\tilde{\mathbf{D}}(\tilde{\tau}, \tilde{\tau}')$ is an equilibrium outcome of the subgame starting in stage 2 – with no reversions in stage 3 – when $\tau = \tilde{\tau}$ and $\tau' = \tilde{\tau}'$, and*
3. *there does not exist a set of decision choices $\check{d}_k$ for a subset of decisions $K_{\check{\mathcal{S}}} \subset K$ such that the two previous conditions are satisfied and $K_{\check{\mathcal{S}}} < K_{\mathcal{S}}$.*

An optimal strategy for $\tilde{\tau}$ is a strategy that implements the optimal outcome $\hat{\mathbf{D}}(\tilde{\tau}, \tilde{\tau}'), \forall \tilde{\tau}'$.

The difference with the earlier definition is that criterium 2 does not condition any more on the decisions $D_k = \tilde{d}_k$ for $k \in K_{\mathcal{S}}$ being fixed and common knowledge.

In terms of the model, I will assume for the rest of this section that the likelihood of agreement is the same for any two players ($\lambda_k^{ij} = \lambda_k \forall i, j$) with disagreement being independent across decisions. In other words, for each decision state T_k, the players agree on the optimal decision ($Z_k^i = Z_k^j$) with probability λ_k for some exogenously given value λ_k. To focus on implementation, I will also assume that players all have the same level of confidence about each decision, i.e, $p_k^i = p_k^j = p_k$ for any D_k. I thus exclude here the possibility that the players may disagree on which decision is strategic. With respect to the decision setting, I will consider the case that $K = 2$, $\beta_{\underline{k}} < \eta$ (so that strategy always has strictly positive value), and $\beta_{\overline{k}} > \beta_{\underline{k}}$ (to exclude the knife-edge case of equality that complicates without adding insight). I will use the simplifying notation Z_k for Z_k^k and let s denote the person developing the strategy, i.e., the strategist.

I now first study how implementation is affected by the strategist being an insider versus an outsider. To that purpose, I will say that a strategy is 'implemented' if the outcome of the subgame after the strategy announcement is the target outcome of the strategist.

One issue here is that, in equilibrium, a participant will only propose a strategy if she knows it will be implemented. I will therefore explicitly condition in the proposition on the strategist proposing a strategy. To that purpose, say that a strategist has developed and announced a 'standard strategy' (for a $K = 2$ setting) if the strategist followed the equilibrium of Proposition 6: the strategist s investigated (only) $T_{\overline{k}}$ in stage 1b, and announced (only) $D_{\overline{k}} = Z_{\overline{k}}^s$ in stage 1c, with the intention of implementing $Z_{\overline{k}}^s - Z_{\underline{k}}^s$. Consider then a subgame starting in stage 2a when strategist s has developed and announced the standard strategy.

Proposition 10a *The strategy is more likely to be implemented when the strategist is the dominant decision maker ($s = P_{\overline{k}}$) than when the strategist is an outsider ($s = O$).*

The likelihood of implementation of the outsider's strategy, relative to $P_{\overline{k}}$'s strategy, increases in the probability of agreement about the dominant decision $\lambda_{\overline{k}}$, increases in the importance and eventual confidence of the interaction (γ and $p_{1,2}$), and decreases in the importance and eventual confidence of both standalone decisions (α_k and p_k).

Proof : The proof is in Appendix A. ■

The main reason why the outsider has a difficult time implementing the strategy is credibility: the subordinate decision maker $P_{\underline{k}}$ doubts that the dominant decision maker $P_{\overline{k}}$ will follow a strategy developed by some outsider. This doubt reduces $P_{\underline{k}}$'s expected gain from following the announced strategy and thus makes it more attractive to follow her own piecemeal optimal action $Z_{\underline{k}}$. When, on the contrary, the strategy was developed by the insider dominant decision maker, then that dominant decision maker will follow her announced strategy, which makes it also optimal for others to follow the strategy.

The comparative statics then show that this credibility is more of a problem if the dominant decision is more controversial in the sense that there is a higher probability of disagreement. Being controversial makes it more likely that $P_{\overline{k}}$ disagrees with the outsider and thus reduces the credibility of the outsider's strategy. Credibility is also more of an issue when η is low and α_k and p_k high. The reason is that the trade-off between alignment versus piecemeal optimality tilts in this case more towards the latter. The credibility must then be higher to convince $P_{\underline{k}}$ to forgo the piecemeal optimality and try to align with $P_{\overline{k}}$. In practical terms, this result suggests that management involvement matters more when the strategic decisions are more controversial and when employee decisions are more important.

But there is also a second issue that may hinder implementation: when the dominant decision maker disagrees with the strategist, she may follow her own belief (even though the other participant may align with what was announced as $P_{\overline{k}}$'s decision). But this raises an interesting question: why doesn't the dominant decision maker *always* follow her own belief? Why would she ever follow a cheap talk announcement about her own decision that she disagrees with? It is here that the public commitment comes in: When the strategist has sufficient credibility that $P_{\overline{k}}$ will follow the announced decision and the alignment benefit η is large relative to standalone importance β_k, then it becomes optimal for $P_{\overline{k}}$ to choose whatever has been publicly announced that she will choose because others will align with the publicly announced choice and she wants to align with these others. This also leads to the comparative static that strategy implementation is more likely when η is large and α_k and p_k small.

Note that if the outsider could *fix* the strategic decisions then such commitment would also resolve the implementation issue. It is here that irreversibility comes in: irreversible decisions create an opportunity to commit to a course of action that makes the strategy credible and convinces employees that it will indeed be implemented. When that is the case, the strategist may in fact build a strategy around these irreversible decisions (similar to how she may build a strategy around less controversial decisions), thus making them strategic. This fits well with Andrews (1987)'s view that 'the essence of successful implementation is commitment'.

From a broader perspective, the key insight here is that strategy formulation and execution will be linked. To develop this insight further, I now turn to the overall equilibrium of the game and how that is affected by who develops the strategy.

I will again compare strategy development by the dominant decision maker $P_{\overline{k}}$ with strategy development by an outsider O. The overall equilibrium turns out to depend on whether the strategist's investigations are to some degree verifiable. I will use the following condition to distinguish along these lines.

Condition 1 *Either it is publicly observed which states O investigates or O can – at no cost – verifiably reveal any of her signals (to back up her announced strategy).*

The following proposition shows not only that the outsider has a harder time getting a strategy implemented but also that she will sometimes propose a strategy that is suboptimal in her own eyes (to increase the likelihood of implementation). Remember that a non-trivial outcome is one in which at least one player chooses $D_k \neq Z_k$ and that I assumed $\beta_{\underline{k}} < \eta$.

Proposition 10b *In equilibrium, an outsider is less likely than the dominant insider $P_{\overline{k}}$ to be able to implement a non-trivial outcome through strategy.*

When implementing a non-trivial outcome through strategy, an outsider is more likely than $P_{\overline{k}}$ to implement an outcome that is suboptimal *(from her own perspective).*

Formally:

When $P_{\overline{k}}$ develops the strategy, she always investigates (only) $T_{\overline{k}}$ and announces as strategy $D_{\overline{k}} = Z_{\overline{k}}^{\overline{k}}$; that strategy is always implemented; and the implemented outcome is always the optimal outcome from $P_{\overline{k}}$'s perspective.

When, on the contrary, O develops the strategy, then the following are the equilibrium regimes:

- *If $(2\lambda_{\overline{k}} - 1)\eta \leq \beta_{\underline{k}}$ and either Condition 1 does not hold or Condition 1 holds but $\beta_{\overline{k}} \geq (2\lambda_{\underline{k}} - 1)\eta$, then O investigates no state and announces* no strategy *at all and the outcome is simply the piecemeal outcome.*

- *If $(2\lambda_{\overline{k}} - 1)\eta \leq \beta_{\underline{k}}$, $\beta_{\overline{k}} < (2\lambda_{\underline{k}} - 1)\eta$, and Condition 1 holds then O investigates (only) $T_{\underline{k}}$ and announces as strategy $D_{\underline{k}} = Z_{\underline{k}}^{O}$; that strategy is always implemented; but the implemented outcome is now* not *the optimal outcome from O's perspective.*

- *If $(2\lambda_{\overline{k}} - 1)\eta > \beta_{\underline{k}}$ then O investigates (only) $T_{\overline{k}}$ and announces as strategy $D_{\overline{k}} = Z_{\overline{k}}^{O}$.*
  - *If $\beta_{\overline{k}} \geq \eta$ then $P_{\underline{k}}$ implements her part of the strategy ($D_{\underline{k}} = Z_{\overline{k}}^{O}$) but $P_{\overline{k}}$ chooses her piecemeal best outcome ($Z_{\overline{k}}^{\overline{k}}$) and the implemented outcome is only sometimes the optimal outcome from O's perspective.*
  - *If $\beta_{\overline{k}} < \eta$ then the strategy is always completely implemented and the implemented outcome is the optimal outcome from O's perspective.*

Proof : The proof is in Appendix A. ■

The most interesting part of this proposition is obviously the result that the outsider will sometimes choose a strategy that implements a suboptimal outcome from her own perspective. The intuition here is that the dominant decision is so controversial – in the sense that any two players are very likely to disagree on the optimal choice – that the outsider has insufficient credibility to implement a strategy around that dominant decision. Instead, the outsider then tries to build a strategy around a less controversial decision, where she has more credibility in terms of the effective strategy. This is captured in the following corollary that follows immediately from the proposition.

Corollary 4 *For an outsider-strategist, less controversial decisions – in the sense of having a higher λ_k – are more strategic.*

The outsider thus makes an explicit trade-off between optimality of the strategy and likelihood of implementation of the strategy, a well-known consideration for consultants. When making this trade-off between optimality and implementation, the role of strategy thus shifts more towards that of the optimal uninformed strategy: establishing a reliable focal point to ensure alignment even though it is not necessarily alignment on the optimal outcome. The earlier (informal) idea that a strategist may build a strategy around irreversible decisions because they provide commitment follows the same logic and could be formalized along the same lines.

There is also another observation of interest here: there exists a parametric region where everyone is strictly better off when the strategist explicitly does *not* investigate or announce a particular decision. This result is further discussed in Appendix A as it requires some insight in the proof of the proposition. The overall idea is that some investigations or announcements may create common knowledge of a potential equilibrium that is inferior but that people may default to once they know it exists.

Beyond the issues surrounding the suboptimal outcomes, the intuition of this result follows almost directly from Proposition 10a that an outsider's strategy is less likely to be implemented.

The following corollary highlights the role and importance of disagreement in these results.

Corollary 5 *With full disagreement, i.e., $\lambda_k = .5, \forall k$, there is completely no value in a strategy developed by an outsider.*

With no disagreement on the strategic decision, i.e., $\lambda_{\overline{k}} = 1$, the value of a strategy developed by an outsider is the same as that developed by a dominant insider. Moreover, the equilibrium derived in Proposition 6 and Corollary 2 then also holds in the cheap talk model.

Proof : With $\lambda_k = .5$, $\rho_k = 0$ and the only outcome that an outsider can implement is the piecemeal outcome, so that there is no value from strategy.
With $\lambda_{\overline{k}} = 1$, $\tilde{Z}_1 = Z_1$ and $\rho_1 = 1$. It follows that the outsider always implements $\tilde{Z}_1 - \tilde{Z}_1$, which coincides with $Z_1 - Z_1$ and which is thus exactly what the dominant insider implements. The last part of the proposition also follows from Proposition 10b ■

This corollary shows that it is not cheap talk per se that complicates implementation, but the combination of cheap talk and disagreement. In a cheap talk model without disagreement, the strategy effectively describes what choices the critical decision makers will make. This provides a form of commitment which makes it optimal for others to follow the strategy too. But the combination of cheap talk with disagreement weakens the link between the announced choices and the eventual choices and thus makes the strategy less credible.

Whereas the above results indicate the kind of issues that arise with an outsider-strategist, it is worthwhile digging a little deeper to see what this implies for a principal who owns the firm but does not make any decisions (and is thus an outsider), which is a common and important setting. I will consider here how such outsider-principal is affected by the identity of the strategist, comparing as strategists the principal herself, some other outsider (e.g., a consultant), and the main decision-maker $P_{\overline{k}}$. For this result and the rest of this section, I assume that Condition 1 does not hold, i.e., that cheap talk is not verifiable.

Proposition 11 *The principal's expected profit is higher when $P_{\overline{k}}$ develops the strategy than when an outsider O other than the principal develops the strategy.*

Proof : Let $\overline{k} = 1$ and $\underline{k} = 2$. Consider first the case that $P_1 = P_{\overline{k}}$ develops the strategy. From earlier propositions and the fact that I assumed that $\beta_2 < \eta$, the outcome is always 'both choose Z_1'. The expected payoff from the perspective of the principal is $\alpha_1 q_1 + \frac{\alpha_2}{2} + \eta$ where $q_k = \lambda_k p_k + (1-\lambda_k)(1-p_k) \in (.5, 1)$ and thus $q_k < p_k$.
Consider next the case that the outsider O develops the strategy. Again from earlier propositions, the equilibrium regimes are as follows:

- If $(2\lambda_{\overline{k}} - 1)\eta \leq \beta_2$ then the equilibrium is 'Z_1-Z_2.' This gives, according to the principal, an expected payoff of $\alpha_1 q_1 + \alpha_2 q_2$ (which is strictly lower than the payoff from the $P_{\overline{k}}$-strategy since $\eta > \beta_2$).

- If $(2\lambda_{\overline{k}}-1)\eta > \beta_2$ and $\beta_1 \geq \eta$ then the equilibrium is 'Z_1-$\tilde{Z}_1$.' This gives, according to the principal, an expected payoff of $\alpha_1 q_1 + \frac{\alpha_2}{2} + (2\lambda_1 - 1)\eta$ (which is strictly lower than the payoff from the $P_{\overline{k}}$-strategy).
- If $(2\lambda_{\overline{k}}-1)\eta > \beta_2$ and $\beta_1 < \eta$ then the equilibrium is '$\tilde{Z}_1$-$\tilde{Z}_1$.' This gives, according to the principal, an expected payoff of $\alpha_1 q_1 + \frac{\alpha_2}{2} + \eta$ (which is the same as the payoff from the $P_{\overline{k}}$-strategy).

The above payoffs are all weakly (and some strictly) lower than the payoff from the $P_{\overline{k}}$ strategy. This proves the proposition. ■

So the principal always prefers that the dominant insider, typically the CEO, develops the strategy herself than that she delegates it to an outsider other than the principal. But can the principal do better by developing the strategy herself? A first problem with this approach is that subordinate employees may be aware of any disagreement between the principal and $P_{\overline{k}}$ and may prefer to follow the latter. In particular, if both the principal and $P_{\overline{k}}$ develop and announce a strategy, then subordinate employees will follow $P_{\overline{k}}$'s strategy and disregard the principal's strategy, at least if they believe that the principal cannot directly change $P_{\overline{k}}$'s decisions or replace $P_{\overline{k}}$. To see this formally, consider a subgame starting in stage 2a when both the outsider-principal and $P_{\overline{k}}$ have developed and announced the standard strategy: each investigated (only) $T_{\overline{k}}$ in stage 1b, and each announced (only) $D_{\overline{k}} = Z^i_{\overline{k}}$ in stage 1c, with the intention of implementing $Z^i_{\overline{k}} - Z^i_{\underline{k}}$ (with either $i = \overline{k}$ or $i = P$, depending on the focal strategist.)

Proposition 12 *The outsider-principal's strategy will be disregarded: the participants will implement $P_{\overline{k}}$'s strategy instead.*

Proof : As before, the effect of the (cheap talk) strategy announcements must go through the players' beliefs about others' actions. Both $P_{\overline{k}}$'s and the principal's announcements reveal information about the likely actions by $P_{\overline{k}}$. But the information contained in $P_{\overline{k}}$'s strategy is a sufficient statistic, so that the principal's strategy announcement will be completely disregarded. It follows that the subgame proceeds as if only $P_{\overline{k}}$ had announced her strategy. And the equilibrium outcome is then that $P_{\overline{k}}$'s strategy gets implemented. This proves the proposition. ■

But even when $P_{\overline{k}}$ is not able to propose her own strategy independently, it is often in the interest of the principal to let $P_{\overline{k}}$ develop the strategy.

Proposition 13 *When either $(2\lambda_{\overline{k}} - 1)\eta \leq \beta_{\underline{k}}$ or $\eta \leq \beta_{\overline{k}}$, the principal's expected profit is higher when she lets $P_{\overline{k}}$ develop the strategy than when she herself develops the strategy.*

Proof : Let again $\overline{k} = 1$ and $\underline{k} = 2$. I can derive the equilibria directly from Proposition 10b.
In the case that $P_1 = P_{\overline{k}}$ develops the strategy, the outcome is always 'both choose Z^1_1'. The payoffs from the perspective of the principal is $\alpha_1 q_1 + \frac{\alpha_2}{2} + \eta$ where $q_k = \lambda_k p_k + (1 - \lambda_k)(1 - p_k) \in (.5, 1)$ and thus $q_k < p_k$.
In the case that the outsider-principal develops the strategy, the equilibrium regimes are as follows:

- If $(2\lambda_{\overline{k}} - 1)\eta \leq \beta_2$ then the equilibrium is 'Z_1-Z_2.' This gives, according to the principal, an expected payoff of $\alpha_1 q_1 + \alpha_2 q_2$ (which is strictly lower than the payoff from the $P_{\overline{k}}$-strategy since $\eta > \beta_2$).
- If $(2\lambda_{\overline{k}}-1)\eta > \beta_2$ and $\beta_1 \geq \eta$ then the equilibrium is 'Z_1-$\tilde{Z}_1$.' This gives, according to the principal, an expected payoff of $\alpha_1 q_1 + \frac{\alpha_2}{2} + (2\lambda_1 - 1)\eta$ (which is strictly lower than the payoff from the $P_{\overline{k}}$-strategy).
- If $(2\lambda_{\overline{k}} - 1)\eta > \beta_2$ and $\beta_1 < \eta$ then the equilibrium is '$\tilde{Z}_1$-$\tilde{Z}_1$.' This gives, according to the principal, an expected payoff of $\alpha_1 p_1 + \frac{\alpha_2}{2} + \eta$ (which is strictly larger than the payoff from the $P_{\overline{k}}$-strategy).

This proves the proposition. ■

The reason why the principal should let $P_{\overline{k}}$ develop the strategy is again that, whereas $P_{\overline{k}}$'s strategy may be suboptimal in the principal's eyes, $P_{\overline{k}}$ is more effective at implementing. And the comparative statics say that this is more attractive when the strategic decision is more controversial. Execution is thus more likely to outweigh optimality when strategic decisions are more controversial. The question is whether you can commit the CEO to follow a particular strategy by announcing it publicly (i.e., by making the other employees follow it).

7 Strategy and Leadership

Both strategy and leadership give direction to an organization. This obviously raises the question how they relate. A particularly intriguing observation in this context is that companies known for their well-aligned strategies often have (or had) a very strong founder or leader. This holds, for example, for Walmart, Ryanair, and Dell.[24]

I will show here that 'vision' – in the sense of a strong belief about the right course of action – provides a clear link between strategy and leadership. On the side of leadership, the central role of vision for leadership has been stressed by management scholars such as Bennis and Nanus (1985) or Kotter (2001). On the formal side, Van den Steen (2005) showed that a leader's vision, in the sense of a strong belief about the right course of action, gives direction to a firm through 3 channels: by directly influencing employees' choice of projects because vision makes clear which projects will get the manager's support, by influencing employees' effort on their chosen project (extending the work of Rotemberg and Saloner (2000) on vision and effort incentives), and by attracting employees with similar beliefs which makes employees act 'as if' they internalized the vision.

This section shows that vision is also key to strategy: a decision maker with vision – again in the very concrete sense of a strong belief about the right course of action – is more likely to announce a strategy and that strategy is more likely to be implemented. This is thus a fourth channel through which vision can provide direction. And firms with a visionary leader will thus indeed be better aligned.

To analyze this formally, I consider the $K = 2$ differing priors model of Section 6, where players may openly disagree on the decision states. To focus the analysis, I will assume that beliefs are uncorrelated ($\lambda_k^{ij} = .5$), that Condition 1 holds, and $\beta_1^1 \neq \beta_2^2$ (eliminating this knife-edge case to simplify the statement and proof).[25] To get to the issue of leadership, I will consider a variation on that model in which each of the participants can unilaterally decide to develop and announce a strategy, i.e., participants can themselves decide to act as strategist. The analysis looks at how the players' strength of belief affects who proposes a strategy and whose strategy gets implemented. As before, however, there is somewhat of a challenge with studying implementation because a participant will only propose a strategy if she knows that it will be implemented. I will therefore, in the proposition, consider subgames where the participant proposes a (reasonable) strategy. In particular, I will condition on the participant proposing the strategy that she would propose in a $K = 2$ setting with full disagreement.[26] To capture this formally, say that a decision maker P_k develops and proposes a 'standard strategy under full disagreement' (in a $K = 2$ setting) if she investigates (only) T_k and announced $D_k = Z_k^k$ as strategy. The following proposition shows indeed that the participant with stronger vision is more likely to propose a strategy and her strategy is

[24] I thank Jonathan Day for pointing this out to me.

[25] These assumptions exclude some sophisticated equilibria that may be interesting from an analytical perspective but aren't very realistic in this context.

[26] Note that, for credibility reasons, she will always formulate the strategy in terms of her own decision.

also more likely to be implemented.

Proposition 14 *The decision maker with stronger beliefs is more likely to announce a strategy and is also more likely to implement a non-trivial outcome through strategy.*

Conditional on one or both participants developing a 'standard strategy under full disagreement', the strategy of the decision maker with stronger beliefs is more likely to be implemented.

Proof : The proof is in Appendix A. ■

Corresponding to the two parts of the result, the intuition is also twofold. Consider first the result on implementation. The strategy proposed by a participant with stronger vision is more likely to be implemented because that participant's strong confidence provides a commitment that she will indeed execute her announced course of action. This commitment makes it more likely that the other player will align and thus be guided by that decision. In other words, the decision maker's strong beliefs makes her strategy credible and thus increases the likelihood of implementation.

The reason why a participant with strong vision is more likely to propose a strategy is not only because that strategy is more likely to be implemented (which makes it more attractive to propose a strategy), but also because her strong belief that it is the right course of action makes her care more about aligning the company around it – because she is more likely to believe that $\beta_k > \beta_l$ – which thus gives her reason to propose that strategy.

These results show that vision and strategy are complements: strategy is more effective when it derives from a vision and a vision can be put into action through strategy. But vision and (explicit) strategy are also to some degree substitutes. In particular, if the leader's beliefs are widely known, then an explicit strategy may not be necessary and common knowledge about the manager's belief then substitutes for an explicitly formulated strategy.

The Role of Culture Leadership may also affect strategy and its implementation indirectly, through corporate culture (in the sense of shared beliefs and values). The fact that corporate culture is strongly influenced by leadership was proposed and argued by Donaldson and Lorsch (1983), Schein (1985), and Kotter and Heskett (1992). Van den Steen (2010c) analyzed this idea formally and showed that selection, self-sorting, and learning cause the employees' beliefs to resemble those of the leader and of each other, leading to shared beliefs and thus culture.

To see how culture, on its turn, affects strategy, remember from Section 6 that implementation problems are caused not by the cheap-talk nature of strategy by itself, but by the combination of cheap talk with disagreement. A strong culture – by its nature as 'shared beliefs and values' – reduces disagreement (on specific dimensions) and should thus reduce or eliminate implementation problems. This suggests that strategy would be more effective in an organization with a strong culture and thus that strategy and culture are complements.

But, similar to leadership, there is also a sense in which culture and strategy can be substitutes. In particular, Section 4 showed that strategy is more valuable when there is high uncertainty because such uncertainty makes it difficult to predict what others will do and thus to align. Culture as shared beliefs, on the contrary, makes it easier to predict what others will do and may thus reduce the need for strategy. This argument also leads to a different conjecture: culture as shared beliefs may allow more concise strategies, i.e., strategies with less decisions, because members of a strong-culture organization may understand each other with half a word.

8 A Note on 'Business' Strategy

The main motivation for this paper was to develop an understanding of business strategy and the role of leaders in it. That raises the question how this general theory of strategy relates to business strategy. Obviously business strategy is strategy in a business context and as such the theory applies. One specific question is how to think about this theory in settings where the outcome depends on competitors' actions and interactions. The introduction of competitors means that some of the players in the stage 2 game will have objectives different from, or even opposite to, these of the focal firm. It also means that decisions controlled by a competitor can't be part of the strategy in 1c. In determining the optimal strategy, it will thus be necessary to take into account the competitors' actions and reactions. And strategy can now also be used as a device to influence competitors' behavior. But that seems to change only how the ideas get applied, not the ideas themselves. But this is definitely an interesting area for future research.

The business context also puts more structure on the setting, making some interactions and patterns more likely than others, which may lead to context-specific recommendations. It is therefore important to understand which ideas are general to strategy versus which are specific to business, i.e., to understand their boundary conditions, especially when trying to apply strategy ideas from a business context to other settings. A good example is the oft-heard recommendation that it is important for businesses to be 'different' or to have a 'unique' competitive advantage. The analysis in this paper has two implications in this regard. First, the *possibility* of different solutions is essential to the concept of strategy because without multiple sensible solutions, everyone should understand the optimal course of action and there is no gain from developing a strategy. Second, however, there is nothing in strategy itself that suggests a *need* to be different. In fact, being 'different' makes no sense without someone or something to be different from and thus implies by necessity some form of competition. The need to be different in business traces back to the logic of the Hotelling line (d'Aspremont, Gabszewicz, and Thisse 1979). The relevance of that strategic recommendation thus depends on the relevance of the Hotelling line logic for the focal setting. Consider, for example, a university that aims to train 'engineers that make a difference.' Whether it is important for this university to be different from others depends on the degree to which it considers its objective to be one that places itself in direct competition (for students, faculty, or funds) with others and whether the proposed differentiation is optimal given the type of competition.

It is in this context also interesting to note that the equilibrium that was derived in this paper is closely related to the hypothesis/options driven approach that is often advocated for the development of business strategy (Rivkin 2002). In these strategy development processes, the strategist hypothesizes a set of potentially optimal strategies and then determines what additional data are required to discriminate among these. This (implicit) backward induction approach minimizes the number of signals/information necessary to arrive at the optimal strategy. In the same way, the equilibrium investigations in this paper are exactly the smallest number of investigations that gets the strategist to the optimal strategy, thanks to the backward induction approach implicit in the equilibrium solution. The hypothesis/options driven approach can be interpreted as the practice equivalent of the equilibrium strategy process in this model, and is – from that perspective – not limited to the context of business strategy.

9 Conclusion

This paper derived, on formal grounds, a simple but concrete definition for strategy: *the minimum set of decisions (sufficient) to guide all other decisions*. It then formalized this and used it to study the value, role, and nature of strategy, and how it is affected by people.

Some of the paper's results confirm general intuition about strategy. I showed, for example, that interaction and uncertainty make strategy more valuable and that important decisions are strategic. Such intuition-confirming results are important for a formal theory because they show that the definition indeed captures (at least part of) the essence of strategy. But these results also add to our insight, either by refining the insight or by providing a clear rationale for it. For example, the reason why important decisions are strategic is *not* because they have a big direct impact on profits, but because they will be chosen on their own terms, without regard for other decisions, so they will guide other decisions. It follows that not all important decisions are strategic: decisions with no implications for other decisions, such as how to invest financial reserves or the decision to hedge currency fluctuations, are usually not strategic even though they can have a tremendous impact on financial performance.

Other results of the paper are either new or even challenge earlier claims. The paper shows, for example, that the value of strategy depends on the *pattern* of interactions – strategy is less valuable with mixture of complements and substitutes than with all complements. The paper also shows that irreversibility per se does not make a decision strategic in this setting. But it provides a new argument for the role of irreversibility: when decisions are controversial, irreversibility can provide the commitment that is necessary for implementation.

The models formally derived at least two functions for strategy and informally suggested a third. The first function, and the main focus of the paper, is that strategy is a tool to guide and coordinate an organization. This role is very explicit in the definition as 'minimum set of decisions to guide all other decisions'. But the analysis also showed that strategy is a decision making tool: understanding the structure of strategy allows the strategist to find the optimal outcome more efficiently, with less investigation and optimization. Finally, the informal discussion also suggested a role that is some mixture of guiding mechanism and decision economizing tool: strategy helps individuals and organizations to be consistent over time by helping them to remember the essence of what they had chosen as the optimal course. By doing so, it reduces the need for repeated optimization (thus economizing) and increases the likelihood that decisions are consistent over time (thus coordinating).

Another overall insight of the paper is to show how the many things that we intuitively associate with strategy fit exactly together: strategy as committing to one path, strategy as being decided by the CEO or general manager, strategy as coordination device, strategy as looking ahead, strategy as broad direction, etc. Such conceptual understanding of how these ideas hang together is helpful for thinking about and developing good strategies.

The models in this paper were all extremely simple, in order to have a starting point and to keep the analysis transparent. That simplicity means that many interesting issues were left unexplored and immediately suggests avenues for further research. One critical simplification is that the model is completely static in the sense that the underlying decision states are fixed and all information comes at once. This begs the questions how the results, in particular the value of strategy and what decisions are strategic, would be affected by the fact that states may change or evolve over time or by the fact that information may trickle in over time. Closely related is the assumption that everyone has the same information and that that information is exogenously determined. This raises at least two questions. First, how might the results change if the 'local' participants have better information about their local decisions than the strategist or the other way around. Second, what happens when the amount of information is endogenously determined by the effort that players exert in collecting such information. Under what conditions would strategic decisions be researched more? An interesting conjecture is that, if strategic decisions get indeed researched more, then endogeneity of information may actually help with implementation, as the participants will endogenously be more confident on strategic decision and less on subordinate decisions. Other obvious directions for research are the role of competition, the effect of different action and payoff structures, or to develop a better understanding why there is a cost from announcing many decisions. Overall, I hope that this paper furthers the formal study of the nature and role of strategy.

A Proofs of Propositions

Proof of Proposition 4: Since the decision choices can always be renamed (and since both P_1 and P_2 will observe $\theta_{1,2}$ before making a decision in stage 2), it suffices to consider $\theta_{1,2} = C$ and $\sigma_2 = A$. Since a strategy can only be optimal when $\beta_{\underline{k}} < \eta$, I will henceforth also assume that $\eta > \beta_{\underline{k}}$.

To determine how the 'value of strategy' depends on the initial uncertainty, note that the expected payoff from the optimal strategy equals $\alpha_{\overline{k}} p_{\overline{k}} + \alpha_{\underline{k}}.5 + \eta$ (i.e., the expected payoff when all signals are known) and is thus independent of the amount of initial uncertainty. So it suffices to show that – for any given set of parameters except μ_2 (and thus for a given optimal strategy payoff) – the expected payoff absent a strategy (and thus absent investigations) decreases as there is more uncertainty, i.e. as U_2 increases or as μ_2 or q decrease, and that this change is larger when η is larger.

Consider thus the case without any (project) strategy, i.e., without any investigation in stage 1b and without any announcement/fixing in stage 1c. And consider now the best response of player P_k in stage 2b. If P_k believes that P_{-k} chooses A and B with equal probability, then P_k's best response is to choose Z_k. Else, let X_{-k} denote P_{-k}'s most likely action according to P_k (based on P_{-k}'s assumed equilibrium behavior and the potential prior signal σ_{-k} about T_{-k}) and let $\psi_{-k} > .5$ denote P_k's belief that $D_{-k} = X_{-k}$. With her choice for D_k, P_k can only affect the direct payoff from D_k and the interaction payoff. Conditional on $\theta_{1,2} = C$, P_k solves

$$\max_{D_k} \alpha_k \left[p_k I_{D_k = Z_k} + (1 - p_k)(1 - I_{D_k = Z_k}) \right] + \gamma \left[(2\psi_{-k} - 1) I_{D_k = X_{-k}} - (2\psi_{-k} - 1)(1 - I_{D_k = X_{-k}}) \right]$$

or $\max_{D_k} \alpha_k \left[(2p_k - 1) I_{D_k = Z_k} + 1 - p_k \right] + \gamma \left[(2\psi_{-k} - 1)(2 I_{D_k = X_{-k}} - 1) \right]$. Since both $2p_k - 1 > 0$ and $2\psi_{-k} - 1 \geq 0$, the payoff increases in both $I_{D_k = Z_k}$ and $I_{D_k = X_{-k}}$. It follows that P_k's best response is either $D_k = Z_k$ or $D_k = X_{-k}$.

Since X_{-k} is derived from common knowledge events (including P_{-k}'s assumed equilibrium behavior, which is also common knowledge), X_{-k} must be common knowledge. It follows that, conditional on $\theta_{1,2} = C$, if P_k's strategy is to choose X_{-k}, then $X_k = X_{-k}$ and P_{-k}'s best response is either to also choose $X_k = X_{-k}$ or to choose Z_{-k}. Furthermore, if P_k's strategy is to choose Z_k, then $X_k = A$ for $k = 2$ (by the assumption that $\sigma_2 = A$), whereas X_k is undefined for $k = 1$ (since there is no prior signal for T_1). This leaves the following as potential equilibria: 'each P_k always chooses Z_k', 'P_2 chooses Z_2 and P_1 chooses A', or 'both always choose X' with $X \in \{A, B\}$.

Consider now first the two potential equilibria of the form 'both choose X' with $X \in \{A, B\}$. This is an equilibrium iff for each player P_k– knowing that P_{-k} will choose X for sure – it is optimal to choose X even when $Z_k \neq X$. This condition (for P_k) can be written: $\alpha_k(1 - p_k) + \eta \geq \alpha_k p_k - \eta$ which thus results in the overall equilibrium condition $\eta \geq \max_k \alpha_k(p_k - .5)$. This condition is the same for 'both always choose A' and 'both always choose B'.[27] The expected payoffs of these equilibria are respectively $\alpha_1/2 + \alpha_2\mu_2 + \eta$ and $\alpha_1/2 + \alpha_2(1 - \mu_2) + \eta$.

Consider next the potential equilibrium where 'each chooses Z_k'. Note that this means, from an outsider's perspective, that $P[D_1 = A] = P[D_1 = B] = .5$ while $P[D_2 = A] = P[\theta_2 = A] = q + (1 - q).5 = (1 + q)/2$. The best response for P_2 to 'P_1 chooses Z_1' is indeed to always choose Z_2. The best response for P_1 to 'P_2 chooses Z_2' is to choose A if $\alpha_1(1 - p_1) + \eta(1 + q)/2 + (-\eta)(1 - q)/2 \geq \alpha_1 p_1 + (-\eta)(1 + q)/2 + \eta(1 - q)/2$ or $q\eta \geq \alpha_1(p_1 - .5)$, and to choose Z_1 if the inequality holds in the other direction (with both being best response under equality). The equilibrium condition for 'each chooses Z_k' is thus that $q\eta \leq \alpha_1(p_1 - .5)$. The expected payoff of this equilibrium equals $\alpha_1 p_1 + \alpha_2 p_2$.

Consider finally the potential equilibrium where 'P_1 chooses A and P_2 chooses Z_2'. The above analysis implies that 'P_1 chooses A' is a best response to 'P_2 chooses Z_2' if $\eta \geq \alpha_1(p_1 - .5)/q$. The best response to '$P_1$ chooses A' is 'P_2 chooses Z_2' if $\alpha_2 p_2 - \eta \geq \alpha_2(1 - p_2) + \eta$ or $\eta \leq \alpha_2(p_2 - .5)$. So the condition for this equilibrium is that $\alpha_2(p_2 - .5) \geq \eta \geq \alpha_1(p_1 - .5)/q$. The expected payoff of this equilibrium equals $\alpha_1/2 + \alpha_2 p_2 + \eta(1 + q)/2 + (-\eta)(1 - q)/2 = \alpha_1/2 + \alpha_2 p_2 + q\eta$.

[27] It will turn out that 'both always B' is never selected by the equilibrium selection criterium, but that can be invoked only later. For now, 'both always B' has to be included among the set of equilibria.

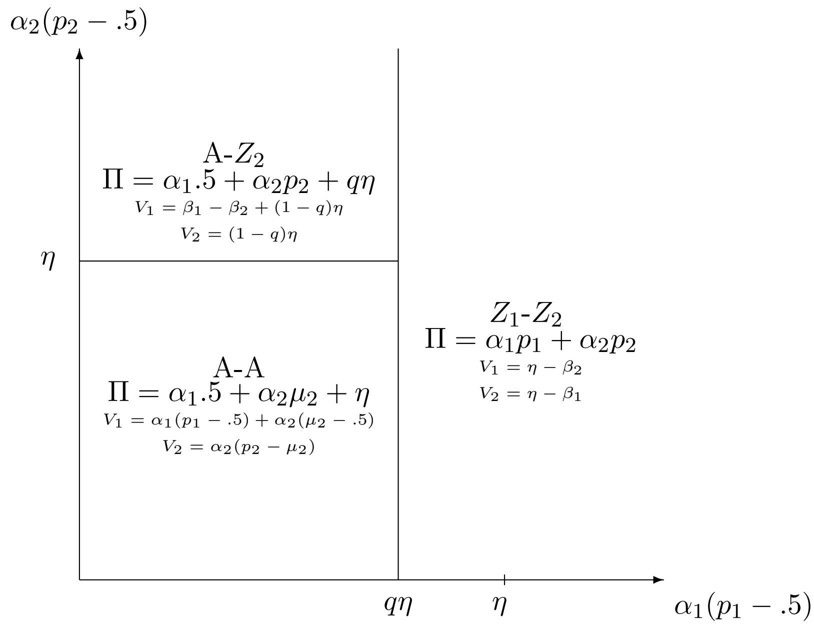

Figure 3: Equilibrium Regimes and Payoffs in Function of Parameters.
(V_k is the value of strategy when D_k is the dominant decision.)

I derive now the equilibria for the different parameter ranges, as depicted in Figure 3. First, whenever $\alpha_1(p_1 - .5) \geq q\eta$, 'each chooses Z_k' is an equilibrium and it is the equilibrium that will be selected by the equilibrium selection criterium (since the starting point of the equilibrium selection process coincides with this equilibrium outcome). Second, when $\alpha_1(p_1 - .5) < q\eta$ (and thus $\eta > \alpha_1(p_1 - .5)$), the equilibrium is '$P_1$ chooses A and P_2 chooses Z_2' when $\eta \leq \alpha_2(p_2 - .5)$ and 'both always choose A' otherwise.

To prove the proposition, I will now show that – for any given set of parameters excluding μ_2 (and thus for a given optimal strategy payoff) – the expected payoff absent a strategy decreases as there is more uncertainty, i.e. as U_2 increases or as μ_2 and/or q decrease, and that these changes are larger when η is larger. To that purpose, it suffices to show that 1) the result hold for each of the equilibrium payoffs and 2) the results also hold upon an equilibrium regime transition.

The fact that each of the (selected) equilibrium payoffs by itself decreases as q decreases and that these changes are larger when η is larger is straightforward.[28] It thus suffices to show the same results upon a transition in equilibrium regime.

In terms of equilibria regime transitions, the effect of a decrease in q is to go from either 'both always choose A' or from 'P_1 chooses A and P_2 chooses Z_2' to 'each chooses Z_k'. So I need to show that these equilibrium regime transitions (weakly) decrease the payoffs and that these changes are larger when η is larger. The change in payoff going from 'P_1 chooses A and P_2 chooses Z_2' to 'each chooses Z_k' equals $\alpha_1(p_1 - .5) - q\eta \equiv 0$ at the equilibrium regime transition (as follows from the equilibrium regime criteria). The change in expected payoff going from 'both always choose A' to 'each chooses Z_k' equals $\alpha_1(p_1 - .5) + \alpha_2(p_2 - \mu_2) - \eta$. This is indeed negative (using the fact that $p_2 - \mu_2 = (1-q)(p_2 - .5)$ and $\alpha_1(p_1 - .5) = q\eta$) and becomes more negative when η increases. This proves the proposition. ■

Proof of Proposition 5: Let, wlog., the states be renumbered so that $\beta_1 \geq \beta_2 \geq \beta_3$ (with $\beta_k = \alpha_k(p_k - .5)$) and the decision choices be renamed so that $Z_1 = A$. Figure 4 shows the optimal outcomes in function of the signal vector θ, the parameter values, and whether the setting is supermodular or not.

[28] The payoff of 'both always choose B' increases as μ_2 decreases, but that equilibrium is never selected by the equilibrium selection criterium.

	Both	Supermodular			Non-Supermodular
θ	$\eta \leq \frac{\beta_3}{2}$	$\frac{\beta_3}{2} < \eta \leq \frac{\beta_2}{2}$	$\frac{\beta_2}{2} < \eta \leq \min\left(\frac{\beta_1}{2}, \frac{\beta_2+\beta_3}{2}\right)$	$\min\left(\frac{\beta_1}{2}, \frac{\beta_2+\beta_3}{2}\right) < \eta$	$\frac{\beta_3}{2} < \eta$
AAA	AAA	AAA	AAA	AAA	AAA
AAB	AAB	AAA	AAA	AAA	AAB
ABA	ABA	ABA	AAA	AAA	ABA
ABB	ABB	ABB	ABB	AAA or BBB	ABA
BBB	BBB	BBB	BBB	BBB	BBB
BBA	BBA	BBB	BBB	BBB	BBA
BAB	BAB	BAB	BBB	BBB	BAB
BAA	BAA	BAA	BAA	AAA or BBB	BAB

Figure 4: Optimal actions for $K = 3$ in function of parameters and whether the setting is supermodular or not

Consider first the *supermodular* case. If the signal vector $\theta = AAA$ then there is no need to announce a strategy and the expected payoff is $\alpha_1 p_1 + \alpha_2 p_2 + \alpha_3 p_3 + 3\eta$. If $\theta = ABB$ then the piecemeal solution gives an expected payoff $\alpha_1 p_1 + \alpha_2 p_2 + \alpha_3 p_3 - \eta$. The (only) potential ways to obtain a higher payoff (through strategy) are either by choosing $D_1 = \overline{Z}_1$, i.e., by switching D_1 from the piecemeal solution (at cost $2\beta_1$), or by choosing both $D_2 = \overline{Z}_2$ and $D_3 = \overline{Z}_3$, i.e., by switching both D_2 and D_3 (at cost $2\beta_2 + 2\beta_3$). There are thus two cases to consider. If $\beta_1 \geq \beta_2 + \beta_3$, then alignment – if optimal – is best obtained by switching both D_2 and D_3. That switch improves the payoff if $\alpha_1 p_1 + \alpha_2(1-p_2) + \alpha_3(1-p_3) + 3\eta > \alpha_1 p_1 + \alpha_2 p_2 + \alpha_3 p_3 - \eta$ or $\eta > \frac{\beta_2+\beta_3}{2}$. So if $\eta > \frac{\beta_2+\beta_3}{2}$ then all decisions should align with Z_1, while if $\eta \leq \frac{\beta_2+\beta_3}{2}$ then the piecemeal outcome is optimal. In the alternative case that $\beta_1 \leq \beta_2 + \beta_3$, alignment is optimally obtained by switching D_1. That switch improves the payoff if $\alpha_1(1-p_1) + \alpha_2 p_2 + \alpha_3 p_3 + 3\eta > \alpha_1 p_1 + \alpha_2 p_2 + \alpha_3 p_3 - \eta$ or $\eta > \frac{\beta_1}{2}$. So if $\eta > \frac{\beta_1}{2}$ then D_1 should align with D_2 and D_3, while if $\eta \leq \frac{\beta_1}{2}$ then the piecemeal outcome is optimal. If $\theta = ABA$ then alignment – if optimal – is best obtained by switching D_2 to $\overline{Z}_2$ (which, at cost $2\beta_2$, always dominates switching both D_1 and D_3 at cost $2\beta_1 + 2\beta_3$), which improves the payoff when $\alpha_1 p_1 + \alpha_2(1-p_2) + \alpha_3 p_3 + 3\eta > \alpha_1 p_1 + \alpha_2 p_2 + \alpha_3 p_3 - \eta$ or $\eta > \frac{\beta_2}{2}$. If $\theta = AAB$ then alignment is optimally obtained by switching D_3 (which always dominates switching both D_1 and D_2), which is worthwhile when $\eta > \frac{\beta_3}{2}$. All other cases are symmetric.

Consider next the *non-supermodular* case. By renaming decision choices (i.e., by switching A and B for, say, D_2) I can in fact choose which of the three interactions is the substitute in the setting with one substitute and two complements. I will use that property here and assume that decision choices have been renamed so that $\theta_{1,2} = \theta_{1,3} = C$ and $\theta_{2,3} = S$ and so that $\theta_1 = A$. In this case, at least one of the interactions is always violated. If $\theta = AAA$, then there is no gain from switching from the piecemeal solution and thus no gain from strategy. The payoff in this case is $\alpha_1 p_1 + \alpha_2 p_2 + \alpha_3 p_3 + \eta$. The same is true for $\theta = AAB$ and ABA, which thus give identical payoffs. When $\theta = BAA$, then all interactions are violated and the piecemeal solution gives payoff $\alpha_1 p_1 + \alpha_2 p_2 + \alpha_3 p_3 - 3\eta$. A higher payoff can potentially be obtained by switching (exactly) one decision. Since any switch has the same effect on the interaction payoffs, the best decision to switch (if switching is optimal) is D_3. This switch improves the payoff if $\alpha_1 p_1 + \alpha_2 p_2 + \alpha_3(1-p_3) + \eta > \alpha_1 p_1 + \alpha_2 p_2 + \alpha_3 p_3 - 3\eta$ or $\eta > \beta_3/2$. All other cases are symmetric.

Taking now all cases (both supermodular and non-supermodular) together, it follows that if $\eta \leq \beta_3/2$ then there is never any gain from strategy. If $\eta > \beta_3/2$, then the expected gain from strategy for the non-supermodular case is always $(4\eta - 2\beta_3)/4 = \eta - \beta_3/2$ where the division by 4 captures the fact that the likelihood that strategy improves the payoff in the non-supermodular case is $1/4$. The gain from strategy for the supermodular case is $(4\eta - 2\beta_3)/4 = \eta - \beta_3/2$ if $\beta_2/2 \geq \eta > \beta_3/2$; it is $2\eta - \frac{\beta_2+\beta_3}{2}$ if $\min(\frac{\beta_2+\beta_3}{2}, \frac{\beta_1}{2}) \geq \eta > \frac{\beta_2}{2}$, and it is $3\eta - \frac{\beta_2+\beta_3}{2} - \min\left(\frac{\beta_2+\beta_3}{2}, \frac{\beta_1}{2}\right)$ if $\eta > \min(\frac{\beta_2+\beta_3}{2}, \frac{\beta_1}{2})$. The likelihood that strategy improves the payoff is identical for the supermodular and non-supermodular cases when $\eta \leq \beta_2/2$ and strictly higher for the supermodular case than for the non-supermodular case when $\eta > \beta_2/2$ (either $1/2$ or $3/4$ versus $1/4$). This proves the proposition. ∎

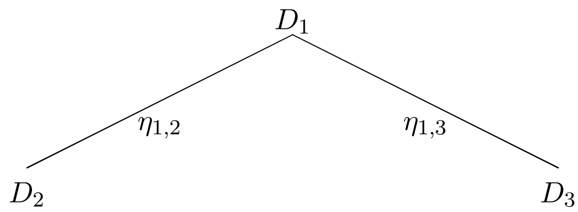

Figure 5: Setup for centrality analysis, $\eta_{1,2} \geq \eta_{1,3}$

Proof of Proposition 7: Let the states be numbered such that D_1 is the decision with 2 interactions and such that $\eta_{1,2} \geq \eta_{1,3}$, as indicated in Figure 5. Consider first the case that $\beta < \eta_{1,3}(\leq \eta_{1,2})$. In this case, it is always better to compromise a decision than to violate an interaction. The optimal outcome will therefore always satisfy both interactions. Moreover, since all decisions are equally important, it will do so in the way that simply minimizes the number of decisions that must be compromised. Since both interactions can always be satisfied by compromising at most one decision, that minimum number of decisions is thus either zero (when the piecemeal solution satisfies both interactions) or one (when it doesn't).

It then follows that the following is an optimal (information collection process and) strategy and thus a potential equilibrium. (Moreover, together with the symmetric process where D_2 and D_3 are switched in roles throughout, these are the only possible optimal (information collection process and) strategies and thus the only possible potential equilibria.) First, investigate T_1, T_2, and $T_{1,2}$. If Z_1 and Z_2 respect $\theta_{1,2}$ then announce as strategy $D_1 = Z_1$. If that is not the case, investigate T_3 and $T_{1,3}$. For the announcement that follows this last investigation, there are multiple possibilities that all lead to the optimal outcome and each of these is an equilibrium (absent any further refinements). Any communication pattern that satisfies the following conditions works: 1) at most one decision is announced, 2) any decision that is announced and fixed must be part of the optimal outcome, 3) one of the following two holds: a) the decision announced (which may be *no* decision announced) is different when $\theta_{1,3}$ is satisfied than when $\theta_{1,3}$ is violated *or* b) the decision announced is either D_1 or D_2. To see that this indeed leads to the optimal outcome, note the following (and remember that $\theta_{1,2}$ is always violated when it gets to this subgame). For an announcement in terms of D_1, it is straightforward how it leads to the optimal outcome as fixing D_1 directly determines what is optimal for the two other decisions. When different D_k are announced depending on whether $\theta_{1,3}$ is satisfied or violated, then each participant can infer from the decision begin announced which of the $\theta_{k,l}$ were respected and can thus also infer both D_1 and the optimal outcome as a function of D_1. So now I only need to consider cases where the same D_k is announced whether $\theta_{1,3}$ is satisfied or violated. The only remaining case, then, is that where the announcement is always in terms of D_2, for which the argument is as follows. When $\theta_{1,3}$ is satisfied, the target outcome is $D_2 = \overline{Z}_2$ and piecemeal for D_1 and D_3, so that fixing $D_2 = \overline{Z}_2$ will indeed implement this. When $\theta_{1,3}$ is violated, the target outcome is $D_1 = \overline{Z}_1$ and piecemeal for D_2 and D_3, and announcing $D_2 = Z_2$ will implement this as P_1 will align by choosing $D_1 = \overline{Z}_1$ (especially given what she can infer about Z_3). Decision D_1 is indeed more likely to be part of the strategy than any other decision (weighing all equilibria equally).

Consider next the case that $\eta_{1,3} < \beta < \eta_{1,2}$. In that case, the optimal outcome will always satisfy $\theta_{1,2}$. If Z_1 and Z_2 satisfy $\theta_{1,2}$, then the piecemeal solution is optimal. If that is not the case, then either D_1 or D_2 will be compromised in such a way that *both* $\theta_{1,2}$ *and* $\theta_{1,3}$ are satisfied (which is always possible with compromising at most one of the two). It follows then that the following is an optimal (information collection process and) strategy. First, investigate T_1, T_2, and $T_{1,2}$. If Z_1 and Z_2 respect $\theta_{1,2}$ then announce no decision (so that the strategy is empty). If that is not the case, investigate T_3 and $T_{1,3}$. As above, there are again multiple possibilities (for the announcement that follows the $\theta_{1,3}$ investigation) that lead to the optimal outcome and each of these is a potential equilibrium (absent further refinements). In this case, any communication pattern that satisfies the following conditions works: 1) exactly one decision is announced and that decision must be part of the optimal outcome, 2) one of the following two holds: a) the decision announced is different when $\theta_{1,3}$ is satisfied than when $\theta_{1,3}$ is violated *or* b) the decision announced is either D_1 or D_2. The argument is analogous to above. It is also again straightforward to verify that D_1 is indeed more likely to be part of the strategy than any other decision (weighing all equilibria equally). This proves the proposition for this second parameter range.

Consider finally the case that $\eta_{1,2} < \beta < \eta_{1,2} + \eta_{1,3}$. In that case, the optimal outcome is the piecemeal solution *unless* compromising D_1 satisfies both $\theta_{1,2}$ and $\theta_{1,3}$ (whereas setting $D_1 = Z_1$ violates both $\theta_{1,2}$ and $\theta_{1,3}$). In particular, the parametric condition implies that compromising a decision is only optimal if doing so ensures that both interactions go from violated to satisfied. This is obviously only possible in the case of D_1. It then follows that the following is an optimal (information collection process and) strategy. Investigate T_1, T_2, and $T_{1,2}$. If Z_1 and Z_2 respect $\theta_{1,2}$ then announce no decision (so that the strategy is empty). If that is not the case, investigate T_3 and $T_{1,3}$. If Z_1 and Z_3 respect $\theta_{1,3}$, then announce again no decision (so that the strategy is empty), else announce as strategy either $D_1 = \overline{Z}_1$, or $D_2 = Z_2$ or $D_3 = Z_3$. D_1 is in this case equally likely – and thus still weakly more likely – to be part of the strategy than any other decision. This completes the proof of the proposition. ■

Proof of Proposition 10a: I will prove this result as part of deriving the full equilibrium of the game. Since the decision can always be renumbered, let $\overline{k} = 1$ and $\underline{k} = 2$, which implies that $\beta_1 > \beta_2$ and $\eta > \beta_2$.

Consider first the case that the strategy is developed by the dominant decision maker, i.e., $s = P_{\overline{k}}$. An analysis completely analogous to that of Propositions 2a and 6 then shows that

1. The optimal outcome according to $P_{\overline{k}}$ is that $D_{\overline{k}} = Z_{\overline{k}}^{\overline{k}}$ and $D_{\underline{k}}$ is chosen to satisfy $\theta_{1,2}$, i.e., $D_{\underline{k}} = D_{\overline{k}}$ if $\theta_{1,2} = C$ and $D_{\underline{k}} = \overline{D}_{\overline{k}}$ if $\theta_{1,2} = S$.
2. If $P_{\overline{k}}$ announces $D_{\overline{k}} = Z_{\overline{k}}^{\overline{k}}$ in stage 1c (after having investigated (only) $T_{\overline{k}}$ in stage 1b), then the above is the selected equilibrium outcome of the subgame starting in stage 2.
3. In the unique (selected) equilibrium (for the full game, not just for the subgame starting in stage 2), $P_{\overline{k}}$ investigates (only) $T_{\overline{k}}$ in stage 1b and announces (as strategy) $D_{\overline{k}} = Z_{\overline{k}}^{\overline{k}}$ in stage 1c. The optimal outcome (from $P_{\overline{k}}$'s perspective) will then be implemented for sure.

Whereas the change to cheap talk adds some potential equilibria and potential subgame equilibria other than those in Proposition 6, none of these are part of an equilibrium or survive the equilibrium selection criterium. The outcome thus remains unique and unchanged from before.

For the proof of the proposition, the above implies that conditional on $P_{\overline{k}}$ investigating (only) $T_{\overline{k}}$ in stage 1b and announcing $D_{\overline{k}} = Z_{\overline{k}}^{\overline{k}}$ as strategy in stage 1c (with the intention of implementing $Z_{\overline{k}}^{\overline{k}} - Z_{\overline{k}}^{\overline{k}}$), the strategy is implemented for sure (given the assumption that $\eta > \beta_{\underline{k}}$). So, to prove the proposition, it suffices to show that the optimal strategy is sometimes *not* implemented when developed by an outsider O and that non-implementation satisfies the comparative statics of the proposition.

Consider therefore now the case with the outsider as strategist, i.e., $s = O$. From O's perspective, the optimal outcome is $D_1 = Z_1^O$ and $D_2 = D_1$ if $\theta_{1,2} = C$ and $D_2 = \overline{D}_1$ otherwise.

Consider the subgame starting in period 2, i.e., after O has (potentially) investigated some of the states and made an announcement in stage 1c. Since in stage 2a all players will get an identical signal $\theta_{1,2}$ about the interaction $T_{1,2}$, that signal will also be common knowledge by the time the decisions are made in stage 2b. I can therefore condition the subgame on, say, $\theta_{1,2} = C$. The results for the alternative case $\theta_{1,2} = S$ are completely analogous, and in fact identical after renaming decision choices.

Since the messages in stage 1c are cheap talk (with no direct effect on actions or payoffs) and since the equilibrium selection is completely driven by expected payoffs, cheap talk can affect the equilibrium only through its effect on expectations, i.e., through its effect on beliefs about what other players will do. Moreover, given the symmetry condition applied to cheap talk (i.e., the condition that switching A's and B's in O's signals also switches A's and B's in O's messages), the effect of the cheap talk messages in 1c on the other players' beliefs is to create common knowledge about one or more of O's signals about decision states. I can thus characterize the effect of O's communication (if there is any) by assuming that the outcome of either one or two of O's signals about decision states become common knowledge (where the equilibrium determines which signals become common knowledge).

Consider now the start of stage 2. Consider the beliefs about T_k for all players but s and P_k. Let $\tilde{Z}_k$ denote the most likely value for Z_k according to all players but s and P_k. For definiteness, let $\tilde{Z}_k = A$ when all players but s and P_k believe that A and B are equally likely for Z_k. Let ν_k denote the common (and common knowledge) confidence of all these players that $\tilde{Z}_k = Z_k^k$. Note that $\tilde{Z}_k \in \{A, B\}$ is completely based on O's investigation and announcement in stage 1 and does not change with the realized Z_k^k. If O investigated T_k and her message created common knowledge about θ_k^O, then $\nu_k = \lambda_k$, else $\nu_k = .5$.

Consider the best responses in stage 2b. Let X_{-k} denote P_{-k}'s most likely action according to P_k (based on the common knowledge beliefs, of all players but s and P_{-k}, about Z_{-k}^{-k} and based on P_{-k}'s assumed equilibrium behavior) and let $\psi_{-k} \geq .5$ denote P_k's belief that $D_{-k} = X_{-k}$. With her choice, P_k can only affect the direct payoff from D_k and the interaction payoff. In particular, conditional on $\theta_{1,2} = C$, P_k solves

$$\max_{D_k} \alpha_k \left[(2p_k - 1)I_{D_k = Z_k} + 1 - p_k\right] + \gamma \left[(2\psi_{-k} - 1)(2I_{D_k = X_{-k}} - 1)\right]$$

Since both $2p_k - 1 > 0$ and $2\psi_{-k} - 1 \geq 0$, the payoff increases in both $I_{D_k = Z_k}$ and $I_{D_k = X_{-k}}$. It follows that P_k's best response is either $D_k = Z_k$ or $D_k = X_{-k}$.

Since X_{-k} is derived from common knowledge events (including P_{-k}'s assumed equilibrium behavior, which is also common knowledge), X_{-k} itself must be common knowledge. It follows that, conditional on $\theta_{1,2} = C$, if P_k's strategy is to choose X_{-k}, then $X_k = X_{-k}$ and P_{-k}'s best response is to either also choose $X_k = X_{-k}$ or to choose Z_{-k}. If, on the other hand, P_k's strategy is to choose Z_k, then $X_k = \tilde{Z}_k$. This leaves the following as potential equilibria: 'each P_k always chooses Z_k', 'P_1 chooses Z_1 and P_2 chooses $\tilde{Z}_1$', 'P_2 chooses Z_2 and P_1 chooses $\tilde{Z}_2$', 'both always choose X' with $X \in \{A, B, \tilde{Z}_1, \tilde{Z}_2, \overline{\tilde{Z}}_1, \overline{\tilde{Z}}_2\}$.

All the potential equilibria of the form 'both always choose X' have the same equilibrium condition: each player P_k must prefer to choose $\overline{Z}_k$ and getting alignment over choosing Z_k and not getting alignment, i.e., $\alpha_k(1 - p_k) + \eta \geq \alpha_k p_k - \eta$ or $\eta \geq \alpha_k(p_k - .5)$, so that the condition for each and all of these to be an equilibrium is that $\eta \geq \max_k \alpha_k(p_k - .5)$.

Consider next the potential equilibrium where 'each chooses Z_k', so that for all D_k, $P[D_k = \tilde{Z}_k] = \nu_k \geq .5$. The best response for P_{-k} to 'P_k chooses Z_k' is to 'choose $\tilde{Z}_k$' if $\alpha_{-k}(1 - p_{-k}) + \nu_k\eta + (1 - \nu_k)(-\eta) \geq \alpha_{-k}p_{-k} + \nu_k(-\eta) + (1 - \nu_k)\eta$ or $(2\nu_k - 1)\eta \geq \alpha_{-k}(p_{-k} - .5)$, and to 'choose Z_{-k}' if the inequality holds in the other direction (with both being best response under equality). Let now $\rho_k = 2\nu_k - 1 \in [0, 1]$ (given that $\nu_k \in [.5, 1]$), then the condition for Z_{-k} to be P_{-k}'s best response is $\eta \leq \alpha_{-k}(p_{-k} - .5)/\rho_k$. The condition for 'each chooses Z_k' to be an equilibrium is then that $\eta \leq \min_k \alpha_{-k}(p_{-k} - .5)/\rho_k$.

Consider finally the potential equilibrium where 'P_k chooses Z_k^k and P_{-k} chooses $\tilde{Z}_k$'. The above analysis implies that 'P_{-k} chooses $\tilde{Z}_k$' is a best response to 'P_k chooses Z_k^k' if $\eta \geq \alpha_{-k}(p_{-k} - .5)/\rho_k$. The best response to '$P_{-k}$ chooses $\tilde{Z}_k$' is 'P_k chooses Z_k' if $\alpha_k p_k - \eta \geq \alpha_k(1 - p_k) + \eta$ or $\eta \leq \alpha_k(p_k - .5)$. So the condition for this to be an equilibrium is that $\alpha_k(p_k - .5) \geq \eta \geq \alpha_{-k}(p_{-k} - .5)/\rho_k$. Given the assumption that $\beta_1 > \beta_2$, this can only hold for $k = 1$. Thus 'P_1 chooses Z_1 and P_2 chooses $\tilde{Z}_1$' is a potential equilibrium iff $\alpha_1(p_1 - .5) \geq \eta \geq \alpha_2(p_2 - .5)/\rho_1$.

I now derive the equilibrium regimes for the different parameter ranges, using the equilibrium selection rule when needed and taking into account the assumptions that $\beta_1 > \beta_2$ and $\eta > \beta_2$. The resulting regimes are depicted in Figure 6. First, whenever $\eta \leq \min_k \alpha_{-k}(p_{-k} - .5)/\rho_k$, 'each chooses Z_k' is an equilibrium and it is the equilibrium that will be selected by the equilibrium selection criterium (since the starting point of the equilibrium selection process is exactly this set of actions).

Second, in the region where $\alpha_1(p_1 - .5) \geq \eta \geq \alpha_2(p_2 - .5)/\rho_1$, the equilibrium is '$P_1$ chooses Z_1 and P_2 chooses $\tilde{Z}_1$'.

Third, when $\alpha_2(p_2 - .5)/\rho_1 < \eta$ and $\rho_2\alpha_2(p_2 - .5)/\rho_1 \leq \alpha_1(p_1 - .5) < \eta$ then the selected equilibrium is 'both choose $\tilde{Z}_1$'. Analogously, when $\alpha_1(p_1 - .5)/\rho_2 < \eta$ and $\rho_1\alpha_1(p_1 - .5)/\rho_2 \leq \alpha_2(p_2 - .5) < \eta$ then the selected equilibrium is 'both choose $\tilde{Z}_2$'.

Note that the equilibrium depends on the strategists' actions in period 1 through the values of ρ_k: if the strategist does not investigate T_k, for example, then $\rho_k = 0$ and the equilibrium regimes change accordingly.

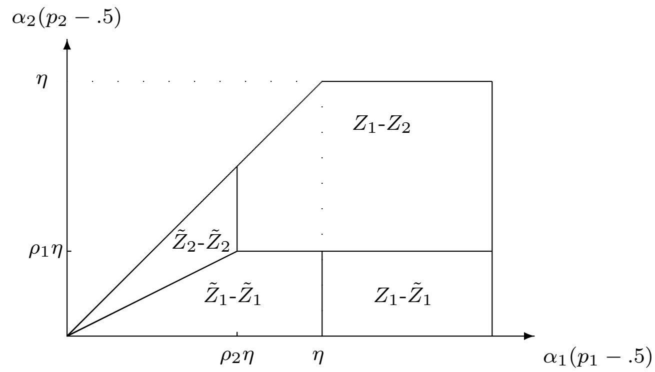

Figure 6: Equilibrium Regimes in Function of Parameters (for $\beta_2 < \beta_1, \eta$)

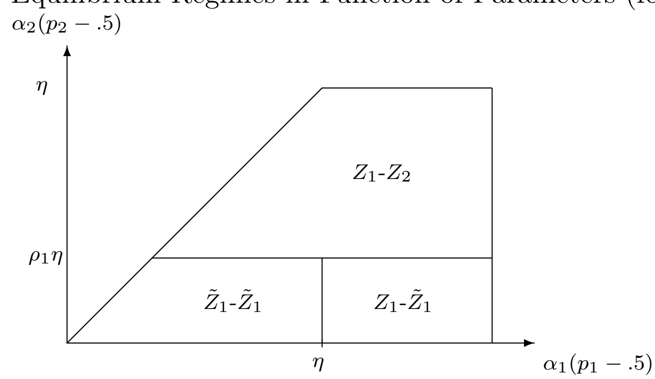

Figure 7: Equilibrium Regimes in Function of Parameters (for $\beta_2 < \beta_1$, $\beta_2 < \eta$) when (only) $T_{\overline{k}}$ is investigated and announced

To conclude now the proof of this proposition, note that O investigating (only) $T_{\overline{k}}$ (with $\overline{k} = 1$) and announcing $D_{\overline{k}} = Z^O_{\overline{k}}$ in stage 1c implies that $\rho_2 = 0$ and $\rho_1 = 2\lambda_1 - 1$. The equilibrium regimes for that case are indicated in Figure 7.[29] It follows that conditional on O investigating (only) $T_{\overline{k}}$ in stage 1b and announcing $D_{\overline{k}} = Z^O_{\overline{k}}$ as strategy in stage 1c (with the intention of implementing the optimal outcome from the perspective of O, which is $\tilde{Z}_1 - \tilde{Z}_1$), there is a strictly positive probability that the strategy is *not* implemented. It follows that the strategy is less likely to be implemented when O developed it than when $P_{\overline{k}}$ developed it. This proves the first part of the proposition.

The second part of the proposition follows immediately from the condition under which $\tilde{Z}_1 - \tilde{Z}_1$ is the equilibrium outcome, as captured in Figure 7. ■

Proof of Proposition 10b: As in the proof of Proposition 10a, I will rename the decisions so that $\beta_1 > \beta_2$ and condition on $\theta_{1,2} = C$.

The first part of the proposition (on the outcome when $P_{\overline{k}}$ develops the strategy) follows directly from the proof of Proposition 10a.

I will now derive the full equilibrium for the case that O develops the strategy. The proof of Proposition 10a showed that the potential equilibria are $Z_1 - Z_2$, $\tilde{Z}_1 - \tilde{Z}_1$, $Z_1 - \tilde{Z}_1$, and $\tilde{Z}_2 - \tilde{Z}_2$ (in the respective ranges as indicated in figure 6). Based on the figure, any potential equilibrium involving $\tilde{Z}_k$ can only be an equilibrium when $\nu_k > .5$, i.e., when O investigated and implicitly or explicitly announced θ_k, and in that case $\nu_k = \lambda_k$ and $\tilde{Z}_k = Z^O_k$. (Moreover, unless $\nu_k > .5$ $\tilde{Z}_k$ is undefined.) The payoffs according to O from these different

[29]To reconcile this figure with the results on $P_{\overline{k}}$ being the strategist, note that in that case $Z_1 = \tilde{Z}_1$ and $\rho_1 = 1$, so that the outcome is indeed everywhere $Z_1 - Z_1$.

potential equilibria are therefore:

$$\begin{aligned}
\Pi^O(\tilde{Z}_1 - \tilde{Z}_1) &= \alpha_1 p_1 + \alpha_2 \frac{1}{2} + \eta \\
\Pi^O(Z_1 - \tilde{Z}_1) &= \alpha_1 q_1 + \alpha_2 \frac{1}{2} + \phi_1 \eta \\
\Pi^O(\tilde{Z}_2 - \tilde{Z}_2) &= \alpha_1 \frac{1}{2} + \alpha_2 p_2 + \eta \\
\Pi^O(Z_1 - Z_2) &= \alpha_1 q_1 + \alpha_2 q_2
\end{aligned}$$

where $q_k = \lambda_k p_k + (1 - \lambda_k)(1 - p_k) \leq p_k$ and $\phi_k = 2\lambda_k - 1$.

The outside strategist O will influence the equilibrium by his cheap talk messages. In particular, if he investigates and communicates θ_k^O then $\rho_k = \phi_k$ else $\rho_k = 0$ (in the equilibrium regime as derived in the proof of Proposition 10a and depicted in Figure 6).

Consider now first the case that $\beta_2 < \phi_1\eta$. Note that $\Pi^O(\tilde{Z}_1 - \tilde{Z}_1) > \Pi^O(Z_1 - Z_2)$ (using the fact that $\alpha_2(q_2 - \frac{1}{2}) \leq \beta_2 < \phi_1\eta \leq \eta$) and $\Pi^O(\tilde{Z}_1 - \tilde{Z}_1) > \Pi^O(\tilde{Z}_2 - \tilde{Z}_2)$ (using the fact that $\beta_1 > \beta_2$). Moreover, given $\phi_1\eta > \beta_2$ and thus $\phi_1\eta > \alpha_2(q_2 - \frac{1}{2})$, $\Pi^O(Z_1 - \tilde{Z}_1) > \Pi^O(Z_1 - Z_2)$ in this range. It follows indeed that the equilibrium is that O investigates (only) $T_{\overline{k}}$ and announces as strategy $D_{\overline{k}} = Z^O_{\overline{k}}$.

- If $\beta_1 < \eta$ then that strategy is completely implemented and the implemented outcome is the optimal outcome from O's perspective.
- If $\beta_1 \geq \eta$ then $P_{\underline{k}}$ implements his part of the strategy ($D_{\underline{k}} = Z^O_{\underline{k}}$) but $P_{\overline{k}}$ chooses his piecemeal best outcome ($Z^{\overline{k}}_{\overline{k}}$) and the implemented outcome is only sometimes the optimal outcome from O's perspective.

Consider next $\beta_2 \geq \phi_1\eta$. The only possible equilibria in this range are $Z_1 - Z_2$ and $\tilde{Z}_2 - \tilde{Z}_2$. When, moreover, $\beta_1 \geq \phi_2\eta$, the only possible equilibrium is $Z_1 - Z_2$. In that range, the equilibrium is thus always that O investigates no state and announces *no strategy* at all and the outcome is simply the piecemeal outcome.

Consider finally the case that $\beta_2 \geq \phi_1\eta$ and $\beta_1 < \phi_2\eta$. I first claim that if Condition 1 does not hold, then the only possible equilibrium is again $Z_1 - Z_2$. To see why, note that to implement $\tilde{Z}_2 - \tilde{Z}_2$, the equilibrium must be that O investigates (only) $T_{\underline{k}}$ and announces as strategy $D_{\underline{k}} = Z^O_{\underline{k}}$, and that strategy is always implemented. But in the absence of Condition 1, O then has a profitable deviation: investigate (only) $T_{\overline{k}}$ (instead of (only) $T_{\underline{k}}$) and announce as strategy $D_{\underline{k}} = Z^O_{\overline{k}}$, and that strategy is then always implemented. This is more profitable for O since $\Pi^O(\tilde{Z}_1 - \tilde{Z}_1) > \Pi^O(\tilde{Z}_2 - \tilde{Z}_2)$ and it gets always implemented since the decision makers can't verify what O's announcement is based upon. So if Condition 1 does not hold, then the P_k will always assume that any announcement by O is about $Z^O_{\overline{k}}$ rather than $Z^O_{\underline{k}}$ and *not* implement the strategy. The only possible equilibrium outcome is then $Z_1 - Z_2$ and the equilibrium is indeed that O investigates no state and announces *no strategy* at all and the outcome is simply the piecemeal outcome. If, however, Condition 1 holds, then O can credibly announce $D_{\underline{k}} = Z^O_{\underline{k}}$ (either by verifiably revealing his $\theta_{\underline{k}}$ signal or, if it is public which states he investigates, simply by investigating *only* $\theta_{\underline{k}}$). In that case, given that $\Pi^O(\tilde{Z}_2 - \tilde{Z}_2) > \Pi^O(Z_1 - Z_2)$ (as $\eta \geq \phi_2\eta > \beta_1$), the equilibrium is that O investigates (only) $T_{\underline{k}}$ and announces as strategy $D_{\underline{k}} = Z^O_{\underline{k}}$; that strategy is always implemented; but the implemented outcome is now *not* the optimal outcome from O's perspective.

This proves the proposition. ■

To see now that there is indeed a region where everyone is strictly better off when the strategist does explicitly *not* investigate or announce a particular decision, consider in Figure 6 the $\tilde{Z}_2 - \tilde{Z}_2$ regime where $\alpha_2(p_2 - .5) < \rho_1\eta$. The $\tilde{Z}_2$-$\tilde{Z}_2$ regime that obtains when both θ_1 and θ_2 are announced has indeed a lower payoff than the $\tilde{Z}_1$-$\tilde{Z}_1$ regime that obtains when θ_2 is *not* announced (and only θ_1 is announced). The reason why the selected equilibrium is $\tilde{Z}_2$-$\tilde{Z}_2$ rather than the Pareto-superior $\tilde{Z}_1$-$\tilde{Z}_1$ is the following. Both participants know $\tilde{Z}_2$. Both also know that P_1 cares more about alignment (relative to making the best decision on a standalone basis) than P_2, so that P_1 is much more likely to compromise when there is any potential for confusion. This leads to the $\tilde{Z}_2$-$\tilde{Z}_2$ equilibrium. But if θ_2 is not announced, then $\tilde{Z}_2$ is not commonly known and even though both know that P_1 is more likely to compromise, the lack of common knowledge of $\tilde{Z}_2$ means that this does not provide a focal point that can be the basis for an equilibrium. In equilibrium, the strategist will thus explicitly not investigate or announce θ_2 in order to eliminate the possibility that this would create a focal point for a suboptimal equilibrium.

Proof of Proposition 14: As in earlier proofs, condition on $\theta_{1,2} = C$. Note also that, as $\lambda_k^{ij} = .5$, a player cannot learn about the other's beliefs by investigating a state: she can only learn the other's beliefs through the announcements.

If both $\beta_k^k \geq \eta$, then the equilibrium is simple and unique (as each player chooses Z_k^k and, in case of indifference, the equilibrium selection criterium selects equilibria where players choose the piecemeal solution): no player investigates or announces, and each player just chooses $D_k = Z_k^k$. So when both $\beta_k^k \geq \eta$, the equilibrium is always $Z_1 - Z_2$. In any subgame where one or both participants develop a standard strategy under full disagreement, no strategy is implemented.

Consider next the case $\beta_1^1 \geq \eta > \beta_2^2$ (or, analogously, the symmetric case). I will show that in this case, the equilibrium is that P_1 investigates (only) T_1, announces $D_1 = Z_1^1$ and both choose Z_1^1. Moreover, conditional on P_1 developing a standard strategy under full disagreement, that strategy is always implemented. Conditional on P_2 developing a standard strategy under full disagreement, that strategy is never implemented.

To see this, note that when $\beta_1^1 \geq \eta > \beta_2^2$, P_1 always chooses $D_1 = Z_1^1$ (in any selected equilibrium) whereas P_2 wants to align with Z_1^1. This immediately implies the results on implementation. Consider now the overall equilibrium. (A potential complication here is that P_1 may not necessarily *want* P_2 to align with Z_1^1 and may thus either refuse to communicate or try to mislead P_2.) In any potential equilibrium, P_1 will choose Z_1^1. The best response of P_2 is to either choose Z_2^2 (if he does not know Z_1^1) or to choose Z_1^1 (if he knows what action Z_1^1 is). The potential equilibria are thus $Z_1^1 - Z_1^1$ or $Z_1^1 - Z_2^2$.

If $\beta_2^1 \leq \eta$, then P_1 also prefers P_2 to align (giving $E_{P_1}[\Pi] = \alpha_1 p_1^1 + \alpha_2/2 + \eta$) and the equilibrium is that P_1 investigates (only) T_1, announces $D_1 = Z_1^1$ and both choose Z_1^1. If $\beta_2^1 > \eta$, then P_1 in fact prefers P_2 to choose Z_2^1 (giving $E_{P_1}[\Pi] = \alpha_1 p_1^1 + \alpha_2 p_2^1$) over P_2 aligning with Z_1^1 (giving $E_{P_1}[\Pi] = \alpha_1 p_1^1 + \alpha_2/2 + \eta$), and prefers the latter over P_2 choosing Z_2^2 (giving $E_{P_1}[\Pi] = \alpha_1 p_1^1 + \alpha_2/2$). Under Condition 1, the equilibrium will be that P_1 investigates (only) T_1, announces $D_1 = Z_1^1$ and both choose Z_1^1. (To see this, note the following. P_1 would like to (investigate T_2 and) announce Z_2^1 as if it were Z_1^1, so that P_2 chooses Z_2^1. This would give the outcome Z_1^1-Z_2^1. But P_2 will realize that and thus disregard P_1's announcement whenever P_1 investigated T_2, leading to $Z_1^1 - Z_2^2$. But, taking that into account, P_1 prefers to (commit to) investigate only T_1. Such commitment is possible thanks to Condition 1.)

Consider finally the case that both $\beta_k^k < \eta$, so that each player is willing to compromise in order to align. Assume wlog. that $\beta_1^1 > \beta_2^2$. I will show that in this case, again, the equilibrium is that P_1 investigates (only) T_1, announces $D_1 = Z_1^1$ and both choose Z_1^1. Moreover, conditional on either player being the *only one* to develop a standard strategy under full disagreement, that strategy is always implemented. Conditional on *both* developing a standard strategy under full disagreement, the strategy of the participant with the highest β_k^k is (the one that is always) implemented.

The results on implementation follow directly from the fact that each participant is willing to compromise in order to align and from the equilibrium selection rule when both Z_k^k are known. Note, furthermore, that in each potential equilibrium each participant P_k either knows for sure what P_{-k} will choose (denoted X_{-k}) or believes that P_{-k} is equally likely to choose A or B. The arguments in earlier proofs then imply that P_k's best response is either Z_k^k or X_{-k}. This leaves the potential equilibria $Z_1 - Z_2$ or $X - X$ with X any publicly known action. The equilibrium conditions for the $X - X$ equilibria combined with the equilibrium selection rule further narrow down the potential equilibria to $Z_1 - Z_2$ and $Z_1 - Z_1$ given the assumption that $\beta_1^1 > \beta_2^2$. The potential complication is again that P_1 may not necessarily want P_2 to align and would, in particular, prefer P_2 to choose Z_2^1. But, realizing that, P_2 will disregard P_1's announcement whenever P_1 investigates T_2 (which is observable given Condition 1), resulting in the $Z_1 - Z_2$ outcome. Since P_1 prefers $Z_1 - Z_1$ over $Z_1 - Z_2$ (since it gives $E_{P_1}[\Pi] = \alpha_1 p_1^1 + \alpha_2/2 + \eta$ instead of $E_{P_1}[\Pi] = \alpha_1 p_1^1 + \alpha_2/2$), the equilibrium is indeed

for P_1 to investigate (only) T_1, to announce $D_1 = Z_1^1$ and for both to choose Z_1^1.
So the equilibrium is

- if $\beta_1^1, \beta_2^2 \geq \eta$: $Z_1 - Z_2$ and no (standard) strategy (under full disagreement) gets implemented
- if $\beta_1^1 > \beta_2^2$ and $\eta \geq \beta_2^2$: $Z_1 - Z_1$ and (only) P_1's standard strategy under full disagreement gets (always) implemented
- if $\beta_2^2 > \beta_1^1$ and $\eta \geq \beta_1^1$: $Z_2 - Z_2$ and (only) P_2's standard strategy under full disagreement gets (always) implemented

which proves the proposition. ■

B Refinement

In some of the analysis, especially when further extending the model, it might be useful to impose additional restrictions in order to refine the strategist's equilibrium choice in stage 1c. The purpose of such restrictions would be to eliminate equilibria where (not) announcing or fixing a *particular* decision is used as a *signal* for something completely *different*. Consider, for example, the following equilibrium: when the optimum is $(D_1 = \overline{Z}_1; D_k = Z_k, \forall k \neq 1)$, then the strategist announces no decisions in 1c. Given common knowledge of the equilibrium, P_1 will make the correct inference when no decision is announced in 1c and choose $D_1 = \overline{Z}_1$. Here, 'no announcement' is used as a signal for something very different ($D_1 = \overline{Z}_1$). This only works if the strategist and P_1 carefully coordinate on the meaning of the (non-)communication. Whereas such signaling and inference may make sense in some contexts, it does not make sense in the context of a large organization that has trouble coordinating, since it will have trouble coordinating on such very precise message equilibria. The most logical way to eliminate such unrealistic equilibria is to introduce a small probability that one or more participants may believe a somewhat different equilibrium is being played and therefore fails to make the intended inference.

The following criterium implements this and thus largely eliminates such signaling. The implicit idea here is that the strategy might sometimes be driven by considerations outside the focal game and that there is always some uncertainty – and thus some possible confusion – whether that happened. Call a (project) strategy 'exogenous' if – instead of the strategist freely choosing what to investigate and what to announce – the investigations and the strategy are (for reasons outside the focal game) determined exogenously, as follows: for each state T_k (independently), with some small probability $\zeta > 0$, the state is investigated and $D_k = Z_k$ announced. An exogenous strategy thus consists of a random number of decisions (including possibly none) with each decision reflecting the piecemeal choice. When the strategy is exogenous, participants cannot infer anything beyond θ_k from an announcement about D_k.

To select the equilibrium that is robust to some small 'confusion' about such exogenous (and thus inference-free) strategy, assume that the project strategy is exogenous with some small probability $\epsilon \downarrow 0$ and every participant gets an independent signal whether that is the case, with the signal being correct with probability $\kappa \uparrow 1$. So even when the strategy is not exogenous, each participant believes with small probability that it is and, in that case, maintains his prior beliefs for each decision that is not announced. If there exists an equilibrium that is the limit for $\epsilon \downarrow 0$, then the players will play that equilibrium.

Along similar lines, it seems that it may be useful in some types of extensions to require some degree of robustness to 'locally focused play' in the sense that players may believe that there are no further interactions beyond the ones that they immediately observe between their own decision and adjacent decisions. This can be modeled by assuming that each setting that is studied is actually drawn from a distribution of settings that has a strong prior towards no interactions. As long as a participant does not actively investigate the interaction, her prior will be that there is no interaction beyond the ones between her decision and the immediately adjacent decisions. This captures the fact that an average employee is typically unaware of any interactions beyond those directly affecting his own decisions.

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