

Rational Inattention and Organizational Focus[†]

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This paper studies optimal communication flows in organizations. A production process can be coordinated ex ante, by letting agents stick to a prespecified plan of action. Alternatively, agents may adapt to task-specific shocks, in which case tasks must be coordinated ex post, using communication. When attention is scarce, an optimal organization coordinates only a few tasks ex post. Those tasks are higher performing, more adaptive to the environment, and influential. Hence, scarce attention requires setting priorities, not just local optimization. Our results provide microfoundations for a central idea in the management literature that firms should focus on a limited set of core competencies. (JEL D23, D83, D85, L23, M11, M54)

Organizations exist to coordinate specialized agents, but have a limited communication capacity or “attention” to do so.¹ Coordination does not necessarily require agents to communicate with each other. According to March and Simon (1958, p. 182), there are two general ways in which organizations can be coordinated:

The type of coordination used in the organization is a function of the extent to which the situation is standardized. (...) We may label coordination based on pre-established schedules coordination by plan, and coordination that involves transmission of new information coordination by feedback. The more stable and predictable the situation, the greater the reliance on coordination by plan.

Importantly, the type of coordination used is an organizational choice. As pointed out by March and Simon (1958, p. 183): “(I)t is possible to reduce the volume of

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¹As emphasized by Herbert Simon, attention may well be the ultimate scarce resource in the economy. According to Simon, “a wealth of information creates a poverty of attention and a need to allocate that attention efficiently among the overabundance of information sources” (Simon 1971, pp. 40–41). Similarly, Arrow (1974, p. 37) notes that “the scarcity of information-handling ability is an essential feature for the understanding of both individual and organizational behavior.”

communication required from day-to-day by substituting coordination by plan for coordination by feedback.”

This paper studies the optimal coordination of production when attention is scarce. We posit a simple model of team production in which a number of complementary tasks, such as engineering, purchasing, manufacturing, marketing, and selling, must be implemented in a coordinated fashion and where agents privately observe task-specific shocks. While coordination by plan saves on communication costs, it prevents agents from responding to such shocks. Our insight is that scarcity of organizational attention makes it optimal to center all communication around a small number of focal tasks. Agents in charge of those tasks are disproportionately responsive to local information and influence the behavior of others. Agents in charge of nonfocal tasks stick closely to preestablished action plans in order to avoid coordination failures. Thus, when attention is scarce, it is optimal to coordinate *ex ante* one group of tasks (by plan) and coordinate *ex post* another set of tasks (through communication). In this way, all tasks are well coordinated, but tasks are heterogenous in their adaptiveness and influence. When attention is abundant, this asymmetry in task coordination disappears. It is thus scarce attention that creates organizational focus.

Our results provide microfoundations for a central idea in the management literature that firms should focus on a limited set of “core competencies” (Prahalad and Hamel 1990) and firms that aim to be “all things to all people” will be “caught in the middle” and fail (Porter 1980, 1996). In our model, when attention is scarce, optimal organizations set priorities—they select a number of tasks to focus attention on—even when all tasks are *ex ante* identical. Organizations which fail to prioritize tasks underperform. Our insights further link bureaucracy and rigid rules to limited organizational attention and the strategic choices of a firm. In the face of conflicting needs for attention, the designer must decide which tasks can be flexible and adaptive and which tasks are coordinated using bureaucratic rules.² This creates a stark asymmetry in the performance of various organizational tasks.

We conceptualize the available attention as the time agents spend in meetings to coordinate production. If attention is abundant, all tasks share attention equally. Equal sharing is intuitive, as we posit that there are decreasing marginal returns to attention: the probability with which communication (and coordination) is successful is concave in the attention devoted to a task. Our central result, however, is that if attention is scarce and coordination important, it is optimal to treat tasks asymmetrically and focus all attention on a few tasks. The mechanism underlying the result above is a complementarity between attention and decision making, which creates a convexity in the value of attention. Agents take initiative by adapting their task to local information. The more attention an agent receives, the more initiative this agent can take as those initiatives are now better coordinated. In turn, the more initiative an agent takes, the more important it is to devote scarce attention to him in order to avoid coordination failures. By the same token, agents who are ignored by others are forced to largely ignore their own private information. Since this makes their behavior predictable, devoting attention to such agents is indeed a waste of

²See Powell (2015) for an incentive-based rationale for rigid rules. In his model, the organization designer reduces the adaptiveness of decisions to new information in order to limit influence activities.

time. Because of the complementarities above, agents either communicate intensively about a particular task, or they ignore it. Decreasing marginal returns to attention, however, provide a countervailing force which dominates when focal tasks receive too much attention. In the latter case, it is optimal to reduce organizational focus by increasing the number of focal tasks.

We derive a number of comparative static results. The scarcer is attention, the smaller is the number of focal tasks. Improvements in communication technology which relax attention constraints thus result in less focused organizations, with more agents being influential and taking initiative. This is consistent with new trends in organizational design toward more network-like organizations where communication flows are horizontal rather than vertical, and decision making and influence is broadly shared in the organization.³ More broadly, such trends can often be usefully interpreted as “a move away from ex ante coordination methods” toward more ex post coordination (i.e., using bilateral communication, rather than bureaucratic rules). Online Appendix H discusses three case studies of organizational change through the lens of our model. The number of focal tasks is also decreasing in task-interdependence and the size of the organization. Larger organizations are thus more bureaucratic and have a more centralized communication network. When tasks are ex ante symmetric, our theory does not select the tasks that the organization focuses on: there are multiple optimal organizations. When tasks are heterogeneous in terms of their importance, however, the optimal organization is unique and the attention devoted to a given task often depends more on the rank-order of a task’s importance than its absolute level. A small decrease in task importance may then result in a task becoming nonfocal and the agent losing all his influence.

Section III, finally, describes how our model can be extended to endogenize organizational size, with larger organizations exploiting economies of scope but facing more daunting coordination problems. As we show, organizations in more volatile environments or where adaptation to local shocks is more important are then smaller but less focused. Perhaps counterintuitively, the impact of communication technology on size is ambiguous.

Literature.—Our paper is part of a larger literature on team theory (Marschak and Radner 1972; Radner 1993), which studies games where agents share the same objective, but have asymmetric information. As Garicano and Van Zandt (2012) emphasize, team theory is a natural framework in which to analyze the questions raised in this paper, as these models study interrelated decision making when information is dispersed and there are limits to communication, a canonical organizational problem.⁴ Despite the need for coordination in all of those models, as far as we are aware, no paper has identified the corner solutions which are at the center of this paper. Proposition 1 highlights why this is the case: it is when communication flows are endogenously designed to support decision making, that nonconcavities arise in team theory models.

Our paper further belongs to a recent literature in organizational economics, most prominently Dessein and Santos (2006)—henceforth, DS; Alonso, Dessein, and

³ See Roberts and Saloner (2012) and references therein.

⁴ See, e.g., Geanakoplos and Milgrom (1991) and Cremer, Garicano, and Prat (2007).

Matouschek (2008); Rantakari (2008); and Bolton, Brunnermeier, and Veldkamp (2013), that emphasizes coordination adaptation trade-offs as a key mechanism determining organizational form.⁵ All these papers study how organizations are designed to coordinate production and assume a similar quadratic payoff structure as our paper. Closest to us is DS, which studies task specialization in organizations, but restricts communication flows to be symmetric; instead the present paper takes task specialization as given and endogenizes communication patterns. Calvó-Armengol, de Martí, and Prat (2015) also endogenizes communication patterns in a framework similar to that of DS. Their focus, however, is on how asymmetries in payoff externalities result in asymmetric communication flows and differential influence for agents.⁶

Finally, a literature on “narrow business strategies” and “vision” (Rotemberg and Saloner 1994, 2000) has argued that the commitment by a principal or leader to select a certain type of projects provides strong incentives for agents to exert effort related to such projects. Similarly, Dewatripont, Jewitt, and Tirole (1999) shows how a lack of focus impairs incentives in a multi-task career concerns model. In contrast to the present paper, organizational focus is thus a tool to improve incentives.

I. The Model

We posit a team-theoretic model, based on Dessein and Santos (2006) and Alonso, Dessein, and Matouschek (2008), to study decision making and communication within an organization.

Production and Payoffs.—Production involves the implementation of n tasks, each performed by one agent $i \in \mathcal{N} = \{1, 2, \dots, n\}$. Organizational trade-offs arise because agents need to adapt tasks to privately observed task-specific shocks while maintaining coordination across different tasks. Specifically, agent i observes a piece of information θ_i and must take a primary action, $q_{ii} \in \mathbb{R}$, and a coordinating action, $q_{ij} \in \mathbb{R}$, for each task $j \in \mathcal{N} \setminus \{i\}$. The local information of agent i , θ_i , is a shock with variance σ_θ^2 and mean $\hat{\theta}_i$, and its realization is independent across agents. Given a particular realization $\boldsymbol{\theta} = [\theta_1, \theta_2, \dots, \theta_n]$, and a choice of actions, $\mathbf{q} = [q_1, q_2, \dots, q_n]$, with $\mathbf{q}_i = \{q_{i1}, q_{i2}, \dots, q_{ii}, \dots, q_{in}\}$, the organization’s profits are

$$(1) \quad \pi(\mathbf{q} | \boldsymbol{\theta}) = nP - \sum_{i \in \mathcal{N}} L_i(\mathbf{q} | \boldsymbol{\theta}),$$

where P is the gross profits per task and $L_i(\mathbf{q} | \boldsymbol{\theta})$ is the expected losses related to task i due to maladaptation and miscoordination:

$$(2) \quad L_i(\mathbf{q} | \boldsymbol{\theta}) = \phi_i(q_{ii} - \theta_i)^2 + \beta \sum_{j \in \mathcal{N} \setminus \{i\}} (q_{ji} - q_{ii})^2.$$

⁵See also Van den Steen (2013), which studies the role of an explicitly formulated “strategy” (a small set of key decisions) in coordinating production.

⁶In contrast to our paper, asymmetric communication patterns do not arise in a symmetric setup.

The profits of the organization depend, therefore, on (i) how well *adapted agent i 's primary action q_{ii}* is to task i 's local information θ_i , and (ii) how well *coordinated agent j 's coordinating action q_{ji}* is to agent i 's primary action q_{ii} . The parameter ϕ_i is the importance of adapting task i to its task-specific shock and β is the weight given to miscoordination. Hence, β can be interpreted as measuring task-interdependence. We assume that $\phi_i < (n - 1)\beta$, for all $i \in \mathcal{N}$, so that coordination losses are nontrivial.

Communication Frictions.—Our starting point is that organizations design communication flows to coordinate production, but organizational attention is scarce. Formally, we define an attention allocation as $\mathbf{t} = [t_1, t_2, \dots, t_n]$, where $t_i \geq 0$ and $\sum_{i \in \mathcal{N}} t_i \leq \tau$, with $\tau < \infty$. We can think of t_i as the “air-time” or “attention” any agent i receives, and τ as the length of time an agent spends in meetings as opposed to production.⁷ We assume that with probability $r(t_i)$ agent j learns agent i 's primary action,⁸ and, with the remaining probability, communication is uninformative, and that $r(t_i)$ follows a poisson process with hazard rate λ ,

$$(3) \quad r(t_i) = 1 - e^{-\lambda t_i}.$$

Importantly for what follows, the communication technology (3) exhibits decreasing marginal returns, $r''(t_i) < 0$. Moreover, we have that $\lim_{t_i \rightarrow \infty} r(t_i) = 1$ and $\lim_{t_i \rightarrow \infty} r'(t_i) = 0$. In what follows, we write the organizational attention constraint $\sum_{i \in \mathcal{N}} t_i \leq \tau$ as

$$(4) \quad \sum_{i \in \mathcal{N}} \ln(1 - r(t_i)) \geq \ln(1 - r(\tau)).$$

Section IA discusses alternative specifications to the communication technology above.

Timing.—In stage 0, an organization designer chooses the optimal attention allocation \mathbf{t} . In stage 1, agents observe their local information and take their primary action. In stage 2, agents observe each other's primary actions according to the attention network \mathbf{t} , and then take their coordinating actions. Following a team-theoretical approach, at stage 0, the designer also specifies the decision rules for both primary and coordinating actions that maximize expected payoffs, and agents follow these rules in stage 1 and 2. Equivalently, we can model the resulting agents' primary and coordinating actions as the equilibrium outcome of a Bayesian game with common payoffs (see Garicano and Van Zandt 2012).

⁷ Alternatively, we can interpret t_i as the total number of signals that agents receive about q_{ii} , where each signal correctly reveals q_{ii} with probability $1 - e^{-\lambda}$.

⁸ In our framework it is immaterial whether the probability of successful communication is correlated or independent across agents $j \neq i$. The reason is that agent i chooses his primary action without knowledge of whether communication will be informative, which simplifies the analysis (see *Timing* below).

A. Interpretation and Assumptions of the Model

We comment on two key modelling choices—organizational objectives and communication technology—and the robustness to alternative specifications.

Organizational Objectives and Trade-Offs.—Expression (1) captures the notion, going back to at least March and Simon (1958), that it is adaptation to unpredictable contingencies, combined with communication frictions, that create coordination problems in organizations. If the organization had unlimited attention, agents can perfectly adapt to their local information, because, by means of communication, they can *coordinate ex post*. Communication frictions, however, make *ex post* coordination less effective. Another option is for agents to ignore their private information and always implement their task in the same manner—stick to a preagreed course of action. No communication is then needed to achieve coordination. Agents *coordinate ex ante*, but this comes at the cost of maladaptation.

We have assumed that each agent takes a primary action and a series of complementary actions. In online Appendix E we study an alternative specification in which each agent chooses a single action, $q_{ii} = q_{ij} = q_i$, in line with Alonso, Dessein, and Matouschek (2008) and Rantakari (2008). We show that qualitatively identical results obtain. Moreover, for our analysis, it does not matter if agent i maximizes, as we have postulated, firm performance (common payoffs) or a mix of firm performance and task performance, as in Alonso, Dessein, and Matouschek (2008) and Rantakari (2008). Finally, the model allows for different task-specific maladaptation costs, $\phi_i \neq \phi_j$, but we have kept miscoordination costs, β , homogeneous across tasks. Online Appendix F extends the model to have different degrees of interdependence $\beta_i \neq \beta_j$.

Communication Technology.—In our model, there is an aggregate constraint on the information sent by agents. Moreover, we posit that all agents $j \neq i$ devote the same amount of attention to task i , consistent with communication occurring in public meetings. Information flows in organizations are of course more complex. Online Appendix C considers some alternative models of communication such as *bilateral communication*, where agents communicate one-to-one (and, hence, agent 3 may devote more attention to agent 1 than agent 2 does) and *individual attention constraints* where each agent has a fixed capacity τ that can be used for both sending and receiving information (and, hence, the time agents 3 and 4 communicate does not affect the attention constraints of agents 1 and 2). They all result in attention allocations that are equivalent to the ones that are optimal under public communication with an aggregate constraint. Far from being exhaustive, our framework thus captures some modal forms of communication inside organizations.⁹ Furthermore, online Appendix G shows that our findings are robust to an endogenous communication capacity τ . While we posit a specific binary communication technology, online Appendix D shows that identical results obtain if communication is noisy instead

⁹Interesting avenues for future research include mixed forms of communication, where members attend public meetings but also meet on a bilateral basis to refine messages and verify instructions. We also do not model the trade-off between time devoted to communication and production.

and, following the literature on rational inattention (Sims 2003), entropy is used to model the cost of more precise communication.

II. Optimal Attention Networks

Without loss of generality, we focus on decision rules that are linear in the agent's information. Consider first stage 2, where agents observe each other's primary actions according to the attention network \mathbf{t} , and then take their coordinating actions. With probability $r(t_i)$, communication about task i has been successful and agent j optimally sets $q_{ji} = q_{ii}$; otherwise the optimal coordinating action is given by $q_{ji} = E[q_{ii}]$. In stage 1, agent i 's primary action can be written as $q_{ii} = \hat{\theta}_i + \alpha_i(\theta_i - \hat{\theta}_i)$ and, at the optimum, minimizes task i 's expected losses $E[L_i(\mathbf{q}|\theta)]$. Note that $\alpha_i = \text{Cov}(q_{ii}, \theta_i)/\sigma_\theta^2$ and, therefore, is a *measure of agent i 's adaptiveness* to his local information. Similarly, a natural *measure of agent i 's influence on agent j* is $\text{Cov}(q_{ji}, \theta_i)/\sigma_\theta^2 = r(t_i)\alpha_i$. Substituting decision rules into (2), we obtain

$$(5) \quad E[L_i(\mathbf{q}|\theta)] = \phi_i(1 - a_i)^2\sigma_\theta^2 + \beta(n - 1)(1 - r(t_i))a_i^2\sigma_\theta^2.$$

A. Exogenous Attention Networks

As a benchmark, we derive optimal decision making under the assumption that communication flows are exogenously given (as in Dessein and Santos 2006). Minimizing (5) with respect to α_i , we obtain that the optimal degree of adaptiveness equals

$$(6) \quad \alpha_i^*(t_i) = \frac{\phi_i}{\phi_i + \beta(n - 1)(1 - r(t_i))}.$$

From (6), the adaptiveness and influence of agent i is decreasing in the need for coordination β and the number of tasks n , but is increasing in the importance of task i (i.e., ϕ_i) and the attention devoted to task i . We obtain the following benchmark result:

PROPOSITION 1: *Assume communication flows \mathbf{t} are exogenously given. Agent i 's adaptiveness and influence is continuous and decreasing in the cost of miscoordination, β , and continuous and increasing in the importance of his task ϕ_i . If tasks are ex ante symmetric, i.e., $\phi_i = \phi$ and $t_i = t$ for all $i \in \mathcal{N}$, then each agent is equally adaptive and influential, i.e., $\alpha_i^* = \alpha_j^*$ for all $i, j \in \mathcal{N}$.*

Proposition 1 shows that, when communication flows are determined independently from decision making, the need for coordination by itself does not create any discontinuities or nonconcavities in organization design. As we show in the next section, organizations operate very differently when communication flows are designed optimally.

B. Endogenous Attention Networks

It is useful to think of a designer choosing both decision rules, i.e., $(\alpha_1, \dots, \alpha_n)$, and communication qualities, i.e., $\{r_1, \dots, r_n\}$, with $r_i = 1 - e^{-\lambda t_i}$, rather than an allocation of attention \mathbf{t} . The organization design problem is then equivalent to

$$(7) \quad \max_{\alpha_1, \dots, \alpha_n, r_1, \dots, r_n} E[\pi(\mathbf{q} | \boldsymbol{\theta})] = nP - \sum_{i \in \mathcal{N}} [\phi_i(1 - \alpha_i)^2 \sigma_\theta^2 + \beta(n - 1)(1 - r_i)\alpha_i^2 \sigma_\theta^2],$$

subject to constraint (4). Inspecting (7), it is immediate that agent i 's adaptiveness, α_i , and task i 's communication quality, r_i , are complementary choices, i.e.,

$$(8) \quad \frac{\partial^2 E[\pi(q | \boldsymbol{\theta})]}{\partial r_i \partial \alpha_i} = \beta(n - 1)\sigma_\theta^2 > 0.$$

The more adaptive is an agent's task, the more important it is to communicate effectively regarding this task in order to ensure coordination. Similarly, the better is the communication quality r_i , the higher is the optimal level of adaptiveness α_i . As we illustrate now, this fundamental complementarity between the attention devoted to an agent and his adaptiveness, implies that, when the organizational attention is scarce, attention is concentrated on a few tasks. This, in turn, dictates large ex post asymmetries across agents in terms of their influence and adaptiveness.

Ex Ante Symmetric Tasks.—Consider first the most striking case where all tasks are ex ante symmetric, i.e., $\phi_i = \phi$ for all $i \in \mathcal{N}$. From (8), if there were constant marginal returns to attention, that is $r'(t_i) = c$, then whenever task l is more adaptive than task $j \neq l$, profits can always be increased by reallocating attention away from task j toward task l . This, in turn, makes it optimal to further increase the adaptiveness of task l and further reduce the adaptiveness of task j . Similarly, when task j and l are equally adaptive and receive equal attention, profits can always be improved by increasing both α_l and t_l and reducing both α_j and t_j . It follows that whenever $r(\tau) < 1$, task l receives all the attention and task j none.

In our model, however, there are *decreasing marginal returns to attention*, as captured by $r''(t_i) < 0$, and it would require an infinite amount of attention to set $r_i = 1$. Decreasing marginal returns provide a countervailing force for organizational focus. Indeed, when $t_l > t_j$ and $\alpha_l > \alpha_j$ it may be optimal to reallocate attention on the margin to task j since $r'(t_j) > r'(t_l)$. As we show in the Appendix, in an *optimal organization*, it must then be that $k \in \{1, \dots, n\}$ focal tasks split the organizational attention evenly and obtain communication quality $r(\tau/k) = 1 - e^{-\lambda\tau/k}$, whereas the remaining $n - k$ tasks receive no attention.

PROPOSITION 2: *Assume all tasks are ex ante symmetric: i.e., $\phi_i = \phi$ for all $i \in \mathcal{N}$. Then in an optimal organization, $k^* \in \{1, \dots, n\}$ tasks split the organizational attention evenly with $t_i = \tau/k$ and the remaining tasks receive no attention.*

Given Proposition 2, the adaptiveness of focal and nonfocal tasks are respectively $\alpha^*(\tau/k)$ and $\alpha^*(0)$, where $\alpha^*(t_i)$ is given by expression (6). Substituting $\alpha^*(\tau/k)$ and $\alpha^*(0)$ in (7) and rearranging terms, expected profits in an organization with k focal tasks can be written as

$$(9) \quad \Pi(k) \equiv nP - k[1 - \alpha^*(\tau/k)]\phi\sigma_\theta^2 - (n - k)[1 - \alpha^*(0)]\phi\sigma_\theta^2,$$

and the optimal number of focal tasks, k^* , is given by $k^* = \arg \max_{k \in \{1, 2, \dots, n\}} \Pi(k)$. We say that an organization is “focused” whenever $k^* < n$, and some tasks receive no attention. An organization is “balanced” when $k^* = n$ and all tasks split attention evenly.

When is a focused organization optimal? From (9), the payoffs associated with task i are linear in its (optimal) level of adaptiveness $\alpha^*(t_i)$. Hence, a focused organization with $k < n$ focal tasks will be preferred over a balanced organization if and only if

$$(10) \quad k[\alpha^*(\tau/k) - \alpha^*(\tau/n)] > (n - k)[\alpha^*(\tau/n) - \alpha^*(0)].$$

Thus, the benefit of moving from a balanced to a focused organization with k focal tasks is the increase $\alpha^*(\tau/k) - \alpha^*(\tau/n)$ in the adaptiveness of k focal tasks; the cost is the decline $\alpha^*(\tau/n) - \alpha^*(0)$ in the adaptiveness of the $(n - k)$ nonfocal tasks. It is easy to verify that the function $\alpha^*(t_i)$ is S-shaped. Because of the complementarity between the attention t_i devoted to a task and the adaptiveness α_i of the same task, $\alpha^*(t_i)$ is convex and increasing in t_i whenever λt_i is small. But because of the decreasing marginal returns to attention, $\alpha^*(t_i)$ becomes concave in t_i whenever λt_i is large. Indeed, we have that

$$(11) \quad \frac{\partial^2 \alpha^*(t_i)}{\partial t_i^2} > 0 \Leftrightarrow \frac{2\beta(n - 1)}{\phi + \beta(n - 1)(1 - r(t_i))} > -\frac{r''(t_i)}{r'(t_i)^2} \Leftrightarrow (n - 1)\beta e^{-\lambda t_i} > \phi.$$

It follows that a focused organization with $k^* < n$ is optimal when effective attention, $\lambda\tau$, is scarce. More generally, fixing $k < n$, a sufficient condition for $k^* \leq k$ is that $\alpha^*(t_i)$ is convex in t_i at $t_i = \tau/k$. We summarize this discussion as follows:

PROPOSITION 3: *Assume all tasks are ex ante symmetric. Fix $k < n$, if $(n - 1)\beta e^{-\lambda\tau/k} > \phi$ then the optimal number of focal tasks $k^* \leq k$. It follows that the optimal organization is focused ($k^* < n$) when $\lambda\tau$ is sufficiently small, n is sufficiently large or the ratio β/ϕ is sufficiently large.*

Our assumption that $r(t_i)$ represents a Poisson learning process allows us to derive clean conditions for organizational focus. More generally, from (11), as long as $-r''(t_i)/r'(t_i)^2 < 2$ for t_i small, organizational focus will be optimal whenever attention is scarce and coordination important. This condition on the curvature of $r(t_i)$

captures the notion that decreasing marginal returns to attention must be mild when t_i is small.¹⁰ In the Appendix, we derive the following comparative static results:

PROPOSITION 4: *Assume all tasks are ex ante symmetric. The optimal number of focal tasks k^* is increasing in effective communication capacity $\lambda\tau$ and the importance of adaptation ϕ , and is decreasing in tasks interdependence β , and the size/complexity of the organization n .*

There are some immediate implications from Proposition 4. Over the last decades, there have been enormous technological innovations in communication and coordination technologies (e-mail, wireless communication and computing, intranet-works, electronic data interchange (EDI)) which can be interpreted as an exogenous increase in the effective attention capacity $\lambda\tau$. An implication of Proposition 4, therefore, is that such technological improvements result in a shift toward more balanced organizations that pay attention to the task-specific information of a larger number of agents. This is consistent with new trends in organizational design toward more network-like organizations where communication flows are horizontal rather than vertical, and where decision making and influence is broadly shared in the organization. These novel organizations have been documented in both cases studies and large-scale empirical studies (Whittington et al. 1999; Guadalupe, Li, and Wulf 2014).¹¹ While our model abstracts away from important organizational issues (hierarchy, for example, plays no role in our model), those new organizational structures can be usefully interpreted as a shift away from ex ante coordination, through bureaucratic rules and standard operating procedures, toward more ex post coordination, through bilateral communication between agents directly involved in production, and this in response to improvements in communication technology. Online Appendix H discusses three case studies of organizational change through the lens of our model. The first case discusses a novel organizational structure at Procter and Gamble, introduced in the early 2000s and widely imitated by other global consumer packaged goods companies. The second example studies changes in the apparel industry toward “lean retailing,” which were caused by the interaction of an increased need for adaptation to fashion trends and improvements in IT such as electronic data interchange (EDI). The final example is concerned with an innovation in management called quality function deployment (QFD), which is geared toward solving problems of coordination between different functions, such as marketing and engineering.

Our results further point to a trade-off between organizational *size* and organizational *focus*. Smaller organizations distribute attention more evenly and, hence, the information of more agents is reflected in decision making. As an organization grows larger, leadership becomes more concentrated as there is more need for coordination. Despite the organization having more members, fewer of them receive attention. An increase in n thus has a similar effect as an increase in β . This is

¹⁰For $r(t_i) = 1 - e^{-\lambda t_i}$, we have that $-r''(t_i)/r'(t_i)^2 = 1/e^{-\lambda t_i}$. Note that $-r''(t_i)/r'(t_i)^2$ grows without bound for t_i large, reflecting strongly decreasing marginal returns for t_i large.

¹¹Guadalupe, Li, and Wulf (2014) document how, in recent decades, C-level executive teams in Fortune 500 firms have almost doubled in size, mainly because of the inclusion of more functional managers.

consistent with the experience of many entrepreneurial firms, whose culture of joint decision making and open lateral communication often disappears as they grow larger and more hierarchical.

Asymmetric Tasks.—When tasks are ex ante symmetric, our theory does not select the tasks that the organization focuses on: there are multiple optimal organizations. Our next result considers the case where tasks are heterogenous in terms of their importance. Not only is the optimal organization unique then, the attention devoted to a given task often depends more on the rank-order of a task's importance than its absolute level.

PROPOSITION 5: *Assume that $\phi_i > \phi_{i+1}$ for all $i \in \{1, \dots, n - 1\}$. In the unique optimal organization, attention is focused on the k^* most important tasks and more important tasks receive more attention—i.e., there exists k^* so that for every $i < j \leq k^*$, $t_i^* > t_j^* > 0$ and $t_i^* = 0$ for every $i > k^*$.*

A corollary of Proposition 5 is that a change in the importance of a task that alters its relative ranking may result in a discrete drop or jump in the attention devoted to that task, and, therefore, to the agent's adaptiveness and influence.¹² In other words, scarce attention requires setting priorities—not just local optimization. In our benchmark with exogenous communication flows (Proposition 1), an agent's adaptiveness and influence was continuous in the importance of its task. In contrast, when communication flows are optimally designed to support decision making, a small decrease in task importance may result in a task becoming nonfocal and the agent losing all his influence. Similarly, an increase in the importance of an already focal task may make it optimal for the organization to focus on less tasks.

III. Concluding Remarks

The main contribution of this paper is to shed light on the coordination of production when communication flows are optimally designed. When attention is scarce, organizations optimally set priorities and coordinate only a few tasks ex post, through communication. Those tasks are higher performing, more adaptive to the environment, and influential. The remaining tasks are coordinated ex ante, and the agents in charge of them stick closely to prespecified action plans—standard operating procedures. Beyond this insight, our model can be used to shed light on new trends in organization design, as discussed following Proposition 4 and in online Appendix H.

To conclude, we informally discuss an extension where organizational size is endogenous. In our basic model, the size or “scope” of the organization is fixed. In multiproduct firms, however, different tasks may correspond to different types of products or services, and it is natural to think of the number of tasks as being endogenous. In online Appendix B, we endogenize the number of tasks by introducing economies of scale or scope: certain fixed costs can be shared among tasks

¹²For example, an increase in the importance of task i , with $i > k^*$, will eventually result in a discrete jump from $t_i^* = 0$ to $t_i^* > 0$ and a discrete drop from $t_k^* > 0$ to $t_k^* = 0$.

(e.g., production facilities or a distribution network), yielding benefits to size. The size of organizations, however, is limited by the need for coordination and limited organizational attention. Two empirically relevant drivers of organizational size are the volatility of the environment and changes in information and communication technologies. Consistent with recent trends in “descoping” (Roberts and Saloner 2012), we show that the optimal scope of organizations *decreases* as the environment becomes more volatile and adaptation becomes more important. Intuitively, by reducing the number of tasks that it undertakes, the organization reduces its coordination needs, hence allowing for better adaptation. At the same time, the number of tasks that receive attention increases. Hence, as the environment becomes more volatile, there is a move from large, focussed organizations that maximize scope economies to smaller, but more adaptive and balanced organizations. Improvements in information technology might be conjectured to always increase the size of organizations, as they allow for better coordination. Interestingly, we show that information technology has a decidedly ambiguous impact on firm scope. Intuitively, information technology makes it optimal for organizations to shift toward a strategy that emphasizes adaptation to its environment, but smaller and more balanced firms are better configured to do so. Hence, while for low levels of information technology, large, nonadaptive firms exploiting economies of scale are optimal, we show that for intermediate levels of information technology, smaller, more flexible firms are often preferred.

APPENDIX

PROOF OF PROPOSITION 2:

Proposition 2 follows from the fact that if \mathbf{t} is optimal, then $t_i = t_j$ for all i and j such that $t_i > 0$ and $t_j > 0$. We now prove this statement. Using (7) and (6) we write the objective of the organization as

$$E[\pi(\mathbf{q}, \mathbf{t} | \boldsymbol{\theta})] = nP - n\sigma_{\theta}^2\phi + \sum_{i=1}^n \left[\frac{\phi\sigma_{\theta}^2}{\phi + \beta(n-1)(1-r(t_i))} \right].$$

Suppose, for a contradiction, that $t_i > t_j > 0$. Consider now two alternative organizations. One organization, denoted by \mathbf{t}' , is the same as \mathbf{t} , but $t'_i = t_i - \epsilon$ and $t'_j = t_j + \epsilon$. The second organization, denoted by $\hat{\mathbf{t}}$, is the same as \mathbf{t} , but $\hat{t}_i = t_i + \epsilon$ and $\hat{t}_j = t_j - \epsilon$. These constructions are derived for some small and positive ϵ .

Since \mathbf{t} is optimal, we must have that $E[\pi(\mathbf{q}, \mathbf{t} | \boldsymbol{\theta})] > E[\pi(\mathbf{q}, \mathbf{t}' | \boldsymbol{\theta})]$. This is equivalent to $[e^{-\lambda t_j} - e^{-\lambda(t_j-\epsilon)}][\beta^2(n-1)^2 e^{-\lambda(t_i+t_j)} - \phi] > 0$, and, since $t_i > t_j$, for small ϵ we have that $e^{-\lambda t_j} - e^{-\lambda(t_j-\epsilon)} > 0$ and therefore optimality of \mathbf{t} requires that $\beta^2(n-1)^2 e^{-\lambda(t_i+t_j)} - \phi > 0$. Similarly, since \mathbf{t} is optimal, we must have that $E[\pi(\mathbf{q}, \mathbf{t} | \boldsymbol{\theta})] > E[\pi(\mathbf{q}, \hat{\mathbf{t}} | \boldsymbol{\theta})]$. This is equivalent to $-[e^{-\lambda(t_j-\epsilon)} - e^{-\lambda t_j}][\beta^2(n-1)^2 e^{-\lambda(t_i+t_j)} - \phi] > 0$, and, since $t_i > t_j$, we have that $e^{-\lambda(t_j-\epsilon)} - e^{-\lambda t_j} > 0$, and therefore optimality of \mathbf{t} requires that $\beta^2(n-1)^2 e^{-\lambda(t_i+t_j)} - \phi < 0$. We have then reached a contradiction. ■

PROOF OF PROPOSITION 3:

Inspection of expression (9) implies that

$$k^* = \arg \max_{k \in \{1, \dots, n\}} \Gamma(k) \equiv k[\alpha(\tau/k) - \alpha(0)],$$

where $\alpha(t)$ is given by expression (6). Simple analysis of the function $\Gamma(k)$ for $k \in [0, \infty]$ reveals that $\Gamma(k)$ is first increasing and then decreasing. Furthermore, the sign of $\Gamma''(k)$ is the same as the sign of $\alpha''(\tau/k)$. By condition (11) we know that $\alpha(\tau/k)$ is concave (respectively, convex) at τ/k if $(n - 1)\beta e^{-\lambda\tau/k} < \phi$ (resp. $(n - 1)\beta e^{-\lambda\tau/k} > \phi$). This implies that there exists a $\bar{k} < \infty$ such that $\Gamma(k)$ is concave for all $k \leq \bar{k}$ and convex for all $k > \bar{k}$. Furthermore, since $\Gamma(k)$ is first increasing and then decreasing, it follows that \bar{k} is strictly higher than $k' = \arg \max_{k \in [0, \infty)} \Gamma(k)$. Hence, if we verify that $k \in \{1, \dots, n\}$ is such that $\alpha(\tau/k)$ is convex at τ/k , then it must be the case that the optimal organization is focused on $k^* \leq k$ tasks. ■

PROOF OF PROPOSITION 4:

We state Lemma A, which is then used to prove Proposition 4. The proof of Lemma A follows by investigating the behavior of the profit function of an organization with k focal tasks, e.g., the function (9); the proof of Lemma A is relegated in online Appendix A.

LEMMA A: *There exist $0 < \bar{\beta}(n) < \dots < \bar{\beta}(k + 1) < \bar{\beta}(k) < \dots < \bar{\beta}(2)$ such that the optimal organization has: $k^* = n$ focal tasks if $\beta/\phi < \bar{\beta}(n)$, $k^* \in \{2, \dots, n - 1\}$ focal tasks if $\beta/\phi \in (\bar{\beta}(k^* + 1), \bar{\beta}(k^*))$, and $k^* = 1$ if $\beta/\phi > \bar{\beta}(2)$. Furthermore*

$$(A1) \quad \bar{\beta}(k + 1) = \frac{1}{n - 1} \left[\frac{e^{\frac{\lambda\tau}{k+1}} + ke^{-\frac{\lambda\tau}{k(k+1)}} - (k + 1)}{k + e^{-\frac{\lambda\tau}{k}} - (1 + k)e^{-\frac{\lambda\tau}{k(k+1)}}} \right].$$

Lemma A implies that the optimal number of focal tasks k^* is decreasing in β and increasing in ϕ . Next, to see that k^* is increasing in $\lambda\tau$, we notice that $\bar{\beta}(k + 1)$ is increasing in $\lambda\tau$ because the numerator is increasing in $\lambda\tau$ and the denominator is decreasing in $\lambda\tau$. Finally, that if $k^*(n) < n$ then $k^*(n + 1) \leq k^*(n)$ follows from the fact that the cut-off $\bar{\beta}(k)$ is decreasing in n . This completes the proof of Proposition 4. ■

PROOF OF PROPOSITION 5:

We order tasks as follows $\phi_i > \phi_{i+1}$. The problem of the designer specified in (7) subject to the constraint (4) can be rewritten as follow: $\max_{r_1, \dots, r_n} G(r_1, \dots, r_n) \equiv \sum_i \phi_i \alpha_i^*(r_i)$, subject to $\sum_i \ln(1 - r_i) = \ln(1 - r(\tau))$ and $r_i \geq 0$ for all i . Recall also that $\alpha_i^* = \phi_i / [\phi_i + \beta(n - 1)(1 - r_i)]$. The Lagrangian is then

$$\mathcal{L} = \sum_i \phi_i \alpha_i(r_i) - \lambda [\ln(1 - R) - \sum_i \ln(1 - r_i)],$$

and, at the optimum, for each task i so that $r_i > 0$ it must hold

$$\phi_i \frac{\partial \alpha_i(r_i)}{\partial r_i} - \frac{\lambda}{1 - r_i} = 0 \text{ if and only if } \alpha_i^2(r_i)[1 - r_i]\beta(n - 1) = \lambda.$$

And so, if $r_i > 0$ and $r_j > 0$, then $[1 - r_i]\alpha_i^2(r_i) = [1 - r_j]\alpha_j^2(r_j)$. We now use this necessary condition to show that at the optimum if $r_i > 0$ then $r_i > r_j$ for all $j > i$. For a contradiction suppose that $r_j \geq r_i > 0$, with $j > i$.

First, consider that $r_j = r_i > 0$. From the necessary condition above we know that $(1 - r_i)\alpha_i^2(r_i) = (1 - r_j)\alpha_j^2(r_j)$, but this is impossible because $r_i = r_j$ and $\alpha_i(r) > \alpha_j(r)$ for all r . Second, consider that $r_j > r_i$. Optimality implies that $G(r_1, \dots, r_i, \dots, r_j, \dots, r_n) \geq G(r_1, \dots, r_j, \dots, r_i, \dots, r_n)$ if and only if, $\phi_i \alpha_i(r_i) + \phi_j \alpha_j(r_j) > \phi_i \alpha_i(r_j) + \phi_j \alpha_j(r_i)$, or, equivalently, $\phi_i [\alpha_i(r_j) - \alpha_i(r_i)] < \phi_j [\alpha_j(r_j) - \alpha_j(r_i)]$. Note that $\phi_i [\alpha_i(r_j) - \alpha_i(r_i)] = \alpha_i(r_i) \alpha_i(r_j) \beta(n - 1) [r_j - r_i]$ and therefore the inequality above is equivalent to $\alpha_i(r_i) \alpha_i(r_j) < \alpha_j(r_i) \alpha_j(r_j)$, which is a contradiction because $\alpha_i(r) > \alpha_j(r)$ for every r . Hence, in the optimal organization there exists a $k^* \leq n$ so that $r_i > 0$ for all $i \leq k^*$ and $r_i = 0$ otherwise, and that $r_i > r_j$ for every $i < j \leq k^*$. ■

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