Behavioral Innovation and Corporate Renewal

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Abstract:
Corporations often seek renewal through internal innovations that create new sources of revenue and help them enter new markets. But research and anecdote continue to show that corporations struggle to renew through innovation. We argue that the primary impediments to corporate renewal through innovation stem from the ways in which human nature interacts with the inherently uncertain aspects of innovation. We suggest that the field needs to adopt a more integrated, behavioral innovation view to account for the behavioral forces shaping the innovation process. In this paper we propose an alternate innovation process model that exposes key behavioral bottlenecks limiting innovation. We then review key extant findings and potential research opportunities related to the model. Finally, we highlight the importance of a research focus on remedies, as well as other future opportunities for the field. We hope this essay can serve as inspiration for a new view of corporate renewal through innovation and for a behavioral innovation view more generally.

1. INTRODUCTION

One of the fundamental issues in strategy is how firms renew their sources of advantage in response to changing environments (Eisenhardt and Martin 2000; Teece et al. 1997). Corporate renewal focuses on the question of how firms refresh or replace their resources, capabilities, and market opportunities (Agarwal and Helfat 2009). While some firms renew through corporate transactions (e.g., acquisitions, alliances), the ability to renew through innovation, namely creating and capturing new sources of value, has always been central to the question of corporate renewal and thus to strategy (Teece 1986, 2006). The innovation process at the heart of renewal, however, is fraught with dilemmas, traps, bottlenecks, and impediments. The tension between innovation and execution (March 1991; O'Reilly III and Tushman 2004), the capability requirements of new technologies (Abernathy and Clark 1985; Leonard-Barton 1992; Tushman and Anderson 1986), structural impediments to sharing information (Christensen and Bower 1996; Siggelkow 2001), and stakeholders who constrain the firm's choices (Benner 2010; Sull et al. 1997) all create challenges that limit the ability of corporations to renew through innovation.

Extending the structural and process solutions have been proposed for the corporate innovation dilemma (Furr and Dyer 2014; Gibson and Birkinshaw 2004; O'Reilly III and Tushman 2004; Tushman and O'Reilly 1996), we argue that understanding renewal through innovation requires attention to the fundamental collective humanness of the actors involved and the specific organizational context of the innovation process itself. Prior innovation research has frequently taken such a behavioral view to explain the innovation process (e.g., Eggers and Kaul 2018; Gavetti and Levinthal 2000; Tripsas and Gavetti 2000). Indeed, Levinthal (2011) argues that the behavioral view may be at the root of any strategic action. But prior behaviorally-oriented research in innovation tends to apply a behavioral view idiosyncratically, either focusing upon single, individual-level decision biases, such as those identified in the psychology literatures (e.g., Kahneman 2011; Kahneman and Tversky 1979, 1984), as general

explanations of innovation dysfunctions or employing Carnegie School models (e.g., Cyert and March 1963; Gavetti et al. 2012; Gavetti et al. 2007; March and Simon 1958) of bounded rationality to provide stylized models of organizational action. Although each perspective provides rich alternatives to a "rational-actor" model of innovation, a true behavioral theory of innovation requires a link between the individual biases that affect the innovation process with an embedded understanding of the organization-level interactions that provide context to renewal efforts (Furr et al. 2016b). We believe the field can best move forward (both theoretically and practically) through a holistic, behaviorally-informed view of the underlying innovation process, particularly in a corporate renewal setting where layers of individuals (e.g., scientists, innovators, managers, leaders, stakeholders, etc.) shape how innovation occurs. Specifically, an integrated, behavioral innovation model draws broadly on both the cognitive disciplines (e.g., psychology, social psychology, neuroscience) and organizational models in the Carnegie tradition. This paper seeks to offer such an integrated treatment, or behavioral innovation theory, and suggests foundations for the theory, highlights key and specific impediments that behavioral forces create to rational processes (such has been suggested by the behavioral revolutions in finance and strategy), and explores remedies to these behavioral bottlenecks.

2. FOUNDATIONS FOR A BEHAVIORAL INNOVATION THEORY

Simon (1990) argued that a behavioral theory describing human action is a scissor with two blades: one blade describes the decision making challenges in the environment and the other blade the cognitive limitations shaping leaders and firms (Posen et al. 2018). Analogously, we begin by articulating two fundamental problems in existing models of innovation and renewal that serve as foundations, or "scissor blades" for a behavioral theory of innovation. First, there are important differences between risk, uncertainty, and ambiguity, most importantly how increasing ambiguity fundamentally changes the task environment, and thus the ability of actors to interpret, model, and act in such an environment. Most models of innovation operate from a risk-based perspective, using tools such as real options or

A/B testing that are designed to reduce risk and optimize results. These approaches fit well for certain types of innovation, particularly incremental innovation. But more radical innovation is typically characterized by uncertainty and ambiguity rather than risk. We believe that uncertainty magnifies the potential impact of behavioral biases and traps (Furr et al. 2016b), thus creating conflict between the prescriptions for risk-based models versus an uncertainty-based world.

Second, many models of innovation explicitly or implicitly employ a latent biological metaphor – variation, selection, retention (VSR) – to explain the innovation process. While VSR provides a rough overview of the innovation process, reliance on the discrete stages of the VSR process and the strongly implied biological metaphor underplays our fundamental cognitive nature and the complexity of actors (e.g., managers, inventors, stakeholders, consumers, developers, etc.) that shape innovation. The VSR framework misses critical elements of motivation, search, evaluation, development, and continuance that are shaped by behavioral forces. We argue that articulating the behavioral forces that shape these processes requires a richer model of how innovation actually occurs.

The goal of this paper is to explore these dilemmas to provide the foundations for a broader re-assessment of the innovation domain through a behavioral lens and thereby refresh the study of corporate renewal through innovation. To do so, we first introduce the general foundations for a behavioral innovation view to encourage a richer discussion of how behavioral forces shape the innovation process. We then use this model to articulate the primary bottlenecks that affect corporate renewal innovation processes. Finally, we provide inspiration for future research as well as a call for attention to solutions, or remedies, that corporations might apply to overcome the bottlenecks to corporate renewal through innovation. Although our focus in this essay is on a behavioral innovation view of corporate renewal, we believe that the arguments we make about the need for a behavioral innovation view apply to the field of innovation generally.

2.1 Risk versus Uncertainty and Ambiguity

One of the core challenges of corporate renewal through innovation is that firms have to make investments without *ex ante* knowing the returns on those investments. The key question, however, is whether to view such decisions as a question of risk, uncertainty, or ambiguity. Work in economics, organization theory, information theory, decision theory, and political science has suggested that there are foundational differences between these concepts that shape the nature of knowing, action, and decision making. In economics, Knight (1921) argued that risk and uncertainty are "fundamentally different" and imply radically different processes and outcomes. Knight argued that risk involves making decisions based upon known probability distributions whereas uncertainty involves making decisions where even the probability distributions are unknown. Subsequent researchers in information theory and decision making (Luce and Raiffa 1958; Shubik 1982), psychology (Garner 1962; Miller and Frick 1949), and organizational theory (Anderson and Tushman 2001; Duncan 1972; Galbraith 1973) have drawn upon this distinction to model decision making under uncertainty as the difference between the information an organization needs and what it has (Schrader et al. 1993). For example, under uncertainty, it may be impossible for leaders to know the relative quality of a given potential idea, given the lack of information about the underlying probability distribution. Furthermore, under uncertainty, mental models are available but they are typically incomplete as additional information to resolve them needs to be gathered (Duncan 1976).

According to these theories an even more extreme situation can exist, namely ambiguity, wherein information may be even more unknowable, mental models lacking, and methods to resolve the unknown lacking (Daft and Lengel 1986; March 1978; Schrader et al. 1993). Such is often the case for more radical innovation, wherein it may not be just the probability distributions that are unknown, but the relevant variables themselves that are unknown. Furthermore, the mental models to understand these situations – the functional relationship between variables – may be undefined or missing (March

1978; Simon 1991). The problem solving algorithm to develop and resolve the relationship may also be unclear or unknown (Schrader et al. 1993). Finally, it may even be the case that certain unknowns may be fundamentally unknowable and irresolvable (Bammer and Smithson 2012). In these cases, the situation is not just unknown, it is ambiguous.[1] While these three constructs – risk, uncertainty, and ambiguity – exist along a continuum, for the purposes of this paper we care most about the distinction between risk versus uncertainty and ambiguity, so we will simply use the term uncertainty to capture both constructs, as is common in the strategy field.

The distinction between risk and uncertainty is critical since many innovation models are based on principles of risk reduction. Under a risk model, corporate renewal through innovation could be interpreted as the process of selecting an optimal expected outcome and using processes to resolve that risk. For example, corporate renewal often draws upon real options theory to suggest that corporations can invest in multiple options and as the probability distribution of those outcomes resolves, select an optimal expected value (Folta and O'Brien 2004; Kim and Kogut 1996; McGrath et al. 1996). Similarly, business planning processes typically at the heart of corporate renewal efforts suggest that actors can plan, with their existing information, the optimal innovation model and then execute upon it (Pich et al. 2002). But as recent research has started to account for uncertainty, scholars have shown how such tools, although useful under risk conditions, start to break down under conditions of uncertainty, including real options (Posen et al. 2016, 2018) and business planning (Dencker et al. 2009; Sommer et al. 2009).

Thus, recognition of the fundamental differences between uncertainty and risk imply that as uncertainty increases the antecedents, process, and outcomes of innovation cannot be understood

[1] Uncertainty and ambiguity differ from complexity, which is about the number of relationships and their interconnectivity, which can also increase the challenges of understanding a model. But uncertainty and ambiguity differ because they consider the lack of information about a model, not the complexity of understanding the model.

without deep attention to how cognitive, behavioral elements play an ever-greater role in shaping the antecedents, execution and outcome of innovation efforts. Specifically, as uncertainty increases—as is often the case with more novel or radical innovations—the likelihood and impact of individual information processing forces (e.g., confirmation bias, representativeness bias) and organization level information processing forces (e.g., aspiration, attention, framing, etc.) that research has identified, and many that may not have been identified in a corporate renewal context, play an ever greater role in the innovation process as the probability distributions, variables, and even the models for an ambiguous problem become more undefined and ill-structured.

2.2 Challenges with the VSR Model of Innovation

A second major challenge to understanding corporate renewal through innovation relates to the nature of how scholars often model the innovation process. Many conceptualizations of innovation rely, implicitly or explicitly, upon the variation-selection-retention (VSR) model drawn from evolutionary biology. The VSR framework describes the innovation process in terms of variation in the search for innovations, selection of a particular innovation, and retention of valuable innovations in a model akin to how genetic traits are randomly generated, then selected and retained through survival of the fittest. Relatedly, NK landscapes, also borrowed from biology, are often used to model VSR as search on a fixed opportunity landscape (variation) and then optimization of a particular opportunity peak (selection and retention). The advantage of the VSR model is parsimony, but the disadvantage is that the underlying, biological, "efficient markets" model which may describe a Darwinian world of natural selection, nevertheless fails to capture critical, behavioral aspects of the innovation process that determine its outcomes. Although cognition may be invoked by scholars at a surface level, in a VSR innovation world variation occurs as a largely rational search among comparable alternatives, selection involves the choice of an optimal expected outcome, and retention involves the maximization of the value created. Thus, the VSR model faces several key limitations as a tool to understand the actual behavioral forces

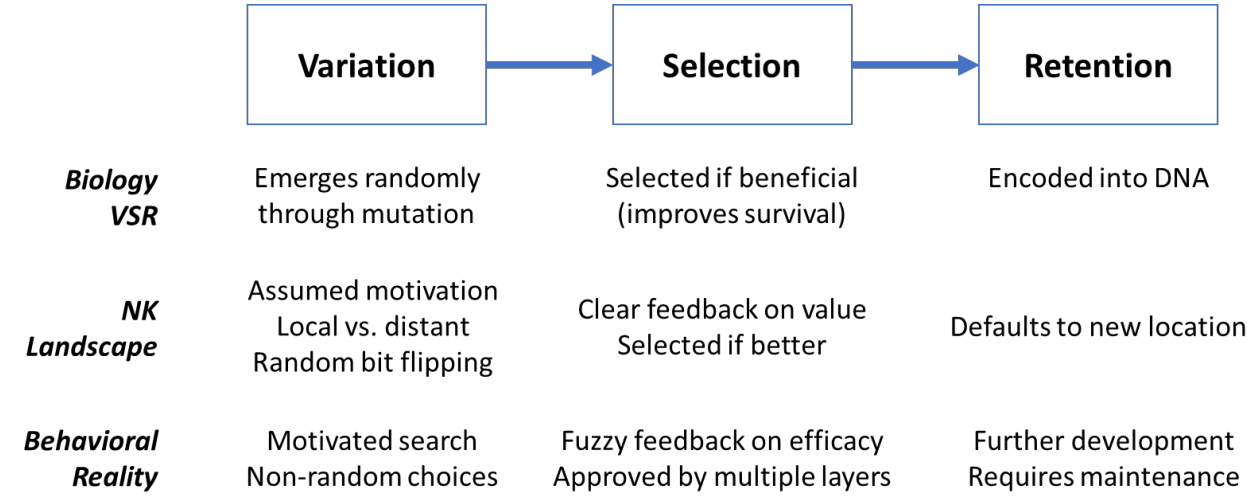
(e.g., cognitive, emotional, social, etc.) shaping the innovation process. Indeed in an organization full of boundedly-rational and cognitively biased individuals playing out structural organizational roles with competing incentives, the VSR model often breaks down or struggles to pre-emptively identify critical anomalies at the heart of corporate innovation (Burgelman 1994; Christensen and Bower 1996).

To be more specific, first, modeling innovation as a VSR process misses key aspects of the actual innovation process that have important implications for innovation outcomes. The prime example is motivation (the reason that an organization chooses to invest in search, innovation, and renewal) has crucial, path-dependent implications for whatever innovation process follows (Cyert and March 1963). Motivation determines where, when, and how variation and selection occur in the first place. In addition, process steps that VSR presents as being relatively trivial (e.g., selecting which innovation to implement) become far more complex and multi-stage in a corporate renewal setting where the array of actors, motivations, processes, and structures demand rich behavioral considerations for an already ambiguous process. For example, in a corporate renewal setting, motivations can be diverse and complex among the network of actors influencing variation in the first place (e.g., corporate renewal actors may be motivated to create breakthroughs, advance their career, create positive external media reputation, garner short-term stock performance and so forth). The VSR model also assumes that innovators who generate variation are matched with a rational selection processes that yields positive outcomes while selection actually involves complex interactions between idea generators, managers, stakeholders, and customers. At the very least, this suggests that selection will be a multi-stage process with different potential pitfalls at each stage. We argue that the VSR analogy often fails to uncover and address the real behavioral forces shaping innovation simply because the VSR model is under-populated by the humans who actually interact and make decisions.

Second, the VSR model typically assumes relatively extreme forms of decision making – variation is presumed to be random (or at least unbiased), selection is presumed to be rational, and retention

occurs when a mutation is adaptive and improves performance (and discarded otherwise). By integrating a more nuanced process model that clearly integrates the role of human decision makers, an alternative approach recognizes the inherent messiness of the innovation process (see Figure 1 for a simplified view of the VSR vs NK landscape vs behavioral innovation views of innovation process).

Figure 1



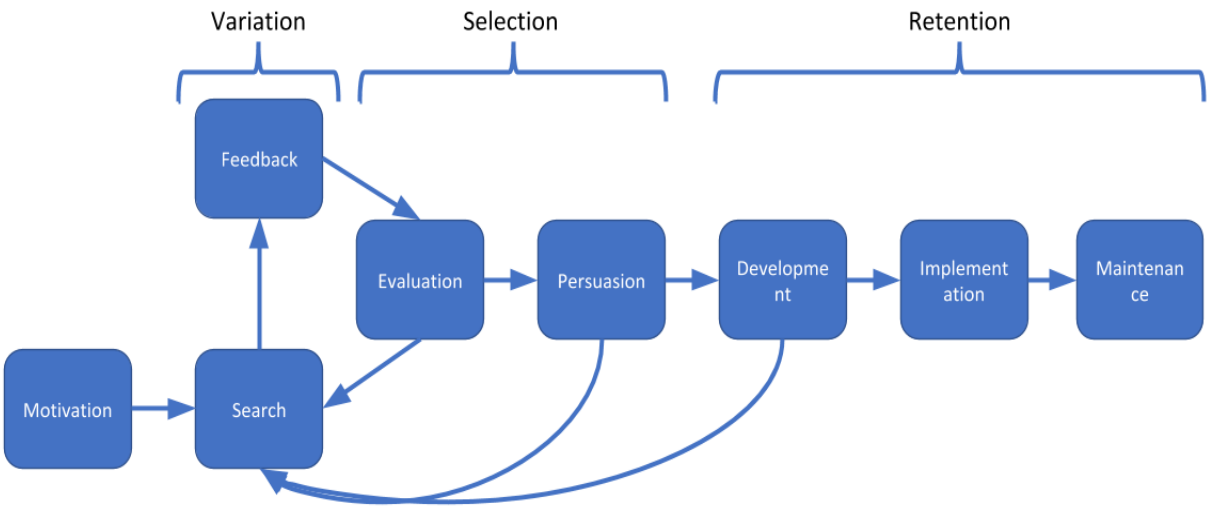
Independently these scissor blades – the distinction between risk and uncertainty, and the under-humanized nature of most models of innovation – present major dilemmas both to how innovation occurs and our understanding of that process. But taken together, the interaction between them implies yet even more significant bottlenecks shaping the emergence, development, and implementation of innovation. The simplest example is the realization that radical innovation (characterized by uncertainty and ambiguity) typically features highly skewed outcome distributions (Davidson 1991; Fleming 2007), while cognitive psychology has explored how decision makers often misrepresent skewed, long-tailed distributions and assume normality (Hogarth 1975). Assumptions of normality may not be problematic for incremental innovation but become disastrous for more radical innovation. Thus, the gap between a rational, simple process of innovation and reality is exacerbated by the fact that VSR does not account for the differences in risk-based versus uncertainty-based contexts. As Furr et al. (2019) suggest, as the uncertainty of a problem or the cost of search increase so does the

tendency to fall prey to the host of mental shortcut biases that can distort variation and selection, such as representativeness bias, confirmation bias, and escalation of commitment biases. Even before variation can begin, questions of motivation, model choice, and search techniques fundamentally shape how variation occurs. In sum, any model of innovation must take a more behavioral view to account for how the actors and their context shape and distort the antecedents, execution, and outcome of an innovation process.

3. BEHAVIORAL PROCESS MODEL OF INNOVATION

As a first step towards a behavioral innovation perspective, we suggest a modification to the VSR model appropriate for corporate renewal. We offer a multi-stage, behaviorally-grounded model of the innovation process that maps to the standard VSR framework, but which highlights important components of the model that are often overlooked. Although the new model we suggest is one of many alternatives, it acts as a starting point for providing insight into sets of previously under-addressed issues in the innovation process. Figure 2 summarizes the model. The model itself may not be comprehensive of all innovation processes (each innovation has a unique character to its evolution) but it allows us to highlight the most critical insights derived from a behavioral innovation view.

Figure 2



The core points of deviation from the VSR model can be summarized as follows:

- Motivation: The new model adds motivation, which is not explicit in VSR. Motivation is critical since the motivation to engage in innovative activity is not constant, and the firm's motivation shapes search and other processes. Simplistically, innovation efforts emerging from poor performance may lead to riskier alternatives (Cyert & March, 1963; Greve, 1998). Additionally, motivation affects the criteria used to evaluate any potential innovation, such as how a motivation to grow revenue will result in revenue-based evaluation while a motivation to reduce costs will be evaluated against the potential for cost improvement.
- Variation: The new model adds cycles of search, ideation and feedback within variation (which may overlap with selection). Unlike VSR, the process of creating variation is not a biological one, where random variations are spawned simultaneously and selected through evolutionary processes. Instead, variation is an iterative, sequential, endogenous, process of search, ideation, and feedback with each sub-stage being shaped by critical behavioral processes. Although such cycles are part of the current "lean startup" fascination among entrepreneurs and corporations (Camuffo et al. 2019; Furr and Dyer 2014), with its internal cycle of hypothesis testing with prototypes, such frameworks rarely account for the behavioral dimension shaping them, particularly as uncertainty increases (e.g., when is it good not to test with customers). Specifically, experimenters are treated as rational actors who can design, run, and interpret the results of experiments when in fact they may be deeply shaped by individual and organizational biases that distort experimentation (Furr et al. 2016b).
- Selection: The new model adds the elements of evaluation and persuasion, as well as acknowledges the overlap of evaluation with variation. These elements are particularly important in the corporate renewal setting, since selection is not unitary, as is implied by VSR. Rather selection occurs both through formal evaluation processes (e.g., the inventor choosing to

pursue the idea further, corporate finance committees), and through a persuasion process recognizing that innovators will not have full decision rights over all necessary resources for the innovation. Thus the persuasion process acknowledges the role of politics within the firm, as well as intra or extra organizational gatekeepers, the market for an innovation (the complex of stakeholders who may purchase, use, implement, and support an innovation, sometimes as one individual and sometimes as multiple individuals), and the competing motivational and informational forces they bring to the process. The distinction between evaluation and persuasion captures the organizational nature of innovation processes.

- Retention: The new model adds the development, implementation, and maintenance stages to an explicit consideration of the VSR model. Rather than assuming that retention occurs through reliable mechanisms as implied by VSR, we acknowledge the behaviorally sensitive stages that determine the direction in which an innovation may be developed, the radical variance in the interpretation and execution of the innovation (e.g., go-to-market strategy, business model), and the maintenance of an innovation (e.g., decisions on the continuance of an innovation and/or the innovators who created it in the first place). These stages are critical to address if we are to understand and model corporate renewal through innovation as evidenced by anecdotal stories about corporations that develop innovations but struggle to maintain them (e.g., Xerox and the computer mouse or Toshiba and the laptop)

The above alternate innovation model more clearly surfaces the points at which behavioral issues shape the innovation process than a simplified VSR model. There are a host of potential issues that may arise at each stage which should be addressed to properly understand the innovation process. By identifying these points of breakdown, the model also suggests the possibility for the eventual development of remedies to these breakdowns.

4. EXTANT FINDINGS AND FUTURE RESEARCH OPPORTUNITIES

Clearly, this paper is not the first effort to apply a behavioral lens to innovation. A review of the entire literature of specific behaviorally-informed innovation studies is beyond the scope of the current paper, but Table 1 provides a *selective and illustrative* review for each of the elements of the behavioral innovation process proposed in this paper in order to provide both a baseline and examples of future research opportunities that build off the model presented here.

[Insert Table 1 here]

Integrating Table 1 and the model presented earlier allows us to identify four particularly salient "bottlenecks" to corporate renewal through innovation. These bottlenecks are specific places in the innovation process where the scissor blades of uncertainty and cognitive biases interact in ways that become particularly problematic for risk-based models to address, and where a behavioral view reveals rich insights. For firms seeking to expand their organizational ability to implement successful radical innovation, these bottlenecks represent the most likely points in the process where traditional models would miss key elements and efforts would break down.

First, while prominent in the behavior view more generally, *motivation* plays a critical but underdeveloped (in the innovation literature) role that affects the willingness, location, direction and intensity of search behavior. The motivation for innovative efforts is embedded in the structure of the organization, the agenda of leaders, and the perspective of individual participants. Existing research has begun to unpack important behavioral elements of motivation, identifying the importance of aspirations (Cyert and March 1963; Eggers and Kaul 2018; Greve 1998; Van den Steen 2004, 2005) and attribution (Billinger et al. 2013; Eggers and Song 2015; Eggers and Suh 2019; Haunschild and Rhee 2004). Aspirations play two key roles. The typical role explores how performance versus aspirations affects the willingness to engage in innovation (Greve, 1998) and radical innovation in particular (Eggers & Kaul, 2018). But prior research also suggests that motivation can result in *aspirational path dependence*, or the tendency of

organizations to search in their local domain for problems or solutions (Cyert and March 1963). This means that multi-business firms, for example, are more likely to look for solutions to problems within one division within the division itself (Eggers and Kaul 2018). This leads to search efforts that focus only within the struggling division, and potentially miss systemic, or architectural solutions (e.g., new technical architectures or digital platforms spanning all divisions) that require different motivation and much broader commitment to recognize. This may explain why incumbent firms are often exceptionally innovative by traditional measures (e.g., patent counts and citations), but still miss significant, disruptive innovations that put their viability at risk (Tripsas and Gavetti 2000).

Similarly, prior research has underscored the importance of managerial attribution to the dynamics of search . Attribution of problems to causes in the external environment will typically lead to efforts to avoid those external challenges, while attribution of struggles to internal failings can spur dynamic efforts to improve the firm (Barr et al. 1992; Eggers and Song 2015; Eggers and Suh 2019). As increased uncertainty makes proper attribution even more challenging, biases in attribution may cloud decision making for future innovative efforts in highly uncertain situations. For example, recent research highlights the additional role of a leader's motivation on the innovation process, arguing that a leader's "vision" can influence the period before search--the labor market sorting process--leading to a pool of employees with similar beliefs (Van den Steen 2005). Such endogenous sorting could be valuable under conditions of uncertainty when the outcome is unknown and attracting high caliber talent is critical to successful search, but it can also introduce critical confirmation biases. Thus, as these examples and those in Table 1 illustrate, not only is a behavioral innovation view necessary to understand how motivation relates to corporate renewal, the relevance of a behavioral view becomes more acute as uncertainty and ambiguity increase.

Despite these foundational advances there are unresolved questions related to motivation that represent significant opportunities for future research. For example, how is motivation (and resulting

search) biased by the interaction of organizational actors? When it comes to corporate renewal, multiple actors must come together, such as scientists, innovators, managers, leaders, and stakeholders, each having their own complex motivations and behavioral biases. A more micro-behavioral view might unpack these forces. For example, incentive conflicts among actors might mean that a corporate leader may call for radical innovation but, as individual managers optimize for career stability, these managers deliver only incremental, low-risk options in response. Alternatively, although independent innovators (scientist entrepreneurs) are free to pursue radical ideas which can lead to a few breakthroughs (and many failures), in a corporate setting motivation-driven targets for innovative investments may get "averaged" by passing through committees, thereby distorting eventual search and outcomes. Unpacking when, where, and how these and other behavioral interactions shape the motivation that kicks off the innovation process is an important next step for understanding innovation.

Second, the nature of human-biased *search* under conditions of uncertainty means that organizational structure and processes bias organizations towards different types of search. Whether based upon the terms of exploitation versus exploration (March 1991) or local versus distant search (Gavetti and Levinthal 2000; Levinthal 1997), prior research shows that organizations are biased towards local search, and has explored distinct processes that shape these biases (Csaszar 2013; Eggers and Kaul 2018; Rosenkopf and Nerkar 2001). While there is significant prior research on search, there are important opportunities for a behavioral approach to provide important insights. One example is the opportunity to explore how the nature of search timing and sequencing biases search outcomes. As uncertainty increases it becomes increasing difficulty to know all (or even many) potential solutions to a given problem *ex ante*, or even how well those solutions match the underlying problem, which means that decision makers are forced to evaluate each potential solution as it emerges. Thus, managers likely must make a decision on whether or not to commit resources to a given potential solution without being able to evaluate (even at a high level) the other potential options that may be "on the menu" as

solutions and without unbiased estimation parameters. Such timing-driven challenges lead to satisficing behavior (Winter 1971). Moreover, both individual and organizational forces bias the search process. Some prior research underscores that corporate leaders are more likely to select options they overestimate in terms of success, but those overestimates are based on the match between the emerging option and their own idiosyncratic priors, thus complicating the ability to accurate estimate an emerging menu of options (Van den Steen 2004). Thus while there are many rich insights relating to search generally (e.g., local versus distant search), unpacking the actual behavioral (human, cognitive) forces that shape search represent significant opportunities for future research.

Third, the adaptive value of the VSR framework hinges on the clarity of *feedback* to inform selection. Prior research has identified general cognitive biases that may shape the interpretation of feedback, such as learning myopias (Levinthal and March 1993), but has also started to unpack biases that affect feedback such as changing aspiration levels over time (Joseph and Gaba 2015) or organizational hierarchy (Keum and See 2017). But the field is just at the beginning of unpacking the behavioral complexity of feedback and there are many future research opportunities. For example, although popular frameworks, like Lean Startup (Ries 2011), advocate pseudo-scientific experiments that yield directional evidence for innovation, such a view makes significant assumptions about innovator rationality in terms of framing, executing and interpreting the feedback from experiments. In addition to the danger of known statistical errors (e.g., type 1 and type 2 errors), one major opportunity for future research is to unpack the innovation-specific biases that distort feedback from search. For example, in corporate innovation settings feedback is drawn from a non-random sample and endogenously shaped by the sequential order in which feedback is received, leading to potential feedback representativeness biases. Likewise, feedback may be path-dependent based on prior products and services the user has been exposed to. Alternatively, feedback may be anchored around early prototypes which may misrepresent the final solution, or lead to biased feedback (e.g., inaccurate

prototypes may create false positives and negatives). These and many other potential biases deserve further investigation, particularly because they become more acute as uncertainty increases. Indeed for novel innovations there is anecdotal evidence that feedback can be heavily biased (Furr and Dyer 2014). Just as importantly, the intuitive idea that iterative A/B testing and prototypes allow for quick and dirty consumer feedback before making significant (irreversible) investments breaks down when considering all of the ways in which biases around feedback can easily push the firm to approve more incremental, as opposed to more radical ideas (Felin et al. 2019).

Fourth, prior research underscores that *evaluation* and *persuasion* in a corporate setting (selling a novel idea to internal or external resource holders) is fraught with challenges. For example, in terms of evaluation, prior research underscores that organizations have a tendency to overvalue low-risk, short-term returns over long-term, uncertain returns leading to bias towards incremental innovation that matches the needs of existing business units (Bernstein 2015; Christensen and Bower 1996; Gao et al. 2018; Henderson 1993). Furthermore evaluation of new opportunities can be biased by the match between manager's existing knowledge and evaluated opportunities leading to an under-selection of novel ideas that do match their internal knowledge sets (Berg 2016; Burgelman 1983, 1993b; Criscuolo et al. 2017; Knudsen and Levinthal 2007; Reitzig and Maciejovsky 2015; Reitzig and Sorenson 2013), favor ideas that match a manager's agenda and self-interest (Keum and See 2017; Reitzig and Sorenson 2013; Sutton and Hargadon 1996), or bias towards ideas that match their pre-existing identity which often leads to elimination of novel or disruptive ideas (Anthony and Tripsas 2016; Tripsas and Gavetti 2000).

Thus, existing research provides a useful but relatively siloed foundation for a behavioral theory of innovation. This provides process-specific opportunities like those discussed above, but also more systemic opportunities for research that span across stages in the innovation process. For example, corporate finance committees typically have a bias towards quantification – business cases are built off

expected financial returns. This quantification is especially difficult for high uncertainty projects for two main reasons. First, most corporate finance systems deal with high risk projects by increasing the discount rate, which further decreases the appeal of projects with longer-term investments (typical of more radical innovation). Second, radical new ideas often draw on knowledge that is new to the firm, meaning that the evaluators (on a corporate finance committee or elsewhere) generally lack the knowledge to accurately evaluate a radical new idea, and will be concerned that the proponent (who likely has relevant knowledge) is over-optimistic about the idea's chances, leading them to further discount the idea. This example highlights the cascading effect that (in this case) narrow-criteria evaluation may have on motivation, search, and feedback that endogenizes and shapes the innovation process. Even when the creation of innovative new ideas occurs, firms are likely to discard those innovations if they don't aligns with the existing power structure (Tripsas & Gavetti, 2000). For example, in an organization like the New York Times seeking to renew through digitization, the move to digital makes unique content (e.g., editorials) and advertising sales more important as differentiators and drivers of value, while making more general content (e.g., sports) and subscription sales less relevant. This potential shift in political power means that those groups already in power are likely to fear any changes in the power landscape, and thus be predisposed against the idea even before attempts to convince resource holders begins. These become key reasons why the non-behavioral view of innovation as a process of retention – selecting and retaining from among the many various options that may exist to solve a problem – within an organization is poorly represented by a VSR process. We summarize these and other future research opportunities in Table 1.

5. DISCUSSION AND CONCLUSION

This paper outlines the advantages of better integrating behavioral factors into an innovation process model, with a specific focus on corporate renewal through innovation (as "corporate" implies the interactions of multiple actors and incentives, and "renewal" implies a preference for at least

moderately radical innovation ideas). For those studying corporate renewal through innovation, the problematic simplifications of the VSR model may seem self-evident through the many ways in which corporate renewal can go awry due to the complex interaction of boundedly-rational, biased actors. This paper, though, seeks to unify these various process-based insights into a more holistic model of behavioral innovation and renewal. Doing so focuses on the essential humanness of the actors involved in the innovation process.

Beyond articulating the model itself, this paper identifies previous research laying the foundation for each element in the model and identifies specific research opportunities. Those opportunities discussed in Table 1 represent a small selection of the many potential issues to investigate by taking a more behavioral perspective on innovation. However, we propose that the ultimate objective for behavioral innovation is to go beyond a simple list of biases (which implies some degree of independence among the biases) so as to also explore an integrated process-based view for how innovation emerges in an organizational context. Although we believe this behavioral innovation view applies generally, a behavioral innovation view is particularly urgent in the corporate renewal context where innovation efforts have a particularly high likelihood of being derailed by behavioral traps (Danneels 2011; Tripsas and Gavetti 2000).

Below we suggest several additional adjacent opportunities for a behavioral innovation view. These include the need to research remedies, the opportunity to incorporate adjacent disciplines beyond psychology, and the possibility to reimagine our existing theories and frameworks.

5.1 Designing Remedies

Much of the existing behavioral research in strategy and innovation focuses is descriptive – identifying and documenting the existence of biases that can lead to suboptimal decision making. This is important work that adds to our understanding of how decision making unfolds in organizations. However, rarely does this research identity or test remedies for sub-optimal processes (the main

exception being formal or simulation modeling work). One reason may be that researchers are averse to normative perspectives because of the relative safety of a positive approach with its appearance of scientific rigor and disinterest. Another reason may be that wandering into the domain of unverified opinions about "what should be" has clear dangers. But an overly eager adherence to a positive perspective will limit the impact of behavioral innovation to that of behavioral economics—producing lists of behavioral breakdowns without attention to remedies.

However, because behavioral innovation models the innovation process of individuals and organizations, there is an opportunity to go beyond identifying bottlenecks to designing robust remedies for these behavioral bottlenecks. This is particularly critical to facilitate corporate renewal efforts through innovation, which may become increasingly frequent in an environment of increasing dynamism. To illustrate the potential of such an approach, we suggest examples of potential remedies for the four behavioral bottlenecks discussed above.

First, we described how *motivational* bottlenecks determine the initiation and direction of search. If the dominant motivation for a corporate renewal effort is a reactionary trigger to poor performance (Bromiley 1991; Greve 2003), then certain classes of search (location and direction) will be systematically under-sampled. One remedy to this bias could be to explore other motivational triggers for corporate renewal through innovation. These include, for example, opportunity, capability, or purpose triggers. Opportunity triggers involves a proactive, open stance oriented towards flexibly capturing opportunities, much like that described by Rindova and Kotha (2001) and Brown and Eisenhardt (1997). These studies described mechanisms, such as the adoption of simple rules, which shaped organization opportunity search (Eisenhardt et al. 2010). But we need further research to think through how to activate opportunity triggers. One suggested by prior literature could be the use of grand visions or stories by corporate leaders to motivate search for valuable opportunities (Furr et al. 2018; Garud et al. 2014; Van den Steen 2005), analogies that help corporations see the opportunity

(Furr et al. 2019; Gavetti et al. 2005), or self-defined identities as “innovative” or “opportunity-driven” companies. Likewise, a capability trigger involves a pro-active motivation to understand how capabilities can be transferred and applied to other uses. For example, if when Amazon.com was primarily a B2C retailer, leaders had only responded to unsatisfied performance aspirations, they might never have developed Amazon Web Services (AWS), a radical innovation in the B2B space that has dramatically renewed the corporation. The motivation for the search came from a discussion at Jeff Bezos’ house about where else Amazon could apply its capabilities. The obvious answers focused around online retailing, but digging deeper revealed a capability managing online services at a time when the internet lacked an “operating system.” This observation of their deeper capability led to the search resulting in AWS (Dyer et al. 2019). Alternatively, purpose triggers may lead firms to engage in search not triggered by performance aspirations. For example, Nuna, a health-care data analytics company changed course to become the cloud infrastructure provider for Medicare because of the founder’s personal mission to enable better data-driven healthcare. These examples provide inspiration of the possibilities to explore remedies for the motivational bottlenecks in the corporate renewal process.

Second, there are many opportunities to develop remedies for *search* bottlenecks around timing and satisficing. One remedy for sequential, satisficing search could be to further unpack the black box of distant search. Several conceptual studies have suggested first steps. For example, Gavetti, Levinthal and Rivkin (2005) use an NK simulation to suggest that analogies can be powerful tools for corporations seeking to enable distant search, as well as identify boundary conditions. Similarly, an experimental paper by Billinger et al. (2013) documents how failure during search on a complex landscape encourages distant search, but this individual-level study doesn't address the corporate renewal setting and how failure affects the political decision making process within organizations in a way that may also constrain search (Eggers 2012). Anecdotal examples suggest other search mechanisms for distant search, such as using science fiction (to envision distant possibilities), exaptation (to identify unexamined, adjacent

possibilities), and first principles analysis (to uncover new search paths) (Furr et al. 2019; Furr et al. 2018). The black box of distant search and the mechanisms that enable it could benefit from further development. As a second example, although popular trial-and-error search tools like lean startup are increasingly being adopted by corporations (Furr and Dyer 2014), the lean startup framework is essentially a sequential search mechanism. But uncertainty, ambiguity, and complexity may be better resolved through different search tools than sequential search. Sommers, Loch and Dong (2009) use a mathematical model to suggest that when uncertainty is low, traditional risk-based search mechanism work well (e.g., strategic or business planning) but when uncertainty is high, trial-and-error works better (e.g., lean startup) whereas when complexity is high, parallel search can be more effective. Likewise, recent research on corporate renewal through innovation documents how firms facing innovation uncertainty are more likely to engage in parallel search to hedge their bets (Eggers and Green 2012). But more work needs to be done to explore the search mechanisms that are best matched to conditions of uncertainty. It is likely that search mechanisms for local search (e.g., lean startup) do not work well for distant search where uncertainty and search costs can be high (Furr et al. 2016b). This work suggests the need to further design search and feedback processes to correct for their inherent limitations.

At the *feedback* stage, one of the key bottlenecks is the fuzzy nature of feedback and the likelihood that innovators are increasingly biased in the design, execution, and interpretation of experiments as uncertainty increases. A first step to designing remedies might be to identify the boundary conditions under which specific experiments yield reliable, unbiased feedback. For example, Camuffo et al. (2019) find evidence to suggest that when entrepreneurs frame and test hypotheses they more quickly update their initial ideas, a potential first step on the road to success. But the boundary conditions for these feedback gathering mechanisms have yet to be specified. For example, Cohen et al. (2019) suggest that bounded rationality may affect entrepreneurs differently than corporate renewal efforts, but go on to identify how startup accelerators provide remedies to overcome entrepreneurs

feedback seeking biases, specifically based on the timing, transparency, and customization of feedback events. These research efforts highlight the potential value of feedback remedies but there is much more work to be done in designing remedies.

At the *evaluation* stage, one of the key bottlenecks is the nature of how corporate leaders interpret and make decisions about which opportunities to pursue. The inherent biases in this process suggest a number of potential remedies. For example, one remedy may be more careful consideration of the latent heuristics of the individuals involved in selection. To illustrate, Berg (2016) examined the ability of managers, customers, and creators to forecast the success of a creative effort (circus acts). He found that creators proved better at selection than managers, hypothesizing that because creators bridge divergent and convergent thinking (whereas managers only engage in convergent thinking), they were better at forecasting the success of an idea. Not only does the study uncover a critical behavioral link between search and evaluation, but it also highlights a potential remedy to existing evaluation mechanisms that directly affect the innovation process. Relatedly, Keum & See (2017) explore how corporate structure and the biases to support one's own ideas affects the process of evaluating which opportunities to pursue, highlighting the interlinked nature between different stages in the innovation process and the challenges associated with selecting good ideas. A second remedy may be to reshape the nature of involvement in the search process. For example, in an interview about corporate renewal through innovation, Scott Stephenson, CEO of Verisk Analytics, argued for earlier involvement in the innovation process. He suggested that leaders involved with evaluation should avoid a loose/tight arrangement which allows internal innovators to search without restraint (i.e., loose) but then when they select are very constrained (i.e., tight). By contrast Stephenson suggested it was more effective to integrate with the innovator during search (i.e., tight) allowing the leader to be much more loose when it came to evaluation (i.e., loose) (Dyer et al. 2019). Although the remedy needs empirical validation, it suggests at a minimum, other approaches to solving the evaluation problem.

5.2 Draw Upon Adjacent Disciplines

Behavioral perspectives draw upon the cognitive sciences to explain human behaviors, which often results in a more accurate picture than models based on rational optimization. To date, behavioral perspectives in economics and strategy have drawn heavily upon psychology to develop more accurate models of decision making (Ariely 2008; Kahneman 2011). This essay drew heavily upon the Carnegie school and psychology to describe a behavioral innovation view. But a behavioral innovation perspective could benefit from integrating these more familiar fields with other fields not as commonly integrated into innovation studies, such as the study of neuroscience, social psychology, or emotion.

For example, neuroscience could be a rich domain for understanding behavioral innovation. Neuroscience has already begun to make major inroads into marketing and has helped provide tools to understand the behavioral dimension of consumer decision making. But it may be that neuroscience also has potential to advance a behavioral innovation perspective through the development of remedies for behavioral innovation failures. Because neuroscience can pinpoint when and how brain activity happens, as well as separate different dimensions (e.g., emotional and rational), there is the potential to design remedies that are matched to the specific mechanisms where behavioral failures occur. For example, Hsu et al. (2005) demonstrate that the brain has separate neural reactions to risk than uncertainty. Although we can talk qualitatively about a remedy, and even observe the impact of that remedy on outcomes (e.g., higher rates of innovation success), applied neuroscience could enable the design of remedies specifically matched to behavioral failure points.

In addition to neuroscience, there are other disciplines that are often under-sampled in their application to behavioral perspectives. As one example, social psychology is often described as the study of individual behavior that is a function of the person and the context. Given the complex social context of corporate renewal efforts, more thoroughly integrating social psychology could enrich our understanding of corporate renewal efforts through innovation. As another example, although emotion

impacts every aspect of our daily life, the discussion of emotion has very limited impact on the management sciences. But as Huy (2002) and others demonstrate, emotion can be a fundamental element of corporate renewal through innovation. These rarely discussed emotions can include ambition that may motivate search, courage to engage in search, fear that could curtail search, loyalty that may distort selection, and greed that may determine retention. This is to name but a few emotions that are rarely discussed but which clearly should inform a behavioral innovation view.

5.3 Reimagining Our Tools

Weick (1996) famously drew upon the analogy of the Mann Gulch fire disaster to suggest new ways to think about organizing (i.e., bricolage, virtual role systems, attitude of wisdom, respectful interaction). In a similar manner, we may consider whether we need new tools to think about and describe innovation in a world of uncertainty. For example, the NK model has often been used to describe an opportunity landscape that actors search. But such a model implies a fixed, static world that may not accurately represent innovation, as suggested by the debate about whether opportunities are discovered or created. But even such a debate may be too binary.

In a world of increasing uncertainty, we may ask, is the correct model an opportunity landscape shrouded in fog, multiple parallel opportunity landscapes that are generated and selected through the actions of the innovator, or not a single landscape at all but a "multi-verse" of parallel landscapes endogenously created through action? What if there are ways to think about a world of uncertainty (resolvable and unresolvable uncertainty), ambiguity, and complexity that better describe the radically endogenous nature of opportunity such that each actor taking a step is constantly reshaping the opportunity landscape? Applying an NK landscape to such a world may be a significant case of inappropriate theory borrowing from a risk-based context to an uncertainty context where it no longer fits (Whetten et al. 2009).

In summary, at the core the behavioral innovation perspective takes both human nature and the impact of uncertainty seriously. Properly incorporating uncertainty may suggest the need to re-see many theories developed in a risk-based context or to develop new theories. For example, in a world of greater dynamism, how corporations organize, particularly for innovation, may fundamentally change. Experiments in non-hierarchical organization (e.g., flat, holocracy, agile, market) and efforts to work in innovation ecosystems suggest many questions to resolve around the future of organization (Furr et al. 2016a; Furr and Shipilov 2018). We hope that a behavioral innovation view is a productive first step to an enriched understanding of innovation and corporate renewal.

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TABLE 1: Behavioral Innovation View: Selected Review of Extant Research and Future Research Opportunities by Innovation Stage

Innovation Stage	Selected Review of Extant Behavioral Innovation Research	Future Behavioral Innovation Research Opportunities

Motivation:
 	
(Motivation to engage in innovation, for example, when, how, and where to engage in search activities)
	• Motivation (and resulting search) is shaped by internal & external comparison.
	  • E.g., Aspirations determine if firms are motivated to search, direction of search, and volume of search. For example, poor past performance or comparison to other firms determines whether firms are motivated to engage in local vs. distant or novel vs. imitative search, as well as search intensity (Cyert and March 1963; Eggers and Kaul 2018; Greve 1998; Van den Steen 2004, 2005).
	• Motivation (and resulting search) is shaped by attribution.
	  ○ The motivation to engage in risky search depends on whether attribution for poor performance derives from prior risky bets (in which case risk preferences decline) or decline in traditional operations (in which case risk preferences increase) (Billinger et al. 2013; Eggers and Song 2015; Eggers and Suh 2019; Haunschild and Rhee 2004).
		• How is motivation (and resulting search) biased by the interaction of organizational actors (i.e., micro-interactive perspective)?
		  • E.g., Incentive conflicts: although leaders may call for innovation, individual actors may optimize around other factors, such as career stability. How does this bias resulting search (for example biasing towards incremental or low risk projects)?
		  • E.g., Aspiration averaging: if initial motivation to search is determined "by committee" of managers, then how does the compromise of the preferences of multiple actors shape motivation, for example, leading to potential "averaging" of objectives that could lead to incremental search (e.g., Gaba and Joseph 2013)?
		• In what other ways are motivations (and resulting search) biased by internal & external comparisons not previously researched?
		  • E.g., Bandwagon effects: how does membership in an industry group lead to "bandwagon effects" that shape motivation?
		  • E.g., Industry narratives: how do shared, implicit, or assumed industry narratives bias motivation?

Search:
 	
(Search activities related to opportunities, for example, identifying problems or solutions)
	• Search is biased towards local search & path-dependent.
	  • Local search: search in firms biased towards local search due to cognitive efficiency, local knowledge, markets, mental maps, etc. Search also tends to be focused on domains where performance is low, as opposed to searching for opportunities across entire firm. Search often expands to distant search only if initial local search efforts fail. (Gavetti and Levinthal 2000; Levinthal 1997; Rosenkopf and Nerkar 2001; Tripsas and Gavetti 2000).
	  • As uncertainty increases and available models to understand distant landscapes decrease, aversion to distant search increases, reinforcing local search biases (Joseph and Gaba 2015; Levinthal 1997).
	Search is biased by identity.
		How does the sequential nature of search bias search?
		  • E.g., Sequential search: search is typically sequential, identifying one (or a small number) potential solution to explore deeper before moving to a second set of alternatives. If all solutions are not manifest simultaneously, how does satisficing behavior bias search (e.g., Hogarth 1975; Winter 1971; Winter 2000)?
		How do individual and organization forces bias selection during search?
		  • E.g., Selection biases: individuals in an organization may select solutions that reinforce a personal position, political agenda, prior investments, etc. (e.g., Dougherty 1992)
		How does search types differ in terms of processes and biases?
		  • E.g., Component vs architectural search: If component level search is often prioritized over architectural search, and architectural search is

	• Search biased towards knowledge domains consistent with firm identity (typically as formed relative to perceived competitors or industry groups) and ignore other domains (Anthony and Tripsas 2016; Benner and Tripsas 2012; Tripsas 2009). Search is biased by recombination heuristics • Firms consistently search for new ways to solve familiar problems instead of applying knowledge to solve new problems (Eggers and Kaul 2018; King Kneeland et al. 2019)	biased by prior knowledge (e.g., Henderson and Clark 1990), what processes and mechanisms are best for each type of search? How does the nature of the environment bias search? • E.g., Endogenous evolution: If the environment is dynamic (hard to predict future evolution) or endogenous (outcomes affected by strategic choices of firm and competitors), how is search biased? What mechanisms can correct for it (e.g., Sommer et al. 2009)?
Feedback: **(Feedback on opportunities, for example, relevant problems, solutions, etc.)**	• Feedback on search is biased by general cognitive forces. • Cognitive at level of individual, team, and organization shape attention to and interpretation of feedback. As uncertainty increases so do severity and impact of cognitive shortcut biases (Furr et al. 2016b; Joseph and Gaba 2015; Keum and See 2017; Kogut 1997; Levitt and March 1988; March 1991; Posen et al. 2018).	• Beyond general cognitive forces, what are the innovation-process specific biases that distort feedback on search? ○ E.g., Feedback representativeness: how is innovation biased because feedback is drawn from a non-random sample and endogenously shaped by the sequential order in which feedback is received? • E.g., Feedback path dependence: existing customers likely to interpret new innovation through lens of existing & familiar products and services, thereby biasing feedback towards status quo (Relates to Christensen 1997; Christensen and Bower 1996). For example, the iPhone, Aeron chair, and Reebok pump concepts were rejected by customers until they had a chance to try it. • E.g., Prototype anchoring: Limitations of prototype representation shape the interpretation of problem/solution pair and feedback given. For example, minimal prototypes may lead to false negatives due to lack of functionality (feedback givers interpret it as a poor solution) or false positives due to lack of specificity (feedback givers assign functionality to the solution that are not present but are superimposed on an incomplete prototype).
Evaluation: **(Evaluation of search results for further development. I.e., initial selection)**	• Evaluation is biased by nature & timing of expected returns. • Low-risk, short-term returns prioritized over long-term uncertain returns leading to bias towards incremental innovation serving existing business units (Bernstein 2015; Christensen and Bower 1996; Gao et al. 2018; Henderson 1993). • Evaluation is biased by managerial knowledge.	• How is evaluation biased by evaluation microprocesses? • E.g., Single criteria biases: Firms often try to apply a single evaluation process for projects based on objective, measurable criteria (e.g., 1-year ROI). But radical innovation may need to be judged on different criteria, and outcomes are harder to reliably quantify. • E.g., Attention biases: In many cases evaluations are very short (5-30 minutes) given the volume of project proposals, which limits a manager's ability to assess radical projects (which require greater

	• Leaders develop specific and general knowledge that may not match knowledge needed to select higher uncertainty projects (Berg 2016; Burgelman 1983, 1993b; Criscuolo et al. 2017; Knudsen and Levinthal 2007; Reitzig and Maciejovsky 2015; Reitzig and Sorenson 2013). • Evaluation is biased by organization politics and self-interest. • Decision makers have a tendency to favor their own ideas or ideas from their own department over external ideas thereby biasing selection (Keum and See 2017; Reitzig and Sorenson 2013; Sutton and Hargadon 1996). • Evaluation is biased by organizational identity. • Even though incumbent firms often develop radical new technologies, they often fail to commercialize because the technologies fail to fit with identity and business model (Anthony and Tripsas 2016; Tripsas and Gavetti 2000). This effect is also sometimes also discussed in terms of persuasion.	cognitive processing). Managers may default to mental shortcuts that are biased towards incremental, familiar projects. • E.g., Agency biases: Over-reliance on agentic managers (who want their own ideas to succeed) may lead to increased discounting of uncertain cash flows, thereby biasing evaluation. • E.g., Erroneous distribution assumptions: Individuals typically assume that distributions are more normal than they actually are, underestimating the length and size of the fat tail, meaning that evaluators may underestimate potential upside of choices under increased uncertainty. • E.g., Omitted option value: Many radical new technologies may, if successful, beget future options that could create additional value for the firm, but these are difficult to articulate for uncertain or new technologies (and much easier for incremental technologies). • E.g., Knowledge mismatch biases: Architectural vs modular innovation requires different knowledge sets. Over time, developers (and leaders) focusing on modules may lose architectural knowledge required for radical leaps and thus prefer incremental innovation.
Persuasion **(Convincing organization actors to pursue or support an innovation)**	• Support for innovation is biased by external actors. • External evaluators with limited attention don't necessarily understand an innovation and its implications for the firm, and so may actively discourage adoption. Most prominently studied with securities analysts (Benner 2010; Benner and Ranganathan 2012, 2013). • Support for innovation depends on coalition building. • Success of new technology hinges on adoption and support by key decision makers, through process of coopting support through influence, politics shaping cognitive frames, etc. (Kannan-Narasimhan and Lawrence 2018; Kaplan 2008; Seidel and O'Mahony 2014).	• How is support for innovation biased by individual incentives? • E.g., Personal incentive biases: Managers know that their own reputation hinges on (perceived) value of ideas proposed to senior leadership, and so offers support more frequently for incremental, low-risk options than radical, high-risk options. • How is support for innovation biased by organization structure? • E.g., Structural hierarchy biases: If any level in hierarchy can veto innovations, and radical ideas are harder to understand, then there will likely be a regression to mean to satisfy multiple layers of hierarchy. Such a bias functions within firm (decision making hierarchy) or external to firm (as innovations involve nexus of ecosystem partners) (e.g., Csaszar 2013).
Development **(Allocation of resources and attention to**	• Development biased by resource allocation processes. • Options theory largely derives from financial options but has been used by firms to model strategic (new product) options. But doing so violates a number of core tenets of option pricing (Adner and Levinthal 2004). There are	• What are the specific microprocesses that bias development? E.g., Valley of death problems: Although many innovations are proven at the prototype / pilot stage, development to broad commercialization often encounters a "valley of death" whereby new dilemmas are presented which organizations struggle to overcome.

elaborating innovation opportunity, for example, through a product development or manufacturing design process)	behavioral challenges in applying options logic creates challenges as well (Klingebiel and Adner 2015; Klingebiel and Rammer 2014). ○ Development often biased by evolving objectives. ○ Teams implementing radical innovation typically see more challenges around shifting goals and idea promotion, which require different inputs from senior leaders (Alexander and Van Knippenberg 2014). ○ Development biased by resource path-dependence traps. ▪ Firms often develop new innovations in a manner biased towards reusing existing resources, leading to an endogenous development path (Garud and Van De Ven 1992; also see McNally and Schmidt 2011 and special issue on decision making and new products).	• E.g., Process structure biases: Although operations research has advocated separate budgets / processes for incremental and radical innovation, adoption of such processes does not appear to lead to radical innovation (Cooper 2013). What are the development processes that encourage radical over incremental innovation? • E.g., Process change biases: often development requires a shift from prototyping to manufacturing design and commercialization processes. How does the handoff or shift of process bias development? • How do forces external to the organization bias development? • E.g., Ecosystem development dilemma: if innovations are dependent on external ecosystem actors, how might these external actors or dependence on an ecosystem bias development?
Implementation **(Commercialization of innovation including go-to-market strategy, business model, etc.)**	• Implementation biased by innovation measurement. • Measurement and reward paradigms built for mature products using standard accounting undermine the implementation of novel innovations (Noda and Bower 1996; Viki et al. 2017).	• What are biases that shape scaling an innovation? • E.g., Organization design biases: Most large organizations have capabilities and processes designed for execution of existing activities at scale (i.e., capabilities to execute at scale) that may be mismatched with new or radical initiatives (i.e., capabilities to get to scale). How does the gap between capabilities to execute an existing businesses bias the implementation of new or radical innovation? • E.g., Process change biases: If exploration processes differ from execution processes, organizations may struggle to unlearn "exploration" processes that made search successful but which hinder execution and learn new "exploitation" processes? ▪ How do mechanisms for implementation feedback bias implementation? ▪ Most incremental projects are implemented under "continue or terminate" processes. Radical projects, however, very likely may need to pivot even through implementation. It is unclear how feedback mechanisms during implementation can be structured to facilitate strategic interpretation and pivoting.
Maintenance **(Continued support for**	• N/A: there is limited research taking behavioral perspective on when firms choose to upgrade or improve specific products	• How do the evaluation criteria bias the maintenance of an innovation? • E.g., Evaluation conflicts: How does the the conflict network of evolving organizational demands shape the maintenance of

innovation, after initial commercialization)		innovation. For example, a CEO may cut established innovation programs to save money over the short term. E.g., Evaluation time frames: How does short term vs long term bias maintenance of innovation. For example, although GE adopted new innovation processes before their collapse, are the innovation processes immediately preceding the collapse at fault, or the decades-long over reliance on execution at fault) E.g., Retention failures: If organizations tend to retain profitable innovations but fail to retain the innovators who created them due to retention practices, how does this bias future innovation?