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Going Underground: Bootlegging and Individual Innovative Performance

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To develop innovations in large, mature organizations, individuals often have to resort to underground, “bootleg” research and development (R&D) activities that have no formal organizational support. In doing so, these individuals attempt to achieve greater autonomy over the direction of their R&D efforts and to escape the constraints of organizational accountability. Drawing on theories of proactive creativity and innovation, we argue that these underground R&D efforts help individuals to develop innovations based on the exploration of uncharted territory and delayed assessment of embryonic ideas. After carefully assessing the direction of causality, we find that individuals’ bootleg efforts are associated with achievement of high levels of innovative performance. Furthermore, we show that the costs and benefits of bootlegging for innovation are contingent on the emphasis on the enforcement of organizational norms in the individual’s work environment; we argue and demonstrate empirically that the benefits of an individual’s bootlegging efforts are enhanced in work units with high levels of innovative performance and which include members who are also engaged in bootlegging. However, during periods of organizational change involving formalization of the R&D process, individuals who increase their bootlegging activities are less likely to innovate. We explore the implications of these findings for our understanding of proactive and deviant creativity.

Keywords: bootlegging; innovation; innovative performance; R&D; creative deviance

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Introduction

We made a small amount of the material, then showed technically that it worked, then started to involve some of our colleagues who I work very closely with. We made some sort of prototype, we went and gave it to consumers, got some consumer data, and at that point, when it all started to look reasonable, we then let the organization know about it.

—Extract from an interview with a senior R&D technologist

The creativity and innovation literature has a long tradition of describing the tension between autonomy and accountability in the generation of innovations (Burgelman 1983, Van de Ven 1986). Organizations often struggle to find a balance between allowing staff, especially research and development (R&D) workers, enough flexibility and autonomy to explore the “novel” and “unusual” and keeping them sufficiently reined in to ensure that their innovative efforts are aligned with company strategies, objectives, and priorities (Amabile 1996, Kanter 2000). Autonomy without accountability may lead to R&D efforts becoming decoupled from the organization, whereas too little autonomy and strict accountability may tie R&D efforts too closely to the

organization’s past and current ways of working. Therefore, organizations need to carefully assess the level and type of autonomy granted to R&D staff.

Although some organizations allow “free time” for their staff to engage in personal R&D efforts, most use a range of formal project management tools to direct and select among their staff’s R&D efforts to ensure that these efforts are accountable to the wider organization (Cooper and Edgett 2009). In recent decades, managers have paid greater attention to formalizing parts of the R&D process to help minimize costs and risks, partly in response to the low rates of return to R&D in many leading science-based sectors and partly in response to the increasing competitive pressure that large R&D active firms face in their markets (Mowery 2009).

As the quote at the beginning of this section illustrates, in contexts where the ability of R&D professionals to work outside the project structure of the organization is severely restricted, individuals may seek to increase their autonomy by taking some of their work “underground” (Abetti 1997, Aram 1973, Augsdörfer 1996, Knight 1967). These underground activities are described as “bootlegging,” named after the practice of hiding alcohol in one’s boots, for example, during

the U.S. Prohibition. We define *bootlegging* as the process by which individuals take the initiative to work on ideas that have no formal organizational support and are often hidden from the sight of senior management, but are undertaken with the aim of producing innovations that will benefit the company (Augsdörfer 2005). The concept of bootlegging relates to the broader streams of work on proactive creativity, which emphasizes the importance of personal initiative in creative processes (Frese et al. 1996, Unsworth 2001), and creative deviance, which highlights that individuals often deviate from formal work requirements in pursuit of creativity (Mainemelis 2010).

The existence of underground R&D efforts conducted by scientists and engineers is frequently commented on but rarely analyzed in detail. The literature on bootlegging (Abetti 1997; Aram 1973; Augsdörfer 1996, 2005) has produced a rich contextual understanding of why and how bootlegging activities take place, yet it says relatively little about the mechanisms through which bootlegging may promote individuals' ability to generate innovative outcomes. It also fails to account for how the characteristics of different work contexts influence the positive and negative aspects of the R&D workers' underground efforts. Thus, it tends to underplay the dangers of bootlegging for both individuals and their organizations.

To explore these aspects, we draw on theories of proactive creativity and innovation to analyze how bootlegging efforts increase the ability of the individual to generate innovations. First, bootlegging allows individuals to explore divergent research directions that fall outside the remit of formal projects (Burgelman and Sayles 1986, O'Connor and McDermott 2004). Bootlegging provides the individual with more freedom to explore uncharted territory and to attain explorative advantage over colleagues who do not bootleg (March 1991). This advantage ultimately translates into superior individual ability to develop innovations that generate value for the organization. Although bootlegging counts as an illegitimate activity, it can function as a channel through which unconventional ideas may be realized. Second, bootlegging allows individuals to delay the moment of monitoring and assessment by the organization until an idea is reasonably developed (Cheng and Van de Ven 1996, Garud et al. 2011). In more extreme cases, bootlegging may even involve continuing to work on projects rejected by formal management systems and re-presenting them to the organization when the time and circumstances are right (Mainemelis 2010). Because embryonic ideas or ideas that conflict with established modes of working are more likely to fail internal selection processes (Knudsen and Levinthal 2007, March 2006), delaying their assessment increases the chances that new discordant ideas may eventually be incorporated into the organization.

Yet whether bootlegging activities lead to innovation or result in a waste of organizational time and resources may in large part depend on the work context in which these activities take place. We build on the concept of normative enforcement (Feldman 1984, Mainemelis 2010, Merton 1968) to propose that individuals may be unable to benefit from bootlegging in social contexts where norms of behavior are strictly enforced. By contrast, work environments that value attainment of goals over the means used for their achievement provide a supportive environment in which individual's bootlegging activities can lead to innovation. We argue that the contingent effect of the emphasis in the work environment on normative enforcement is manifested in three main ways.

First, building on the observation that groups that meet their objectives have lower levels of normative enforcement (Feldman 1984), we argue that high-performing units with strong innovation track records can afford to be more tolerant of deviant behavior. In such units, local managers are more disposed to providing discretionary resources for bootlegging and show less hostility toward bootleg ideas when they are presented, making it easier for the individuals in these units to convert bootleg activities into realized innovations. Second, in units where bootlegging is more widespread, individuals are less likely to disapprove of the deviant behavior of colleagues and more likely to take the view that the norm of working exclusively on formal projects need not always be adhered to. Thus, bootleggers will be more likely to find that colleagues offer positive reinforcement for their bootlegging ideas and may help them navigate such projects back into the formal stage-gate system. Third, work environments that increase formalization of the R&D process by introducing more rules and regulations and stricter monitoring of R&D work signal a greater emphasis on conformity to rules rather than achievement of creative goals. In this context, we suggest that those who increase their bootlegging activity in parallel with greater formalization—thus going against organizational objectives of increasing normative enforcement—may alienate themselves from the organization, with the risk that their creative efforts will be misaligned with corporate objectives (Greene 1978).

The paper makes three contributions. First, we contribute to the literature on the link between autonomy and innovation (Amabile 1996, Kanter 2000). We argue that autonomy affects innovation not only through the level of autonomy formally granted by organizations but also through the autonomy that individuals' proactively claim for themselves. In this context, we characterize bootlegging as a vehicle enabling R&D scientists and engineers to achieve greater autonomy to define their research agendas and goals in settings where this is not formally granted. Second, we ground the concept of bootlegging in the wider literature on informal R&D

and proactive and deviant creativity processes in organizations (Mainemelis 2010, Unsworth 2001), advancing understanding of the mechanisms that enable individuals to profit from bootlegging. In particular, we identify exploration of uncharted territory and delayed assessment of embryonic ideas as major factors linking bootlegging to individual innovation performance. Third, following the argument that bootlegging can flourish in units with relatively low levels of normative enforcement, we identify the organizational contingencies that dictate whether individuals—and indirectly, organizations—ultimately profit or lose from bootlegging, and we construct a theoretical link between individuals' proactive and deviant creative efforts and the organizational factors that may moderate their impact on innovation.

Bootlegging and Innovation

The Role of Individuals in Generating Innovation

Scientists and engineers in R&D organizations are primarily judged on their ability to harness the creative potential of new knowledge and technologies to find new products, processes, and services (Amabile 2000, West and Farr 1990). Accordingly, the focus of performance assessment in R&D is largely on the ability of the individual to contribute to the development of novel and useful ideas that will create value for the organization (Griffin and Hauser 1996). Thus, although innovation may be a team effort and most often achieved within a managed process, the performance of R&D scientists and engineers is typically assessed on the basis of their individual contributions to successful outcomes (Sarin and Mahajan 2001). This tendency to focus on individual contributions is heightened in dual-career structures common in R&D, where scientists and engineers are required to scale “technical career ladders” as opposed to managerial ones (DiTomaso et al. 2007). R&D scientists and engineers who pursue technical careers are freed from managerial tasks, enabling them to concentrate on the discovery and development of new creative ideas that contribute to the organization's innovative efforts.

Although the innovation literature identifies a broad range of individual and organizational factors that may influence individual innovative performance in R&D contexts (e.g., Scott and Bruce 1994), there is significant tension between autonomy and accountability in the management of R&D workers (Kanter 2000). Innovation studies traditionally suggest that creativity and innovation are fostered by allowing individuals substantial autonomy (Amabile 1996, Bailyn 1985, Pelz and Andrews 1966). It is understood that a degree of “playfulness” stimulates individuals to come up with nonobvious, nontrivial, or groundbreaking ideas and to incorporate elements of unplanned variation within the frame of set project objectives (Miner 1994). To extend Kanter's (2000, p. 168) metaphor of letting a thousand

flowers bloom, organizations need to allow individuals the autonomy to experiment with the “organic,” the “natural,” and even the “wild” side of innovation. Research at the organizational level suggests that formal rules and procedures may constrain the flexibility and creativity required for the exploration of new and valuable opportunities and limit the scope for experimentation (Benner and Tushman 2002, Burns and Stalker 1961, Jansen et al. 2006).

Yet the desire to ensure autonomy in the search for new ideas and the development of innovations must be balanced by a level of accountability (Kanter 2000). The freedom to let a thousand flowers bloom can result in a garden full of weeds if this freedom spirals out of control and individuals' innovation efforts are no longer geared toward the needs and goals of the organization (Kanter 2000, Sharma 1999). To shape and structure the R&D process, most organizations use a range of formal processes such as stage-gates to ensure that the creative efforts of R&D staff remain aligned and that R&D budgets are put to productive and efficient use (Cooper 1990, Schilling 2010). These tools provide a formal structure to partially reduce the inherent uncertainty of the R&D process through the enclosing of creative efforts in project management structures. These kinds of approaches are critical also for enabling project selection, allowing the ideas of different individuals to be judged against one another (Knudsen and Levinthal 2007). Selection criteria help to ensure that the R&D budget is distributed across a balanced portfolio that includes short- and long-term objectives, has senior management support, and is aligned with the organization's overall strategy and capabilities. Although these methods are most often applied to the management of downstream innovation projects, it is increasingly common to apply them to the front end of the innovation process (Cooper and Edgett 2009).

Forms of Autonomy in R&D

Organizations have different ways of dealing with the costs and benefits of allowing their R&D staff autonomy. Bailyn (1985) suggests that in R&D contexts, two types of autonomy are particularly relevant: operational and strategic. Because the typical R&D organization is characterized by the employment of highly skilled individuals who work on complex and difficult projects, it is common for R&D staff to be allowed high levels of operational autonomy in their work (Amabile and Grysiewicz 1987). That is, within a given resource envelope, the means by which set goals are achieved are left largely to the individual (Bailyn 1985). Some organizations formally grant staff a degree of strategic autonomy that gives researchers the opportunity to define their own research agendas and goals and set the overall direction of their R&D undertakings (Amabile and Grysiewicz 1987, Bailyn 1985). Organizations

may allow—even encourage—a degree of playfulness (Miner 1994). For example, Google allows its staff to spend 20% of their time on personal projects and claims that 50% of its innovations originated in such efforts (Iyer and Davenport 2008).

However, few organizations are willing or able to put in place similar arrangements; most severely restrict the strategic (although not operational) autonomy of their R&D staff by allocating their time to working exclusively on formal projects with well-defined goals and objectives. This approach may not always be well suited to capturing the features specific to the R&D process, in which path-breaking ideas can take shape only through additional investment and cognitive efforts with less strictly defined boundaries (Nelson and Winter 1977). Also, although some novel ideas become incorporated within formal projects, there is a high risk that they will be prematurely rejected in the stage-gate process (O'Connor and DeMartino 2006) since there is insufficient time for them to mature and show convincing market potential. The selection process in organizations is likely to reject projects that do not conform to the firm's established ways of working, a problem that is especially acute in large, mature companies (Knudsen and Levinthal 2007).

Bootlegging in R&D

As a result, individual R&D workers may resort to informal methods in order to obtain greater strategic autonomy. They may decide to work underground to devote considerable time to bootleg projects and to nurture ideas before revealing them to the formal management system (Abetti 1997, Augsdörfer 1996, Knight 1967). They may also decide to continue working on a project that has been formally rejected by the organization (Mainemelis 2010). Thus, we propose that bootlegging is a vehicle that enables individuals to obtain greater strategic autonomy in their R&D efforts. In line with Augsdörfer's (2005, p. 2) definition, we describe bootlegging as an R&D activity in which motivated individuals secretly engage in bottom-up, nonprogrammed innovation efforts not officially authorized by management but which are for the benefit of the company. This definition incorporates three key elements.

First, bootlegging is a **secret activity** in the sense that individuals' work plans do not provide any formal authorization for these activities. Bootleggers deviate from their formal work requirements to build into their work an element of creativity that they cannot place in their day-to-day project work (Masoudnia and Szwedzewski 2012). Although colleagues and sometimes line managers may be aware of the bootlegging activities, such activities typically take place out of sight of senior management (Augsdörfer 2005). Thus, although intended for the benefit of the organization, bootlegging qualifies as a risky behavior. In extreme cases, bootlegging

can be seen as a form of creative deviance where individuals continue to work on projects that have been formally stopped by management (Mainemelis 2010). The absence of formal organizational approval distinguishes bootlegging from free-time models of innovation support, such as 3M's 15% rule (Gundling and Porras 2000). Bootlegging also differs from skunkworks and other structured initiatives that focus on radical innovation within separate dedicated units, where individuals can work outside the normal rules of the organization (Tushman and O'Reilly 1996).

Second, bootlegging is a **bottom-up, nonprogrammed activity**. In this context, bootlegging can be seen as a behavior involving individuals taking personal initiative, associated with an active and self-starting approach to work (Frese et al. 1996). Those individuals who exhibit proactive behaviors make persistent efforts, often in the face of considerable barriers, and go beyond formal requirements. These efforts may include engaging in proactive creativity, actively searching for problems to solve, and generating unsolicited new solutions (Unsworth 2001), described by Levinthal and March (1981, p. 309) as "the pet projects of playful engineers." In this context, bootlegging is not simply a one-off activity; rather, it is an approach to R&D work in which individuals operate partly outside the formal system to develop new ideas through informal preproject work or underground continuation of rejected projects (Augsdörfer 2005). The bottom-up and nonprogrammed nature of bootlegging makes it different from organizational initiatives such as brainstorming or other forms of institutionalized experimentation (Miner 1994).

Third, although bootlegging activity is illegitimate, the **innovations arising from underground efforts are legitimate**. Individuals tend to be rewarded for innovative outcomes regardless of whether or not they have been achieved through legitimate means (Mainemelis 2010). Bootlegging appears to be focused on achieving organizational rather than individual goals, and it thus can be classified as a form of constructive deviance (Warren 2003). Bootlegging should not be regarded as a form of "hobby" innovation (Dahlin et al. 2004) or considered unethical, pro-organizational behavior (Umphress and Bingham 2011). Despite being a type of deviant behavior that may violate organizational norms—particularly if these underground efforts are unsuccessful—bootlegging does not involve actions that violate societal norms, values, or rules of proper conduct.

Although the literature on bootlegging and associated concepts of proactive creativity and creative deviance has grown in recent years, very few, if any, studies investigate what impact these behaviors have on individual performance in terms of generating innovations or how the value of these efforts is contingent on the individual's work environment. To fill this gap, we explore two

main questions: (1) *Does bootlegging make individuals more innovative?* And (2) *what organizational contexts enable individuals to profit (or lose) from bootlegging?*

Bootlegging and Individual Innovation Performance

The primary purpose of R&D is to generate practical ideas that can be commercialized or implemented as new products and processes; thus individuals in R&D organizations are assessed on the basis of their efforts that contribute to this goal. Researchers differ in how they approach the R&D process and in the extent to which they seek structural autonomy through bootlegging. Their choices can have important implications for their ability to develop new products, processes, and services. More specifically, we suggest that bootlegging has two advantages for individual-level innovativeness.

First, **bootlegging allows individuals to follow unconventional paths to explore novel ideas**, which reduces the barriers to developing innovations in mature organizations. Smith (2003) shows that creative outcomes within mature organizations are often the result of unconventional development pathways. In their study of corporate entrepreneurship, Burgelman and Sayles (1986) note that novel ideas often emerge in organizations from the bottom up as a result of individual proactivity rather than as a product of structured decision making or management strategy. Indeed, research has shown that formal process management systems can constrain the flexibility and creativity required for the exploration of new opportunities (Benner and Tushman 2002). By operating free of the “straitjacket” of formal management systems, individuals achieve the flexibility to explore directions that fall outside the remit of formal projects or are not constrained by the need to meet short-term strategic objectives (Burgelman 1983). Because bootleg efforts tend to be unstructured and result from personal initiative, they are likely to involve wider search efforts in unconventional directions because they do not require that the individual’s search efforts be directly linked to the requirements or needs of the organization from the outset (O’Connor and McDermott 2004). Such efforts allow individuals more freedom to explore uncharted territory, providing an explorative advantage over their more constrained colleagues (March 1991). Bootlegging gives individuals a channel through which to elaborate new ideas informally alongside more formalized attempts (Mainemelis 2010) that are perhaps outside the company’s strategy or the individuals’ permitted fields of work (Masoudnia and Szwedzewski 2012). In addition, bootlegging may affect individual innovative performance indirectly. Exploration advantages associated with bootlegging may spill over to individuals’ formal work and enable them to introduce greater novelty and creative thinking into their formal projects, thus boosting the ability to drive innovation within the formal system.

Second, by engaging in bootlegging, **individuals can delay the assessment of novel ideas and postpone judgment by the wider organization on their usefulness and novelty** (Garud et al. 2011, Mainemelis 2010). Individuals who engage in bootlegging can explore their ideas without having to document, justify, and codify their elements before they are reasonably well developed, and thus they **avoid the trap of premature exposure** of an idea before it is “ripe” for organizational exploitation (Koch and Leitner 2008). This delay allows the accumulation of richer, more compelling evidence about the merits of the idea. For an idea to pass the selection processes in large, mature organizations, which tend to be conservative, solid evidence is required of its potential (Dougherty 1992, Knudsen and Levinthal 2007). Insufficient evidence of the potential for future rewards means ideas that are discordant with existing knowledge are likely to be rejected (Cheng and Van de Ven 1996, March 1991). However, a level of risk and imprecision is frequently a prerequisite of true novelty. As March (2006, p. 210) suggests, “Most attempts to distinguish creative instances of craziness from useless or dangerous ones at an early stage impose criteria of conventionality on craziness and thereby impose self-defeating filters that reduce novelty.” Even after ideas have been rejected by the organization, bootleggers may keep these ideas alive (Mainemelis 2010) to collect more evidence and to strategically pick the time and place to (re)expose them to senior management (Garud et al. 2011). By presenting an idea only when its value can be demonstrated and at a time when the organizational environment is likely to be more receptive, bootleggers increase the chances of their efforts being incorporated into the firm’s range of products or processes. Based on these two advantages, we posit the following.

HYPOTHESIS 1 (H1). *Individuals’ bootlegging is positively related to their innovative performance.*

The Contingent Role of Normative Enforcement in the Work Environment

It is unlikely, however, that bootlegging will be uniformly beneficial to individuals. Building on the concept of normative enforcement (Feldman 1984, Mainemelis 2010, Merton 1968), we posit that individuals will be better able to take advantage of unconstrained exploration and delayed assessment of unconventional ideas if they operate in work environments where the norms of behavior are not too rigidly enforced. Bootlegging is an illicit activity that is typically hidden from senior managers and that deviates from the normative behavior of allocating one’s time exclusively to formal project engagements. Yet work environments may differ in the extent to which this norm is enforced by local managers or colleagues. At one extreme, work environments may prioritize conformity to norms and rules so that

the ways in which goals are achieved becomes more important than the goals themselves (Mainemelis 2010). In such environments, bootleggers may receive little support for their activities or may encounter hostility. At the other extreme, work environments that emphasize the pursuit of creative goals while compromising on the enforcement of normative behavior may provide bootleggers with financial resources, advice, and support to bring their ideas to fruition. Thus, we propose that units with higher levels of innovation performance and higher average levels of bootlegging will have relatively lower levels of normative enforcement and will help individuals to innovate through bootlegging. By contrast, increased formalization and expectations of adherence to organizational norms will make it more difficult for those who increase their bootlegging activity to realize its advantages. We explore each of these contingencies in more detail below.

Unit Performance and Bootlegging. Within large R&D organizations, there is considerable variation in the productivity of different R&D units; some have better track records of generating innovations than others. Feldman (1984) argues that groups or units that achieve their goals can afford to be more tolerant of deviant behavior than groups that fail to meet their goals; the latter are more likely to reject deviation from the norm. Based on this line of reasoning, we suggest that unit-level performance significantly shapes the benefits and costs of bootlegging for individuals.

First, because high-performing units are less likely to attribute importance to strict adherence to organizational norms, they are more likely to lend informal support to an individual's bootlegging activities. Although bootleg projects are underground activities, local managers may make small amounts of resources available on a discretionary basis (Augsdörfer 2005) to help individuals realize the exploration advantages of bootlegging. Such resources are typically more readily available in innovative units, which may have accumulated slack resources from past success (Cyert and March 1963, Levinthal and March 1981, Voss et al. 2008). In poorly performing units, pressure to achieve formal targets may drive local managers to ensure conformance to organizational norms. In these environments there will be little willingness to spare resources to indulge bootlegging efforts (Mainemelis 2010). High-performing units thus provide better opportunities for individuals to develop their ideas and enhance the quality of their bootleg projects, alongside work on their formal projects. Individuals in successful units are likely to produce more mature ideas with greater potential for success. These ideas are more likely to be incorporated in the organization's formal products and processes.

Second, successful units are also less likely to be hostile to ideas that deviate from established behaviors.

This, in turn, increases the chances that ideas originating from bootlegging will survive their eventual assessment by the organization. These high-performance units will be less bound by norms of accountability for R&D efforts, more likely to tolerate a degree of "irresponsible search" and may relax organizational controls (Levinthal and March 1981, p. 309). Moreover, senior managers are likely to be hostile to illegitimate innovation efforts from units with a poor reputation for novelty, whereas members of high-performance units may be allowed to deviate from the organizational norms for R&D accountability. Thus, once revealed to the organization's project management system, bootleg projects emanating from innovative units are more likely to convince senior managers than are initiatives from less innovative units. For these reasons, we posit the following.

HYPOTHESIS 2 (H2). *Unit-level innovative performance moderates the relationship between individuals' bootlegging and their innovative performance, such that the positive effect of bootlegging on individual innovative performance is stronger (weaker) in units with higher (lower) levels of innovative performance.*

Average Unit Bootlegging and Individual Bootlegging. The work environment's emphasis on conformity to norms does not depend exclusively on the views of local managers and senior decision makers. A group's level of normative enforcement is determined in large part by the attitudes of coworkers (Feldman 1984). R&D units in large organizations can differ substantially in the extent to which members of the unit work beneath the surface of the formal organizational structure, deviating from organizational norms over the allocation of time exclusively to formal projects. We suggest that there are two reasons why individuals that work in units with high levels of underground activity may be better able to exploit their bootlegging activities to generate innovative outcomes.

First, the presence of fellow bootleggers signals that the work environment is characterized by low normative enforcement. Thus, individuals surrounded by bootlegging colleagues are more likely to obtain positive reinforcement from their local peers for their attempts to explore novel and unusual directions. Bootlegging typically does not occur entirely in isolation but benefits from the support of colleagues in the form of discussion and interaction around bootlegging ideas (Augsdörfer 2005). For example, individuals may be able to obtain material and logistical support from fellow bootleggers to enrich the evidence supporting their ideas. Individuals may also be influenced by the behavior of their immediate group (Bercovitz and Feldman 2008) and learn from the way its members go about developing innovations underground. Therefore, a work environment with high levels of bootlegging may stimulate individuals to profit from their own bootlegging efforts. By contrast, in units

with low levels of bootlegging, fellow R&D scientists and engineers may be unsupportive of individuals who break from organizational norms of accountability, making it more difficult for them to bring to fruition the ideas that emerge from their bootlegging efforts.

Second, in units with high levels of bootlegging, bootleggers are more likely to benefit from the experience of others in reintroducing bootleg ideas into the formal project management systems that will allow such an idea to be incorporated in innovative outcomes. Units with high levels of bootlegging may have local routines and practices in place to enable bootleggers to navigate the path to bring ideas to the attention of the wider organization, including senior managers (Garud et al. 2011). Widespread bootlegging activity in a unit—and perhaps successful precedents—may accustom unit members to deviation from organizational norms. In units with low levels of bootlegging, there is little experience in how to overcome the barriers to acceptance of ideas that have “come in from the cold.” In this context, individuals’ bootlegging efforts are less likely to result in innovations. Thus, we hypothesize the following.

HYPOTHESIS 3 (H3). *Unit-level bootlegging moderates the relationship between individuals’ bootlegging and their innovative performance, such that the positive effect of bootlegging on individual innovative performance is stronger (weaker) in units with higher (lower) levels of bootlegging.*

Increasing Bootlegging in Periods of Formalization. Despite the merits of unstructured initiatives such as bootlegging for the generation of innovations, many organizations impose formal structures and accountability routines on the fuzzy front end of the innovation process (Cooper and Edgett 2009, Reid and De Brentani 2004). Formal R&D management approaches have been introduced at the front end of innovation in an attempt to strengthen the organization’s control over—and monitoring of—the direction of individual search efforts in a bid to render the process of idea generation and early-stage innovation more efficient and cost-effective. In this context, formalization is a move toward increased emphasis on normative enforcement and a signal of the prominence of the rules and procedures through which creative goals are achieved relative to the achievement of these goals.

These attempts to formalize the early stages of the innovation process can represent major changes in the way scientists and engineers work (Bercovitz and Feldman 2008), most notably by reducing their strategic autonomy in the pursuit of their daily work. The literature on organizational change shows that individuals respond in different ways to organizational change (Greenwood and Hinings 1996). Ultimately, the successful implementation of a change initiative depends on the individual changing his or her behavior in the intended

direction (e.g., Whelan-Berry et al. 2003). In the context of formalization of the front end of innovation, some may engage in less bootlegging activity, signaling their conformity to the organization’s desire for more control over the front-end innovation process. However, some may resist the changes imposed by the organization and respond by increasing their bootlegging efforts. In contexts where organizational change threatens freedoms that are important to an individual’s work (e.g., reducing strategic autonomy), the response may be resistance (Ford et al. 2008). In an attempt to retain strategic autonomy, and potentially out of frustration with the organizational change being implemented, some may respond to the organization’s attempts at control by increasing their levels of deviance (Lawrence and Robinson 2007).

We argue that, despite the advantages of bootlegging remaining intact, increasing the level of this activity during a period of organizational change toward greater formalization may harm individuals’ innovation performance. Greene (1978, p. 487) discusses how formalization processes and the introduction of organizational guidelines may become a “source of alienation, particularly for professionals.” In these circumstances, bootleggers who increase their efforts run the risk that those efforts will become increasingly misaligned with corporate R&D objectives. This misalignment can be detrimental to the bootlegger’s ability to be innovative for two reasons.

First, the decoupling between individual efforts and the organization may harm the individual’s ability to develop innovations that can be successfully exploited by the organization. Increased bootlegging during a period of formalization can result in exploration activities being too far removed from the firm’s portfolio of projects and strategic initiatives, and they may separate them from the ideas and work of colleagues. Increased bootlegging during the formalization of R&D is thus seen as greater deviation from organizational norms; as a result, bootleggers may find fewer willing accomplices when they reach out for support or guidance from others in the organization. This compromises the ability of the individual to convert the bootleg idea into a successful innovation. Similarly, the scope for spillovers from increased bootlegging efforts to formal projects is reduced; formal projects with well-defined goals from the front end to downstream will have little scope to incorporate elements of novelty that deviate excessively from corporate goals.

Second, the benefits of delayed assessment may be compromised by increased bootlegging during formalization. At such times, bootleggers may be able to continue to delay assessment by taking projects underground. However, the increased misalignment of their creative work as a result of the imposed organizational changes increases the likelihood of rejection when the

project is eventually revealed. In times of greater formalization, those who increase their bootlegging are unlikely to find a receptive and tolerant environment for their underground efforts.

Thus, we expect that increased bootlegging during a period of formalization will be negatively associated with individual innovation performance. This does not contradict our earlier argument. Hypothesis 1 posited that the level of individual bootlegging is positively associated with individual innovation performance; **here, we focus on changes in levels of bootlegging efforts during periods of formalization.** Thus, we hypothesize the following.

HYPOTHESIS 4 (H4). *During a period of increased formalization, increases in individual bootlegging will be negatively related to their innovation performance.*

Research Context, Data, and Study Design

The present study was undertaken in Neptune, a pseudonym for a large, technology-intensive multinational company. Neptune operates in multiple highly competitive product markets and has built a strong reputation for developing innovative products and processes. The firm invests heavily in R&D at multiple sites on several continents and is a keen user of process management systems for R&D. Despite the company's reputation as a leading innovator, senior management expressed some concern that Neptune struggles to develop innovations; a considerable share of Neptune's R&D efforts is focused on sustaining and improving the existing portfolio of products and technologies rather than on developing new ones.

In its R&D organization, Neptune employs a dual-career ladder system that distinguishes between technical and managerial careers. All those on the technical career ladder are senior scientists and engineers who have contributed significantly to innovating Neptune's product portfolio. They are expected to be subject specialists, and most have doctoral degrees. They perform a number of different job roles, including product development, process engineering, and design. They have no formal project management responsibilities, which frees them from administrative duties.

We collected data on the community of technical R&D staff, following a two-step approach. In the first step, we interviewed 25 senior members of the technical career ladder and 10 R&D managers. Interviews lasted approximately 60 minutes and were aimed at a better understanding of the work contexts of these individuals. Interviews were semistructured; interviewees were asked to describe their professional histories, the nature of their innovative efforts, their approach to conducting R&D, and the tactics used to search for new ideas.

The second step involved a survey of all 600 senior scientists and engineers on the technical career ladder.

The survey was administered electronically in 2010.¹ After three reminders, we received 408 responses, a response rate of 67%. The respondent population was representative of the overall population in terms of grade, tenure, and location. We compared early and late survey respondents to determine whether there were significant differences in the responses to our main questions; we found no statistical differences (Armstrong and Overton 1977). After removing responses with incomplete or missing variables, we were left with a final sample of 238 individuals.

As measuring bootlegging was a core part of the survey, we developed a new measure. Although there are existing scales that capture individual-level exploration (e.g., Mom et al. 2009) and intrapreneurship (e.g., Antoncic and Hisrich 2001), these were not suited to our research question on individuals' underground and possibly deviant forms of exploration or to our setting in which all R&D staff routinely engage in high levels of exploration and intrapreneurship. Although our interviews were designed to elicit rich descriptions of individuals' bootlegging efforts, interviewees were reluctant to report on their bootlegging efforts in a company-supported survey for fear of exposure to and sanction by senior managers. We decided to make the survey anonymous, similar to the approach taken in other studies dealing with sensitive or deviant behaviors in organizations (Hannah 2005).

Partway through our study, the organization introduced a new system to formalize the front end of the innovation process (see Cooper and Edgett 2009 for a description of similar initiatives). The system created a structured process for judging the merits of early-stage R&D efforts. Both before and after the formalization, individuals in Neptune were required to register their early-stage ideas as projects in the formal system; the formalization imposed a greater level of organizational accountability through the introduction of stricter selection and evaluation procedures. We exploited this organizational change to conduct a retrospective before–after study to examine how an increase in bootlegging *after* the implementation of the organizational change shaped innovative performance outcomes, controlling for the individual's innovative performance *before* the formalization.

Bootlegging in Neptune

Unlike R&D staff employed in Google and 3M, scientists and engineers in Neptune are not allowed dedicated or slack time to work on “pet projects.” In fact, Neptune's researchers are required to declare how they spent their time on the various projects within their formal work plans; this accounting is audited by their managers. Some scientists and engineers try to “work the system” and

pursue underground activities to explore new opportunities. A senior product developer noted that

we should spend everything in declared space that should be on our work plan. But, like with all creative and opportunistic work that I'm involved in, sometimes things pop up that seem like too good an opportunity to have a little bit of a dig. And then it could be that one of those then actually turns into one of your big rocks, which is what has just happened to me, with one of my projects.

In Neptune, there are numerous reasons for bootlegging. It is undertaken to enable preresearch—for example, collecting empirical evidence to demonstrate the validity and potential of an idea before exposing it to management (see also Augsdörfer 2005). Gathering data, developing a prototype, or carrying out a pilot study often requires the support of colleagues with a similar passion for the idea:

It was probably a group of [Neptune] people who, kind of, first started it, like, just kind of on the side, like we [the interviewee and a colleague] thought this was a great idea, then we did some prototyping, and then we shared it with management, who created it into a project.

Another, more extreme form of bootlegging involves continuing to pursue an idea that has been rejected by management, which makes the activity closer to the concept of creative deviance (Mainemelis 2010). The following comments from a senior engineer illustrate this behavior when a novel idea was rejected by management:

If the senior manager says that's no good, he's more powerful than me. If I then go and get some data, then it changes the whole power balance.

So when we [the interviewee and a fellow technologist started working on [the product], we started doing the work and we went to our management and said, "Oh, isn't this fantastic." And they said, "Don't be stupid, people tried that years ago, it's never going to work, consumers are going to hate it." So we made [the product] by hand and we found some people in the local vicinity; we gave them some and asked them to try it. And they came back and then we had another quick meeting with the management and they said, "Don't be so stupid, the consumers won't like it." And we said, here's some data that says that ten consumers have tried it and nine of them think it's absolutely fantastic; they think they'd buy it.

In both cases, the main driver of these activities was enthusiasm for discovery, as illustrated by the following quote from a technologist:

It's like exploration that I was not asked to look at, but you know, I'm playing with those projects and if they look promising after a while, then I'll try and establish those projects officially as part of my work plan and get management's support and funding and resources. And if not, I'll play with something else. There are things that you typically manage to fit in your workload because you have passion for them.

Researchers often go underground when they want to explore new opportunities, when they feel their ideas would be rejected were they to become official projects at an early stage. A senior product developer noted,

[Underground activities] tend to be on the ideas that are a little bit further out and aren't as obvious, you know, to what the potential could be.

It's absolutely the wrong thing to ask management whether you should work on something new, because they all say no, all right, because they're risk-averse. I'm working on some new [product], okay, I am unlikely to talk to the management about it until I've convinced myself that it's worth it. Otherwise, all you get is pain.

The formalization of the front end of the innovation process promoted a widespread perception among our interviewees that there would be significantly less tolerance for individuals who engage in unofficial projects and efforts, as the following quotes from two technologists and an R&D manager, respectively, illustrate:

The front end of innovation used to be a lot more, kind of, woolly, and... people were just working on what they fancied, and that isn't the most effective way to run. But I also think that one of the watch-outs with this is that there is no real space for seedlings, or the kind of unexpected, because everything's quite orchestrated, now.

This system is so prescriptive that it doesn't give you the opportunity to really freestyle around it, and I think, in innovation, you need to have, you know, you need to have the opportunity to bring new stuff in.

What's happened now is that even in the front end of innovation, you now have a list of projects, right? It's now been totally formalized, which then removes most of your ability to go and do what you want to do.

Measures

Dependent Variable. Innovative performance. Neptune conducts an annual evaluation involving a committee of line managers from the different business divisions who assess the performance of individual technologists relative to peers. The line managers base their appraisals on specific contributions to new products, processes, features, business development, technologies, or designs that create value for the organization. Rather than focusing on the technologist's scientific and technical outputs such as patents, assessment is based primarily on the realized impact of the individual's efforts, the organization's sales performance, and operating costs. The contributions of each individual are tracked over the year for this evaluation process and recorded on their formal work plans. The appraisal system classifies individuals into two bands with a forced distribution across the three seniority levels. We drew on this system using the innovation rating as our measure of individual innovative performance.

The rating process is highly competitive, and being awarded the highest rating is a significant accomplishment

that determines salary and promotion. In our sample, 24% of individuals received the highest rating. We asked individuals to declare their innovation rating for each of the last three years to allow us to control for past performance and conduct additional analyses of the direction of causality between bootlegging and individual innovative performance.

Supervisors' ratings have been shown to be relatively unbiased, for example, in terms of gender or race (Arvey and Murphy 1998), and hence they are considered a valid indicator of individual task performance (e.g., Mehra et al. 2001). In addition, objective measures of innovative performance (e.g., invention disclosures, patent disclosures, research reports) can show high levels of correlation with supervisors' ratings (Scott and Bruce 1994, Tierney et al. 2006).

Although in our survey the innovation rating was self-reported, it is not a self-assessed measure since the evaluation was made by others. In addition, in our research context, the diverse roles and outputs of R&D scientists make it difficult to use simple counts of specific innovation outcomes, such as the number of new products, as a measure of individual performance. The advantage of the rating is that it accounts for the objectives specific to the individual's work role and the nature of the R&D efforts in his or her job function and unit. Neptune senior managers and technologists considered the innovation rating to be the central innovative performance measure in R&D. In our interactions with Neptune, this point was emphasized repeatedly, giving the measure a high level of content and face validity.

Independent Variables. Bootlegging activity. Capturing individual bootlegging efforts poses significant challenges for researchers because of their nonprogrammed and often secretive nature. Previous work on bootlegging uses research designs that study only bootleg projects (e.g., Augsdörfer 2005). Although helpful for providing detailed insights into bootlegging, this approach can introduce significant sample selection bias. In contrast, our approach focuses on identifying bootlegging among a diverse population of R&D scientists, whose levels of bootlegging differ. Also, given its secretive nature, a social desirability bias might affect measures of bootlegging; individuals may be more likely to report lower levels of bootlegging given the deviant nature of this activity. We tried to overcome this problem by assuring respondents of absolute anonymity. Moreover, since the survey focused on a number of issues related to individuals' innovative efforts, and because our interest in bootlegging was not made explicit in the invitation letter, we thought that respondents would be less likely to hide (or exaggerate) their bootlegging activity.

To measure the extent to which individuals engage in bootlegging, we developed a new measurement scale building on our interview material and prior studies

(Augsdörfer 1996, 2005). To guide the shaping of our scale items, we exploited terms used by interviewees, such as "unofficial" or pet projects, to describe their bootlegging at Neptune. Moreover, we were also concerned that more strongly worded items might deter disclosure since senior management was supporting our research project. We constructed a five-item measure in which all items were measured on a seven-point scale ranging from 1 for strongly disagree to 7 for strongly agree. Exploratory factor analysis of the five items using the principal factor method resulted in a one-factor solution (with an eigenvalue above 1), signaling the unidimensionality of our scale and explaining 98% of the variance. Four of the five items had factor loadings above 0.4 (see Table 1); we excluded the item with a factor loading below 0.4. The resulting bootlegging scale shows strong internal reliability with a Cronbach's α of 0.80.

As an additional measure, we consider the proportion of *time* individuals allocated to bootlegging. The related question came immediately after the question about bootlegging described above so as to guide respondents on the types of activities associated with bootlegging. We asked individuals how much of a typical work week during the previous 12 months had been devoted to unofficial side projects, outside of formal work plans. We asked respondents to provide the same information for the three years prior to the survey. Time devoted to bootlegging in 2010 and 2007 was used to derive the measure *growth in bootlegging time*, calculated as the difference in the log of the percentage of time allocated to bootlegging in 2010 minus the log transformation of the percentage in 2007. There is the possibility of recall bias in the calculation for 2007 based on inaccurate recollection of the time dedicated to this activity three years earlier. Although we cannot assess the extent of this problem, we found it reassuring that the average time allocated to bootlegging had decreased after formalization of the front end of the innovation process.

Table 1 Principal Factor Analysis of the Bootlegging Scale
($\alpha = 0.85$)

Scale items	Factor loading
I have the flexibility to work my way around my official work plan, digging into new potentially valuable business opportunities.	0.608
My work plan does not allow me the time to work on anything other than the projects I have been assigned to.	0.592
I enjoy tinkering around with ideas that are outside the main projects I work on. ^a	0.349
I am running several pet projects that allow me to learn about new areas.	0.762
I proactively take time to work on unofficial projects to seed future official projects.	0.784

^aThis item had a factor loading below 0.4 and was removed when factor scores were computed.

Unit innovative performance. To measure unit innovative performance, we calculated the share of technologists with the highest innovation rating in 2009, exploiting Neptune's archival data on the distribution of ratings across the entire population of technologists, across all of its R&D sites. Neptune has over 20 units, each having between 5 and 80 R&D staff members.

Unit bootlegging time. To measure unit bootlegging, we derived the average bootlegging time of researchers in 2007 for each R&D unit using all the survey responses ($N = 405$). In calculating this measure, we dropped those individuals in R&D units where fewer than three employees had responded to our survey. We excluded the focal individual when calculating unit average bootlegging.

Control Variables. Building on the literature on the determinants of individual-level innovativeness, we control for a number of individual and contextual factors. First, we control for individuals' *grade* level, since more senior members of staff might have more autonomy in their work (Amabile 1996, Bailyn 1985). Second, to control for individual perception of the work environment as supportive of creative and innovative efforts, we use a reduced version of the 22-item scale proposed by Scott and Bruce (1994). We focused on the eight items that loaded into the factor "support for innovation," labeling it *climate for innovation* (Cronbach's $\alpha = 0.86$). Third, to account for the effect of having a manager supportive of creativity (Oldham and Cummings 1996), we included a measure of *managerial support*, consisting of a seven-item scale adapted from the scale developed by Greenhaus et al. (1990), which measured the perceived level of supervisory support for career advancement. We modified this to capture the perceived level of support received by senior scientists and engineers from their peers on the management career ladder (Cronbach's $\alpha = 0.94$). Fourth, since research shows that both *intrinsic motivation* and *extrinsic motivation* play a role in shaping individual creativity (Amabile 1996), we derived measures of these motivations using an eight-item scale adapted from Rynes et al. (2004). Respondents were asked to indicate on a scale from 1 (not at all important) to 5 (crucial) the importance of different features of their job, such as intellectual challenge, degree of independence, salary, and job security. The data were subjected to principal factor analysis, which resulted in a two-factor solution corresponding to intrinsic and extrinsic motivation with equal internal reliability (Cronbach's $\alpha = 0.69$).

To account for the possibility that the contributions of technologists working on longer-term projects might be more difficult to assess, we included a dummy variable (*long-term focus*) equal to 1 if the outcome of the individual's research activities would take more than two years to reach the market. Furthermore, since the potential to develop an innovation might be shaped by the type of products targeted by the individual, we included

a dummy variable equal to 1 if the respondent's R&D efforts were focused on improving an *established product line*. Finally, we included control variables for *gender*, *tenure*, and whether the individual was working at the company *headquarters*, as well as dummy variables for *division* and *job function*.

Although we use several individual-level variables to account for significant differences in the individual ability to generate innovations, we may have failed to capture a particular individual characteristic that affects both the likelihood of achieving a high innovation rating and the extent of bootlegging activity. Because a past innovation rating might be a proxy for other individual features for which we are unable to control, we include this measure in our analysis. More specifically, we include the *past innovation rating* (the two years prior to our survey).²

Assessment of Common-Method Variance

Given that all the subjective measures used in this study are constructed based on responses to the same survey and are self-reported, it is possible that our estimates might be affected by common-method and single-respondent biases (Podsakoff et al. 2003). In trying to mitigate this problem, we first used different response formats to prevent response fatigue and the tendency to agree or disagree with attitude statements regardless of content. Then, we posed "neutral" questions at the beginning and more sensitive questions (e.g., about managerial support) at the end of the survey to avoid context-induced mood, which might lead respondents to carry over positive or negative evaluations to subsequent questions. Finally, we used an inductive approach with items generated on the basis of the interviews and worded items according to company jargon to reduce complexity and/or ambiguity of scale items. This was especially important in the context of the bootlegging scale to ensure that respondents understood the content of the questions. To test empirically whether common-method variance remained an issue, we carried out a Harman's single-factor test by performing an unrotated factor analysis including all 55 items across the 11 constructs in our survey. We obtained 12 factors with eigenvalues greater than 1, where the first factor explained only 18.4% of the variance. This suggests that common-method variance may not be a problem in this study. We also adopted Lindell and Whitney's (2001) marker variable technique by including in the survey a variable that is theoretically unrelated to the variables of interest in our study.³ Because the marker variable should not be correlated with other variables, the presence of common-method bias can be assessed by calculating the correlations between the marker variables and the variables of interest. We checked partial correlations between all our variables, controlling for our marker variable, and found that all significant bivariate correlations among our variables of interest remained

unchanged. Thus we can conclude that common-method bias is unlikely to have shaped our findings.

Results

Because innovation rating is a dichotomous variable, we tested our hypotheses by estimating logit models. Individuals with low innovation ratings (“0-rated”) are underrepresented in our sample with respect to the distribution of ratings across Neptune; thus we estimated our models using weights equal to the number of 1-rated (0-rated) respondents in our sample over the percentage of 1-rated (0-rated) respondents in the population to attribute additional weight to the 0-rated group. All equations were estimated clustering the errors by respondent’s grade.⁴ Innovation rating has a forced distribution across the three seniority levels, which could introduce correlation in the error terms, for individuals on the same grade. To test our main hypothesis, we focused on bootlegging activities and time. In the moderation analysis, we rely on bootlegging time because this variable captures past rather than current bootlegging efforts and therefore better accounts for reverse causality issues.

Table 2 presents the descriptive statistics and bivariate correlations of the variables used in our econometric models. On average, the scientists and engineers in our sample have worked for Neptune for almost 20 years. The level of correlation among our key variables is generally low. The maximum variance inflation factor is less than 2.5, signaling that multicollinearity is not a problem in our data.

Table 3 shows the tests for the impact of bootlegging on innovation rating. Model 1 includes only the control variables and represents our baseline model. As expected, we find that past innovation rating and average innovative performance of the R&D unit employing the individual are strong predictors of the innovation rating. Model 2 shows that bootlegging activities have a positive and significant effect on the likelihood of obtaining the highest innovation rating: a one standard deviation increase in bootlegging from its mean value increases the individual’s chances of obtaining a top rating by 6%. This provides support for Hypothesis 1. Model 3 reports the effect of past bootlegging time on innovative performance. Again, we find strong support for Hypothesis 1 since the coefficient of bootlegging time at $t - 3$ is positive and significant. In particular, our estimates indicate that a one-standard-deviation increase in bootlegging time from its mean value (i.e., from 14% to 23%) increases the probability of obtaining a high innovation rating by 17%.⁵

As a supplementary analysis, we also explored the possibility of a curvilinear relationship between bootlegging and innovative performance by adding a squared term for *bootlegging activities* and *past bootlegging time* to Models 2 and 3, respectively. We obtained confounding

Table 2 Descriptive Statistics and Bivariate Correlations

Variable	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Innovation rating	0.24	0.43	0	1																
2 Bootlegging activity ^a	4.72	1.26	1	7	0.11															
3 Bootlegging time at $t - 3$	14.17	9.40	0	50	0.20	0.11														
4 Growth in bootlegging time	-0.19	1.09	-3.26	3.04	-0.10	0.43	-0.55													
5 Unit innovative performance	0.18	0.05	0	0.43	0.20	0.09	0.03	0.00												
6 Unit bootlegging time at $t - 3$	15.24	2.18	7.50	25	-0.08	0.13	-0.01	0.08	0.30											
7 Grade	1.23	0.45	1	3	-0.03	0.22	0.12	0.04	0.14	0.02										
8 Climate for innovation ^a	4.69	1.06	1.50	7	0.01	0.24	-0.11	0.24	-0.05	0.00	0.04									
9 Managerial support ^a	5.59	1.26	1	7	0.14	0.16	-0.05	0.07	0.06	0.08	0.02	0.36								
10 Intrinsic motivation ^a	4.17	0.53	2.33	5	0.17	0.16	0.04	0.06	0.07	-0.02	0.10	-0.05	0.02							
11 Extrinsic motivation ^a	4.12	0.52	2.50	5	-0.09	-0.12	-0.07	-0.01	-0.07	0.01	-0.13	0.03	0.06	0.01						
12 Gender	0.18	0.39	0	1	-0.06	-0.04	-0.15	0.12	-0.08	-0.03	-0.03	-0.02	-0.01	0.05	0.17					
13 Long-term focus	0.67	0.47	0	1	-0.04	0.11	-0.02	0.09	0.03	0.09	0.13	0.07	0.17	0.00	0.03	0.04				
14 Tenure	19.83	7.93	0	44	-0.03	-0.01	-0.07	0.04	0.13	0.12	0.30	0.00	-0.02	-0.01	-0.07	0.08	0.02			
15 Established product line	0.60	0.49	0	1	0.06	0.06	0.06	0.06	-0.02	-0.03	0.03	0.15	0.13	-0.03	-0.13	-0.14	0.03	-0.10		
16 Headquarters	0.66	0.47	0	1	0.01	0.00	0.04	-0.04	0.20	0.17	0.20	-0.14	-0.03	0.07	0.05	0.07	0.04	0.31	-0.06	
17 Past innovation rating	0.28	0.45	0	1	0.26	0.05	-0.03	0.06	0.12	0.02	0.00	0.03	0.01	0.05	0.00	-0.06	0.13	-0.11	0.06	-0.06

Note. Correlations greater than |0.040| are significant at 5% ($N = 238$).

^aMean, S.D., Min, and Max shown are averages across all items included. Regressions were performed with factor scores with mean 0 and S.D. 1.

Table 3 Impact of Bootlegging on Innovation Rating and the Moderating Effect of Unit-Level Innovative Performance ($N = 238$)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
<i>Bootlegging activity</i> ^a		0.237*** (0.064)					
<i>Bootlegging time at $t - 3$</i> ^a			0.681*** (0.174)	0.657*** (0.200)	0.685*** (0.168)	0.667*** (0.192)	0.639*** (0.178)
<i>Bootlegging time at $t - 3 \times$ Unit innovative performance</i>					0.322*** (0.054)	0.286*** (0.058)	
<i>Bootlegging time at $t - 3 \times$ Unit bootlegging time at $t - 3$</i>				0.459*** (0.170)		0.412*** (0.182)	
<i>Growth in bootlegging time</i> ^a							-0.082*** (0.015)
<i>Unit innovative performance</i> ^a	0.803*** (0.042)	0.777*** (0.058)	0.812*** (0.026)	0.796*** (0.021)	0.805*** (0.028)	0.773*** (0.022)	0.812*** (0.022)
<i>Unit bootlegging time at $t - 3$</i>	-0.511*** (0.158)	-0.560*** (0.179)	-0.548*** (0.103)	-0.619*** (0.068)	-0.675*** (0.194)	-0.757*** (0.160)	-0.536*** (0.101)
<i>Grade</i>	-0.868*** (0.178)	-0.938*** (0.187)	-1.173*** (0.329)	-1.159*** (0.332)	-1.232*** (0.343)	-1.242*** (0.356)	-1.160*** (0.318)
<i>Climate for innovation</i>	-0.031* (0.016)	-0.086*** (0.003)	0.044*** (0.013)	0.038*** (0.011)	0.064 (0.050)	0.050* (0.028)	0.069*** (0.008)
<i>Managerial support</i>	0.504*** (0.167)	0.488*** (0.179)	0.614** (0.247)	0.590** (0.265)	0.618*** (0.226)	0.610** (0.242)	0.607** (0.240)
<i>Intrinsic motivation</i>	0.454* (0.232)	0.413* (0.233)	0.472* (0.249)	0.487** (0.238)	0.469* (0.254)	0.486** (0.247)	0.485** (0.246)
<i>Extrinsic motivation</i>	-0.205 (0.147)	-0.181 (0.139)	-0.184 (0.188)	-0.167 (0.235)	-0.182 (0.199)	-0.171 (0.242)	-0.187 (0.196)
<i>Gender</i>	-0.609*** (0.114)	-0.671*** (0.089)	-0.331*** (0.118)	-0.295** (0.141)	-0.305*** (0.088)	-0.289*** (0.111)	-0.288** (0.129)
<i>Long-term focus</i>	-0.600*** (0.006)	-0.649*** (0.013)	-0.681*** (0.046)	-0.765*** (0.019)	-0.686*** (0.063)	-0.780*** (0.024)	-0.667*** (0.045)
<i>Tenure</i>	0.029*** (0.004)	0.031*** (0.006)	0.048*** (0.002)	0.041*** (0.003)	0.045*** (0.002)	0.041*** (0.002)	0.047*** (0.002)
<i>Established product line</i>	0.451*** (0.048)	0.459*** (0.048)	0.341*** (0.024)	0.382*** (0.045)	0.352*** (0.017)	0.372*** (0.072)	0.341*** (0.031)
<i>Headquarters</i>	0.464** (0.190)	0.479*** (0.175)	0.485* (0.254)	0.618** (0.276)	0.622*** (0.203)	0.785*** (0.224)	0.488** (0.239)
<i>Past innovation rating</i>	1.550*** (0.320)	1.550*** (0.350)	1.731*** (0.191)	1.710*** (0.192)	1.736*** (0.218)	1.738*** (0.206)	1.740*** (0.191)
<i>Constant</i>	-0.769*** (0.164)	-0.686*** (0.183)	-0.781*** (0.245)	-0.756*** (0.219)	-0.771*** (0.230)	-0.762*** (0.212)	-0.83*** (0.253)
McFadden pseudo- R^2	0.20	0.210	0.250	0.260	0.260	0.270	0.250

Notes. Division and job function dummies are included. Robust standard errors for two-tailed tests are clustered by grade.

^aStandardized by subtracting the mean from the value and dividing by the standard deviation.

*Significant at 10%; **significant at 5%; ***significant at 1%.

results; the squared term of *bootlegging activities* was positive and significant, whereas the squared term of *past bootlegging time* was negative and significant at the 10% level. In addition, we experimented by with repeatedly removing single items from the bootlegging activities scale and rerunning the analysis with these different item combinations. The results did not change, which suggests that our results are not dependent on a single item in the scale.

In Model 4, we test Hypothesis 2, which states that the effect of time spent on underground research activities on innovative performance is amplified by the innovative performance of the R&D unit employing the individual. Consistent with this hypothesis, Model 4 shows

that the interaction term for the amount of time that an individual dedicated to bootlegging in 2007 and the innovative performance of the R&D site is positive and significant. Model 5 includes the interaction term for individual bootlegging time in 2007 and average bootlegging time of colleagues working in the same R&D unit. The interaction term is positive and significant, suggesting that the effect of bootlegging time is amplified if the individual works in an R&D unit with high levels of bootlegging. This supports Hypothesis 3. Model 6 includes both interaction terms, and it supports both of our moderation hypotheses.

To interpret these moderation effects, we plot them using the simulation-based procedure advocated by

Zelner (2009). Interaction terms are more difficult to analyze in nonlinear than in linear models because their direction and magnitude are a function of all the other variables in the model (Ai and Norton 2003). However, a graphical representation of the predicted probabilities is helpful. The method proposed by Zelner (2009) computes the predicted probabilities of receiving a high innovation rating at different levels of the moderated variable (*bootlegging time at $t - 3$*) for high and low values of the moderating variable (*unit innovative performance* and *unit bootlegging time at $t - 3$*), setting all the other control variables in the model to a given value. We derived these plots by setting the moderating variables at two standard deviations below the mean (low value) and two standard deviations above the mean (high value), with all the remaining control variables as described in Endnote 3. In line with Hypothesis 2, Figure 1 shows that, at high levels of unit-level performance (the solid line), an increase in past bootlegging time increases the likelihood of receiving a top innovation rating, whereas at low levels of unit innovative performance, an increase in bootlegging time in 2007 does not affect the chances of receiving a high innovation rating. Similarly, consistent with Hypothesis 3, Figure 2 shows that the benefits of bootlegging exist only for individuals working in units with high levels of bootlegging.

Figure 1 The Moderating Effect of Unit Innovative Performance on Bootlegging Time

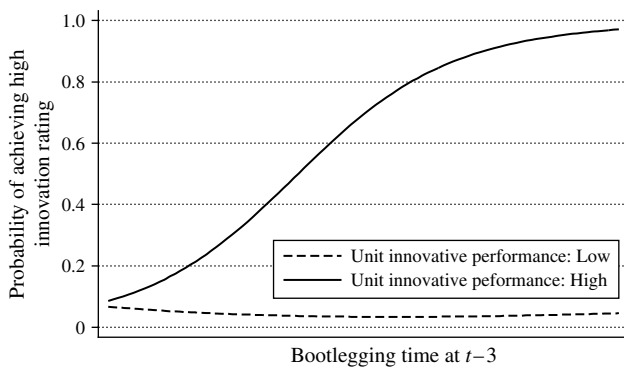
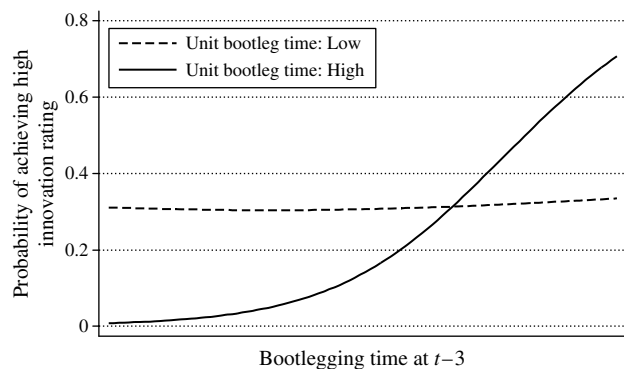


Figure 2 The Moderating Effect of Unit Bootlegging on Bootlegging Time



The effect of a change in bootlegging time during a period of increased formalization of the front end of the innovation process is reported in Model 7. Supporting the predictions in Hypothesis 4, the estimates from Model 7 suggest that, after controlling for bootlegging time in 2007, those individuals who increased the time spent on bootlegging activities are less likely to achieve a high innovation rating.

Testing for Reverse Causality

As suggested above, because of the cross-sectional nature of our data, there is a possibility that the results could be affected by endogeneity bias. Using past values for innovation rating helps to address the problem of omitted variables bias but does not rule out reverse causality as another source of endogeneity. It might be that innovative performance determines bootlegging rather than vice versa because more successful individuals may have more autonomy and may have earned sufficient “credit” to engage in bootlegging activities. To address this, we carried out a Granger (1969) causality test exploiting information on the time individuals reported spending on bootlegging activity in 2010 (*bootlegging time_t*) and 2007 (*bootlegging time_{t-3}*) combined with information on innovation rating in 2010 (*innovation rating_t*), 2009 (*innovation rating_{t-1}*), and 2008 (*innovation rating_{t-2}*):

$$\begin{aligned} \text{Bootlegging time}_t &= \alpha_1 \text{Bootlegging time}_{t-3} + \alpha_2 \text{Innovation rating}_{t-1} \\ &\quad + \alpha_3 \text{Innovation rating}_{t-2} + \text{controls} + \varepsilon, \end{aligned} \quad (1)$$

$$\begin{aligned} \text{Innovation rating}_t &= \beta_1 \text{Bootlegging time}_{t-3} + \beta_2 \text{Innovation rating}_{t-1} \\ &\quad + \beta_3 \text{Innovation rating}_{t-2} + \text{controls} + \varepsilon. \end{aligned} \quad (2)$$

Since the coefficient of bootlegging time at $t - 3$ is significant in Equation (2) ($\beta_1 = 0.166$, $p = 0.01$), but the innovation rating at times $t - 1$ and time $t - 2$ are not significant in Equation (1) ($\alpha_2 = -1.252$ and $\alpha_3 = -0.401$, respectively), we can conclude that bootlegging drives innovative performance, but not vice versa.

Conclusions

Our investigation of the nature and effect of individuals’ bootlegging efforts on innovative performance highlighted a practice in R&D that is often referred to but is rarely observed systematically. In describing bootlegging as an attempt by R&D scientists to gain higher levels of strategic autonomy through nonprogrammed, underground R&D efforts, we linked bootlegging to notions of proactive and deviant creativity, helping to extend our understanding of how individuals in large, mature organizations break free of the constraints of accountability to generate innovations. Drawing on theories of proactive creativity and innovation, we explicated the mechanisms

that link a bootlegger's efforts to innovative performance, suggesting that bootlegging enables individuals to gain both explorative advantage over colleagues and more time and space to nurture and substantiate embryonic ideas before organizational assessment.

In addition, we suggested that the costs and benefits of bootlegging for innovation are contingent on the emphasis that the work environment places on normative enforcement. The impact of individuals' bootlegging efforts on innovative performance is heightened in the context of high unit innovative performance and the bootlegging efforts of their colleagues, settings where the achievement of goals prevails over the means by which they are achieved. In contrast, individuals who increase their bootlegging during periods of formalization—where a greater emphasis on conformity to rules signals that the opposite change of behavior is expected—cannot count on support and tolerance for their bootlegging behavior. Exploiting a major organizational change in our studied organization toward greater formalization at the front end of the R&D process, we found that, despite the benefits that bootlegging might bring even during formalization periods, increasing the amount of time dedicated to underground research has a negative impact on individual innovation performance. We argued that increasing bootlegging, perhaps out of frustration over the proposed organizational change, can lead to a misalignment between the individual's R&D efforts and corporate objectives, reducing the ability of the former to generate innovations that the organization can incorporate in its products and technologies.

Implications for Theory

Our study has important implications for our understanding of creativity and innovation. First, it has been argued that the ability of individuals to be creative or innovative depends on the balance between the degree of autonomy allowed by their organizations and the extent to which their work is monitored and constrained by accountability practices (Burgelman 1983, Kanter 2000, Van de Ven 1986). Our study adds to this body of literature: we found that what matters is not just the degree of strategic autonomy that organizations grant to their staff but also the degree to which individuals seek to increase their strategic autonomy, on their own initiative, in settings where it is constrained. We portrayed bootlegging as the means by which individuals create greater strategic autonomy in high-accountability settings and found that engaging in underground R&D efforts helps them to produce innovations for the organization. These results suggest that the autonomy–innovation relationship is shaped by the form of autonomy sought by individuals, as stressed by Bailyn (1985), in addition to the autonomy that is formally granted.

Second, our study unpacked the mechanisms that enable individuals to gain from bootlegging. Although

the literature on bootlegging shows that it is an important form of bottom-up, nonprogrammed innovation effort (Abetti 1997; Aram 1973; Augsdörfer 1996, 2005), the mechanisms through which it stimulates innovation are mostly implicit. Building on March (1991, 2006), we posited that bootlegging might facilitate the exploration of new domains along unconventional paths that fall outside the remit of formal projects. Moreover, by paying attention to the specific contextual features of R&D in large, mature organizations, we identified delayed assessment of embryonic ideas as an additional mechanism that links underground creative efforts to innovative performance. R&D workers can use bootlegging to postpone the monitoring and assessment of early-stage ideas until they are better developed. They may even reintroduce rejected ideas that they have continued to work on until the environment has become more conducive. By exploring these two mechanisms, we documented the pathways through which bootlegging shapes innovative outcomes, and we helped to ground the concept of bootlegging as an important form of proactive, deviant creativity (Mainemelis 2010, Unsworth 2001).

Third, we contributed to the literature on bootlegging, and on creative deviance more broadly, by demonstrating that the benefits of bootlegging are highly contingent on the work environment. Although bootlegging takes place underground and remains hidden from senior managers, it is unlikely to promote innovation in settings where behavioral norms and conformity to rules are rigidly enforced. Our theorizing and results suggest that an individual's bootlegging efforts tend to be successful only in high performance work settings and in the presence of fellow bootleggers. In such environments, local managers and coworkers are more likely to provide support for bootleggers in their exploration of novel and unconventional ideas and to provide guidance and understanding when these ideas eventually reach the surface of the organization. In the absence of these conditions, bootlegging will fail to result in innovative outcomes and should be regarded as a costly use of organizational resources. We also showed that, during periods of formalization, increasing the time dedicated to bootlegging has negative effects on individual innovation performance and thus is considered a cost to the organization. This may be because individuals who increase their deviation from the formal work allocation system—during a period of greater formalization, where greater emphasis on rules and procedures prescribes the opposite behavior—risk not only misalignment between their innovation efforts and corporate innovation objectives but also alienation from colleagues and managers. In exploring these contingencies, we showed *when* and *how* proactive and deviant forms of creativity shape innovative outcomes and increased our understanding of how organizational change toward more formalization shapes the benefits and costs of proactive and deviant creativity for the individual.

Implications for Practice

Although bootlegging is an activity initiated by individual scientists and engineers, by providing a work setting where accountability and conformity to rules and procedures are prioritized over autonomy, or vice versa, organizational decision makers have a major indirect influence over individuals' ability to gain from their bootlegging behavior. Local managers can choose to tolerate or condemn the bootlegging efforts of their staff. We believe our findings have important implications for managers and organizations.

First, formal R&D management systems may help to promote alignment and improve selection, but these monitoring efforts may drive some R&D activities underground. Our study suggests that underground efforts, rather than undermining the goals and needs of the organization, may produce significant innovations for the organization. We suggest that managers use monitoring mechanisms, such as R&D management, as a form of "soft power" to provide guidelines and incentives for alignment and coordination of creative efforts without invoking the organization's "hard power" (i.e., the enforcement of norms through sanctions and punishment), which may crush independent initiative (Nye 2004). In this sense, R&D management should be seen as an enabling form of bureaucracy rather than a "clenched fist" that stops the deviant, creative efforts of individuals (Adler and Borys 1996). However, the notion that bootlegging has positive benefits for the achievement of innovation in organizations cannot be extended too far. Most of the individuals in our study engaged in relatively modest levels of bootlegging (on average, 14% of their time) and were able to combine this activity with their formal project work. All bootlegging efforts should eventually be integrated into the organization to ensure that the latent potential of employees' ideas can be fully realized by the wider organization. Ultimately, senior management must decide whether it would be worthwhile to scale up these initiatives (Burgelman and Grove 2007).

Second, although our focus was a high-accountability organization that provides no free time for its staff, our results can be related to the question of how organizations might nurture creative efforts by allowing such free time. Our study suggests that even in organizations where there is no explicit free time, unofficial R&D efforts are commonplace. An implication of this finding is that free-time programs may only legitimize something that already occurs within organizations (Garud et al. 2011). Moreover, and somewhat paradoxically, by providing dedicated free time, organizations might reduce the allure of these hidden creative efforts since they are no longer forbidden. The critical question is to what extent the deviance of an act adds to its emotive and behavioral attraction (see Becker 1997): Does the forbidden nature of the "fruit" increase its sweetness?

Or, alternatively, is it the formally provided autonomy that counts, or is it the autonomy that individuals achieve informally through underground activities? It might be more productive for organizations to impose restrictions on the free time of would-be innovators in order to heighten its allure while tolerating the existence of bootlegging and enabling the integration of its outputs into the organization's formal management processes. This approach might be less expensive in terms of managerial resources than organization-wide provision of unstructured free time, but it could be just as productive.

Limitations and Future Research

Our study has several limitations that lead to questions for future research. First, because our study focuses on a single, high-accountability organization, we should be cautious about generalizing our results to other organizations. Although Neptune is a fairly diverse organization with many autonomous units, across sites there are few differences in its human resource practices. This means we cannot explore how different practices within and between firms might influence the relationship between bootlegging and innovation. Also, our single-organization setting means that we cannot compare the effectiveness of governance arrangements for encouraging the creative behavior of individuals, such as free-time models versus bootlegging. Similarly, we cannot compare the performance implications of a change in the time allocated to bootlegging between individuals experiencing or not experiencing the introduction of the formalization of the front end of the innovation process. That is, in our quasi-natural experiment, we lack a control group to allow a counterfactual analysis, which limits our ability to provide an unambiguous demonstration of causation.

Second, bootlegging is difficult to measure because it is a deviant form of behavior in that it takes place without organizational approval. We attempted to tailor our bootleg measures to the specific context of Neptune. Although this approach helps to ensure the context validity of our measurement, it also limits applicability to other organizational settings. To try to elicit information from respondents on underground activity, we used mild terms, such as "unofficial projects," since even in anonymous surveys, individuals may underreport bootlegging. Other methods, such as in-depth observation, time logs, and detailed case studies, might provide a more detailed picture of the nature of underground efforts inside organizations and the implications of these efforts for the organization's ability to innovate. Future research could compare the innovation journey of bootlegged versus nonbootlegged projects inside organizations.

Third, this study relied on a single measure of individual performance, innovation rating, which is subject to important limitations. Although the innovation rating has benefits related to its face validity and applicability across job roles in Neptune, alternative

measures of performance obtained from archival data, such as patent applications or invention disclosures, would have provided additional evidence on the impact of bootlegging on individuals' abilities to innovate. However, in promising anonymity to try to obtain a more reliable measurement of bootlegging, we sacrificed the possibility of pairing our survey data with company records of performance at the individual level.

Finally, our study focused on the bootlegging efforts of individuals and how these efforts shape their contribution to the organization's innovative performance. This means we cannot comment directly on the impact of bootlegging for teams and units. We also cannot assess the impact of manager's response to bootlegging. To obtain a better understanding of this activity, future research with a multilevel setup could examine more organized forms of bootlegging to investigate team and/or unit-level underground activities and how these efforts shape performance at each level. Similarly, a multilevel study could assess whether other unit-level characteristics in addition to those explored in this paper affect the ability of an individual to benefit from underground R&D efforts.

By theorizing and measuring the impact of the underground efforts of individuals in R&D on innovation, this paper has shed new light on a perennial managerial challenge—the need to support creativity while simultaneously ensuring that efforts are well managed and aligned with the organization's goals and capabilities. It suggests a range of future research to provide a better understanding of how proactive and deviant creative efforts can support and sustain organizational renewal and development.

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Endnotes

¹Responses to this survey have been used in other working papers (Salter et al. 2012, Ter Wal et al. 2011).

²Although introducing lagged values of the dependent variable does not completely rule out endogeneity issues arising from

omitted variables bias, in the absence of valid instruments, it should substantially mitigate this problem (Wooldridge 2009). Because the inclusion of a lagged dependent variable as an explanatory variable might lead to autocorrelation in the error terms and thus to inconsistent estimates (Greene 2003), we used the innovation rating for two years prior to our survey, which is not highly correlated with the current innovation rating (the phi-correlation coefficient between the current rating and rating two years earlier is 35%). In addition, Monte Carlo simulations (Beck et al. 1998) show that the problem of autocorrelation of the error terms in this context is less severe in logit than in ordinary least squares models.

³We use as a marker variable a self-developed three-item scale on environmental concern at work (Cronbach's $\alpha = 0.62$), which can be assumed to be unrelated to bootlegging activity and innovative performance.

⁴To account for the error terms across our observations not being statistically independent, which arises from the unit innovation performance variable not varying among individuals working in the same unit, we also estimated our weighted logit models clustering the errors by unit in addition to grade. We found that the moderation effect of unit innovative performance on past bootlegging time remains significant, with the same sign and comparable coefficient size.

⁵To derive the magnitudes of the effects of bootlegging activities and past bootlegging time, we set the past innovation rating to 1, unit innovative performance to 0.25, seniority level to 2, gender and long-term focus dummies to 0, and headquarters and established product dummies to 1, leaving all the other control variables at their mean values.

⁶In an additional analysis, we retested H2 and H3 moderating the unit-level variables with bootlegging *activities* instead of bootlegging *time*. The results are consistent with the findings reported for bootlegging time.

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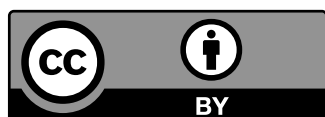
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