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The Role of IT Feature Recombinations in Individuals' Innovative Use of IT

Short Paper

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Abstract

Innovations do not emerge in isolation but are to some extent recombinations of previously existing building blocks. In this paper, we build on the recombination processes feature set broadening and deepening to show how individuals innovate with IT. We employ a qualitative research setting using a rich case of a self-tracker, who constantly changed his use of a stress tracking device from simple meditation to, eventually, a creative use configuration allowing him to sense stress at work, address prejudicial work-related behavioral patterns, and increase his work-related performance. Our preliminary analysis show that innovating with IT operates in constant cycles of feature set broadening and deepening, with broadening preceding the deepening. By linking feature set broadening and deepening to existing tasks as well as to new deliverables, we intend to clarify the relationships and transitions between different configurations of innovative use and show which patterns of innovative use occur over time.

Keywords: IT post-adoption; IT innovation; IT features

Introduction

The attainment of innovations is a complex, non-linear process (Argote & Miron-Spektor, 2011). Indeed, there is a common understanding among scholars that innovations do not emerge in isolation but are at least to some extent resulting from the recombinations of previously existing building blocks (e.g. Flath et al., 2017; Fleming et al., 2007; Gruber et al., 2013; van de Ven, 1986). Innovation by recombination manifests in two fundamental processes – the acquisition of new knowledge and the transformation of existing knowledge – which have in an information technology (IT) context been conceptualized as scanning and evaluating (Majchrzak et al., 2004), knowledge acquisition and conversion (Nambisan et al., 1999), sensing and experimentation (Carlo et al., 2012), or, when referring to specific features, building blocks or knowledge assets, as deepening and broadening (Benlian, 2015; Carlo et al., 2012; Flath et al., 2017; Kaplan & Vakili, 2015; Ryu et al., 2005). In this paper, we will build on these two recombination processes, feature set broadening and feature set deepening, to show how individuals innovate with IT.

We employ a broad conceptualization of innovative IT use in that we define it as covering all types of IT use aimed at finding new uses on an existing IT. These new uses involve users that optimize task-performance of existing tasks (e.g. Ahuja & Thatcher, 2005; Jasperson et al., 2005) as well as uses that result in novel deliverables (e.g. new processes, new products) (Agarwal, 2000; Nambisan, 2013; Rahrovani & Pinsonneault, 2014). As a result the outcomes of innovative use can be performative (i.e. improving existing task performance) or creative (i.e. leading to new deliverables, may it be tasks, processes, or products) with performative outcomes being visible rather in the short-term, and creative outcomes in the longer term. Looking at the long term outcomes of IT use, such as individual innovativeness, has also been the recent subject of call for future research (Ortiz de Guinea & Webster, 2013). Following this call for research, in this paper, we seek to answer the following research question: Which patterns of recombination processes occur during individuals' innovating with IT, and how do these processes impact different outcomes of innovative IT use?

To address our research objectives, besides recombination research, we build on and extend previous research on adopting and innovating with IT. In particular, we see our work rooted in research on IT use as feature adaptation (Bagayogo et al., 2014; Benlian, 2015; Hsieh et al., 2011; Hsieh & Zmud, 2006; Sun, 2012). As a result, we build on the concept of deep structure IT usage (Burton-Jones and Straub 2006) and use the definition of IT use as "an individual user's employment of one or more features of a system to perform a task" (p. 231), where a task "is a goal-directed activity performed by a user" (p. 231). In the same vein, we investigate innovative IT use with a lens on the features of IT and link them to IT-enabled outcomes, i.e. IT use is comprised of a system (represented by its features), a user (represented by the learning associated with feature set broadening and deepening) and a task (addressed by feature set).

We employ a qualitative research setting using a rich case of a self-tracker, who – over a period of several months – constantly changed his use of a stress tracking device from simple meditation to, eventually, a creative use configuration allowing him to sense stress at work, address prejudicial work-related behavioral patterns, and increase his work-related performance. For this paper, we focus on the creative outcomes of innovative IT use, and keep the performative outcomes for subsequent analyses.

This paper is structured as follows. In the next section, we introduce the theoretical background on outcomes of innovative IT use and feature sets. We also develop our basic theoretical conceptualization of feature set broadening and deepening as basis for our qualitative analysis. Our methodological case research approach to address our research question along with a brief introduction of our case is introduced in Section 3. We have summarized our state of analysis and an outlook for next steps in our research in the last section.

Theoretical Background and Development

We employ a broad conceptualization of individual innovativeness in that we define it as being comprised of a performative (i.e. improving existing task performance) and a creative (i.e. leading to new deliverables, may it be tasks, processes, or products) dimension. Hence, we consider three specific task-related outcomes of innovative IT use: efficiency and effectiveness representing the performative outcomes of innovating with IT, and new deliverables representing the creative outcomes. We will next review both dimensions, before we introduce our research framework.

Creative Outcomes of Individual Innovativeness

Papers investigating the creative aspect of individual innovativeness focus on the emergence of new deliverables by using an existing IT. These new deliverables may involve new tasks, goals, or practices (Agarwal, 2000; Bagayogo et al., 2014; Nambisan, 2013; Nevo & Pinsonneault, 2016). On a higher level, such new deliverables may not just impact how an IT is used as tool, they may also impact associated roles, processes, and procedures involving an IT's use (Lassila & Brancheau, 1999). Hence, individual innovativeness may have an impact on task performance and eventually lead to "true" innovation in that an organization has gained insights on e.g. how to offer new services to customers (Flath et al., 2017; Robert & Sykes, 2017).

From an individual perspective, it is important to clarify the conditions under which the use of IT can be considered as "novel" (Rahrovani & Pinsonneault, 2014). Management scholars frequently measure innovativeness by considering how novel an innovation is to a specific team or individual (e.g. Dreu & West, 2001; Robert & Sykes, 2017; Stowell & Cooray, 2017) and purposefully abstract from a larger network perspective. Indeed, even though the use of an IT in a specific way is innovative for a given individual, from a broader perspective, it may be that the individual is only closing up to the knowledge level of colleagues. At the individual level, it re-mains an innovative use. Following this argumentation, we define the creative outcomes of individual innovativeness as follows: Creative outcomes of innovativeness refer to new tasks that can be solved using an IT and that were previously unknown to an individual.

Feature Set Broadening and Deepening

System features are the functional building blocks of an information system (Griffith, 1999; Sun, 2012). They reflect the "specific types of rules and resources, or capabilities, offered by the system" (DeSanctis & Poole, 1994) and result from both the design process and individual decisions about use (Griffith, 1999). System features may be grouped, or (re-)combined in feature sets (Benlian, 2015; Griffith, 1999; Sun, 2012). Building on the literature above, we define a feature set as a group of features that an individual has associated together and assigned to one tasks or a group of tasks (see Figures 1 and 2). Accordingly, feature sets are the result of individual cognition processes and may involve all features available in an information system or only parts of them.

The configuration of these feature sets depends on available knowledge and cognitive absorption (Burton-Jones & Straub, 2006; DeSanctis & Poole, 1994) and is, thus, constantly changing and adjusted by the user. Feature sets have been used by various authors who build on the system-user-task structure introduced by Burton-Jones and Straub (2006). For instance, Benlian (2015) investigates how a change in the configuration of a user's mental feature subsets related to specific task groups may lead to distal and mid-term task-performance outcomes. Furthermore, Bagayogo et al. (2014) describe how reconfigurations of task-related feature set may help gaining higher levels of innovativeness. The idea to employ feature set reconfigurations to ex-plain creative outcomes of IT use can also be found at Nambisan et al. (1999).

Researchers have also investigated how the feature sets of a user change as she either extend her use behavior, or reduces and resists using features of an IT (Bagayogo et al., 2014; Griffith, 1999; Jasperson et al., 2005). For example, Sun (2012) describes "a user's revisions of which and how system features are used" (p. 453). He distinguishes between four behaviors (trying new features, feature substituting, feature combining, and feature repurposing). Similarly, Bagayogo et al. (2014) reflect novel ways of employing IT features that involve either using a formerly unused set of available features, using IT features for additional tasks, or using feature extensions. Jasperson et al. (2005) and Hsieh & Zmud (2006) have also discussed the concept of feature extensions. In sum, prior research shows that the changes to a user's feature sets operate through the recombination processes feature set broadening and deepening.

Feature set broadening

As users broaden their feature set, they acquire knowledge on new features and, hence, extend the scope and variety of IT features they can apply for task completion (Griffith, 1999). However, simply using more features alone is not sufficient, since they may be used in an unproductive way (Benlian, 2015; Yeo, 2008). Feature set broadening is the process of "actively extending the basket of IT features that may be used by a particular user to accomplish tasks" (Benlian, 2015). We have summarized conceptualizations of feature set broadening in Table 1. All of the conceptualizations build on the role of features and their relationships with existing and new tasks. The broadening process, hence, tightly links to the learning of new features.

Table 1. Conceptualizations of Feature Set Broadening

Griffith, 1999	IT sensemaking, during which users consciously include or exclude features into their task solving.
Benlian, 2015	Obtaining a broad grasp of a system's functionality while actively extending the basket of IT features that may be used to accomplish tasks.
Hsieh et al., 2011 Jasperson et al., 2005	Learning and using more of the functions available in the IT.

Sun, 2012	Extension/adjustment of the content of the features in use to cope with changing environment.
Ortiz de Guinea & Markus, 2009	Learn how to use entirely new IT features.
Limayem et al., 2007	Extent to which an individual uses the various features of the IS system in question.

Table 1. Conceptualizations of Feature Set Broadening

Two different manifestations of feature set broadening exist (Bagayogo et al., 2014; Hsieh & Zmud, 2006; Sun, 2012), with each having a different task-related impact (Figure 1). The knowledge acquisition may lead to an extension of the task-related feature set, or to an extension of the features in use without any task association. Accordingly, in the first case (left-hand side in Figure 1) new features are added to existing feature sets. The association between feature set and task remains unaffected (new feature, existing task). Hence, the user has more task-solving options and may thus come up with better, situation-tailored solutions due to higher flexibility: the additional feature(s) added to the feature set allow for more configurations in how to achieve a task since all or only a subset of the features might be involved in task completion. In the case of an extension of the features in use without any task association (right-hand side in Figure 1), new features are added to the features in use without being integrated into existing feature sets. Hence, again, existing tasks are not affected, but also no new tasks are identified (new feature, no task). Still, since the user better grasps the IT's features and capabilities, she may try to imagine scenarios in which the new features are useful and thus come up with new application scenarios of the IT.

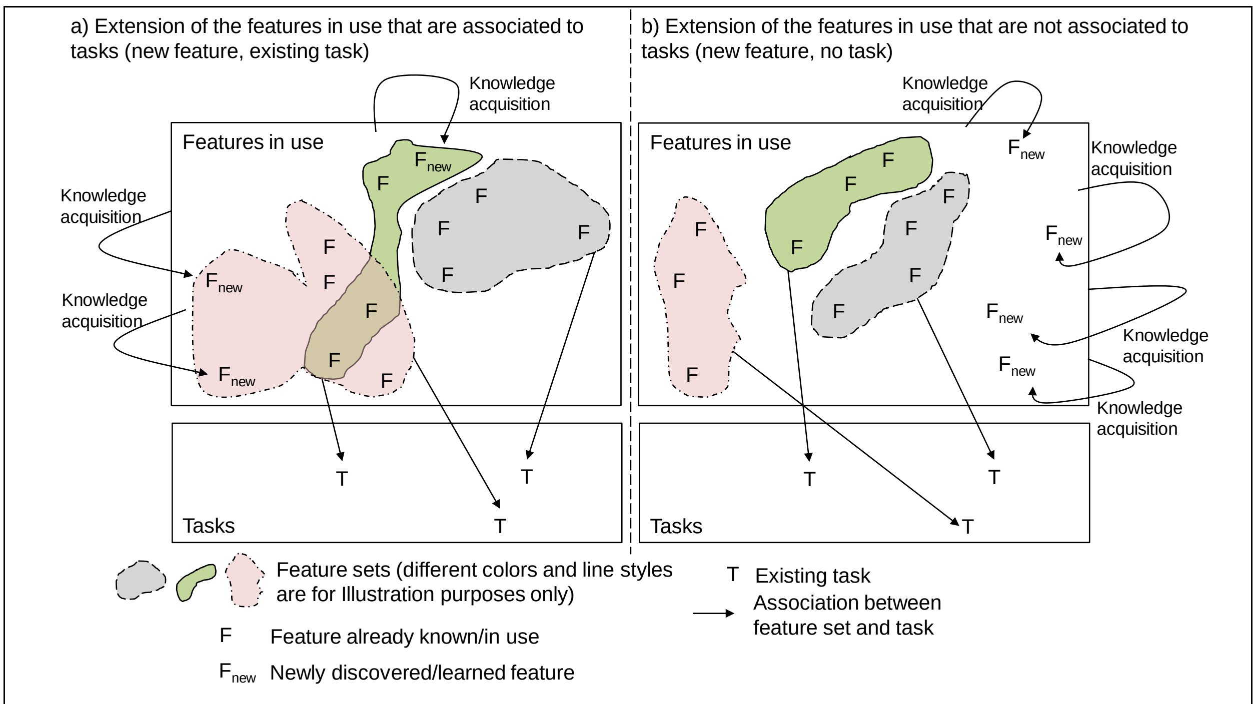

Figure 1. Configurations of Feature Set Broadening

Feature set deepening

Feature set deepening involves the transformation of task-solving-related knowledge (i.e. the creation and modification of "how-to knowledge") and requires the user to connect different features to current and potential tasks (Nambisan et al., 1999). The higher the feature set depth, the better will be the solutions produced to solve tasks. We have summarized different conceptualizations of feature set deepening in Table 2. The table shows that the deepening process is often linked to individual abilities in mastering an IT.

Hence, it involves a transformation of *existing and new feature set* by recombining, substituting, or removing included features. Technically, an increase in feature set depth has also been linked to the number of feature combinations (DeSanctis & Poole, 1994; Sun, 2012), the number and length of sequences of features (Ortiz de Guinea & Markus, 2009), or the number of feature set (i.e. the number of tasks that can be solved) (Benlian, 2015; DeSanctis & Poole, 1994).

Table 2. Conceptualizations of Feature Set Deepening	
DeSanctis & Poole, 1994	Different combinations of features to find a solution for solving a task.
Jasperson et al., 2005	Understanding of how to use IT features and how these features complement other features.
Sun, 2012	Feature combining or repurposing as an adaptation of how the features are used, separately or together, in an existing or new way.
Ortiz de Guinea & Markus, 2009	Learn how to apply known IT features in entirely new sequences and contexts.
Benlian, 2015	Increase the mastery of already known features and functionalities. Fully grasp the features' affordances, effects, and their associations with already-known IT features.
Burton-Jones & Straub, 2006	Extent to which features in the system that relate to the core aspects of the task are used.

Table 2. Conceptualizations of Feature Set Deepening

Again, two different manifestations of feature set deepening exist (Figure 2). First, the deepening may lead to a modification of existing task-related feature sets (left-hand side in Figure 2). Consequently, feature sets may be recombined or adjusted by repurposing, adding or removing features (Barki et al., 2008; Sun, 2012). As seen in Figure 2, for some feature sets, the number of features included is reduced, while for others new features might be included, while again other sets both reduce and include. The task association remains unaffected (existing feature, existing task). Second, the knowledge transformation may lead to a compilation of new feature sets for new tasks (right-hand side in Figure 2) (Benlian, 2015; Saeed & Abdinnour, 2013). In this case, existing feature sets remain unaffected, while completely new feature sets for new tasks are compiled (existing feature, new task). These feature sets may include features already included in other feature sets or new features that are not included so far. The user has identified new and creative uses of the IT.

In sum, a theoretical postulate in this paper is that the only way to include new features into feature set is by feature set broadening, and the only process by which new tasks can be addressed is by feature set deepening. Following this understanding, the main postulate in this paper is that during IT use users will experience different configurations of feature set broadening and deepening, which in turn will lead to different patterns and sequences of feature set broadening and deepening. Using this understanding as research framework, we hope that the different patterns will not only foster a more systematic understanding and differentiation of different types of innovative and creative use, but also allow for more detailed insights into the sequences of feature set broadening and deepening that lead to these use types.

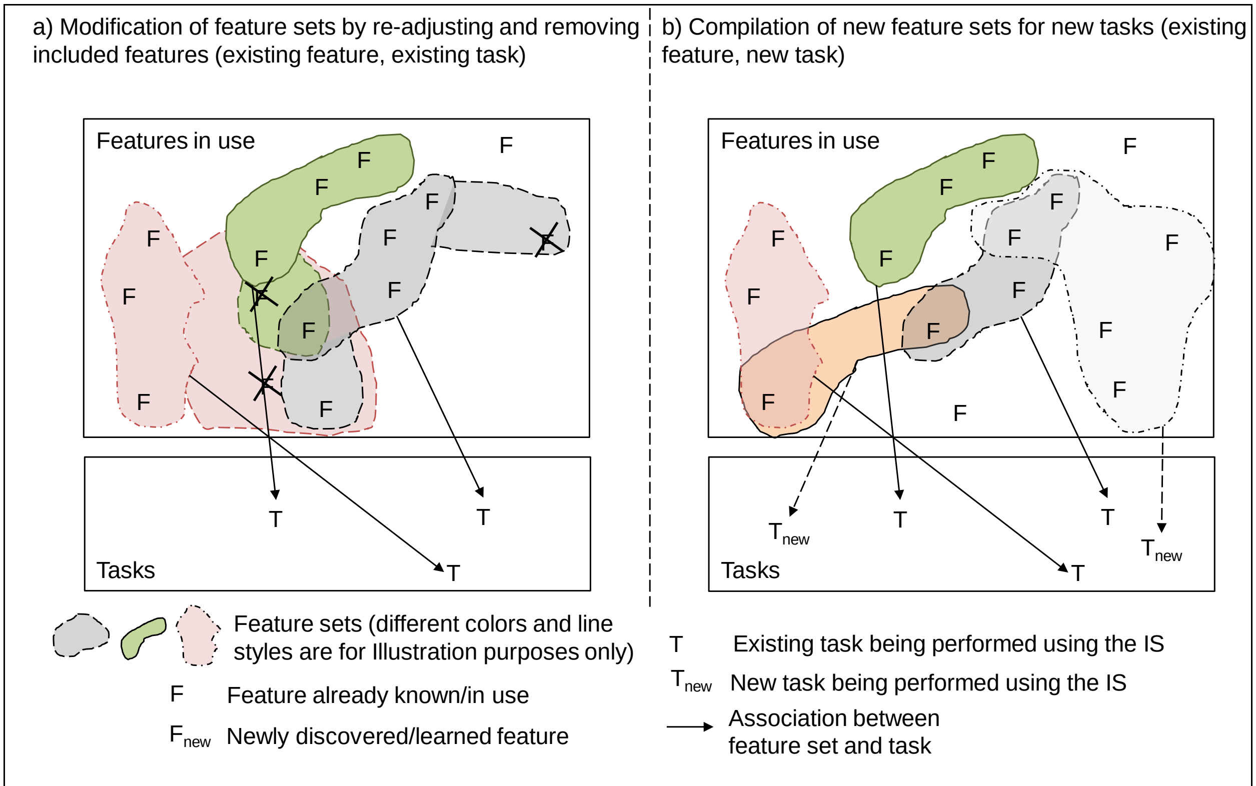

Figure 2. Configurations of Feature Set Deepening

Research Method

Studying complex phenomena such as innovative IT use requires a rich data set. Hence, we decided for a qualitative research setup (Benbasat et al., 1987; Dubé & Paré, 2003; Yin, 2009), which allow us to capture the nuanced and multifaceted phenomena related to innovative IT use. We chose a case of an innovative self-tracker, John, who, in a private effort to improve his meditation, found a way to become more productive at work using the same IS that he used for meditation. Given the innovative behavior we see in this case, we decided to investigate this case in depth. In doing so, we are aware that a single case setup will not lead to generalizable insights nor fulfill saturation demands (Urquhart et al., 2009). Single case setups are mostly recommended when a single case has a highly illustrative potential or offers rich insights on a new phenomenon that requires further inquiry (Dubé & Paré, 2003). We hold that given the complexity of our theorizing and preliminary results in combination with the richness of our case, the single case setup is adequate to gain a first understanding of which patterns of recombination processes occur during individuals' innovating with IT, and how do these processes impact different outcomes of innovative IT use. However, as we will discuss in our section "work to be done", we are currently working on further cases to refine and triangulate our insights in additional contexts. Table 3 presents a brief profile of the case underlying this paper.

Table 3. Case profile

Context	Stress tracking work productivity
Origin	John works as a professional data analyst and, as a hobby, organizes a large group of self-trackers from the USA

IT	emWave2, a tool for tracking and visualizing heart rate variability (HRV)
Affected tasks	Stress reduction, investigating the occurrences of stress
Impacted outcomes	Creative outcomes of innovative IT use

Table 3. Case Profile

We employ multiple data sources for our analysis. Since John, the self-tracker, is very active in presenting the results of his stress tracking, we revert to three different detailed presentations on John's stress tracking he gave on his experiences between 2012 and 2015. Contrasting John's different presentations as part of the data analysis allows us to construct his course of adoption longitudinally. We also triangulate our findings by analyzing John's varying emphasis of certain aspects of his adoption over time. This way, we are able to differentiate routine use from innovation processes (e.g. in his first presentation he presented the use of the ear clip as a major innovation, while in 2015 he considered it as standard use) and more precisely construct a logical chain of evidence and rule out rival explanations (Patton, 2002; Yin, 2009). Furthermore, since John used different words to describe the same events and phenomena, we can secure that we understand him correctly and not dive into false interpretations (Schultze & Avital, 2011). To further enrich and triangulate our database, we are browsing and analyzing John's tweets between January 2011 (beginning of stress tracking) and May 2016. We are also analyzing two interviews he gave to self-tracking magazines, browsing and collecting relevant posts from all his forum activities in the self-tracking forum of his group. Finally, to precisely capture his feature recombination behavior, we also download the manuals of all tools and apps he used during his stress tracking and compared the descriptions with his reports. The latter step is essential to identify the default setup of the tools and clarify some details that John did not report about. We are also compiling a case diary and detailed case write-up. Overall, we are collecting extensive empirical material that help us constructing and triangulating the logical chains of evidence (Miles & Huberman, 1994; Yin, 2009).

For our data analysis, we are first developing a detailed code list, in which we operationalize our major concepts using established definitions and operationalizations (e.g. Benlian, 2015; Burton-Jones & Straub, 2006; Griffith, 1999; Sun, 2012). We have, so far, identified twenty codes representing the different feature set recombinations, the deep structure usage, outcomes, features, and tasks. One of the co-authors selectively coded the collected empirical materials (Miles & Huberman, 1994) using the qualitative data analysis software Atlas.ti (version 8). Another co-author performed a detailed review and revision of the coding. Different interpretations are being discussed by these two co-authors and resolved by re-checking the different data sources to increase coding reliability and reduce coding bias. Additionally, one further co-author was asked to provide input regarding the coding of randomly chosen excerpts or those whose interpretation was difficult, thus, helping to exclude rival explanations (Dubé & Paré, 2003; Patton, 2002).

The pattern coding is being performed jointly by the same two co-authors (Yin, 2009). The goal of this step was to detect re- and co-occurring patterns of feature set modifications and their relationship to creative outcomes during the whole IT use process. To that end, the initial codes are grouped together into synthesizing categories (Benbasat et al., 1987). High-level code categories and the relationships between them are organized with help of network displays (Miles & Huberman, 1994), which also foster the building of logical chains of evidence.

Conclusion and Work to be Completed

In this paper, following the call for research by Ortiz de Guinea and Webster (2013), we develop on the nature of the processes underlying individual innovative IT use. We are currently working on the analysis of the pattern coding described above to identify the occurrences and patterns of feature set broadening and deepening. To that end, we graphically visualized each feature set adjustment graphically, and arranged them in chronological order. We also mapped existing, and new tasks to this representation. To link our observation back to the case, we also have illustrated John's stress levels graphically for every feature set adjustment. These representations, in combination with a systematic analysis of the clustered network displays (i.e. codes are arranged and grouped together based on code grounding and code density), allows us to systematically link our theoretical conceptualizations to the empirical data in a reliable and understandable way and helps ruling out rival explanations.

Our preliminary analysis shows that innovating with IT operates in constant cycles of feature set broadening and deepening, with broadening preceding the deepening. Furthermore, it seems that different configurations of the feature set broadening and deepening correspond not only to different forms of innovative IT use, but also other types of post-adoption use (e.g. routine use). By linking feature set broadening and deepening to existing tasks as well as to new deliverables, we hope to be able to clarify the relationships and transitions between different configurations of innovative use and show which patterns of innovative use occur over time. Once the analysis of the different sources of data is completed, we will develop propositions to guide future research. In particular, we aim to identify which patterns of feature set broadening and deepening correspond to which types of post-adoption use. Building on that understanding, we hope to gain a process-oriented understanding of how individuals arrive at different IT-enabled innovative outcomes over time. We hope to stimulate discussions on such a complex phenomenon as innovating with IT and shed light on the nonlinearity of innovating with IT.

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