COGNITIVE BIASES IN NEW TECHNOLOGY APPROPRIATION: AN EXPERIMENT ON THE IMPACT OF JUDGMENTAL AND PRESENTATIONAL PRIMING

Completed Research Paper

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Abstract

This paper extends individual-based theories of adaptive structuration by exploring the role of cognitive biases in shaping the individual sensemaking of a new technology (i.e., an online product configurator). We question whether cognitive biases intervene in the sensemaking process to influence the ensuing appropriation of the technology. We experimentally trigger cognitive biases by priming participants (N=645) with positive/negative judgments about the technology and with textual/visual instructions about its features. As outcome variables, we measure subjective and objective faithfulness of appropriation (FOA), and satisfaction with the technology. Results indicate that negative judgment lowers users’ satisfaction, but at the same time increases their objective FOA. Compared to textual priming, visual priming leads to higher satisfaction, and triggers an illusion of having appropriated the technology faithfully – although without influencing objective FOA. We conclude by showing implications for IS scholars and practitioners.

Keywords: Adaptive Structuration Theory, Features-Based Theory of Sensemaking Triggers, technology user satisfaction, faithfulness of appropriation, judgmental priming, visual priming
Introduction

With the advent of a new generation of mobile and computer-based applications, users are facing a multitude of novel interfaces that do not necessarily follow widely known conventions. In introducing such interfaces, organizations confront a high degree of uncertainty. There are instances in which the users’ responses to a new technology are unanticipated by the developers, with substantial costs being imposed on both parties. To mention a recent example, Microsoft has admitted failure of a major product such as Windows 8, with the Head of Marketing and Finance recognizing the need to better understand the user’s “learning curve” in the adoption of novel interfaces (Financial Times, 7 May 2013). Microsoft’s customers in fact found Windows 8’s touch-screen interface confusing due to the omission of the brand’s famous “start” button, replaced with an interactive “tile”-based start screen. As they appropriated the new Windows 8, users seemed to be bound by their very knowledge of previous releases of the software.

In this paper we explore whether, and to what extent, cognitive boundaries (i.e., cognitive limits in processing, evaluating, and using information) may constrain the process by which individuals make sense of, and use a new technology. Individual-based theories of adaptive structuration (Griffith 1999; Sun 2012; Sun and Zhang 2006; Sun and Zhang 2008) offer a conceptual approach to better comprehend the reactions of users when encountering new information technologies. These theories, however, have thus far neglected the role of cognitive boundaries in new technology appropriation. In order to fill this gap, we have conducted an experimental study where we have triggered cognitive biases, by priming the users (N=645) of a new product configurator with different judgmental and presentational stimuli. We have used observed and self-reported measures to assess the impact of such priming mechanisms on the user’s faithfulness (i.e., correctness) and satisfaction in appropriating the technology.

Drawing on the literature on cognitive priming, we expected visual stimuli and positive judgments to increase the user’s faithfulness of appropriation, as well as their satisfaction with the technology use. Yet our statistical analyses reveal surprising results: First, providing negative rather than positive judgments of the technology usability (i.e., judgment priming) lowers the users’ satisfaction, but at the same time objectively increases their faithfulness in appropriating the technology. Second, providing visual rather than textual instructions for use (i.e., presentation priming) fosters the users’ satisfaction and triggers an illusion of having used the technology correctly, although without having any influence on objective measures of faithfulness of appropriation.

Our primary contribution consists of filling a gap in individual-based theories of adaptive structuration, by showing how cognitive biases intervene to influence the sensemaking process that users undergo when first exposed to a new technology. We structure our article as follows: In the next section, we provide the theoretical background of our study, by introducing Adaptive Structuration Theory (AST) and defining its central constructs of faithfulness of appropriation and satisfaction. Afterwards, we take a closer look at priming effects, and elaborate on the likely influence of judgmental and presentational cues on the individual sensemaking of a new technology. Based on this theoretical background, we develop ten hypotheses and propose a research model whereby we link cognitive biases to faithfulness of appropriation and satisfaction. We then describe the methodology employed to experimentally test our research model. This is followed by a presentation of the results in the form of a discussion of measures and hypotheses. In the final section of the paper we provide explanations for the unexpected results of our study, and highlight their theoretical and practical implications.

Theoretical Background and Hypotheses Development

Adaptive Structuration Theory (AST)

Adaptive Structuration Theory (AST) explores how information technologies – such as group decision support systems (GDSS) – are appropriated by users in organizational contexts (Chin et al. 1997; DeSanctis and Poole 1994; DeSanctis et al. 1994; Poole and DeSanctis 2004). As clarified by DeSanctis and Poole (1994), structuration occurs when technology is brought into use, and is therefore produced and reproduced in social action. In this sense, structuration takes place in “a recursive relationship
between technology and action” where structures inherent to the technology and structures unfolding in action iteratively shape each other (DeSanctis and Poole 1994, p. 125).

The structures provided by an information technology can be described in two ways, namely the structural features embedded in the technology itself, and the spirit underlying this feature set. The structural features are the specific rules, resources, and capabilities offered by the system, such as anonymous recording of ideas, periodic pooling of comments, or alternative voting algorithms in the case of GDSS. The spirit is the general intent underlying such features, or “the official line which the technology presents to people regarding how to act when using the system, how to interpret its features, and how to fill in gaps in procedure” (DeSanctis and Poole 1994, p. 126). The features and the spirit of an information technology converge to define its structural potential, which users can leverage to produce social structures through interaction.

Recent research has extended the breadth of AST to include not only the social uses of technology, but also the initial processes by which individuals make sense of technology (Griffith 1999; Sun 2012; Sun and Zhang 2006; Sun and Zhang 2008). The most important constructs of individual-based theories of adaptive structuration are summarized in Figure 1, and illustrated in the remainder of this section.

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>PROCESS</th>
<th>OUTCOMES</th>
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<tbody>
<tr>
<td><strong>Structural potential of the technology</strong>&lt;br&gt;&lt;br&gt;Structural features (rules, resources and capabilities offered by the technology)&lt;br&gt;• core (vs. tangential) features are essential to the functioning of the technology&lt;br&gt;• concrete (vs. abstract) features can be easily noticed and described by users&lt;br&gt;&lt;br&gt;Spirit of the technology (the general intent underlying structural features)&lt;br&gt;• objective spirit: the user’s externally imposed conception of the spirit&lt;br&gt;• subjective spirit: the user’s internally developed conception of the spirit</td>
<td><strong>Individual sensemaking</strong>&lt;br&gt;&lt;br&gt;Context-based triggers of sensemaking&lt;br&gt;• Novel situations: Situations that are unfamiliar to the user&lt;br&gt;• Discrepancies: Misalignment between the user’s expectations and experiences of reality&lt;br&gt;• Deliberate initiatives: The user’s responses to an external request</td>
<td><strong>Appropriation of the technology</strong>&lt;br&gt;&lt;br&gt;Faithfulness of appropriation (i.e., the extent to which appropriation is consistent with the spirit)&lt;br&gt;&lt;br&gt;Assessment of faithfulness&lt;br&gt;• self-reported: assessment against the user’s perception of their faithfulness&lt;br&gt;• observed: assessment against the developer’s definition of correct use&lt;br&gt;&lt;br&gt;Satisfaction with the technology&lt;br&gt;• User’s satisfaction with their use of the technology&lt;br&gt;&lt;br&gt;Adaptation of the technology&lt;br&gt;&lt;br&gt;Revising features&lt;br&gt;• Exploration: Add new features to expand the technology’s structural potential&lt;br&gt;• Substitution: Replacing features with others with similar functions&lt;br&gt;&lt;br&gt;Revising spirit&lt;br&gt;• Combination: Using features together for the first time&lt;br&gt;• Repurposing: Using features in a new way</td>
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**Figure 1. Summary of major constructs of individual-based theories of adaptive structuration (sources: Griffith 1999; Sun 2012; Sun and Zhang 2006; Sun and Zhang 2008)**

Beaudry and Pinsonneault (2005) argue that technology appropriation begins with the user’s appraisal of the likely consequences (i.e., threats and opportunities) of technology adoption. Griffith (1999) establishes a link between structural features and individual sensemaking, suggesting that core and concrete features are most likely to trigger deliberate reflection in the encounter with a new technology. Core (versus tangential) features are essential to the functioning of the technology; concrete (versus abstract) features can be described in a specific fashion and are easily noticed by users. For example, the “insert function” feature in Microsoft Excel is likely to be the focus of user’s sensemaking, being central to the spreadsheet (core) and comprised of a definite set of functions (concrete). On the contrary, the Analysis Toolpak add-in – by which Microsoft Excel can be turned into a statistical package – is unlikely to trigger much sensemaking, being optional (tangential) and not accessible from the main menu (abstract). Griffith’s Features-Based theory of Sensemaking Triggers (FBST) complements AST: “Whereas FBST
addresses how users initially make sense of the capabilities of a new technology, adaptive structuration theory uses this initial user sensemaking as an input for understanding how technology is used and adapted within an organization” (Griffith 1999, p. 475).

Extending Griffith’s (1999) FBST, Sun (2012) suggests that contextual factors such as novel situations (e.g., changes in the system’s hardware, software, peripherals), discrepancies between the expected and actual functioning of features, as well as explicit demands to try out new features are all likely to trigger more individual user’s sensemaking. Sun’s theory of Adaptive System Use (ASU) (Sun 2012; Sun and Zhang 2008) takes a closer look at individual appropriation, focusing on the user’s behavior of modifying the feature set in an adaptive manner. The user’s adaptive moves are classified into the two dimensions of revising the content and revising the spirit of features in use: The first dimension refers to what features are being used, and includes moves such as the exploration of features and the substitution of features with others presenting similar functions. For example, in Microsoft Word users may substitute features by using keyboard shortcuts (e.g., Ctrl + C and Ctrl + V) instead of menu commands (e.g., copy and paste). The second dimension pertains to how features are being used, and comprises the moves of combining features for the first time, or repurposing features through innovative uses. To stay with the Microsoft Word example, users may repurpose the “track change mode” by adding the date after their user names so that revisions made on different dates appear in different colors.

Although providing important insights, current research on individual appropriation has not yet made an attempt to include shortcomings in the user’s sensemaking of new technologies, and to accordingly derive implications for IS practitioners. While the above mentioned theories implicitly build on the assumption of human rationality, a long-standing research tradition in managerial cognition suggests that user’s sensemaking may be characterized by bounded rationality (Simon 1972). In particular, sensemaking is likely to be shaped by cognitive biases – i.e., mental shortcuts that individuals employ to reduce cognitive load when they are confronted with complex information (Henfridsson 2000). Before discussing the influence of cognitive boundaries, in the next section we elaborate on the relationship between faithfulness of appropriation and satisfaction, two central constructs of AST.

**Faithfulness of appropriation and satisfaction**

In appropriating a technology, users select specific features from its structural potential and adapt such features to their needs (DeSanctis and Poole 1994). The users’ appropriation thus creates structures in use that may differ even when the structural potential of the technology is constant (Chin et al. 1997). Such an appropriation may be faithful or unfaithful “The features are designed to promote the spirit of the technology, but they are functionally independent and may be appropriated in ways that are not faithful to the spirit ... Unfaithful appropriations are not ‘bad’ or ‘improper’ but simply out of line with the spirit of the technology” (DeSanctis and Poole 1994, p. 344). To the extent that faithfulness of appropriation varies across users, the achievement of the processes and outcomes expected by technology developers is not guaranteed (Boonstra and van Offenbeek 2010; Chu and Smithson 2007; Griffith 1999).

As further explained by Chin et al. (1997, p. 354), the spirit serves as a cornerstone for the evaluation of faithfulness, and takes the form of “an explicit or implicit construction in the mind of the individual”. The explicit or objective spirit is externally imposed by the technology developer, and includes a set of moves that the user interprets as indicative of a correct appropriation. As the technology is gradually appropriated, the externally imposed conception of the spirit is interpreted by the user, therefore laying the ground for an internally developed conception, i.e. the implicit or subjective spirit.

Drawing on such a distinction between explicit and implicit spirit, Chin et al. (1997, p. 346-348) derive implications for the assessment of faithfulness, suggesting the adoption of both self-reported and observed criteria: “Any assessment of faithfulness, which is an assessment of technology usage with respect to its spirit, must take into account the internal interpretation of spirit against which it is evaluated ... However, the fact that spirit refers to a phenomenon encountered by the individual rather than to an objective reality does not mean that some common conception of spirit cannot be discerned”. Therefore, a self-reported scale could be used to assess faithfulness against the implicit interpretations of the spirit (i.e., subjective faithfulness), whereas observed measures could be premised on the evaluation of objective faithfulness.

Faithfulness of appropriation is theorized as having a direct influence on satisfaction, based on the
reasoning that the correct appropriation of a technology strongly fosters self-fulfillment with the technology use. Chin et al. (1997) underscore the distinctiveness of faithfulness and satisfaction: While faithfulness refers to the act of technology usage, satisfaction refers to a consequence of technology usage. Therefore, technology users may acknowledge having used the system improperly but may nevertheless be satisfied with the outcomes of its use. As an example, many individuals incorrectly use spreadsheets for word processing tasks, yet they are satisfied with the manner in which they use the software.

Whereas a link between faithfulness and satisfaction has already been established, previous research has failed to consider whether both subjective and objective faithfulness influence satisfaction. Building on Chin et al. (1997), we suggest that faithfulness of appropriation and technology satisfaction are theoretically distinct constructs, and we hypothesize that both subjective and objective faithfulness directly influence satisfaction. On the one hand, the belief of using the technology features in the correct manner (i.e., subjective faithfulness) should increase satisfaction by leveraging the perception of self-efficacy in technology adoption. On the other hand, the objectively correct use of the technology's features (i.e., objective faithfulness) should foster satisfaction by enabling a smooth and full exploitation of the technology potential. We thus derive the following set of hypotheses that we will subsequently test in our experimental study:

**H1:** Objective faithfulness directly influences user’s satisfaction with the technology.

**H2:** Subjective faithfulness directly influences user’s satisfaction with the technology.

**Priming**

The term “priming” is generally used to indicate a phenomenon whereby prior exposure to a stimulus (i.e., the prime) increases the accessibility of information already existing in memory. When primed, the stimulus – in the form of an event, judgment, or object – becomes more salient, and thus is more likely to play a role in the formation of mental representations (Mandel and Johnson 2002; Wang 2007). In this regard, priming works by leveraging bounded cognition: In processing information, individuals do not rely on all of the relevant knowledge stored in their memories. Instead, they adopt a “shortcut strategy”, by forming mental representations based on the pieces of information that are most readily accessible (Brewer et al. 2003; Krosnick and Brannon 1993).

A priming effect can be activated by different processes: In **categorical priming**, positively or negatively valued information is primed to influence the formation of judgments about a target object. In **feature priming**, a subject is primed with a particular feature (e.g., price) of a given object (e.g., car), which in turn plays a heightened role in the formation of attitudes (e.g., purchase intention) towards the object at hand (Mandel and Johnson 2002). In this study, we will experimentally assess if priming users with different judgments about the technology usability (a type of categorical priming) and with different presentations of the technology features (a type of feature priming) influences their faithfulness of appropriation and satisfaction with the technology.

As we will describe in the next paragraphs, judgmental priming simulates the effects of social pressure on technology appropriation, and includes the modes of positive, negative and no judgment about the usability of the technology. Presentational priming refers to the way technology features are presented to the user, and comprises the modes of visual, textual and no instructions for technology use. The priming manipulations of our study are thus close to the central constructs of AST, with judgment priming triggering the emergence of structures in action, and presentation priming being connected to the structural features inherent to the technology.

**Judgmental priming**

An individual’s appropriation of a new technology occurs in a social context, and is therefore likely to be influenced by exposure to the judgment of external referents (Beaudry and Pinsonneault 2005). Previous research in technology adoption has suggested that the individual behavior is shaped by the perceived social pressure to adopt or not the technology in question (Ajzen 1991; Davis et al. 1989; Taylor and Todd 1995; Thompson et al. 1991; Venkatesh et al. 2003). The effect of social pressure is visible in that people choose to enact the behavior (technology adoption) not because they are personally inclined to do so, but
rather because they feel the need to meet the expectations of their referents (e.g., peers).

In addition to shaping behavioral intentions, social pressure has been found to influence task performance, by implicitly setting a reference term for individuals (Mitchell et al. 1985). Meyer and Gellatly (1988) have shown that suggesting the average score achieved by peers has a positive effect on task performance, with individuals scoring higher than the norm they were presented to. Such effect has been replicated in a variety of experimental tasks (Button et al. 1996; Mathieu and Button 1992; Meyer and Gellatly 1988; Mitchell et al. 1985): For example, Martin and Manning (1995) used different versions of an anagram task, whereas Weiss and Shaw (1979) proposed an electrical assembly task requiring subjects to wire an electrical circuit board.

In our experiment, we assess whether providing statements about the technology usability influences individual performance in appropriating a new technology, measured as faithfulness of appropriation. We suggest that a positive (negative) judgment about the ease of appropriation is likely to increase (decrease) both objective and subjective faithfulness. Firstly, a positive judgment may increase objective faithfulness by providing an incentive to understand the spirit of the technology, and fostering individual motivation to appropriate correctly the technology features. Secondly, a positive judgment may increase subjective faithfulness, by reinforcing individual self-confidence about the ease, and therefore the correctness of technology appropriation. As suggested in the following hypotheses, we propose that positive judgment leads to the highest level of faithfulness, whereas negative judgment produces the lowest level of faithfulness. For control purposes, we introduce a neutral condition (no judgment), and we conceive the two treatment conditions (i.e., positive and negative judgment) as the opposite ends of a continuum where the neutral lies in between.

H3.a: Positive judgment priming leads to higher objective faithfulness than no judgment priming.
H3.b: No judgment priming leads to higher objective faithfulness than negative judgment priming.
H3.c: Positive judgment priming leads to higher objective faithfulness than negative judgment priming*.
H4.a: Positive judgment priming leads to higher subjective faithfulness than no judgment priming.
H4.b: No judgment priming leads to higher subjective faithfulness than negative judgment priming.
H4.c: Positive judgment priming leads to higher subjective faithfulness than negative judgment priming*.

In addition to influencing the usage behavior and perceptions, social pressure has been found to shape the expected outcomes of technology appropriation, most notably perceived usefulness and ease of use (Lewis et al. 2003; Venkatesh and Davis 2000). Fulk (1993) has shown that the extent to which influential others view the technology use as valuable has a positive influence on individual perceptions of the technology usefulness. Lewis et al. (2003) further showed that top management’s commitment and support for a technology positively influence the users’ beliefs about the usefulness and ease of use of such a technology. Since satisfaction is modeled as an expected outcome of technology appropriation (Chin et al. 1997), we suggest that judgmental priming influences satisfaction, both in a direct way and via the mediation of faithfulness of appropriation (subjective and objective). In particular, positive judgment is expected to lead to higher satisfaction than negative judgment, with the neutral condition of no judgment lying in between these two extremes.

H5.a: Positive judgment priming leads to higher satisfaction than no judgment priming.
H5.b: No judgment priming leads to higher satisfaction than negative judgment priming.
H5.c: Positive judgment priming leads to higher satisfaction than negative judgment priming*.
H6.a: The relationship between judgment priming and satisfaction is partially mediated by objective faithfulness.
H6.b: The relationship between judgment priming and satisfaction is partially mediated by subjective faithfulness.

**Presentational priming**

Different ways of presenting information affect how individuals process, understand and evaluate
information, with important consequences in terms of individual behavior. For the purposes of this study, we define presentation priming as the use of visuals and text to manipulate information about the features of a new technology. Previous research has suggested that visual priming enhances user's awareness of technology instructions, by making important information more noticeable than just plain text (Mandel and Johnson 2002; Wang 2007; Wang and Dowding 2010). By operating in a manner similar to visual readiness (Wang 2007), visual priming is likely to foster the user's readiness to respond to technology instructions designed to facilitate its appropriation (Mandel and Johnson 2002).

Several studies have shown that pictures yield better results than text in terms of information processing, recall and comprehension (Durso and Johnson 1979; Nelson et al. 1976; Paivio 1971; Stewart and Stewart 2001). The cognitive psychology literature suggests at least two reasons why visual descriptions lead to superior recall: First, pictures are more likely to be registered in both the image and the verbal stores; Second, the pictorial code increases information salience and is therefore more effective for item memorization (see Snodgrass and Vanderwart 1980). In their seminal article “Why a diagram is (sometimes) worth 10,000 words”, Larkin and Simon (1987) further argue that pictorial representations can be superior to verbal descriptions for solving problems: Unlike verbal representations, where the data structure is indexed by position in a list, pictorial representations group together all the information, thus avoiding large amount of search for the elements needed to make a problem-solving inference. Pictorial representations also typically display information that is only implicit in sentential representations, therefore increasing computational efficiency and minimizing the need to make information explicit for use. At the same time, pictorial representations support a larger number of perceptual inferences, since cues to the next logical step in problem solving may be present at an adjacent position.

Building on the above literature, we suggest that visual priming leads to higher objective faithfulness of appropriation, by fostering understanding of the features, and of the general purpose (i.e., the spirit) of the technology. At the same time, we suggest that visual priming should also increase subjective faithfulness of appropriation, by reinforcing the user's perception of having appropriated the technology in a correct way. For control purposes, we are also interested in testing the hypotheses that textual priming leads to higher (objective and subjective) faithfulness of appropriation than no presentation priming (i.e., neutral condition).

H7.a: Presentation priming through a photo leads to higher objective faithfulness than presentation priming through text.
H7.b: Presentation priming through text leads to higher objective faithfulness than no presentation priming.
H7.c: Presentation priming through a photo leads to higher objective faithfulness than no presentation priming*.

H8.a: Presentation priming through a photo leads to higher subjective faithfulness than presentation priming through text.
H8.b: Presentation priming through text leads to higher subjective faithfulness than no presentation priming.
H8.c: Presentation priming through a photo leads to higher subjective faithfulness than no presentation priming*.

In addition to influencing performance on cognitive tasks, pictorial descriptions have been found to exert a “cajoling effect”, and in turn to foster satisfaction with the content being represented (Bresciani and Eppler 2009; Comi and Eppler 2011). In the field of business communication, the use of visual representations – as compared to textual descriptions – has been found to increase managerial satisfaction and commitment to strategy implementation (Kernbach and Eppler 2010). In advertising research, pictures have been shown to be more persuasive than text, especially for individuals scoring high in affective processing (Hill 2008; Sojka and Giese 2006). Building on this evidence, we argue that pictorial representations of technology features may “enchant” the users, whereas less appealing textual instructions may leave more room for spontaneous criticism. As summarized in the following hypotheses sets, we propose that visual priming – as compared to textual and no presentation priming – may increase satisfaction with the use of a new technology, both directly and via the mediation of faithfulness of appropriation:
H9.a: Presentation priming through photo leads to higher satisfaction than presentation priming through text.
H9.b: Presentation priming through text leads to higher satisfaction than no presentation priming.
H9.c: Presentation priming through a photo leads to higher satisfaction than no presentation priming*.
H10.a: The relationship between presentation priming and satisfaction is partially mediated by objective faithfulness.
H10.b: The relationship between presentation priming and satisfaction is partially mediated by subjective faithfulness.

In Figure 1, we show how the hypotheses advanced into this section converge to define a research model about the influence of cognitive boundedness on user’s faithfulness of appropriation and satisfaction.

**Empirical Study**

**Experimental Design**

We have conducted an online experiment where 645 participants have worked with a novel, interactive and graphic product configurator (Figure 2), after having been exposed to all possible combinations of judgmental and presentational priming. The experiment is based on a between subjects, 3x3 factorial design – since the manipulations are varied across participants, with the independent variables comprising 3 conditions each. Judgment priming simulates the effects of social influence, and includes the conditions of positive, negative and no judgment about the technology usability. Presentation priming refers to the way technology features are presented to the user, and comprises the conditions of visual, textual and no instructions for product use. As dependent variables, we have measured the user’s faithfulness of appropriation and satisfaction with the technology, making use of both self-reported and observed measures for the first construct.
Experimental Task

Prior to being exposed to the experimental manipulations (i.e., judgmental and presentational priming combinations), all the 645 participants received task instructions for using the product configurator. They were instructed to configure a laptop of their choice using a €1000 voucher, in way of exploiting the value of the voucher as much as possible although without exceeding the lump sum. They were requested to perform a number of appropriation moves, for example to fill in the blanks of the bottom row with a color range for the laptop, and to accordingly make a selection by taking into account both the color and the price.

Experimental Participants

The experimental participants were recruited through a mailing list purchased from a market research company based in Germany. Out of a total of 645, 319 were male and 322 female (4 missing values); the age was comprised between 15 and 85 with the average being 39. All the participants were German speakers living in Austria, Germany or Switzerland; their modal educational attainment (N=226) was the high school diploma with professional training (12 schooling years).

Independent Variables

The participants have been randomly assigned to different levels of the independent variables, according to a 3x3 factorial design. We describe below the manipulations that we have used for priming the participants.

Judgment priming

We have simulated social pressure by exposing the participants to different statements about their peers’ perceptions of the usability of the product configurator. While in the neutral condition no statement was presented, positive priming emphasized the user-friendliness of the technology. On the contrary, negative priming presented the technology as non-intuitive and cumbersome to use.

Presentation priming

We have manipulated the way of presenting the technical features of the product configurator. While participants in the control condition did not receive any instructions, subjects in the visual condition were exposed to the picture of a ruler simulating the configuration mechanism (Figure 3). Participants in the
textual condition received a verbal description of the configurator, in a format similar to the user’s guide that often accompanies software products.

![Figure 4: The visual priming manipulation](image)

**Dependent Variables**

**Faithfulness of appropriation**

In order to assess faithfulness of appropriation, we have made use of both self-reported and observed measures. As self-reported measures, we have selected a validated instrument (Chin et al. 1997), requiring the users to express the subjective (i.e., internally developed) conception of spirit of the technology. Whereas self-reported measures of faithfulness are readily available in the IS literature, observed measures are scarce or lack external validity\(^1\). For the purposes of our experimental study, we have developed a rating system to assess the extent to which the users’ appropriation moves correspond to the objective (i.e., externally imposed) definition of spirit (Table 1). The underlying dimensions of our rating system – understand, discover, relate – are derived from Griffith (1999), and reflect the sense making process that the user undergoes when first exposed to a new technology. Building on Griffith, we assume that sense making is triggered by exposure to the different features of the new technology. The user’s sense making develops gradually, from an understanding of the system’s basic features (concrete and core), to the discovery of advanced features (abstract and tangential), to the appropriation of the underlying relations among such features. In other words, the user fully exploits the potential of the technology when realizing how all its features can be combined to achieve the desired output.

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<tr>
<th>Dimension</th>
<th>Parameter</th>
<th>Description</th>
<th>Score</th>
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<tbody>
<tr>
<td>Understand</td>
<td>Price</td>
<td>Price is equal or below 1000</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Price is greater than 1000</td>
<td>0</td>
</tr>
<tr>
<td>Discover</td>
<td>Slider</td>
<td>Using both the arrows and the grabbers</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Movement</td>
<td>Using only the grabbers</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Using only the arrows</td>
<td>1</td>
</tr>
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\(^1\) For defining objective measures, DeSanctis et al. (1994) suggest to develop a reading of the spirit by treating the technology as a text, and to perform a micro-coding analysis of the speech acts of group members. However, interpretive and micro-level research leads to idiosyncratic results, not generalizable beyond a specific technology, and a particular group interaction (Poole and DeSanctis 2004).
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<table>
<thead>
<tr>
<th>Relate</th>
<th>Placement</th>
<th>Not moving the slider</th>
<th>0</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>The selected cells are positioned within the central windows (average distance of all sliders with distance &gt; 0 is lower than 5 and no slider has a distance greater than 10).</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The selected cells are not positioned within the central windows (average distance is higher than 5 or one slider has a distance greater than 10).</td>
<td>0</td>
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</table>

For example, respecting the €1,000 price limit is linked to the Understand dimension, reflecting the basic purpose of the product configurator, i.e. to calculate a summative score after choosing among diverse options. The slider movement parameter exemplifies the Discover dimension, and represents an additional step in the appropriation process – i.e., discovering the possibility of using “grabbers” instead of clicking on “arrows” to move the ruler sliders. Finally, the placement parameter is an instance of the Relate dimension, reflecting the user’s understanding of the interconnections between the text filling, the slider movement and the pricing mechanisms. While the measures and scores used in the table above are tied to the interactive ruler application used in our experiment, the underlying dimensions can be used to devise objective appropriation scales suitable to other software applications.

**User’s satisfaction**

In order to measure the user’s satisfaction, we have adapted 5 items from the End-User Computer Satisfaction (EUCS) scale originally developed by Doll et al. (2004), assessing the system’s accuracy, ease of use, and format of presentation. Furthermore, we have introduced 4 items to measure satisfaction in terms of the perceived usefulness of the system with respect to the task at hand.

**Control variables**

In addition to demographic variables (i.e., age, gender, education, nationality), we have measured the baseline knowledge of IT by adapting 4 items from Bassellier et al. (2003). Moreover, we have controlled for the time spent on appropriating the ruler application, and on filling out the questionnaire.

**Results**

**Measurement Model**

Before proceeding with the hypotheses testing, we have performed a preliminary analysis to establish confidence in the self-reported measures selected for assessing the dependent and control variables of our research model. We have conducted a principal component analysis (PCA) with varimax rotation on all the 21 scale items (validity check), and we have accordingly computed the Cronbach’s α for each component (reliability check). From the PCA, three components were extracted – corresponding to subjective faithfulness of appropriation, user satisfaction (dependent variables), and IT competence (control variable). The Cronbach’s α suggested high reliability for the three instruments, with values of .952 for the self-reported faithfulness scale, .939 for the satisfaction scale, and .903 for the IT competence scale.

**Hypotheses Testing**

The first hypotheses set (H1-H2) is confirmed by the data analysis, since the linear regression of both objective and subjective faithfulness on satisfaction returned significant values (β = .132, p < .001, F=11.331, p<.001 and β = .428, p < .001, F=144.109, p<.001, respectively). Thus, our study confirms the relationship between faithfulness of appropriation and satisfaction (Chin et al. 1997), while also making clear that such a relationship applies to both objective and subjective definitions of the faithfulness
As regards the H3 hypotheses set – concerning the impact of judgment priming on objective faithfulness – the ANOVA returned a significant, yet negative value for the contrast positive vs. negative judgment, with a mean difference of -.422 (p<.05). Contrary to our expectations, a negative judgment is found to increase – rather than decrease – the user’s performance in appropriating the technology at hand (i.e., objective faithfulness). This may be the case, since a negative judgment triggers a challenge mechanism whereby the user tries his or her best in appropriating the technology. We will further comment on this unexpected finding in the next section.

The ANOVA for the H4 hypotheses set returned a non-significant value, therefore indicating that judgment priming does not influence significantly the user’s perception of having appropriated the technology faithfully (i.e., subjective faithfulness).

The H5 hypotheses set – concerning the impact of judgment priming on satisfaction – is partially supported, since the ANOVA returned a significant value only for the contrast positive vs. negative judgment, with a mean difference of .275 (p<.05). Therefore, a positive judgment – as compared to a negative judgment – is found to increase the user’s satisfaction with the technology, whereas the difference with respect to the intermediary condition of no judgment is non-significant.

The results of H3-H5 concerning the direct effects of different judgmental stimuli on faithfulness of appropriation (objective and subjective) and satisfaction are summarized in Table 2.

To test for mediation effects we used Sobel tests with bootstrapping the confidence intervals. The Sobel test, evaluating a mediation effect of objective faithfulness between judgment priming and satisfaction (H6.a) returned a significant value for the contrast positive vs. negative judgment ($\beta = .039$, 95% LB = .007, 95% UB = .095, percentage mediated = -14.47%), indicating a negative mediation effect. In other words, a correct appropriation of the technology partially counters the effect of negative judgment on satisfaction, and ultimately increases the user’s satisfaction (14.47%)$^2$.

To sum up the results for judgmental priming, negative judgment about the technology at hand lowers the user’s satisfaction but increases their faithfulness of appropriation – which in turn partially counterbalance the negative effect on satisfaction.

| Table 2. Summary of effects of judgmental priming |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Mean Comparisons            | (I) judgment                | (J) judgment                | Mean Difference (I-J)       | Std. Error | Sig. | 95% Confidence Interval |
|                            | positive                    | negative                    | -.422$^2$                   | .156        | .021 | .795 - .049             |
| H3 subjective FOA           | positive                    | none                        | -.459$^2$                   | .152        | .008 | .822 - .095             |
|                            | none                        | negative                    | .037                        | .145        | .992 | -.311 - .384            |
| H4 subjective FOA           | positive                    | negative                    | .053                        | .140        | .974 | -.282 - .389            |
|                            | positive                    | none                        | -.008                       | .130        | 1.000 | -.320 - .305            |
|                            | none                        | negative                    | .061                        | .134        | .957 | -.261 - .383            |
| H5 satisfaction             | positive                    | negative                    | .275$^2$                    | .114        | .047 | .002 - .547             |
|                            | positive                    | none                        | .076                        | .097        | .816 | -.156 - .308            |
|                            | none                        | negative                    | .198                        | .114        | .228 | -.075 - .472            |

* The mean difference is significant at the 0.05 level.

The ANOVA for the H7 hypotheses set returned a non-significant value, therefore indicating that presentation priming does not influence significantly the user’s performance in appropriating the technology.

$^2$ We do not comment on H6.b (The relationship between judgment priming and satisfaction is partially mediated by subjective faithfulness) since the direct effect of judgment priming on subjective faithfulness of appropriation is not confirmed.
technology at hand (i.e., objective faithfulness).

The H8 hypotheses set – concerning the impact of presentation priming on subjective faithfulness – is partially supported, since the mean differences are significant for the contrasts photo vs. text presentation (mean difference = .451, p<.01), and photo vs. no presentation (mean difference = .515, p<.01). Therefore, photo presentation increases the user’s perception of having appropriated the technology faithfully, with the largest difference being observed with respect to the condition of no presentation. On the contrary, the mean difference is non-significant for the contrast textual vs. no presentation, which suggests that including or omitting textual instructions in the software package does not influence the user’s perceptions of faithfulness of appropriation.

The H9 hypotheses test – concerning the effect of presentation priming on satisfaction – is partially confirmed, with the mean comparison test returning significant values for the contrasts photo vs. text presentation (mean difference = .253, p<.05) and photo vs. no presentation (mean difference = .375, p<.01). On the contrary, the inclusion of textual presentation – as compared to no presentation – does not increase significantly the user’s satisfaction with the technology.

The results of H7-H9 concerning the direct effects of different presentational stimuli on faithfulness of appropriation (objective and subjective) and satisfaction are summarized in Table 3.

For testing the mediation effects, we used Sobel tests and bootstrapped the confidence intervals. The mediation effect of subjective faithfulness on satisfaction (H10.b) is significant for the contrast photo vs. no presentation ($\beta = -.099$, 95% LB = -.165, 95% UB = -.049, percentage mediated = 46.49%) as well as for the contrast photo vs. text presentation ($\beta = -.141$, 95% LB = -.241, 95% UB = -.051, percentage mediated = 55%). Therefore, the effect of photo presentation on satisfaction is partially mediated by the user's perception of having appropriated the technology in a correct way.

To sum up the results on presentation priming, photo presentation leads to higher self-reported faithfulness of appropriation and satisfaction compared to text presentation and no presentation. The perception of faithfulness of appropriation partially mediates the effect on satisfaction.

### Table 3. Summary of effects of presentational priming

<table>
<thead>
<tr>
<th>(I) presentation</th>
<th>(J) presentation</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>H7 objective FOA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>photo</td>
<td>textual</td>
<td>-.108</td>
<td>.146</td>
<td>.840</td>
<td>-.458</td>
<td>.241</td>
</tr>
<tr>
<td>photo</td>
<td>none</td>
<td>.067</td>
<td>.149</td>
<td>.957</td>
<td>-.289</td>
<td>.424</td>
</tr>
<tr>
<td>none</td>
<td>textual</td>
<td>-.176</td>
<td>.159</td>
<td>.609</td>
<td>-.557</td>
<td>.205</td>
</tr>
<tr>
<td>H8 subjective FOA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>photo</td>
<td>textual</td>
<td>.451*</td>
<td>.135</td>
<td>.003</td>
<td>.127</td>
<td>.775</td>
</tr>
<tr>
<td>photo</td>
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<td>.515*</td>
<td>.131</td>
<td>.000</td>
<td>.200</td>
<td>.830</td>
</tr>
<tr>
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<td>textual</td>
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<td>.133</td>
<td>.950</td>
<td>-.383</td>
<td>.255</td>
</tr>
<tr>
<td>H9 satisfaction</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>text</td>
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<td>.104</td>
<td>.046</td>
<td>.003</td>
<td>.503</td>
</tr>
<tr>
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<td>.002</td>
<td>.115</td>
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<tr>
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<td>-.121</td>
<td>.112</td>
<td>.623</td>
<td>-.389</td>
<td>.146</td>
</tr>
</tbody>
</table>

* The mean difference is significant at the 0.05 level.

The inclusion of covariates into the model did not alter significantly the results reported above. No interaction effects were found between judgmental and presentational priming.

The following Figure provides a graphical representation of the results of our tests, therefore suggesting a revised model of the influence of judgmental and presentational priming on faithfulness of appropriation.

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3 We do not comment on H10.a (The relationship between presentation priming and satisfaction is partially mediated by objective faithfulness), since the direct effect of presentation priming on objective faithfulness of appropriation is not confirmed.
Testing for family-wise errors

Given the use of a relatively large number of independent tests in our study, we checked whether our findings are affected by family-wise errors. We performed the Benjamini-Hochberg procedure for testing different levels of false positives (Benjamini and Hochberg 1995). This approach focuses on controlling the expected proportion of false positives, namely the “false discovery rate”. A level for the accepted false discovery rate $Q$ is chosen and the $p$-value adjusted based on the ranking of the $p$-value $i$ (from the smallest to the largest) and the number of tested hypotheses $m$. The $p$-values are significant when the actual $p$-value is smaller than the correction term $(i/m)^*Q$.

Using a false positive rate of 10%, all significant $p$-values of our hypotheses tests remain smaller than the correction term, which is the requirement set by the Benjamini-Hochberg procedure. For instance, a level of 0.06 is required for the influence of contrast between "no judgment priming and negative judgment priming" on satisfaction. Our analysis showed a $p$-value below .05, which is not only below the commonly used alpha level, but also below the level of the adjustment term from the Benjamini-Hochberg procedure. This leads to the conclusion that family-wise errors do not affect our predictions.

Discussion of Findings

Our study shows that visual priming has a substantial impact on technology appropriation, with photo presentation leading to significantly higher satisfaction and self-reported faithfulness of appropriation compared to textual and no presentation. On the contrary, including or omitting textual instructions from a software package does not produce any impact on the user’s satisfaction and faithfulness in appropriating the technology. Nevertheless, it should be remarked that visual priming exerts a significant impact on self-reported, but not on objective faithfulness of appropriation. Although unexpected, this result is consistent with prior studies in cognitive science, which suggest that visual representations “trigger a strong illusion of understanding [...] especially if they are easy to mentally animate. The
prominence of visible, transparent mechanisms may fool people into believing that they have understood, and successfully represented what they have merely seen" (Rozenblit and Keil 2002). Because they are exposed to a “vue d’ensemble”, participants are induced into a false belief of “explanatory depth” (Alter et al. 2010), whereas they have only developed a general understanding of the concept. In this regard, the “illusion of visual clarity” induces the users to feel more confident and satisfied with the appropriation of a new presentation, regardless of their actual performance in using such a technology.

The impact of judgmental priming on technology appropriation is less substantial, as the sole contrast positive vs. negative judgment leads to significant mean differences in satisfaction and objective faithfulness of appropriation⁴. In comparison to positive judgment, negative judgment of the technology at hand lowers the user’s satisfaction, but increases their objective faithfulness of appropriation. Although unexpected, the positive impact of negative judgment on objective faithfulness can be explained with reference to the salience of unfavorable judgments: negatively valenced information is more attention-getting and triggers more deliberate reflection as compared to positively valenced information (Fiske 1980; Shen and Wyer 2008; Skowronski and Carlston 1989). Martin and Manning (1995) found that task performance increases with low normative information (“others did poorly”), although this is true only for low goal commitment individuals. In their words: “since subjects were led to believe others did poorly, their motivation may have been to out-perform their peers rather than to achieve a certain goal” (Martin and Manning 1995, p. 78). Thus, the warning that other users have found an interface difficult to use triggers a “try-it-harder effect”, by increasing the user’s level of attention, which translates into a more accurate use of the interface. Users seem to take on the challenge implicitly posed in the negative judgment and thus use the interface more correctly than those who have been primed with positive judgment. This explanation is substantiated by recent research in cognitive psychology, suggesting that the perception of difficulty increases cognitive engagement and leads to deeper processing, with positive effects on the performing of cognitive operations (Diemand-Yauman et al. 2011).

Conclusions

In this study we have addressed the questions of whether the appropriation of a new technology – specifically, a product configurator – can be influenced through two priming mechanisms, i.e. presentation and judgment priming. To answer these questions, we have conducted an online experiment where 645 users have worked with the product configurator, after having been exposed to different judgments about its usability and to different presentations of its features. We have therefore measured whether priming mechanisms influence faithfulness of appropriation (self-reported and observed), and in turn the user’s satisfaction with the technology. The data suggest that visual priming – as compared to textual priming – leads to significantly higher satisfaction and self-reported faithfulness of appropriation. In comparison to positive judgment, negative judgment of the technology lowers the users’ satisfaction, but at the same time increases their objective faithfulness of appropriation. While our hypotheses were generally confirmed, we have introduced the concepts of the “illusion of visual clarity” and the “try-it-harder effect” to explain unexpected findings – i.e., objective faithfulness is not influenced by visual priming, but increases with negative judgment.

A major implication for IS professionals is to employ priming effects (i.e., presentation and judgment priming) in order to shape the appropriation process, and to influence the user's satisfaction. More precisely, software instructions should be presented in a visual format in order to increase the user’s satisfaction, and to trigger the impression of a faithful appropriation (i.e., self-reported faithfulness of appropriation). Furthermore, technology developers should insert positive judgments in the software package to increase satisfaction, but at the same time should challenge the users to “try it harder” in order to foster their faithfulness in appropriating the technology.

In terms of theoretical implications, our paper extends Adaptive Structuration Theory (AST) to incorporate cognitive biases into the technology appropriation process, thus uncovering an important individual aspect that had thus far been neglected in the more socially-oriented AST discourse. We have

⁴ As mentioned in the theoretical section, we interpret the two treatment conditions (i.e., positive and negative judgment) as the opposite ends of a continuum where the control condition (i.e., no judgment) lies in between. Unlike the distance between the treatment conditions at the extreme ends, the distance between each treatment and the control condition in the intermediary position is not sufficiently large to observe significant differences.
shown how faithfulness of appropriation and satisfaction – two central constructs of AST – can be influenced by simple priming activities. Visual priming can create an illusion of clarity and increase perceived faithfulness of appropriation and satisfaction. Negative endorsements regarding a software application can induce users to try harder when using such software for the first time. We thus see one of our major contributions to AST in the conception of the “illusion of visual clarity” effect and in the “try-it-harder” effect. Both are ambivalent effects in the sense that they do not only have positive sides. The illusion of visual clarity increases satisfaction, but it does not actually improve user performance. The same holds true for the use of negative judgments, which increase performance through a try-it-harder mechanism, but have negative effects on user satisfaction. Our study also has theoretical implications with regard to Griffith’s theory of technology features as triggers for sensemaking and his view that concrete features gain more salience from the user’s point of view than abstract ones. We have extended this concreteness construct from the software itself to the means of instructing users about it, showing that visual instructions may in deed be more salient than text-based instructions.

While providing an important contribution, this work is not without limitations: First, the lower path of our research model is verified when contrasting the experimental conditions, but not when contrasting the treatment and the control conditions. Second, it should be remarked that judgment priming – as an experimental manipulation – suffers from an inherent artificiality, and fails to fully replicate the mechanisms of social influence. As follows, caution is needed in generalizing the experimental results to real-life settings, as well as in formulating implications for technology developers. Future researchers may complement our study with quasi-experiments and/or direct observations of individuals appropriating an advanced technology after exposure to priming mechanisms. In spite of these limitations, our study has begun to open the black box of cognitive biases in new technology appropriation, therefore leading to a set of new questions and directions. Future research may delve further into the management cognition literature to uncover, compare, and prioritize the effects of other types of cognitive biases. We assume that the so-called confirmation bias (i.e., seeking confirmatory evidence that one has applied the software correctly), as well as the recency bias (re-applying appropriation moves learned recently) may also intervene to shape the user’s sensemaking of a new technology. Future studies may further explore these individual mechanisms and isolate biases through more fine-grained experimental runs.

Note

* Although this hypothesis could be logically inferred from the previous ones in the hypotheses set, we state explicitly all the contrasts for the purposes of greater clarity.

Acknowledgments

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