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The Novelty Effect in Large Display Deployments – Experiences and Lessons-Learned for Evaluating Prototypes

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Abstract. *This exploratory paper addresses the novelty effect in large display field deployments by combining findings from both the existing body of knowledge and our own research. We found that the novelty effect is prevalently present on two occasions: (a) immediately after a new system is deployed in a new environment, and (b) in reoccurring situations, when changes are made to an existing system. Both instances share similarities such as a system's higher usage during a particular time frame. However, we also observed that their individual reasons to occur are multifaceted. The present work's main contribution is twofold. Firstly, the paper outlines related literature regarding the novelty effect, particularly in CSCW and HCI. Secondly, the paper illustrates the effect's complex nature and suggests explicit means that should be considered in related research endeavors.*

Introduction

Understanding the practical application of technology is an important part of CSCW and HCI research. Lab-based studies, however, provide little information on how technologies can be adopted and applied in real-word contexts, or if they

are ever likely to be adopted at all. Field deployments or pilot implementations which evaluate the impact of new technologies in real-world environments are needed to understand how people utilize technology in their everyday lives (Hertzum, Bansler, Havn, & Simonsen, 2012; Siek, Hayes, Newman, & Tang, 2014). Specifically, field deployments and pilot implementations provide rich data about how closely a concept meets the target demographic's needs and how users accept, adopt, and appropriate a system in actual use over time. Field deployments can also be used to validate a concept or prototype – both for systems based on well-established, recognized needs, and for groundbreaking technological innovations.

Overcoming the novelty effect is a major challenge in determining a new technology's practical application potential. For example, research shows that it can take up to six months for a new behavior, such as the full adoption of a new technology, to become habit (Prochaska & DiClemente, 1982). In that time, social pressures or trends that drive initial use may wear off over time, or unforeseen issues with, e.g., scalability or maintenance may arise.

When planning research, one must address the question of how long an innovation should be deployed and evaluated in order to avoid skewing research outcomes. In our research on semi-public and public displays in collaborative environments, we encountered this issue quite often, and began searching for appropriate answers. We found some generic guidelines for evaluating public displays, such as (Alt, Schneegaß, Schmidt, Müller, & Memarovic, 2012), but little practical guidance regarding novelty effect's impact in various deployment contexts, or how long one should evaluate a new system in order to mitigate the effect's influence.

This paper sets out to explain the patterns we observed in our research and to derive some lessons-learned in order to assist researchers in similar studies. The following is structured as follows: firstly, mentions and findings about the novelty effect are collected from multiple disciplines, including CSCW and HCI; secondly, findings regarding the novelty effect in our studies and experiments with semi-public and public displays are presented; thirdly, these findings are discussed, and a set of preliminary dimensions for summarizing influencing factors on the novelty effect is described; finally, we conclude by providing direction for future research.

The novelty effect in different disciplines

A formal and comprehensive definition of the novelty effect is currently missing. However, Wikipedia provides a summary of what appears to be a commonly-accepted definition:

> "The novelty effect, in the context of human performance, is the tendency for performance to initially improve when new technology is instituted, not because of any actual improvement in

> learning or achievement, but in response to increased interest in the new technology." ("Novelty Effect", 2017)

Another definition for the novelty effect is provided in (Ott, 2018):

> "The curiosity effect is the decreasing intensity of use of a new or recently updated technical component in a sociotechnical system, which is due to the increasing integration in the workday life and the loss of interest by the social actors that is accompanied by this." (translation by the authors)

To summarize, the novelty effect is an increased motivation to use something, or an increase in the perceived usability of something, on account of its newness. When novelty eventually fades, usage patterns and/or perceived usability changes.

Novelty effect and Hawthorne effect

Psychologists noticed a phenomenon similar to the novelty effect in the 1930s, when several changes affecting working conditions in the Hawthorne Works factory were implemented and evaluated for their effects on productivity. The studies found that it did not matter what had changed – any change in the workplace produced a temporary boost in productivity (Landsberger, 1958). The Hawthorne effect states that those who perceive themselves as members of an experimental or otherwise favored group tend to outperform control groups, even in the absence of applied variables. Thus, the Hawthorne effect describes the effects of knowingly being observed. In contrast, the novelty effect stems solely from an innovation's newness with no regard to observation or a user's knowledge thereof.

Novelty-Encoding Hypothesis in medical psychology

In medical psychology and neuroscience, there is a so-called "Novelty-Encoding Hypothesis" proposed by (Tulving & Kroll, 1995), suggesting that the encoding of online information into long-term memory is influenced by its novelty, and that novelty increases recognition performance. This hypothesis was confirmed in several different settings, for example in (Kormi-Nouri, Nilsson, & Ohta, 2005) and (Poppenk, Köhler, & Moscovitch, 2010). This effect is closely related to what we have described as the novelty effect, but again, it is not the same. The hypothesis focuses on recognition performance of memorized information, while the novelty effect focuses on usage patterns as a direct result of an object's initial installation or changes to its state (e.g., adding new features).

Novelty effect in educational research

First quantifications of the novelty effect can be found in educational research. There are several studies concluding that students learn better when working with computer-based learning material (Kulik, 1994). However, (Clark & Sugrue, 1988) already noted that achievement gains can be attributed to an increase in students'

attention, but diminish once students become familiarized with the new medium. They found that novelty effects caused an increase in standard deviation averages of 30% concerning achievement gains, but then decays to a smaller margin after eight weeks. (Krendl & Broihier, 1992) presented a study which showed that improvement is even lower, or absent altogether, when studies are conducted over longer periods of time. Their study covered a period of three years, and the findings clearly demonstrate evidence of novelty effect. Students' preference for computers, as well as their perceptions of learning from technology, declined significantly during the three years. Contrary to expectations, the perceived difficulty of using computers remained stable.

Novelty effect and technology acceptance

An approach to generalize the results from educational research would be to examine the relationship between a utility's novelty and its usage patterns. Initial thoughts on this topic can be found in an online article by Clive Thompson (Thompson, 2014). He elaborates on "why a new high-tech tool makes you suddenly more productive or creative – until it doesn't".

Enterprise Social Networks (ESN) are one particular category of online collaboration tools in which the novelty effect has been documented. For example, (Glaser & Ebersbach, 2013) attribute changes in wiki usage patterns to the wiki's fading novelty and the subsequent dwindling of user curiosity. The tool "becomes part of the gray ordinary working day and loses attractivity".

While some reports indicate steady growth in ESN usage, albeit at widely differing rates, (Koch & Bentele, 2011) state that approximately 58% of potential users visit the ESN daily. Others present a steady decrease in usage until an incentivized challenge was released, a reminder was sent, or new features were introduced (e.g., (Müller & Stocker, 2012)).

When investigating models explaining the influence of novelty on adoption, studies on the determinants of acceptance provide preliminary insights. The Technology Acceptance Model (TAM) is one of the most widely used theoretical frameworks that addresses user acceptance or rejection of a new technology (Davis, Bagozzi, & Warshaw, 1989). Novelty can influence the factors of *Perceived Usefulness* and *Perceived Ease of Use* in TAM. It might also influence the factor of *Perceived Enjoyment* (Merikivi, Nguyen, & Tuunainen, 2016). For example, (Webster & Ho, 1997) tested the effects of increasing variety by incorporating new sound effects and animations into a presentation. (M.-H. Huang, 2003) employed the term "novelty" to refer to aspects of a system that users perceived as surprising or unfamiliar. Additionally, a tool's novelty can be seen as a user experience dimension, e.g., to be measured using the User Experience Questionnaire (UEQ) (Laugwitz, Held, & Schrepp, 2008).

The novelty effect in CSCW and HCI research

Several studies exist in CSCW and HCI research that mention the novelty effect in some way. For example, Huang et al. discussed various factors for success and failure with large-display groupware systems (E. M. Huang, Mynatt, Russel, & Sue, 2006). They found that several deployments were characterized by strong initial usage followed by decreasing, more sporadic use.

In their methodology section, Gallacher et al. argued that their artifact was deployed for four weeks in order "to provide enough time to investigate the initial novelty effect" (Gallacher et al., 2015). In the quantitative analysis, they reported that the initial spike in usage declined to a stable level by the second week.

Guerrero et al. suggested that "the novelty factor" likely impacts the motivation to use their artifacts (Guerrero, Ayala, Mateu, Casades, & Alamán, 2016). They concluded that they would need to evaluate their solution over a longer duration in order to determine the extent of this effect.

Hosio et al. stated that many of their displays were deployed in the same place for several years and thereby outlasted their perceptions as novelties, "which is important, as inserting novel technology in public often leads to strong novelty effects and bias in the actual usage." (Hosio, Goncalves, Kostakos, & Riekki, 2014)

As Hazlewood, Stolterman & Connelly noted, "The four-week mark was selected because it was predicted that this was adequate time for most people to have noticed the display, and for the initial novelty factor to wear off." (Hazlewood, Stolterman, & Connelly, 2011)

One example wherein the novelty effect received attention is a study on Chained Displays (ten Koppel, 2011; ten Koppel et al., 2012). The authors investigated to what extent a novelty factor was present following the installation of a game designed to study varying configurations of large interactive screens. To address the novelty effect, they included a post-game questionnaire asking users if they had had seen the installation already, and if it was their first time playing the game. The results (day 1: 93.8%, day 2: 73.1%, day 3: 59.1%) indicated that general awareness of the installation progressed throughout the study; however, the question regarding user's first gameplay experience showed that 72.7% of users who played the game were still new users on the third day.

Additional implicit information on the novelty effect can be found in reports on lengthier studies in the context of playable cities. One example is the UBI Hotspots in Oulu (Ojala et al., 2010, 2012). The authors stated in their 2012 review:

> "We have also observed the novelty factor when we introduce new system features or release a major system upgrade. In both cases, use spikes but then gradually decreases. The effects of novelty vary across instances, but we have consistently observed its impact to some degree [...]"

Finally, the novelty effect can be linked to the idea of "display blindness" discussed and measured in large screen deployments, e.g., "[...] numbers early in the deployment allow a potential novelty effect to be quantified. Numbers at the end of the deployment are most interesting, since they reflect the degree to which

a deployment manages to overcome display blindness beyond the novelty effect." (Memarovic, Clinch, & Alt, 2015)

Discovering the novelty effect in large (semi-)public display deployments

Above, we presented some examples of public display research where the novelty effect was either explicitly mentioned or rudimentarily measured. Motivated by the questions surrounding the novelty effect, we closely examined the data from our own field deployments and then identified metrics that would help us investigate this effect more thoroughly. In the following examples, we present selected results and insights gained from these studies.

(Semi-)public information displays in the CommunityMirror project

In the CommunityMirror project, public displays present non-work-related information deemed nonetheless interesting or useful in the workplace. The screens are installed in semi-public places, e.g., beside elevators, in break rooms, and other social areas where people congregate. By displaying such information, these interfaces can help increase visibility of happenings within the organization (awareness) and facilitate the "accidental" discovery of relevant information without employees having to look it up explicitly (serendipity) (Ott & Koch, 2012).

Experiment 1: IdeaMirror (Blohm et al., 2010)

In this study, we deployed a large interactive screen (IdeaMirror) near elevators and in a business incubator's cafeteria for six weeks. A set of customer-generated ideas was presented to 198 employees from 59 start-ups for voting and commenting purposes.

The actual usage of the IdeaMirror was evaluated by analyzing log file data. In the first days of testing, initial interest in interacting with the new technology was observably strong. Interest decreased over time but spiked following external stimuli (e.g., mentions in an email newsletter), followed again by eventual decrease. Thus, a wave pattern is present in the usage data (see Figure 1).

Experiment 2: Focus on getting attention (Lösch, Alt, & Koch, 2017)

In this study, we deployed an interactive installation consisting of (1) a direct-touch information display with which users could interact using touch gestures, as well as (2) larger projected screens, referred to here as *hallway displays*. The interactive installation was built alongside a pathway. The hallway displays were dynamic, i.e., arrangeable in various configurations, and allowed the evaluation of multiple deployment setups within the interactive hallway.

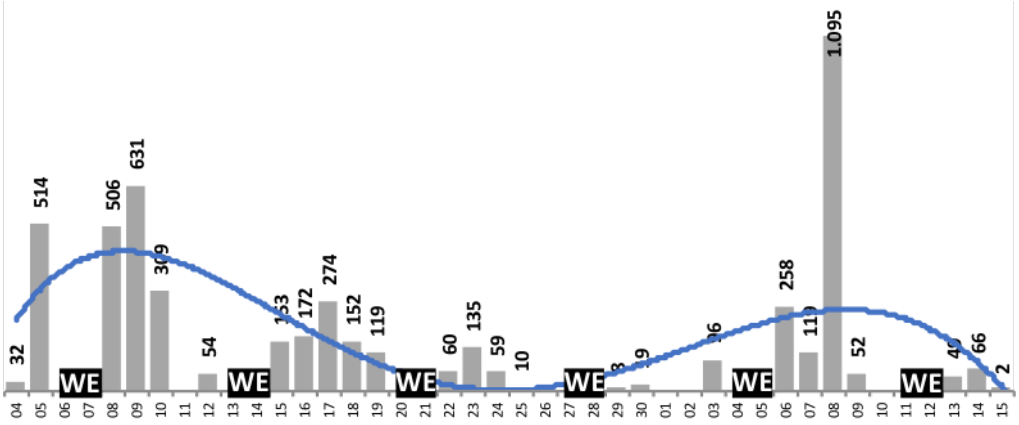

Figure 1. Timely distribution of interactions with the IdeaMirror during the whole field test.

The interactive installation was deployed in a university canteen during lunchtime for six weekdays over two consecutive weeks (from Tuesday to Thursday, respectively). In the field study, five different variants of the interactive hallway (v1-v5) were evaluated. During the six days of our deployment, we changed the setup daily.

To better understand the novelty effect in our setup, we decided to utilize one configuration (v5) of the hallway displays twice – once at the beginning and once at the end of the deployment. Note that the canteen is the main location on campus to have lunch; hence, it can be assumed that many students and staff members visited daily, and crossed the long, one-sided hallway during the initial deployment. The result: the percentage of passers-by that stopped at the installation decreased from 24.7% on the first day to 14.2% on the last day. The interaction rate decreased from 17.1% to 9.9%. The average duration of interaction was also higher (31 s) on the first day than the last (23 s).

Experiment 3: INFMirror

In this study, we deployed a large interactive screen in the semi-public area of a university building next to info-boards that many students and staff members walk by daily.

The screen showed information about people in the department, publications and projects by department members, as well as upcoming departmental events. The display's standard view only visualized items with titles and images. By touching an item, users could access additional information.

We measured direct interaction with the screen over twelve weeks. In the data, there was an observable peak in the first week (70 interactions/week) – followed by lower rates of interaction in subsequent weeks (about 30 interactions/week). This could be explained by the novelty effect – people interacted with the screen out of sheer curiosity rather than having an actual interest in the displayed content.

Ambient Surfaces: a long-term study of semi-public displays for co-located agile software development teams

In recent years, we collected data using experimental interactive display installations in real-world environments, such as in (Schwarzer & von Luck, 2012). Different scenarios and runtimes were applied depending on the deployment's application context and intent; nonetheless, it was consistently evident that the novelty effect influenced the intensity of use in the early stages of each study. Our ongoing research has produced similar results, and so we began to thoroughly document parameters that we believed were influencing this phenomenon (e.g., the release dates of new features and updates).

The Ambient Surfaces project aims to provide the project partner's agile software development department with large interactive displays (see Figure 2). In collaboration with the department, these systems were revised over the years to maintain their value, e.g., by continuously integrating new or upgrading existing information views such as GoCD[1]. The intent is to (a) access and display relevant information from the company's intranet and (b) display this information in a high-traffic common room on large screens (≥ 46 inch), thereby encouraging informal gatherings and discussions. The displays contain multiple information layers when accessing their contents. Some views display basic information such as a website; in these cases, one layer is sufficient to present the information. In other instances (e.g., GoCD), the volume of data required us to build several view layers and incorporate user interface elements such as scrollable lists. In addition, different colors and animations were utilized to attract attention (e.g., when automated builds failed to execute). The first Ambient Surface was installed in February 2014 followed by the installation of a second system in August 2015. This was due primarily to usability issues resulting from the amount of relevant information accessible from the various development tools in the department.

A mixed-design grounded theory is used in our research. Data collection techniques incorporate qualitative as well as quantitative data, including touch interactions, observations, interviews, team calendar information, field notes, email feedback, and visual data recorded by two Microsoft Kinect cameras. Initial results were presented in (Schwarzer et al., 2016). By contrasting various data parameters, we set out to understand how, when and in what contexts the Ambient Surfaces are being utilized, what information is relevant, and how this correlates to the department's "formal frame" of communication (e.g., daily stand-up meetings). Throughout the study, by analyzing touch interaction logs, two phenomena were dominant in the material with respect to the novelty effect: (a) an increase in interactions following the systems' initial deployments, and (b) reoccurring spikes in interaction during or immediately following system updates.

[1] https://www.gocd.org/

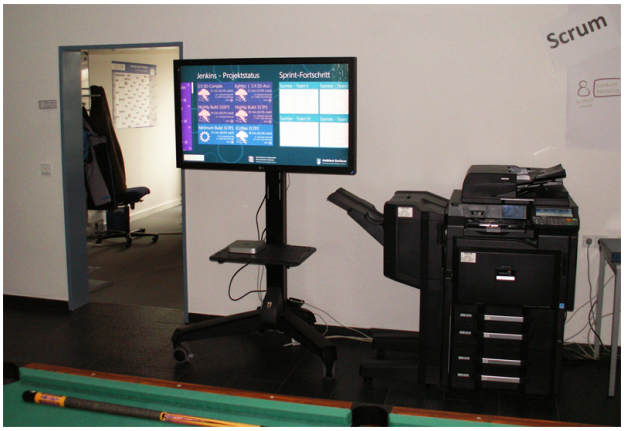

Figure 2. Ambient Surface setup in a common room area (March 2015).

In 2014, the mean touch-down events[2] per week first fell below the all-year mean (485.22) in Week 18, which was the 11th week of the field study (see Figure 3). Out of 21,835 touch-down events in 2014, weeks 8–17 accounted for approximately 73% (15,949) of them. It is worth noting that, due to some initial technical issues, the system went operational on Friday during Week 8, which explains why the largest number of interactions ever recorded occurred in Week 9. Furthermore, as a result of third-party component compatibility issues, it was not possible to deploy a web browser component for displaying content from a wiki website until Week 11. In addition, out of roughly 75 employees who worked in the same building, only a few were familiar with the Ambient Surfaces prior to deployment. A small team of representatives (including management personnel, Scrum Masters and developers) were involved in the final phases prior to February 2014. The use of such physical artifacts was also novel in the department. Another factor worth considering stems from the circumstance that not all employees were always present. While discussing touch interaction patterns in a group interview, it was apparent that there were several reasons for absences in the workplace, such as illnesses, trainings, and holiday seasons. With respect to the all-year mean interactions, this may explain the lengthier and greater amount of interactions during the first ten weeks when compared to examples from related literature (Hazlewood et al., 2011). However, the first four weeks showed the highest quantity of interactions.

[2] In the following, only touch-down events occurring between 7.00 a.m. and 8.00 p.m. were considered.

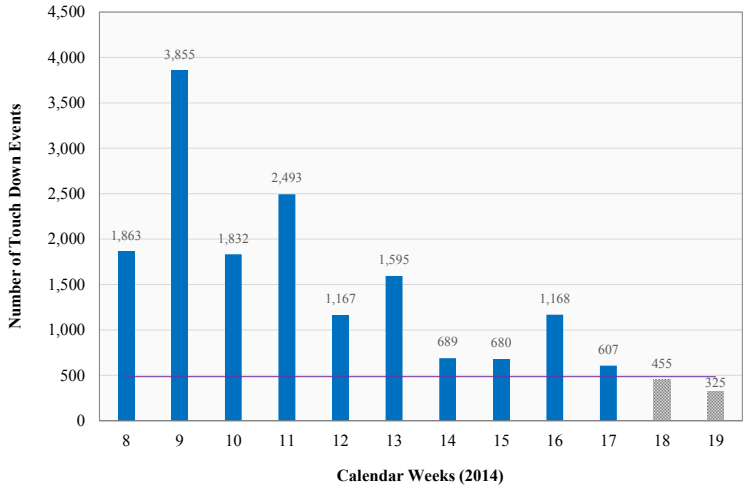

Figure 3. Touch down events per week (8–19) in 2014 (all-year mean=485.22).

Additional patterns were observable before, during, or after changes were applied to the systems (e.g., replacing or updating an information view). The following exemplarily displays three events which occurred during the first 20 weeks of 2015 (see Figure 4).

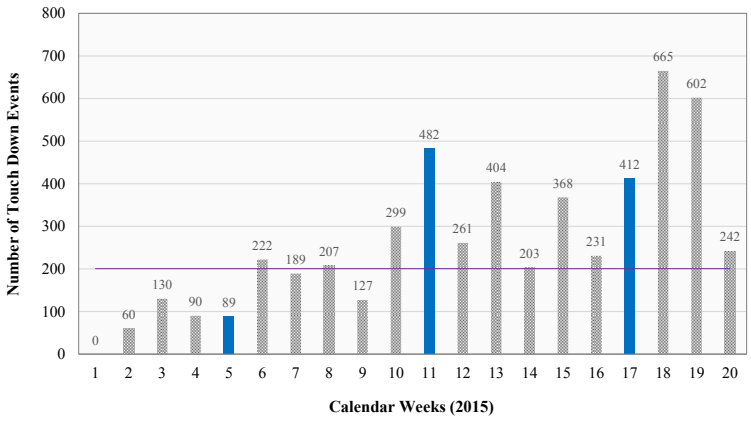

Figure 4. Touch-down events per week in the first 20 weeks of 2015 (all-year mean=200.66).

The first update was on account of the department's use of Jenkins[3] for continuous integration tasks. Occasionally, new product versions are created and new projects are generated in Jenkins therefor. These projects must be registered in a configuration file to be displayed on the Ambient Surfaces (as indicated in Week 5). As a result, the number of interactions per week increased throughout the following weeks, possibly due to the increased usefulness of the presented contents as development progressed over time. These change requests are predominantly communicated by Scrum Masters.

[3] https://jenkins.io/

The second update was the result of direct discussions with developers, and a new information view was added in Week 11. The view displayed a table with known bugs and corresponding teams who were responsible for resolving the issues. By Week 13, this view was revised in collaboration with developers. The modification also resulted in a higher number of interactions, possibly attributable to an increase in content quality. It should be noted that the collaboration and revision process with the developers likely affected the total number of interactions. For example, developers reviewed recently deployed user interface updates with colleagues and interacted with the surface.

The third update followed observations, informal discussions, and a subsequent group interview; the whole system then underwent considerable revision in Week 17. Some information views were removed, a new view was added, and another was updated. Three Jira[4] RSS feed visualizations were removed due to the high volume of dynamic information displayed throughout the day. Respondents found it difficult to follow; thus, the Jira visualizations were of little value. Users preferred to utilize the display's available space more efficiently by displaying other helpful contents, which included another Jenkins view to better distinguish between product versions and their corresponding Jenkins projects. Furthermore, a Jira-based burndown chart was added to display a product version's progress. All of these changes resulted in an increase in interactions. It is worth noting that, prior to the revised deployment on Sunday of Week 17, the system was evaluated by at least some members of the management team (who sent us an email with final instructions on Friday), which may explain the increased interactions in Week 17 and suggest an increase in the perceived value of the content displayed in subsequent weeks.

We consistently observed patterns similar to the examples above when deploying other updates and revisions to the Ambient Surfaces throughout the entire study.

Lessons-learned for designing prototype evaluations

As noted in the introduction, the novelty effect must be considered in any research dedicated to understanding the potential use of novel technologies. In the following section, we distilled some lessons-learned and crafted recommendations for future researchers. We found that the novelty effect was predominantly present in two scenarios: (a) initially, after a system's deployment, and (b) when changes are made to the system's state. The results suggest that formulating conclusions with respect to the novelty effect can present more challenges than researchers may initially anticipate.

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[4] https://de.atlassian.com/software/jira

How long does the initial novelty effect last?

Existing research recommends conducting deployments for a sufficient period of time in order to ensure that results are not tainted by the novelty effect. For example, (Hazlewood et al., 2011) emphasized "*Run[ning] for an extended time"* to ensure that the display was adopted and fully integrated into participants' daily routines. They reported that the timeframe adequate for most people to notice the display was four weeks, i.e., the novelty effect diminished during that time. Additional evidence proposes that it can take up to six months to mitigate the novelty effects of new technology (Prochaska & DiClemente, 1982). We found that the novelty effect took ten weeks to subside in our Ambient Surface project. One week, however, was sufficient for the usage patterns to stabilize in Experiment 2 of the CommunityMirrors project.

Further examination of factors influencing the novelty effect is necessary to provide guidance for researchers. For example, the CommunityMirrors and the Ambient Surfaces can be categorized as voluntary and mandatory applications, respectively. This distinction was relevant in the context of enterprise social networks, where maintainers commented that they did not see decreased usage because daily log-ins were mandatory. However, this approach could have its own limitations because, even with mandatory usage, users may demonstrate varying levels of engagement. More precisely, the novelty effect may be related to how deeply integrated a tool or technology is into an organization's operations. If this is the case, then the effect would be highly dependent on a tool's operational necessity, ranging from mission-critical (e.g., ERP systems) to occasionally useful (e.g., coworker status updates). The CommunityMirrors, for example, are not intended to be integrated into business operations. Finding ways to attract an individual's attention is already an inherent design challenge, and so the novelty effect quickly faded (e.g., Experiment 2). By contrast, the Ambient Surfaces are designed for integration into business operations by displaying only relevant, work-related information. Employees are more motivated to use them, thereby influencing the observable duration of the novelty effect.

How long does the reoccurring novelty effect last?

We found that the novelty effect is not only important at the beginning of a deployment, but also throughout its operational lifespan. Especially in long-term deployment studies, novelty is repeatedly caused by changing a system's state, e.g., adding new features, drawing attention to the installation and/or its existing features, or simply updating its content. For systems not designed for workplace integration (e.g., the CommunityMirrors), this reoccurring novelty effect, i.e., the increased attention and the subsequent usage spikes following content updates, is critical. The effect helps maintain user interest and bolster perceived usefulness.

As with the initial novelty effect, we were interested in learning more about its counterpart. In the Ambient Surfaces deployment, we found that usage pattern anomalies (i.e., compared to all-year mean analyses) were regularly observable because the systems needed frequent updating in order to provide continuous value for employees. Precisely identifying the root causes of usage spikes, however, is not always possible without the constant presence of a researcher in the workplace (e.g., when a new employee first encounters a system). In other cases, causes were easily identifiable, e.g., after adding new features developed in collaboration with select employees. Thorough observation of the effect can also help determine a feature's practical value. In one instance, we found that our *meeting reminder* feature was of little value – it was seldom used even in the novelty phase, and usage then rapidly dropped to zero.

Our data revealed varying magnitudes with respect to the reoccurring novelty effect. Some changes entail a higher usage in subsequent weeks, such as in Week 5 (see Figure 4); other changes suggest that this implication may not always be the case, such as in Week 11. We conclude that, even in reoccurring cases, the novelty effect can last several weeks, but additional research is necessary to substantiate these findings.

Summary and preliminary set of dimensions

Identifying the exact reasons for the novelty effect in both reoccurring and initial contexts is a highly complex procedure, as is determining when the effect begins to abate. It implies the need for resource-intensive data collection techniques such as in-situ observation. Furthermore, some influential factors are not feasibly measurable, such as parental-leaves and holiday seasons.

In our research, the novelty effect is relevant for both deployments, but may not necessarily be relevant for related studies. For example, initial identification of the effect helped to validate the Ambient Surfaces' perceived value to employees for months and even years after the initial deployment. It also prevented us from presenting arbitrary conclusions. The reoccurring cases assisted, e.g., in determining a feature's long-term value. Table 1 summarizes our projects' findings in relation to the novelty effect.

Novelty Effect Occasions	Purpose	Duration
CommunityMirror project		
Initial	*E.g., determining the system's usefulness.*	*1–2 weeks.*
Reoccurring	*E.g., importance of constantly introducing new information for maintaining usage.*	*Still to be analyzed.*

Ambient Surfaces project		
Initial	*E.g., determining the systems adoption.*	*10 weeks (based on mean analyses).*
Reoccurring	*E.g., value of new features.*	*In some cases, several weeks. Further research necessary.*

Table 1. Novelty effect occasions, purposes, and durations in our research projects.

The duration of novelty-based behavioral change depends on a variety of contextual variables. Table 2 proposes a set of preliminary dimensions to classify deployment situations in order to assist researchers with classification of their own research endeavors and help identify factors that influence the novelty effect in their studies. In summary, we see two categories of dimensions combining (1) factors related to the user, usage, and value to the user and (2) factors related to novelty-inducing changes, including, e.g., changes to the setup, functionality, and the displays' contents in particular.

Regarding the first category, we found that an individual's *intrinsic motivation* (e.g., Scrum Masters' and management's interest in keeping the contents up-to-date) must be considered. Furthermore, the *number of potential users* (e.g., in cafeterias versus offices), the typical *intensity of use* (e.g., the number of touch inputs necessary for system interaction), the *required competence* (i.e., necessary training), and the *relevance for practice* (e.g., CommunityMirrors in contrast to Ambient Surfaces) have been identified as key influential factors.

In the second category we observed that the *frequency of change*, the *magnitude of change*, the *contents' presentation*, the *means for attracting attention*, and the *participatory development* process during a system's deployment or update are important considerations. As noted above, the Ambient Surfaces deployment utilizes various designs and interface components for displaying content, e.g., color schemes, animations, scrolling lists, and nested layers. The interfaces were regularly updated with new components and features to varying extents, sometimes developed in direct collaboration with employees. The implicit effects of applied interface components must be considered when investigating the novelty effect. Navigating through multiple information layers or scrolling through content, for example, will increase the number of logged interaction events. In one case, we received feedback that blinking red Jenkins items (indicating unexpected build failures) often raised the attention and curiosity of employees as to their cause. This was sometimes averted by the automatic update feature which fetched the latest data from the Jenkins server every ten minutes. Spikes in content navigation and scrolling events were nonetheless evident to a degree in our interaction log analyses. Furthermore, collaborative development has likely affected the degree of perceived novelty present in our research. For example, when the number of employees involved in collaborative development increases, we hypothesize that

the observable post-update novelty effect decreases, i.e., the number of interactions does not notably increase.

Influencing factors	Range of Value	
	From	*To*
(1) Influencing factors related to users		
Action orientation / Relevance for practices	*None (e.g., advertising)*	*Strong (e.g., dashboards)*
Intrinsic motivation for use	*Low*	*High*
Number of users	*Low*	*High*
Intensity of use	*Occasionally (e.g., ticket machine)*	*Regularly (e.g., dashboards)*
Required competence	*None (e.g., naive users)*	*Training (e.g., business users)*
(2) Influencing factors related to change (causing novelty)		
Frequency of change	*Occasionally*	*Regularly*
Magnitude of change	*Low*	*High*
Presentation (of content)	*Simple*	*Complex*
Means for attracting attention	*Few*	*Many*
Participatory development	*Without end users*	*With end users*

Table 2. Preliminary set of dimensions of influences and their attributes.

The CommunityMirror example can be categorized as follows: occasional use, naive users, weak action orientation, low intrinsic motivation, and a high number of users. The research questions focused primarily on drawing user attention and awareness. For the system's use case, the reoccurring novelty effect is strategically useful for achieving the intended goal, but the initial novelty effect can lead to misinterpretation of the data. The Ambient Surface deployment, however, can be categorized as follows: regular use, trained users, strong action orientation, high intrinsic motivation, and a high number of users. In addition, changes – including cases with considerable revisions (high magnitude) – were regularly deployed. The content depth ranged from simple to complex, and in addition, various means to draw attention and increase the value of displayed content were conceived and deployed, occasionally in direct collaboration with employees.

The novelty effect in both contexts (initial and reoccurring) is a relevant influencing factor when analyzing interaction data. Depending on the research questions, these patterns should be identified in the corresponding log data, and their affects accounted for to ensure unbiased analysis.

Conclusions

This paper presented and discussed the current body of knowledge regarding the novelty effect, particularly in the CSCW and HCI disciplines. Two denotations were used to depict the novelty effect on different occasions: (a) initially, when a system is deployed and (b) reoccurring, when a system is changed or updated. Examples were provided and possible impact factors were explained for both cases. Although this exploratory paper presents preliminary results, we believe our findings contribute to the discussion of the novelty effect in CSCW and HCI research by explicitly identifying observed instances of occurrence. Researchers, specifically those conducting studies on a system's adoption, may find valuable insights in our discussion, and practitioners can learn more from multifaceted questions regarding the introduction of new technologies in practical contexts.

Our research is not without limitations, which primarily stem from a conceptional and methodological level. CSCW and HCI research has only recently begun to investigate what *novelty* inherently implies. Novelty is a complex concept, highly dependent on intertwining variables such as application context and target demographics. Thus, promising directions for future research include exploring means to more precisely conceive the term novelty. One approach is to clarify the concept itself by distinguishing between characteristics such as new content, new interactive features, and new hardware. Another approach is to address the practical influence of novelty, and provide researchers with a standard for identifying and measuring the novelty effect's presence, and a means to account for the effect's influence on their own studies. We learned that qualitative tenets (e.g., thick description) helped in investigating the novelty effect, but research still fails to present sound methodological recommendations for evaluating prototype technologies in this regard. The intent of this explorative paper is to provide initial ideas for accomplishing this goal. We were not aiming at creating a model for the various factors that influence novelty and how these factors affect (initial) usage. However, technology acceptance research suggests that initial use involves alignment of artifact, work practices and organization. This results in the identification of a range of factors influencing use as defined in the TAM model (Davis et al., 1989). According to this model, a decline in usage may stem from decreased perceived usefulness and difficulty of use. We invite further conceptual discussion including technology acceptance models (e.g., TAM, UTAUT, or (DeLone & Mclean, 1992)) to clarify the novelty effect's plausibility.

Lastly, we call for more thorough research into the distinctions between related effects such as the Hawthorne effect. Such research is valuable for short-term experiments in real-world environments as well as the novelty effect's conceptualization.

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