Everyday Appropriations of Information Technology: A Study of Creative Uses of Digital Cameras

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Abstract

Repurposive appropriation is a creative everyday act in which a user invents a novel use for information technology (IT) and adopts it. This study is the first to address its prevalence and predictability in the consumer IT context. 2,379 respondents filled in an online questionnaire on creative uses of digital cameras, such as using them as scanners, periscopes, and storage media. The data reveal that such creative uses are adopted by about half of the users, on average, across different demographic backgrounds. Discovery of a creative use on one's own is slightly more common than is learning it from others. Most users discover the creative uses either completely on their own or wholly through learning from others. Our regression model explains 34% of the variance in adoption of invented uses, with technology cognizance orientation, gender, exploration orientation, use frequency and use tenure as the strongest predictors. These findings have implications for both design and marketing.

Introduction

It is now commonly accepted that *adopting* a piece of technology is only partially about using it to accomplish ends for which it was designed. Rather, adoption also entails transformation of an initially alien and impersonal artifact into something practical and personal by modifying and repurposing it (Al-Natour & Benbasat, 2009; Carroll, Howard, Peck, & Murphy, 2003; Dourish, 2003; Haddon,

2003, 2007; Kellogg & Erickson, 2005; Orlikowski, 1992, 1996; Rice & Rogers, 1980; Silverstone, Hirsch, & Morley, 1992; Wirth, von Pape, & Karnowski, 2009). One cornerstone of adoption is *repurposive appropriation*: a creative everyday act wherein a user invents and adopts a *new* use. For example, digital cameras are appropriated in surprising ways, as "periscopes" at rock concerts and as "scanners" of paper documents. Appropriations are an example of everyday creative acts that regular people may perform and are not specific to artistic activities only.

Appropriation has potential economic implications (von Hippel, 1988). The hacker, do-it-yourself and maker communities have shown that even consumers with low social power may repurpose the technology beyond what has been afforded by the manufacturers (Abu-Lughod, 1989; Eglash, 2004; Schäfer, 2011; Turner, 1992). The open source movement has successfully activated end-user communities to create new markets and technologies (Raymond, 1999; Tuomi, 2002). Seeking further understanding of appropriation should be a central research goal for modern information technology (IT) research.

The majority of scientific work on appropriation's predictive factors has been done in organizational contexts, where a culture of experimentation and innovation (Balka & Wagner, 2006; Kellogg & Erickson, 2005; Mackay, 1990; Nambisan, Agarwal, & Tanniru, 1999) as well as organizational changes and conflicts (Lassila & Brancheau, 1999; Majchrzak, Rice, Malhotra, & King, 2000; Tyre & Orlikowski, 1994) have been found to promote appropriation. The role of individuals is also essential: those with knowledge of multiple domains (Fleischmann, 2006) or technological competence can act as "translators" (Mackay, 1990), "tinkerers" (MacLean, Carter, Lövstrand, & Moran, 1990), "gardeners" (Nardi, 1993), and "mediators" (Bansler & Havn, 2006; Orlikowski, Yates, Okamura, & Fujimoto, 1995) of novel uses. But the relevance of these findings to consumer IT appropriation is unclear.

What is known about individuals' propensity for appropriation? Technology acceptance models (TAMs) tell little about this matter, because they have traditionally predicted *intention* to use instead of *actual* use (e.g., Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 2000), overlooking the richness of different ways "adoption" takes place (Al-Natour & Benbasat, 2009; Barki, Titah, & Boffo, 2007; Burton-Jones, 2005; Burton-Jones & Straub, 2006; Jasperson, Carter, & Zmud, 2005; Salovaara & Tamminen, 2009). Moreover, TAM studies have often focused on adoptions that are aligned with managers' views of "proper" use (e.g., Nambisan et al., 1999; Rüel, 2002). Outside organizational IT, qualitative observations have linked the individual's tendency to appropriate to affordances perceived in the environment (Wakkary & Maestri, 2007, 2008), to development of "resources for action" (Salovaara, 2007), and to representations developed by interacting with the world and the artefact (Salovaara, 2008). In the only quantitative study we are aware of, self-efficacy theory (Bandura, 1986) was employed to explain creative use in terms of general computing knowledge and belief in ability to use computers (Mills & Chin, 2007), explaining

62 % of the variance in creative uses. However, this work measured creativity in technology use on a general self-assessment level, without explication of the actual creative uses.

Our study focuses on individual-oriented factors to predict repurposive appropriation. Within this scope, the present online questionnaire study expands upon earlier work in both depth and breadth. First, we study *specific* appropriations instead of the general, *unspecified* creativity considered by Mills and Chin (2007). This allows us to look at factors such as whether appropriations were invented autonomously or through social learning. We focus on a widely adopted everyday technology: digital cameras, including those in mobile phones. The digital camera is both a clearly defined artifact (i.e., designed for taking pictures and storing them in digital form) and an open-ended one, in that the same functionality can serve many ends. The specific appropriations addressed in our study were the uses of a digital camera for the following less self-evident purposes: mirror, map, note-taking device, scanner, memory storage, lamp, instruction device, and periscope. Second, we examine a broader set of variables. It is known that creative people in all domains tend to evaluate and reflect on their progress and weaknesses in their practice (Weisberg, 1993) and often take up goals that require risk-taking, exploration, and solving of poorly defined problems (Mumford, Mobley, Uhlman, Reiter-Palmon, & Doanes, 1991; Sternberg & Lubart, 1995). Creative people in the arts and sciences are also more likely to exhibit particular personality traits (esp. openness of experience, introversion, and lack of agreeableness). In addition, artists often show signs of anxiety (or neuroticism) and lack of conscientiousness (Feist, 1999). These personality characteristics are included also in this study. In addition, the present study also looks at adoption of appropriations to recurrent use. Adoption requires ability from a user to generalize the creative insight to the varying instances of daily life where the novel use can be applied. We therefore explore the users' tendencies to make original discoveries and also the abilities to adapt these discoveries to multiple life instances in long-term use practice. In this dual interest in both discovery and adoption, we follow MacKinnon's (1962) definition of creativity, which involves generating a new solution to a problem and realizing it in action.

Related work and open questions

We address the following open research questions (RQs) in the present questionnaire-based study:

RQ1: How common are creative uses?

The commonness of creative uses has not been previously measured in the consumer IT domain (e.g., Igbaria, Zinatelli, Cragg, & Cavaye, 1997, measured only routine uses in small companies). The present study reports digital-camera users' tendency to adopt creative uses.

RQ2: How frequently are the creative uses learned individually?

Previous studies have left open the question of whether users invent appropriations individually or if appropriations rather emerge in situations of social learning, for example through direct

demonstrations or mimicking. For design and marketing, it would be useful to understand whether appropriations are due to personal discovery or adoption of practices from creative individuals in the user community.

RQ3: Which individual characteristics predict personal discovery of creative uses?

Previous technology-oriented work has not led to a consistent picture of the factors involved in discovery of creative uses. Many experience-related background variables have been hypothesized, such as fixation caused by prior exposure (Huysman, Steinfield, Jang, David, Huis in 't Veld, Poot, & Mulder, 2003), transfer from previous systems (Salovaara, 2007; Van Rijnsoever & Castaldi, 2009), technical knowledge (Mills & Chin, 2007), and perceived familiarity with the system (Höök, 2006). An explorative technology-oriented mindset (MacLean et al., 1990) has also been proposed as a contributing factor. In the construction of the questionnaire, we sought to operationalize these factors and include new ones. We addressed the experience-related factors with Technology cognizance and Technology cluster cognizance constructs. The previously presented general creativity-related factors and the above-mentioned technology-related explorative mindset were operationalized using constructs for Goal-setting of personal projects, Reflexivity, Curiosity, Spontaneity, and Appropriation-seeking. In order to contrast these individual-oriented factors with the importance of learning from others, we added a Consultancy construct. Finally, we also included the factors from the Five Factor model of personality in order to explore the similarities of a creative personality and a creative technology user.

RQ4: Which individual characteristics predict adoption of creative uses?

It is important to understand the change in practices after the creative discovery, because the user may later abandon the novel use as impractical or for other reasons. We therefore use the same set of factors as in RQ3 to address *Adoption* of creative uses, in order to learn which personal characteristics increase a user's tendency to adopt a creative use into an ongoing practice.

RQ5: Which type of discovery predicts adoption to long-term use?

Knowing whether adoption of a novel use is more common when the use has been discovered on one's own than when learned from others should aid in determination of how best to support appropriation. To date, computer-based solutions have been centered on concepts with an individualistic tenor, such as customization, end-user programming, and parameterization (Henderson & Kyng, 1991), as well as visual programming (Nardi, 1993), programming by modifying example pieces of code (Nardi, 1993; Mørch, 1997) and other end-user development methods (Lieberman, Paternò, Klann, & Wulf, 2006). Designers and researchers have also pondered what makes technology appropriable without programming (Chalmers & Galani, 2004; Dix, 2007; Gaver, Beaver, & Benford, 2003; Höök, 2006; Sengers & Gaver, 2006) and have proposed such design goals as configurability (MacLean et al., 1990; Williams, Stewart, & Slack, 2005), equivocality (Bansler & Havn, 2006), malleability (Carroll,

2004), and supporting multiple viewpoints (Dourish, 2003). We believe that better understanding the trajectory from discovery to adoption would help in focusing design efforts.

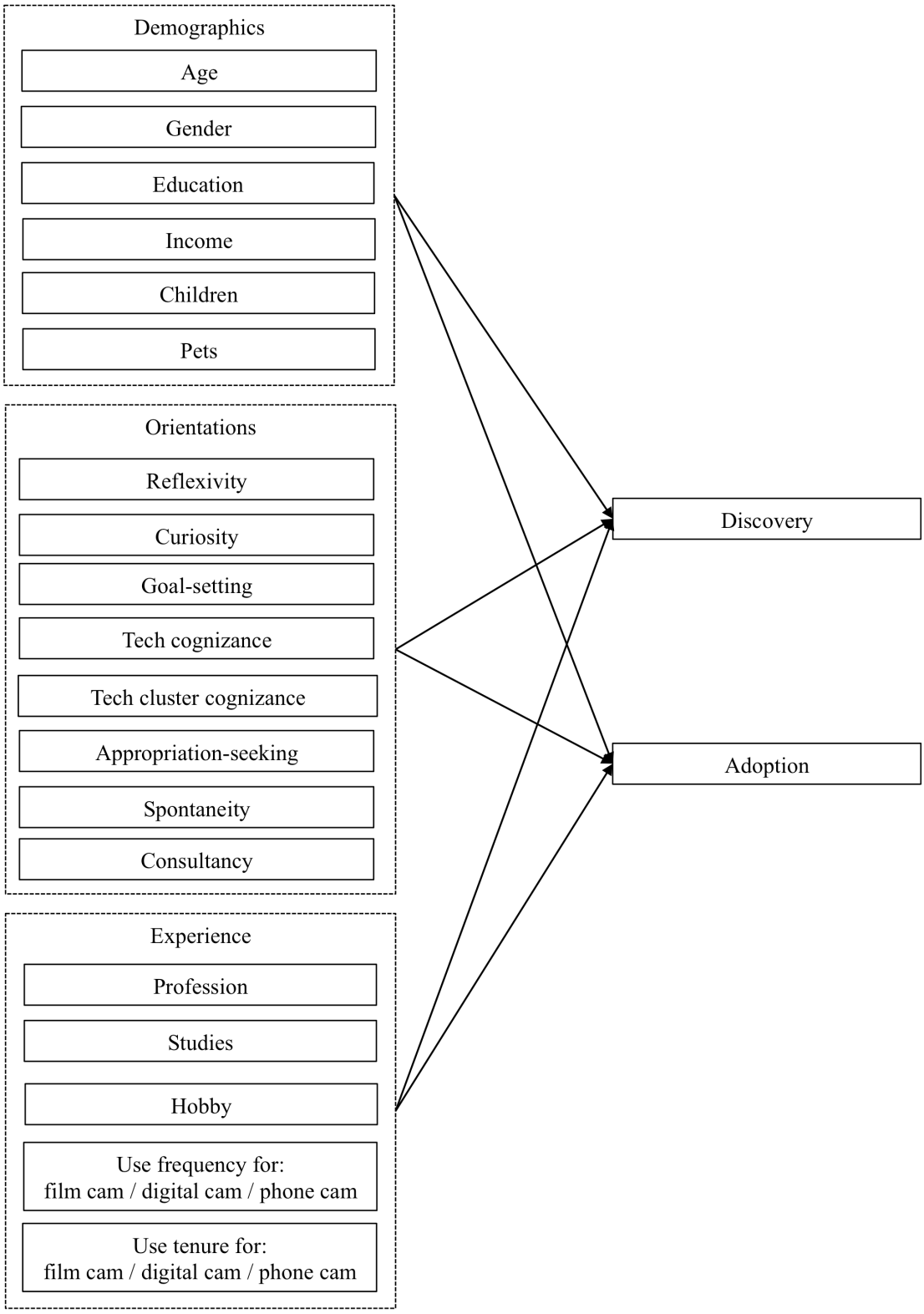

Figure 1. Initial research model.

Research design

Our research model is presented in Figure 1. The model covers three sets of factors. The first set contains *demographic* and other background variables unrelated to photography. The second set describes *orientations*: different practices and ways how users approach photography. Finally, the third set measures *experience* and activeness as a photographer. While the first set logically precedes the others, the dependency between orientations and experience-related factors cannot be judged. Therefore, the model is analyzed sequentially in two regression stages, first addressing the contribution of demographic variables only, and then adding the orientations and experience to improve the predictive capability of the model.

In line with our interest in both initial discovery and subsequent adoption, we use two dependent variables describing appropriation (*Discovery* and *Adoption*) for a predefined list of creative digital camera uses.

In addition to the online questionnaire sample (N = 2,379), we gathered a separate personality sample (N = 103) in which the respondents also participated in a Five Factor Model personality test, in order to evaluate the importance of personality in relation to demographics, orientations and experience-related factors.

Sampling

We decided to administer the study online because of the generality of the sampling frame: digital cameras are an everyday technology that almost all Westerners are familiar with. The sampling frame covered the entire population of Finland, and probability sampling was not possible.

The questionnaire was advertised in student associations' and universities' e-mail lists, in photography-related forums, and as a Web banner and a newsletter remark for the most popular photo upload Web site in Finland (www.kuvaboxi.com). Keyword-based advertising space was bought from a Finnish search engine company Eniro. We also received help from camera clubs and associations that distributed the questionnaire to members. Moreover, snowball sampling was used: the last page of the questionnaire allowed respondents to invite friends. Responding was anonymous, but to participate in a raffle of 15 gift cards (each for €20), the participant was asked to provide an e-mail address. We carried out two rounds of pilot studies before releasing the final questionnaire in November 2008 in Finland.

The personality sample was collected as a part of a large longitudinal study conducted at University of Jyväskylä, Finland (Helfenstein, 2010). The respondents had participated in two rounds of questionnaire-based data collection prior to their participation in the data collection for the study presented in this paper.

Respondents

The respondents represented both genders (males 46.8%) and covered people 8–97 years of age, with 41.4% being between 20 and 40 years old (mean: 42.0 years, *SD* = 15.0).

Hobbyists/amateurs and experts/professionals (as measured on a four-point self-report scale) participated actively, with 47.9% of the respondents classifying themselves as hobbyists/amateurs and 5.5% as experts/professionals. Casual snapshot-takers accounted for 36.2% and novice photographers for 8.6%. The "other" category covered 1.7% of the responses. In a follow-up question, respondents in the "other" category mostly described cameras as tools for their practical work rather than means of expression. These exposure and experience-related characteristics are summarized in Table 1.

The snowball sampling somewhat remedied the natural bias towards higher education levels caused by advertisement of the study for student associations. Among the respondents, 2.3% had not finished their comprehensive school, 10.3% had a comprehensive school degree, 17.8% had a high school degree, 35.5% had a vocational secondary education degree, 11.0% had a BA-level polytechnic degree, and 26.6% had a MA degree or higher. Compared to the national averages in Finland (Statistics Finland, 2009) this sample was overrepresented by people with higher education degrees (i.e., polytechnic, BA or higher) among 25–35 year olds (*N* = 565; 23.7% of the respondents) by 15.7 percentage points and among 55–65 year olds (*N* = 533; 22.4% of the respondents) by 14.0 percentage points.

Table 1. Respondents' experience levels and frequencies of use of various camera types.

Camera type	Had experience in using	Was using at least once a month at the time of the study
Film camera	82.6%	11.6%
Digital camera (compact or single-lens reflex camera)	97.7%	90.1%
Phone camera	79.5%	47.7%

The separate personality sample consisted of present and past university students with a mean age of 28.7 (*SD* = 5.7), 41.2% of them males. Of the participants, 50.5% classified themselves as snapshot photographers, 33.0% as hobbyists/amateurs, 7.8% as novices, 1.0% as experts/professionals, and 7.8% as belonging to some other category.

Dependent variables (DVs)

Our study had two dependent variables:

- *Level of personal discovery (Discovery)*: differentiates the respondent's own role vs. social basis of the discovery. In one extreme are the cases in which the discovery has been made

completely on one's own while the other extreme denotes the cases in which the discovery has been mimicked from other people .

- *Extent of adoption* (*Adoption*)*:* differentiates levels of actual adoption ranging from no use at all to habitual, continuous use.

Regarding the moment of discovery, we originally planned to gather data about also other contextual factors than the individual–social dimension. However, we had to decide after two pilot studies that the respondents would not be able to reliably recall and describe more details about the situations, particularly because the discoveries had typically taken place years before.

To measure these two DVs, respondents were asked a set of questions related to the following eight creative and non-obvious purposes of digital camera use.

1. *Mirror*: Pointing the camera toward oneself – to see how one's face looks, for example.
2. *Map*: Taking a photo of a map and using that photo in place of a paper map.
3. *Note-taking device*: Using the camera for taking notes when the content is highly visual – e.g., when shopping for clothes.
4. *Scanner*: Capturing printouts and text as images with a camera.
5. *Memory storage*: Plugging the camera into a computer as one would a USB memory stick (does not work with all models equally).
6. *Lamp*: Exploiting the camera as a light source.
7. *Instruction device*: Using a sequence of photos to provide step-by-step instructions.
8. *Periscope*: Inspecting places that are otherwise inaccessible to human vision but where a camera can enter.

These uses were selected for the reason that they are specific to digital cameras. For example, traditional film cameras lack memory cards and displays and cannot support these uses. To generate this list, we used data from previous studies of everyday digital media use (e.g., Salovaara, Jacucci, Oulasvirta, Saari, Kanerva, & Tiitta, 2006; Salovaara, 2007, Jacucci, Oulasvirta, Ilmonen, Evans, & Salovaara, 2007) and websites listing untypical camera uses (e.g., www.diylife.com/2009/09/14/unusual-uses-digital-cameras-22-clever-uses/). The set of uses was therefore researcher-generated: the respondents did not have the option of extending the list with their own suggestions. Preselection was necessary in order to ensure that respondents would answer to the same questions. However, in two pilot studies we gave respondents a chance to propose additional appropriations, but we found no new appropriations suitable for the study this way.

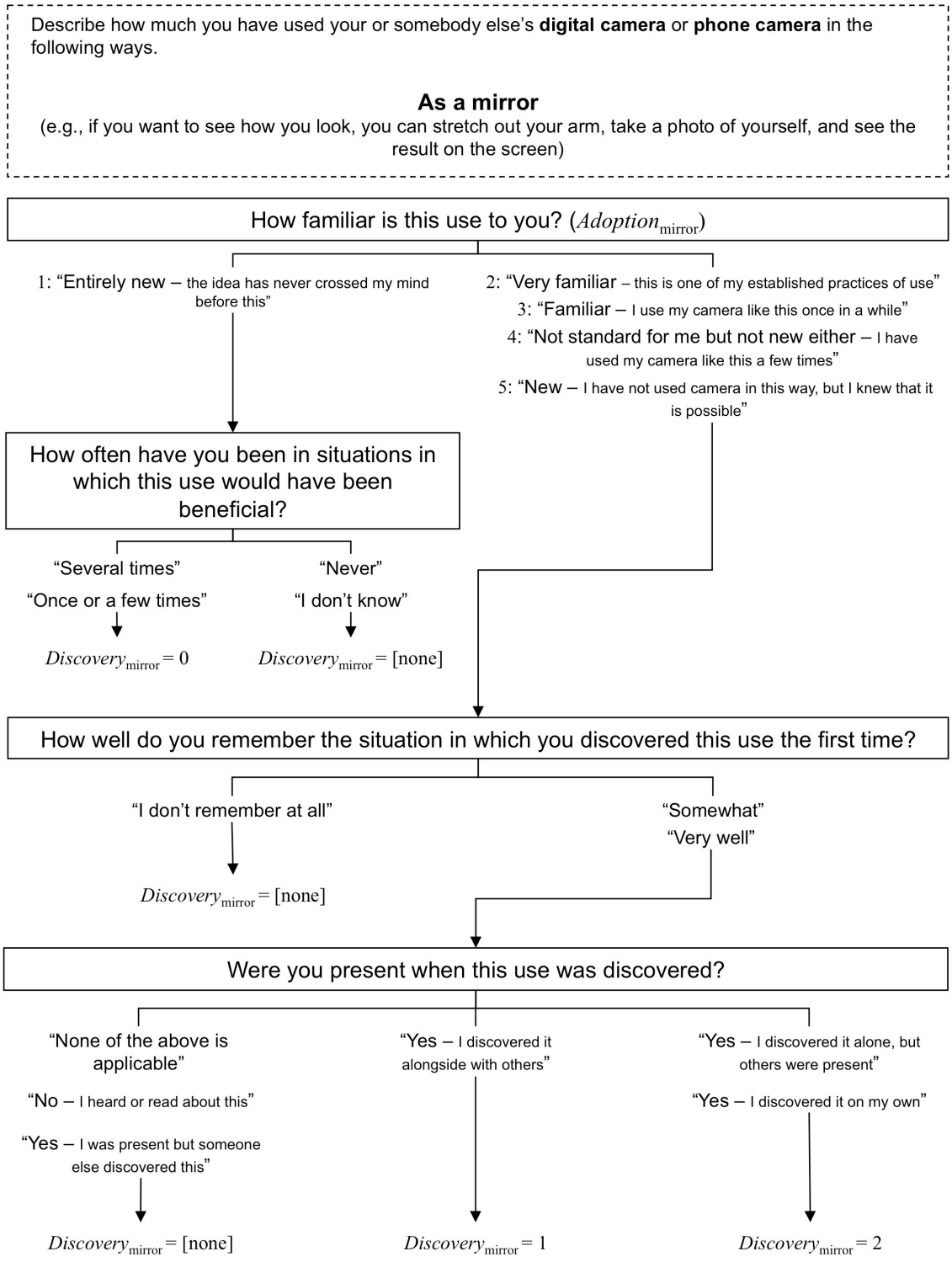

Figure 2. An example of the tree-structured questionnaire, showing also the scoring used for *Discovery* mode and degree of *Adoption*.

Figure 2 shows our tree-structured procedure developed for asking questions about each appropriation. The questionnaire items were organized such that follow-up questions were asked only in the

condition wherein the respondent was able to provide an answer to it, given the previous answer. *Discovery* and *Adoption* were calculated as an average (with missing values omitted in the calculation of *Discovery*) over the eight appropriations. The benefit of this approach is that respondents are not shown questions they would not be able to answer.

Independent variables (IVs)

We organized the IVs into three distinct sets. The first set included the respondent's age, gender, education level, and level of income, as well as whether the respondent had children or pets. We included the latter two variables because they had been found to correlate positively with a person's camera-use frequency (Sarvas, personal communication, 24 October 2007).

The second set measured the level of experience, in terms of photography-related experience from one's studies, hobbies or work tasks, as well as use tenures (in years since first usage) and use frequencies (in days per month) separately for film camera, digital camera (including single-lens reflex cameras), and phone camera use.

The primary interest in the study was in the third set of variables that consisted originally of eight orientations toward photography. These orientations were practice-based: they described different ways in which a user makes use of a digital camera and learns about its functionalities:

1. *Goal-setting:* Setting personal goals for one's photography activities.
2. *Reflexivity:* Reflecting on one's practices by evaluating shots.
3. *Technology cognizance:* Having a comprehensive and correct mental model of a camera.
4. *Technology cluster cognizance:* Having a broad understanding of the surrounding technology cluster.
5. *Curiosity:* Being curious about trying new ways of photography.
6. *Spontaneity:* Taking photos spontaneously and in *ad hoc* ways, disregarding prevailing ideas of what cameras are designed for.
7. *Appropriation-seeking:* Having awareness that a digital camera is an appropriable tool and pursuing use of this capability.
8. *Consultancy:* Learning new ways of use from others.

Each of these orientations was represented with 2–5 sub-constructs that described different aspects of that orientation. Some sub-constructs received two formulations, focusing on their technical and substance-oriented sides, resulting in altogether 35 statements to be answered on a 5-point Likert scale (see Appendix A).

Because respondents in online surveys may quickly lose their interest, we set the target time for completion of the questionnaire to 10–15 minutes, in order to keep it attractive, and did not include existing technology use scales in it (candidate scales are listed in Discussion). How the constructs of the model here and the scales in previous literature are interrelated needs to be studied in future research.

The questionnaire for the personality sample also included the Finnish translation of the 100-item IPIP-NEOAC personality inventory, which is similar to the NEO-PI-R (Costa & McCrae, 1997, Goldberg, Johnson, Eber, Hogan, Ashton, Cloninger, & Gough, 2006; Norman, 1963).

Questionnaire design

We implemented the online questionnaire in MySQL and PHP. It had seven sections (the variable names used in the research model are given in parentheses):

1. General experience in photography: a four-point self-reported level of expertise (novice, snapshot-taker, hobbyist/amateur, expert/professional, and "other"), the role of photography in the respondent's profession ("Profession"), previous and present studies ("Studies"), and hobbies ("Hobby"), and the year when the respondent started taking photos.
2. Film camera use: The start and end years of use ("Use tenure for film cam") and the current frequency of use, in photos taken per month ("Use frequency for film cam").
3. Digital camera use: The same questions as for film cameras ("Use tenure for digital cam" and "Use frequency for digital cam").
4. Phone camera use: The same questions as for a film camera ("Use tenure for phone cam" and "Use frequency for phone cam").
5. Individual photography orientations: The 35 Likert-scale statements described above.
6. Appropriations: The questions shown in Figure 2 about each of the eight predefined creative uses.
7. Demographic information: Education level ("Education"), age ("Age"), gender ("Gender"), income ("Income"), being a pet-owner ("Pets"), and being a parent ("Children").

Although the self-reported level of expertise was inquired in the questionnaire's first section, we did not include it in the model's IVs because of its subjectivity compared to the other variables. We considered it as a compound of other more objectively measurable factors included in the model. We evaluate the generalizability of the findings to different levels of self-reported expertise, age, and the level of education in the end of the Results section.

Preprocessing

We filtered out those respondents who had not filled in the questionnaire completely, those who used neither a digital camera nor a mobile phone camera, and finally those who had both completed the

questionnaire in less than 10 minutes and responded monotonously (e.g., all values 1) to the orientation-related Likert-scale question battery. With this preprocessing, the final number of analyzable responses decreased from 3,113 to 2,379, mostly as a result of a moderately high breakoff rate (22%). Regarding the separate personality sample, 252 invitations were sent to which 112 people responded. Nine respondents (4%) did not complete it, yielding a 41% final return rate and 103 valid responses.

Construct validity, reliability, and refinement of the research model

We analyzed the orientation items for their discriminant validity. A factor analysis (maximum likelihood analysis with varimax rotation, loadings given in Appendix B) suggested removing the Appropriation-seeking orientation. There was no support for maintaining a distinction between substance-related and technical points of view, perhaps reflecting the technical nature of present-day photography. Curiosity and Goal-setting scored high for the same factor. Because they were related to exploratory use and future directions of photography, we combined them to form a new "Exploration" construct. The items in reflexivity orientation were split into separate "Use-reflexivity" and "Self-reflexivity" constructs. Finally, since the technology-related constructs clustered together, we combined them into a larger "Technology cognizance" construct. The Consultancy and Spontaneity orientations did not need to be changed. The orientations after these refinements are shown in Table 2. In a refined factor analysis, these six factors accounted for 61.7% of the total variance.

Considering reliabilities, Table 2 shows that two constructs – Self-reflexivity and Spontaneity – do not exceed the value of .80 recommended for Cronbach's alpha (α) coefficients (Nunnally, 1978). We nevertheless retained them in the analysis because of the exploratory nature of the study.

For the reliabilities of the personality characteristics, an earlier analysis (Helfenstein, 2010) on the same sample of participants had proved a good alignment with the Five Factor Model. A factor analysis (principal component analysis with varimax rotation) yielded five factors, as predicted, and accounted together for 45.12% of the total variance. Cronbach's α reliabilities for the five scales (neuroticism, extraversion, openness, agreeableness, and conscientiousness) noted between .79 and .95.

We also inspected the DVs for their suitability for regression analysis. Because *Discovery* had a severely non-Gaussian distribution, with 44.2% of the values at the scale's extremes, we applied a median split to it, creating a new binary variable denoted hereafter as $Discovery_2$. *Adoption* did not present similar difficulties, since it had close to a normal distribution, and therefore no transformations were required.

Table 2. The final set of orientations after factor analysis.

Final orientation	Initial orientations	Items	Cronbach α	Average interitem correlation	Composite item variable		Description
					Mean	SD	
Self-reflexivity	Reflexivity	refl_2s, refl_2t	.76	.62	3.73	.92	Increased sense of self-criticism regarding photography and camera use skills.
Use reflexivity	Reflexivity	refl_1s, refl_1t, refl_4s, refl_4t	.81	.51	3.78	.90	Reflecting on the success of one's photos immediately after shooting or afterwards.
Spontaneity	Spontaneity	spont_2, spont_3s, spont_3t	.61	.33	3.23	.90	Taking photos spontaneously in a spur of action, without always thinking before acting.
Exploration	Goal-setting, Curiosity, Spontaneity	goal_1s, goal_2s, goal_3s, cur_1t, cur_2t, cur_3s, cur_3t, spont_1s	.89	.49	3.48	.95	Exploration of new ways and directions of photography.
Technology cognizance	Technology cognizance, Technology cluster cognizance	tech_1t, tech_2t, tech_3t, ecol_1t, ecol_2t, ecol_4t	.85	.43	3.72	.89	Having an accurate understanding of how digital camera works and how its features can be combined with other technologies and tools.
Consultancy	Consultancy	cons_1s, cons_2s, cons_2t, cons_3s, cons_3t, cons_4s, cons_4t, cons_5	.85	.42	3.07	.91	Learning new ways of use from others through teaching, observation or exchange of ideas.

Results

This section presents results for the research questions posed in the introduction.

How common creative uses are (RQ1)

Table 3 displays frequencies of *Adoption*. "Note-taking" and "Scanner" were the most common and "Instruction tool" and "Periscope" were least common among the uses. On average, 29.8% of respondents reported having been unaware of a given use, and 22.3% were aware but had never employed it. Summing the mean percentages for a few instances of application (20.4%), intermittent use (18.6%), and established use (9.0%), we obtain an *average employment rate* of 48.0% for the respondents who had at least once employed the creative uses on average. Of those who were unaware of these creative uses (29.8%), one quarter (7.1%) reported that this was due to not finding the

application useful. Another quarter (7.6%) had, despite a potential need, not discovered the use. The rest (15.0%) were not sure of their need of being aware of the use in the past.

Creative uses of digital camera were therefore fairly commonly employed. On average, a creative use had been applied once or more often by 48% of the participants.

Table 3. Percentages of different extents of adoption (*Adoption*) with respect to eight creative uses of a digital camera.

Level of adoption of creative use (*Adoption*) (%)	Creative use								Mean
	Mirror	Map	Note-taking tool	Scanner	Memory storage	Lamp	Instruction tool	Periscope	
Had never even thought about this	14.8	25.3	18.4	18.0	37.3	35.2	40.0	49.0	29.8
- because there had been no need	4.2	4.5	3.8	3.7	9.6	9.1	10.3	11.9	7.1
- but knowing about this use would have been helpful a few times	2.3	8.4	5.3	4.4	4.8	4.7	8.6	9.5	6.0
- but knowing about this use would have been helpful many times	0.8	2.7	2.7	1.2	1.0	1.1	1.7	1.9	1.6
- and don't know if knowing about this use would have been useful in the past	7.6	9.7	6.6	8.7	21.8	20.3	19.4	25.6	15.0
Was aware of this use but never applied it	25.8	25.4	16.9	16.9	24.5	18.3	30.5	20.0	22.3
Has applied this use a few times	35.1	22.0	19.6	22.6	14.5	19.0	15.7	14.8	20.4
Applies this use now and then	19.6	20.1	28.6	27.3	14.0	17.3	9.8	11.9	18.6
Has this as one of the established ways of use	4.6	7.2	16.5	15.3	9.8	10.2	4.0	4.4	9.0

How frequently are the creative uses learned individually (RQ2)

The distribution of responses to *Discovery* in Table 4 shows that, with the exception of "Instruction tool" and "Memory storage," personal discovery was somewhat more common than social learning, with figures of 20.3% and 16.0%, respectively. However, 31.5% of the respondents could not recall the circumstances of the discovery.

For each respondent, we calculated a *proportion of personal discovery*: the percentage of (remembered) personally discovered uses. The proportions suggest that respondents can be dichotomized into two groups. 24.1% of respondents had learned all uses socially from other people (i.e., *proportion* = 0), while 31.9% reported personal discovery for all uses (i.e., *proportion* = 1). The remaining respondents had learned some uses on their own and other uses through the influence of others and their values fell in between the extremes.

Correlations between the eight original *Adoption* variables (one for each creative use) were uniformly weak and positive (Kendall's $\tau = .23–.46$, all significant at the $p < .01$ level). That is, if a respondent had made one of the discoveries independently, it was slightly more likely that that person had made other discoveries independently too. There were no signs of clustering.

To summarize, personal discovery of creative uses of digital cameras was widespread among the respondents and slightly more common than social learning.

Table 4. Percentages of different personal discovery (*Discovery*) modes with respect to eight creative uses of a digital camera.

	Creative use								
Personal discovery level (*Discovery*)	Mirror	Map	Note-taking tool	Scanner	Memory storage	Lamp	Instruction tool	Periscope	Mean
					Personal discovery				
On one's own	19.2	14.5	19.7	23.2	12.4	15.6	7.4	10.6	15.3
In the presence of others	4.2	8.8	7.8	5.8	2.3	4.2	2.7	3.9	5.0
Total	23.4	23.3	27.5	29.0	14.8	19.7	10.1	14.5	20.3
					Social learning				
Discovery jointly with others	3.7	4.7	5.9	5.3	2.6	3.3	3.6	2.8	4.0
Observation of others	5.1	4.2	5.1	5.0	3.1	3.8	2.6	2.6	4.0
Hearing or reading	11.7	9.6	8.5	8.9	9.8	4.8	6.5	4.4	8.0
Total	20.5	18.5	19.5	19.2	15.6	12.0	12.7	9.8	16.0
					Other alternatives				
Some other way	4.5	2.7	2.7	2.3	2.4	1.8	1.9	1.4	2.5
Don't remember how discovered	36.7	30.2	31.9	31.5	30.0	31.2	35.3	25.3	31.5
Never discovered	14.8	25.3	18.4	18.0	37.3	35.2	40.0	49.0	29.8

Which individual characteristics predict personal discovery of creative uses (RQ3)

We developed two regression models, using demographic characteristics in Model 1 and augmenting it with the orientations and experience in Model 2. We created these models for both $Discovery_2$ and *Adoption*. Table 5 presents the ordinal regression[1] results for $Discovery_2$. The demographic variables alone reached pseudo-R^2 of .09, with Gender (male), lack of Children, Income, and Age as the best predictors.

With all variables added in the second model, pseudo-R^2 reached a value of .21.[2] From this full model, we identified the most important individual predictors by first selecting all of the significant

[1] Because *Discovery* had a significant proportion of the values at its extremes, cauchit was used as the link function, instead of the more common logit function.

[2] Note that this cannot be interpreted as 18% of the variability having been explained. Being a non-parametric regression method, ordinal regression does not lend itself to such interpretations.

coefficients and then repeatedly removing from this set the least significant variable until the model's log-likelihood deviance when compared to a perfectly fitted model became statistically significant. Following this procedure, we found that retaining all the seven significant variables directly resulted in a final model from which any further variable removal was not possible without creating a significantly deviating model. However, since the least important factor (Children) was not anymore a significant predictor in this model, we decided to remove it. Therefore, the most important predictors in the minimal model were (in decreasing order of *B* coefficient, reaching pseudo-R^2 = .19): Technology cognizance (*B* = .49), Gender (male) (*B* = .47), Exploration orientation (*B* = .17), Use frequency for digital camera (*B* = .12), Income (*B* = .08), and Use tenure for digital camera (*B* = .05). To evaluate the importance of Technology cognizance alone, we carried out a separate analysis that showed that Model 2's pseudo-R^2 dropped to .18 by a removal of Technology cognizance, with approximately the same amount as by a removal of all the experience-related predictors together (which had a drop to .19).

Finally, we analyzed the predictive power of the personality traits by running separate analyses of our smaller personality dataset. We tested how much additional explanatory value can be gained by adding the personality features as a separate predictor block to a model that consisted of the six above-listed most important predictors. We found no added explanatory value for personality dimensions.

We believe that the low predictive value of our variables for $Discovery_2$ is partly due to the fact that respondents were not able to accurately recall the original episodes that had possibly occurred a long time ago where the creative use had been discovered. Weak recall probably increased the error variance of *Discovery*-related responses.

To summarize, our full model reached pseudo-R^2 = .21 in prediction of $Discovery_2$, and the six best predictors alone reached pseudo-R^2 = .19. Personality factors did not provide added power to this six-predictor model.

Table 5. Ordinal regression results for the tendency to discover creative uses independently.

	Variable	*r*	Model 1 *B*	Model 2 *B*
Demographics	Age	.11***	.01***	.01
	Gender (male)	.22***	.68***	.45***
	Education	.00	-.06	-.07
	Income	.14***	.09**	.08*
	Children	.01	-.24*	-.29*
	Pets	-.01	.07	.02
Experience	Profession	.09***		.08
	Studies	.11***		.04
	Hobby	.16***		.14
	Use frequency for film cam	.07***		-.02
	Use tenure for film cam	.12***		.01
	Use frequency for digital cam	.21***		.11*
	Use tenure for digital cam	.15***		.05*
	Use frequency for phone cam	.03		-.00
	Use tenure for phone cam	.05*		-.01
Orientations	Self-reflexivity	.15***		.02
	Use-reflexivity	.18***		-.04
	Spontaneity	-.14***		.07
	Exploration	.25***		.21*
	Technology cognizance	.32***		.53***
	Consultancy	.17***		-.07
	Nagelkerke's pseudo-R^2		.09	.21
	Deviance from perfect model χ^2		1726.83***	2005.95***
	Model fit (-2 log likelihood) χ^2		1930.47	2005.95
	Model fit d.f.		6	21
	Model fit improvement $\Delta\chi^2$ from 1 to 2			75.48***
	* $p < .05$.			
	** $p < .01$.			
	*** $p < .005$.			

Which individual characteristics predict adoption of creative uses (RQ4)

The analysis of *Adoption* yielded more promising results. Because of a normal distribution, we could treat *Adoption* as a continuous variable and use normal linear regression analyses with a sequential structure, thereby improving the statistical power of the analysis. In addition, using the sequential regression allowed us to control the effect of demographic variables (Model 1) when analyzing the contribution of orientations and experience (Model 2).

Results are presented in Table 6, suggesting that *Adoption* can be explained better by means of individual-oriented characteristics than $Discovery_2$ can. In addition to the commonly used standardized regression coefficients (β), the table presents the squared semipartial correlation (sr^2) for each

variable. The reason is that many orientation-related variables were correlated with each other, thus weakening the validity of βs in measurement of contribution to regression. Tabachnick and Fidell (2007, pp. 144–5) recommend using the square of *sr* that indicates the amount by which the overall R^2 will be reduced if the variable is removed from the regression equation while all other variables remain.

Table 6. Sequential linear regression results for tendency to adopt creative uses in long-term practice.

			Model 1		Model 2	
Block	**Variable**	***r***	***β***	***sr²***	***β***	***sr²***
Demographics	Age	.01	-.05	.00	-.01	.00
	Gender (male)	-.29***	.29***	.07	.16***	.02
	Education	.05*	.03	.00	.04	.00
	Income	.12***	.05	.00	.02	.00
	Children	-.02	-.01	.00	-.04	.00
	Pets	-.02	.03	.00	-.01	.00
Experience	Profession	.18***			.05**	.00
	Studies	.17***			.01	.00
	Hobby	.24***			.02	.00
	Use frequency for film cam	.09***			-.00	.00
	Use tenure for film cam	.08***			.06**	.00
	Use frequency for digital cam	.31***			.08***	.00
	Use tenure for digital cam	.23***			.10***	.01
	Use frequency for phone cam	.24***			.18***	.03
	Use tenure for phone cam	.15***			.03	.00
Orientations	Self-reflexivity	.18***			-.00	.00
	Use reflexivity	.27***			-.11***	.01
	Spontaneity	-.18***			.04*	.00
	Exploration	.42***			.20***	.01
	Technology cognizance	.47***			.20***	.02
	Consultancy	.38***			.11***	.00
		R^2	.09		.35	
		Adjusted R^2	.09		.34	
		R^2 *change* from 1 to 2			.26***	
	* $p < .05$.					
	** $p < .01$.					
	*** $p < .005$.					

The adjusted R^2 for the full model (Model 2) was .34. Separate ad hoc analyses showed that the added value of experience variables (R^2 *change* = .18) and of orientation variables (R^2 *change* = .20) were nearly identical.

To identify the most important predictors in the full model, we applied manual backward elimination until all variables had $sr^2 > .01$. This procedure resulted in a model with the following five variables (from the most important, according to sr^2): Use frequency for phone camera ($\beta = .19$, $sr^2 = .04$), Technology cognizance orientation ($\beta = .23$, $sr^2 = .03$), Exploration orientation ($\beta = .23$, $sr^2 = .03$), Gender (male) ($\beta = .14$, $sr^2 = .02$), and Use tenure for digital camera ($\beta = .11$, $sr^2 = .01$). This five-variable model's adjusted R^2 was .32.

Finally, we assessed with the separate personality dataset whether personality dimensions add predictive power to the model. In this dataset, the above-listed five most important variables had an adjusted R^2 of .40. With the personality dimensions added to the model comprising these predictors, the adjusted R^2 rose to .48, with a significant enhancement in prediction (non-adjusted R^2 *change* = .11, $p < .05$). From among the five personality dimensions, Openness ($\beta = .35$, $sr^2 = .03$) was the only predictor with statistically significant β-value ($p < .05$). Agreeableness ($\beta = -.58$, $sr^2 = .02$), Neuroticism ($\beta = .29$, $sr^2 = .02$) and Extraversion ($\beta = -.28$. $sr^2 = .02$) had marginally significant βs ($p < .10$). These results showed signs of over-fitting, but tentatively coincided with the personality profile for creative people in arts (Feist, 1999).

Therefore, in contrast to findings to RQ3, here both the full model and the minimal 5-variable model predicted *Adoption* fairly well, with adjusted R^2 values of .34 and .32, respectively. Also the personality factors tentatively improved the predictive power of the model.

Which type of discovery predicts adoption to long-term use (RQ5)

Non-parametric Kendall's τ ordinal correlations were calculated to quantify the relationship between *Discovery* and *Adoption*. For each creative use, following the classification of the discovery mode in Table 4, we recoded *Discovery* either as social learning (1) or personal discovery (2). We then calculated correlations between the new variables and the corresponding values in *Adoption* (high values meaning high extent of adoption; see Figure 2) for each use. We found weak positive correlations between personal discovery and activeness of adoption, ranging from $\tau = .21$ ("Mirror," $p < .001$) to $\tau = .38$ ("Instruction device," $p < .001$). The average τ across the eight uses was .28.

The results therefore indicate that it was slightly more common for a creative use to have been adopted in recurrent use if the use had been learned through personal discovery instead of through social learning.

Generalizability

We investigated the generalizability of these findings across different age groups, educational levels and self-reported levels of expertise. In the analyses, we used the educational and expertise levels directly. For comparing the ages, we divided the respondents into deciles, creating ten equally sized subsamples. The findings appear to hold albeit with some remarks concerning RQ1 and RQ5.

Regarding RQ1, although *Adoption* was not correlated with Age (τ = .00, p > .05) or Education (τ = .00, p > .05), there was a weak correlation (τ = .27, p < .01) with self-reported expertise. Also the employment rate of creative uses increased monotonously from 33.3% (novices) to 40.5% (snapshot-takers), 53.9% (amateurs), and 68.1% (experts/professionals).

In contrast to RQ1, we did not find any effect of expertise level, Education, or Age on the tendency to discover the creative uses independently (RQ2). This was the case also with prediction of *Discovery* (RQ3) and *Adoption* (RQ4) using the variables presented in our research model. Separate analyses showed that the similar predictive powers for all age deciles and educational levels. In addition, to analyze the effect of the self-reported expertise on these DVs, we first combined novice and snapshot-takers into a larger novice subsample, and amateurs and experts similarly into an expert subsample, ensuring sufficient cases-to-variables ratios for regression analyses. We found that the model performed better in predicting *Discovery* and *Adoption* for novices than experts. We believe that the difference may be an artefact of the way in which the two subsamples had been created. In the expert subsample, especially the experience-related variables (i.e., use frequencies and tenures as well as Hobby, Studies and Profession variables) became homogenous and lost much of their predictive power. This made the research model less suitable for predicting *Discovery* and *Adoption* for experts only.

Finally, regarding RQ5, we found no differences due to Age or self-reported expertise. However, separate analyses on each level of education showed that those with least education – an unfinished comprehensive school degree or only a comprehensive school degree – had lower *Discovery–Adoption* correlations (τ = .03 and τ = .18, respectively) than the respondents with higher degrees (τ = .25 – .32). This finding was *not* due the less educated respondents' younger ages, since their mean age was as high as 35.8 (median 35) and therefore close to the average of the whole sample (42.0 years).

Thus, the findings are to large extent generalizable across different educational levels, age groups and self-reported levels of expertise. Exceptions to this conclusion are that expertise affects positively to the employment of creative uses (RQ1) and that those with low level of education appear to less often adopt such creative uses that they themselves have discovered (RQ5).

Discussion and Conclusions

In this paper, our motivation was to investigate repurposive appropriation by studying such uses of a digital camera that are not evident, requiring creativity from the user to discover them and adapt them to different situations in long-term use. Our interest was to explore how individual respondents' orientations to photography contribute to discovery and adoption of novel uses. Also, we wanted to compare them with factors that are experience-based, such as use frequencies and tenures or mastery acquired through education or from profession. We included personality dimensions as additional potential explanatory factors. We made the following findings:

- *How common are creative uses (RQ1)?*: Awareness of creative uses was common among digital camera users. On average, a creative use had been at least tried out by 48% of the participants, speaking for a considerably widespread adoption of creative uses. Even the least-known use ("Periscope") was familiar (even if not tried out in practice) to 51% of the respondents.
- *How frequently are the creative uses learned individually (RQ2)?*: Most users can be classified as either people who learn all of the creative uses socially from others or users who discover them independently, without any help from others. On average, personal discovery of a creative use was slightly more common than learning it from others (20.3% vs. 16.0%). The remaining cases accounted for cases in which a use had never been learned or there was no memory of how it had taken place.
- *Which individual characteristics predict personal discovery (RQ3)?*: Demographics, photography-related orientations, and experience characteristics together reached a pseudo-R^2 of only .21 for predicting personal discovery. The orientations were more predictive than the experience characteristics. Technology cognizance was the single most important predictor, being equally important as all of the experience characteristics put together. The minimum set of constructs having a predictive fit not different from the best possible model consisted of Technology cognizance, Gender (male), Exploration orientation, Use frequency for digital camera, Income, and Use tenure for digital camera, in decreasing order of importance. Personality dimensions did not bring added predictive power to this model.
- *Which individual characteristics predict adoption (RQ4)?*: Overall, the model explained 34% of the variance. In contrast to what was found with RQ3, orientations and experience proved equally important, with R^2 *change* = .20 and R^2 *change* = .18, respectively. Here Use frequency for phone camera, Technology cognizance orientation, Exploration orientation, Gender, and Use tenure for digital camera were the variables with the greatest contribution. This five-variable model's adjusted R^2 was .32. The model predicted Adoption considerably well, given that we looked at specific appropriations instead of general creativity in technology use. A separate analysis suggested tentatively that the active adopters also had similarities with a personality profile of creative artists: open to new experiences, non-conforming, neurotic, and introverted.
- *Which type of discovery predicts adoption to long-term use (RQ5)?*: Personal discovery has a small but positive effect (average Kendall's τ correlation: .28) on a creative use becoming part of the user's permanent use practice.

Our study covered basic demographic variables and factors that are relevant to photography. Except for personality, we did not address general factors that may be relevant in individual's technology use. Future research can extend the model with motivational and emotional factors (Reeve, 2009), cognitive and learning styles (Riding & Cheema, 1991; Sternberg & Grigorenko, 1997), creativity (e.g., divergent

thinking or remote association skills; see Guilford, 1968; Torrance, 1974; Mednick, 1962), playfulness (Webster & Martocchio, 1992; Woszczynski, Roth, & Segars, 2002) and self-efficacy (Compeau & Higgins, 1995; Mills & Chin, 2007), as well as variables related to technology perception, such as perceived ease of use, perceived usefulness, task–technology fit, product meaning, and involvement (Allen, 2000; Fournier, 1991; Zaichkowsky, 1985). There are also cultural and economic factors that support creativity, including openness, tolerance and societal diversity (Florida, 2002) as well as encouragement for experimentation and sharing knowledge (Mokyr, 2010). These factors are however not appreciated in all settings. For instance, it is commonplace in organizational contexts that IT is prepared for particular purposes and that reinventions of use are considered to be nuisances (Rogers, 1995). This paper provides evidence that, at least in consumer technology, users are however able to make more out of their tools when given an opportunity to do so.

For design and marketing, it can be useful to know that Technology cognizance, Gender, Exploration-orientation, and Use tenure for digital camera are the most important predictive variables both for *Discovery* and *Adoption*, and that Use frequency (for digital or phone camera, depending on the dependent variable) comes right after them. For instance, Technological cognizance can be supported by making the inner workings of the system more easily observable and understandable, and Exploration can be encouraged with improved error-tolerance, a playful user interface, and "undo" functionality. The system can be made more frequently available through remote access or provision in different information appliances. Finally, users with long use tenures may be useful informants about creative uses and viable design improvements. For marketing efforts, the findings provide new information for market segmentation. The study suggests that technologically minded customers would value the possibility of using the technology in an unrestricted way, because such customers are likely to discover ways to make use of that freedom and develop new practices around them. This, in turn, may have a positive effect on customer loyalty.

Technology cognizance proved the most important single factor in our study. It is associated with richer mental representations (e.g., Bibby & Payne, 1993, 1996; Kieras & Bovair, 1984; Norman, 1988; Payne, 1991, 2003; O'Malley & Draper, 1992) that can support repurposive appropriation. Users who appropriate actively probably possess or have gained more accurate and comprehensive representations of the technology, making it easier to notice opportunities in novel situations. Therefore, in order to promote creative uses of technology by means of teaching, training, design, and marketing, we should try to better understand mental representations of the active appropriators versus those of the less appropriating users. Active appropriators are able to overcome functional fixedness (e.g., Duncker, 1963) that can block insights on novel use. Through transfer of learning (e.g., Gick & Holyoak, 1983; Singley & Anderson, 1989), they may also apply models of technologies to contexts in which those technologies are not present. Recent studies on feature-centric technology usage models (Al-Natour & Benbasat, 2009; Harrison & Datta, 2007; Jasperson et al., 2005) may be useful when

researching users' representations of use. In these studies, technologies have been broken down into sub-components and the focus has been on users' understandings on that level.

The present paper has studied creative uses of consumer IT. It has shown that they are widespread at least in the case of digital cameras and demonstrated that repurposive appropriation plays a role in adoption. Based on these results, we contend that consumer IT should be designed with openness as a design goal. Doing so would not hinder the primary envisioned way of use but would leave room for users' creativity and thereby also increase the likeliness for innovation, user satisfaction, and customer loyalty.

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Appendix A

The antecedent factors of appropriation as measured in the study.

		Items		
Factor	Description	Description	Code	Likert statement
Goal-setting	Setting personal goals for one's photography activities (e.g., personal projects or directions for improvement).	Future project plans	goal_1s	I have ideas about the things I want to shoot in the future.
		Form and work method	goal_2s	I have plans about the ways in which I can improve my ways of working and my photographic style.
		Purpose	goal_3s	I have plans to make use of photography for more purposes than I do right now.
Reflexivity	Reflection on one's practices by evaluating one's shots.	Learning from shots that one has taken	refl_1s	When I browse my photos, I pay attention to my success in capturing the essential elements and the "idea" of the subject.
			refl_1t	When I browse my photos, I pay attention to my success in choosing the right settings for the shooting situation.
		Knowledge of one's strengths	refl_2s	I know my personal strengths and weaknesses in capturing interesting shots.
			refl_2t	I know my personal strengths and weaknesses as a camera-user.
		Tendency to describe oneself	refl_3s	I think often about what kind of photographer I am.
		Evaluation of success right after a shot	refl_4s	Right after taking a picture, I evaluate whether I managed to capture the subject in the way I wished, and I ask myself how to do it even better.
			refl_4t	Right after taking a picture, I evaluate its technical qualities (exposure, focus, colors, etc.) and ask myself whether I could reach an even better result.
Technology cognizance	Having a comprehensive and correct mental model of how a camera works and what its functions are.	Comprehensive studying of features	tech_1t	I have acquainted myself with, more or less, every feature of my camera(s).
		Understanding of cause and effect	tech_2t	I know how to adjust the settings of a camera such that the photos are usually of good quality.
		Awareness of the good and bad sides of the device	tech_3t	I know the most important technical strengths and weaknesses of my camera(s).
Technology cluster cognizance	Having a broad understanding of the surrounding technology ecology – e.g., how photos can be edited or used with other media.	Formats	ecol_1t	I know which storage formats to use in response to different needs for image quality and file size.
		Data transfer between devices	ecol_2t	I transfer images between different devices (computers, cameras, and other storage devices) frequently.
		Use of photos in conjunction with other digital media	ecol_3t	I use the photos that I have taken embedded in other media (text documents, presentations, graphics programs, Web pages, etc.).
		Command of other electronic devices	ecol_4t	I am used to using and taking up different electronic devices.
Curiosity	Curiosity about trying new ways of photography.	Experimentation with features	cur_1t	I have a habit of testing different shooting settings from pure interest in seeing what the outcome is.
		Experimentation with themes and subjects	cur_2s	I sometimes shoot also less ordinary objects, because I am interested in seeing what they look like in a photo.
		Experimentation with circumstances	cur_2t	I shoot photos in different conditions to see how it affects the outcome.
		Breaking of boundaries	cur_3s	I sometimes try shooting objects that I have never tried shooting before.
			cur_3t	I sometimes try shooting with settings and equipment that I have not tried before.
Spontaneity	Taking photos spontaneously and in *ad hoc* ways, at the spur of the moment, without always thinking before acting.	Spontaneous stopping to photograph while on the go	spont_1s	Whenever I have a camera with me, I tend to stop to photograph also things that come my way without planning.
		Shooting before thinking about what to do with the photo	spont_2	I sometimes take photos without thinking too much about what I am going to do with them later.
		Omission of preparations	spont_3s	I usually take my photos quickly, without considering shooting angles and other photographic goals.
			spont_3t	I usually take my photos quickly, without considering which settings I should use.
Appropriation-seeking	Being aware that a digital camera is an easily appropriable tool and thus a potentially useful tool in many situations.	Habit of searching for technological ways to carry out practical tasks	apseek_1	In general, I commit my time to making everyday routines easier through various instruments, even if it requires some effort or inventiveness.
		Awareness of non-apparent purposes of use	apseek_2	I am aware that in some situations it is beneficial to use devices in ways for which they may not have been designed.
Consultancy	Learning new ways of use from others through teaching, observation, or exchange of ideas.	Learning by observing when others take photos	cons_1s	Whenever I see someone taking photos, I will follow what he or she is photographing.
		Learning through others' photos	cons_2s	Other people's photos have given me ideas for my own selection of topics and objects.
			cons_2t	Other people's photos have taught me how the features of a camera can be used.
		Learning through opinion exchange	cons_3s	I exchange opinions on photography styles and topics with other hobbyists.
			cons_3t	I exchange opinions on cameras and camera instruments with other hobbyists.
		Learning through being taught	cons_4s	Other people have given me guidance and feedback on the selection of objects, composition, and success of the outcome.
			cons_4t	Other people have given me guidance on how the camera features can be used.
		Learning through collaboration	cons_5	Taking photos with a camera is involved in many things I do when with other people.

Note. Most item codes have been suffixed with "s" and "t". These letters denote whether the item is primarily oriented towards the substance-oriented or technology-oriented aspects of photography and camera use, respectively. When no letter has been used, the distinction between substance and technology has not been made in statement formulation.

Appendix B: Factor structure of orientation items

Factor loadings from factor analysis, using maximum likelihood extraction and varimax rotation, sorted according to the strongest factor loadings.

Item	Technology cognizance	Consultancy	Exploration	Use reflexivity	Self-reflexivity	Spontaneity
tech_3t	**0.68**	0.21	0.12	0.23	0.24	0.14
ecol_1t	**0.68**	0.21	0.21	0.08	0.10	0.15
ecol_4t	**0.64**	0.03	0.18	0.09	0.02	0.00
tech_2t	**0.64**	0.17	0.18	0.24	0.15	0.24
tech_1t	**0.63**	0.19	0.12	0.22	0.11	0.16
ecol_2t	**0.41**	0.09	0.29	0.09	0.08	-0.03
~~apseek_1~~	~~**0.36**~~	~~0.15~~	~~0.33~~	~~0.13~~	~~0.14~~	~~-0.01~~
~~apseek_2~~	~~**0.33**~~	~~0.13~~	~~0.31~~	~~0.11~~	~~0.10~~	~~-0.09~~
cons_3s	0.30	**0.74**	0.26	0.12	0.14	0.15
cons_3t	0.37	**0.68**	0.24	0.12	0.13	0.16
cons_4s	0.15	**0.59**	0.21	0.16	0.09	0.07
cons_4t	-0.06	**0.53**	0.07	0.10	0.04	0.00
cons_2t	0.28	**0.49**	0.27	0.23	0.10	0.04
~~refl_3s~~	~~0.14~~	~~**0.44**~~	~~0.35~~	~~0.26~~	~~0.20~~	~~-0.01~~
cons_2s	0.24	**0.42**	0.42	0.23	0.04	0.02
cons_1s	0.17	**0.40**	0.29	0.27	0.01	-0.04
cons_5	0.21	**0.38**	0.34	0.08	0.16	-0.01
goal_1s	0.22	0.30	**0.60**	0.18	0.19	0.12
cur_3s	0.22	0.21	**0.59**	0.28	0.08	0.04
goal_3s	0.21	0.35	**0.58**	0.10	0.21	0.10
cur_2t	0.28	0.31	**0.49**	0.35	0.11	0.09
goal_2s	0.29	0.44	**0.45**	0.16	0.21	0.13
cur_3t	0.39	0.27	**0.44**	0.31	0.01	0.07
~~spont_1s~~	~~0.19~~	~~0.23~~	~~**0.44**~~	~~0.27~~	~~0.02~~	~~-0.07~~
cur_1t	0.39	0.29	**0.42**	0.35	0.01	0.14
~~ecol_3t~~	~~0.34~~	~~0.24~~	~~**0.38**~~	~~0.00~~	~~0.10~~	~~0.02~~
refl_4t	0.23	0.24	0.18	**0.67**	0.10	0.11
refl_4s	0.15	0.19	0.18	**0.67**	0.11	0.06
refl_1t	0.36	0.23	0.33	**0.49**	0.13	0.19
refl_1s	0.19	0.21	0.38	**0.42**	0.21	0.08
refl_2s	0.13	0.16	0.15	0.11	**0.74**	0.05
refl_2t	0.22	0.14	0.14	0.10	**0.70**	0.02
spont_3t	-0.30	-0.16	-0.19	-0.26	0.02	**-0.65**
spont_3s	-0.17	-0.09	-0.25	-0.29	0.03	**-0.61**
spont_2	0.02	0.01	0.14	0.09	-0.06	**-0.42**

Note. The greatest absolute loading is marked in boldface for each item. Items that were removed from the improved model on account of insufficient or unexpected loadings have been struck through.