FOSTERING INITIAL TRUST IN APPLICATIONS – DEVELOPING AND EVALUATING REQUIREMENT PATTERNS FOR APPLICATION WEBSITES

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Abstract

When users first encounter an application, or decide which application from a number of options to use, their initial trust in this application is a determinant for their willingness to adopt it. At this time, users have not yet had a chance to interact with the application, and hence their perceptions are based on the application presentation on the website rather than on the application's actual performance. To help providers select supporting measures for the website to improve the perceived trustworthiness of their application, we propose a set of requirement patterns. Patterns are used in requirements engineering to recognize important and recurring issues, thus reducing the effort during requirements specification. We developed them from trust theory, following the design-science based evaluation framework for patterns. To evaluate the feasibility of our approach, 17 teams used the patterns to specify a website for a mobile application. The results indicate that the teams frequently used ten of our proposed patterns. A subsequent survey regarding pattern quality shows an overall acceptance and that the team members rated the patterns as comprehensible, understandable and helpful. We hence conclude that our approach to incorporating trust-based requirements to foster initial trust in application website specifications is feasible.

Keywords: Initial Trust, Requirement Patterns, Application Websites.

1   Introduction

Application software (or application/app) is software that helps the user to perform a specific task. With the rise of smartphones and tablet PCs, applications are both ubiquitous and abundantly available. With this variety comes the choice for customers as to which application to use to perform a task. Making an informed decision is difficult; however, as users generally do not have the necessary knowledge to judge the quality of an application. As a result, the users try to reduce the complexity by making a choice based on their trust (Luhmann, 1979). This is caused by the inherent need of people to understand others and their surroundings. By trusting, people reduce their perceived social complexity by a belief that allows people to act in uncertain environments, albeit this belief may be irrational and may lead to vulnerable behavior (Luhmann, 1979). The same argument also holds true for new technologies. User trust is a key factor for the adoption of new technologies and applications (Gefen et al., 2003). As trust is a high individual concept, trust building relies completely on the user's perception of the applications. Consequently, a technical improvement of a system, e.g., using a better encryption algorithm, will only improve the users' trust if this change is communicated to them in a way that allows them to understand the benefits.

Trust in applications is relevant at two different stages with different characteristics: first, whether the users can rely on the functionality of the application concerned, and second, whether the users can trust the stakeholders who are developing or marketing the application (providers). The first stage concerns the trust based on users' experience when using the application. The second relates to trust in second hand information, i.e., where users have to trust individuals or groups that may not be known to them. As new users deciding for an application have not yet encountered the application, it is necessary to create such initial trust that will lead to users trying out and using an application. The challenge thus is how to foster this trust in potential users. Research on the integration of behavioral insights on trust into application development (Patrick et al., 2005, Hoffmann et al., 2012a) aims at system properties influencing the trust relationship during use. Due to the importance of initial trust (McKnight et al., 2002), we investigate how trust can be addressed prior to application usage.

In application stores or application webpages, providers make use of textual descriptions and other visual aids to advertise the application. Their intention is to convince users to download and purchase the application. With this in mind, we aim to answer the research question of how the presentation of an application can be specified to improve the formation of initial trust. To answer the question, we provide requirement patterns that show how an application can be presented in a way that increases users' initial trust in the application. Requirement patterns are an approach to reuse requirements (Franch et al., 2010). Reuse is an established practice in software engineering that can help requirements analysts to elicit and document requirements. There are pattern approaches that differ in scope, notation and application (Franch et al., 2010). We follow the approaches that are used at the analysis stage for writing requirement specifications (Withall, 2008, Renault et al., 2009). The possible benefits for analysts are not only the reduction of time spent to perform the requirements elicitation, but also the improvement of the quality of the specifications obtained (Renault et al., 2009).

Our main contribution is thus to demonstrate how insights from trust theory can be systematically used to build initial trust, hence fostering initial adoption. To achieve our goal, we followed the design science based framework for patterns by Petter et al. (2010). We begin by determining the antecedents of trust from theory that are applicable to generating initial trust based on subjective information. Next, we derive requirements that need or should be fulfilled by the application's presentation on webpages or in application stores. Based on these requirements, we then identify and describe candidates for requirement patterns as a collection of good practices that are valid, and thus can be reused in multiple settings. In a final step, we evaluate the use of these requirement patterns in an experiment where 17 teams specify the web presentation of a recommender application.

The remainder of the paper is structured as follows. The following section provides the theoretical background on trust, after which section 3 describes our design science based research design in

greater detail. Next, we present requirement patterns that help address the trust antecedents in order to build initial trust. In section 5, we show and discuss the results of the experiment we conducted for evaluating whether the patterns are predictive and whether the pattern are understandable. The paper closes with the limitations, future research and conclusions.

2   Initial Trust in Applications

Various disciplines strive at understanding the concept of trust itself and its formation, articulating insights into how to foster trust. This multifarious investigation of trust has led to different conceptualizations. In computer science, most of the research on trust focuses on aspects such as security, authentication and access control (Artz and Gil, 2007). Other disciplines – such as Information Systems and Human Computer Interaction – focus on developing an understanding of trust in human-computer relationships (Söllner et al., 2012). The focus of trust research in these disciplines lies on understanding trust in social situations (Luhmann, 1979). The disciplines rely mainly on users' perception of a system in order to understand why they would trust or distrust a system and what can be done to foster their trust. Given our focus on fostering trust, we define trust based upon the contributions of Mayer et al. (1995) as the belief of a party [trustor] that it is worth to make oneself vulnerable to the actions of another party [trustee] based on the expectation that the trustee will perform a particular action important to the trustor, irrespective of the ability to monitor or control the trustee.

Trust has been shown to be a dynamic concept. Consequently, trust has to be built over time and in different phases. Trust building is divided into at least two phases: pre-encounter and post encounter (Singh and Sirdeshmukh, 2000), with encounter being defined as the first trust-related behavior (e.g., purchasing or using). Since this paper aims at building a user's initial trust in an application, we focus on the pre-encounter phase of trust building. Research on initial trust investigates how trust in an unfamiliar trustee, one with whom the trustor has no prior experience (McKnight et al., 2002), can be built. Unfamiliar actors are defined as those who do not have reliable information about each other (Bigley and Pearce, 1998). In such situations the users need to rely on information in addition to their own experiences in order to judge whether or not to trust and adopt an application. In the context of e-Commerce, McKnight et al. (2002) argue that the trusting beliefs in an online shop is a major factor driving users' initial trust in the online shop. Following this line of reasoning, we argue that trusting beliefs will drive users' initial trust in an application. Fostering the trusting beliefs of potential users by the presentation of the application is the focus of our research.

3   Research Design

The development of patterns is a design science activity (Petter et al., 2010, Hevner et al., 2004) in which one or more patterns are created as an artifact to communicate about and improve upon the current state-of-practice. Petter et al. (2010) propose a pattern lifecycle consisting of three steps (Figure 1). In the following sections we describe the steps as well as the evaluation techniques and criteria that we used at each stage of the pattern lifecycle (Table 1).
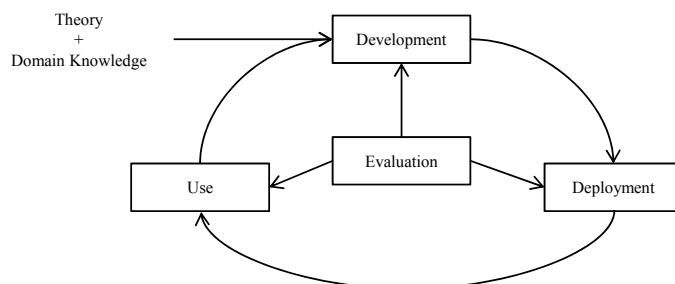

Figure 1.   Pattern lifecycle (Petter et al., 2010)

Step in lifecycle	Evaluation technique	Evaluation criteria
Development	Expert review	Plausibility, effectiveness (Petter et al., 2010)
Deployment	Requirement pattern workshop	Effectiveness (Petter et al., 2010)
	Peer review	Effectiveness, feasibility (Petter et al., 2010)
Use	Experiment	Predictability (Petter et al., 2010)
	Survey	Quality (comprehensibility, understandability, helpfulness, acceptance) (Wurhofer et al., 2010)

Table 1.   *Evaluation techniques used for trust based requirement patterns*

3.1   Development of candidates for trust-based requirement patterns

As a first step, we compiled a list of requirements that an application's presentation, e.g., on a website, needs to fulfill in order to increase the perceived user trust from trust theory. To achieve this, a literature review was conducted on the formation of trust to identify suitable antecedents to build initial trust. The trust relationship we focus on is referred to as trust in automation, trust in technology, trust in the device or system trust. System trust is used in literature both for organizational systems and IT systems, whereas we take only the latter meaning into account. The literature was reviewed to specifically identify trust antecedents, which are factors or elements that lead to trust. They are often interchangeably referred to as antecedents, dimensions, determinants, bases or principles of trust.

Due to the large number of published articles on trust and many different proposed antecedents, we build on the results of previous meta-studies on cataloguing trust antecedents. A systematic literature review to identify such meta-studies was conducted in the following electronic libraries: AISeL, ACM, IEEE Xplore, EBSCO BSP, Emerald (Journals), Springerlink, Wiley Interscience, JSTor, PsycArticles, PsyINFO and Sage. Key words were the mentioned synonyms for trust in automation and the synonyms for antecedents in all combinations. To further filter out unsuitable articles, the title and abstract were read. The search resulted in ten meta-studies (Beatty et al., 2011, Beldad et al., 2010, Hancock et al., 2011, He, 2011, Holsapple and Sasidharan, 2005, Kumaraguru et al., 2006, Lee and See, 2004, Li et al., 2012, Papadopoulou et al., 2001, Shankar et al., 2002), which summarized 117 publications overall, providing a total of 146 trust antecedents. In most cases, we were able to use the antecedents without modification for our further research. For some antecedents we needed to consult the literature that the meta-studies referred to in order to find a definition. At this stage of our research, we did not check whether the definitions of two antecedents with different names overlapped.

Based on the collection of the trust antecedents identified in our literature review, the first two authors developed requirement patterns for each suitable antecedent. Requirement patterns have the following attributes (Franch et al., 2010): goal, template, source and name. We reviewed the definitions of the antecedents in our collection and checked whether in each case it was possible to address the antecedent in the presentation of the application. We clarify here that in relation to fostering trust, we did not consider antecedents that addressed ease of use of the website and the perceived website quality because these did not relate to the trusting beliefs (McKnight et al., 2002). For each antecedent where this was possible, we described the pattern goal that expressed what the pattern should achieve. In our case, this is generally to raise the associated trust antecedents. The goal plays an important role, since it will help the requirements analyst to decide whether the pattern is applicable for the application (Renault et al., 2009). For each goal we wrote the pattern template representing the solution for the problem described in the goal section of the pattern, using the structure suggested by Hooks (1993). In our case of requirement patterns, this was a sentence or paragraph to be used in a system requirement specification – with the possibility of having multiple solution templates for the same goal. Pattern templates do not have to indicate how this goal can be achieved, i.e., they do not propose a design (Renault et al., 2009). Finally, we used the antecedents for the pattern attribute source and gave it a name to summarize the core of the templates in only a few words.

To evaluate the requirement patterns that we derived from the literature at the development stage, we conducted an expert review (Petter et al., 2010). The candidate patterns were reviewed by the trust

expert co-author, who joined the research at this stage. He checked the candidate patterns for plausibility and effectiveness. For plausibility, he checked if the patterns were reasonable for the proposed use and if they were believable beyond conjecture (Petter et al., 2010). For effectiveness, he compared the suggested templates with the source antecedent. In collaboration with the trust expert, we adapted the requirement patterns.

3.2 Deployment of the trust-based requirement patterns

The second step in the pattern lifecycle is the deployment, that is, the pattern has to be adapted to the specific context of its intended use (Petter et al., 2010). Since the users of the pattern were requirements analysts, we further developed the patterns by adding attributes recommended by Chung et al. (2012): requirement engineering (RE) activity, pattern type, stakeholders and relationships.

We presented the idea of requirement patterns addressing the perceived user trust in applications at a requirement patterns writers' workshop (Hoffmann et al., 2012b). Experts in the field discussed the idea of trust based patterns that increase the perceived users' trust in an application. They gave advice for improvements on the content and use of the requirement patterns. We further conducted a peer review with the requirement patterns for initial trust. These patterns were reviewed by the authors, a full professor in Information Systems and a novice requirements analyst to ensure that the patterns were understandable. Subsequently, we changed some phrasings of the goal and templates of the requirement patterns, adjusting the names as well.

3.3 Use and final evaluation of the trust-based requirement patterns

To evaluate the effects of the requirement patterns in use, we conducted an experiment with students trained in RE and prototyping, as they should have knowledge and experience similar to novice requirements analysts. 17 self-selected teams with two students each were asked to elicit requirements for a website that presented a mobile recommender application within one week. The communicated aim of the website was to increase the users' initial trust. We provided the pattern catalogue for the teams, but gave them the choice of using the requirements engineering techniques they preferred. We analyzed the final requirements lists to find out which patterns the teams had used. We dropped (†) the patterns that were used by less than one fourth of the teams.

After the experiment we surveyed the people that had used the pattern catalogue (Petter et al., 2010). We based our survey on the quality framework for pattern validation suggested by Wurhofer et al. (2010) for design patterns – adapting it to our requirement pattern collection and the experiment. Thus, we adapted the suggested questions to match the parts of the pattern and to change the wording of questions to the properties of requirement patterns instead of design patterns. To ensure understandability by students, we translated the questions into German. Each member of the teams was asked to fill out the questionnaire within 24 hours after the completion of the task.

4 Requirements to Increase Initial Trust

This section describes the trust-based requirement pattern for the presentation of the application and the underlying trust antecedents. The requirement patterns were developed in German and translated into English for this paper. The aim for the requirement pattern is to increase the perceived users' trust in the application before the first usage of the system. We briefly describe the patterns and their sources in the following paragraphs. As the definitions and descriptions of antecedents of trust (i.e., their underlying concepts) overlap, different antecedents could lead to the same requirement patterns.

The competence antecedent (Lee and See, 2004) describes the users' perception of whether the application was able to help achieve the users' goals (Beatty et al., 2011). This is suitable for initial trust building, since users can build a perception regarding the overall suitability to solve their desired goals before using the application. Hence, the presentation should include information allowing users to

understand the underlying problem the application helps to solve, that is, to assess the fit between their needs and the task for which the application is designed (Pattern 1). Further, the presentation should include detailed information on how the problem is solved using the application in order to allow users to assess whether the problem solving approach seems suitable for their problems (Pattern 2).

1	Application purpose		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users know which user problem the system is supposed to solve.		
Template	The provider shall illustrate which problem of the user shall be solved by the application.		
Relationships		*Source*	
-		Competence	

Pattern 1: Application purpose

2	Problem solving approach		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users comprehend in general how the application achieves its goals.		
Template	The provider shall illustrate the general approach the application follows to achieve its goals.		
Relationships		*Source*	
Pattern 4: Interaction preview		Competence	

Pattern 2: Problem solving approach

From competence together with faith (Lee and See, 2004), that is, the perception that the application can be relied on in the future, we derived that the presentation should include performance information, allowing the users to assess whether they believe that the application will really help them in fulfilling their needs (Pattern 3). Two related trust antecedents are understandability and predictability. Understandability describes how easy it is for users to build up a mental model of the application characteristics (Madsen and Gregor, 2000). Ultimately, the mental model allows users to predict future system behavior. Understanding relates to the users' perception that they are able to understand how the application works and how possible outputs are generated. Thus, the presentation should explain the interaction process between the user and the application (Pattern 4). Detailed information on how an application works can be presented to the potential users prior to first usage.

3	Performance information		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users know that they have the ability to get information about the performance of the application.		
Template	The provider should give information about the performance of the system and communicate this to the user when describing the application.		
Relationships		*Source*	
Pattern 7: Reference use / users Pattern 8: Independent certifications		Faith, Competence	

Pattern 3: Performance information

4	Interaction preview		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users get a first impression of how the interaction with the application will be like.		
Template	The provider shall provide a preview of the user interaction with the application.		
Relationships		*Source*	
Pattern 2: Problem solving approach		Competence, Understanding	

Pattern 4: Interaction preview

Users should know who is providing the application, and for this reason, a visible organization logo (Rafaeli et al., 2008) or other kinds of identification that enable users to recognize the providers are suitable (Pattern 5). Thus, the user can invoke past interactions with them. Furthermore, the provider can provide communication (Shankar et al., 2002) in the form of contact opportunities (Pattern 6).

5	Recognize the provider		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users know who provides the application.		
Template	The provider should be recognizable for the user.		
Relationships		*Source*	
-		Visible Organization Logo	

Pattern 5: Recognize the provider

6	Provider contact		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users have the opportunity to contact the provider prior to application usage.		
Template	The provider shall offer contact opportunities prior to application usage.		
Relationships		*Source*	
-		Communication	

Pattern 6: Provider contact

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Suitable to raising the initial users' trust is third party information (Beldad et al., 2010, Holsapple and Sasidharan, 2005). This involves establishing links between known entities that the third-party recommends as being trustworthy, and providing the same for the providers (Pattern 7). This can also be done with trust seals (He, 2011) or certifications from independent institutions (Pattern 8).

7	Reference use / users		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users have the possibility of getting information about which known people or organizations use the application.		
Template	The provider shall provide known people or organizations that use the application.		
Relationships		*Source*	
Pattern 8: Independent certifications Pattern 9: User feedback		Reputation	

Pattern 7: Reference use / users[†]

8	Certification from independent institutions		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users have the possibility of getting information about the quality of the application from an independent organization.		
Template	The provider shall provide certifications from independent institutions.		
Relationships		*Source*	
Pattern 7: Reference use / users Pattern 9: User feedback		Certification	

Pattern 8: Independent certifications

Another third party that can propagate trust is the range of users of the application. Therefore, the provider should provide feedback mechanisms (He, 2011) that enable current users to comment on the application and allow prospective users to read the comments (Pattern 9). This can somewhat play the same role in trust building as word-of-mouth communication. Another pattern is about explications of intentions, meaning that the providers explicitly state or display their intentions (Madsen and Gregor, 2000). They need to provide this information about their motives (Lee and See, 2004) to the average user (Pattern 10). This information of the provider can be communicated prior to first usage.

9	User feedback		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users have the possibility of providing feedback for the app and to get feedback from other users.		
Template	The provider shall publish user feedback for the application.		
Relationships		*Source*	
Pattern 7: Reference use / users Pattern 8: Independent certifications		Feedback Mechanism	

Pattern 9: User feedback

10	Provider motivation		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users know why the provider provides the application.		
Template	The provider shall describe why the application is provided.		
Relationships		*Source*	
-		Explications of Intentions	

Pattern 10: Provider motivation[†]

With the presentation, the providers can also advertise their benevolence (Beatty et al., 2011, Lee and See, 2004, Kumaraguru et al., 2006). Benevolence of the provider is the perception of users that the provider of the application has a positive orientation towards users. Regarding the benevolence, the providers should include statements addressing issues important to the users in the presentation. They should present statements that clarify their privacy policy (Pattern 11) and data security policy (Pattern 12) (Spiekermann, 2007). This is very suitable for initial trust building, since benevolence – the belief that the trustee keeps the interest of the trustor in mind (Mayer et al., 1995) – can be communicated prior to first usage. Control is the users' perception regarding their control of the application.

11	Privacy statement		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users know how the provider respects their privacy.		
Template	The provider shall provide a privacy statement.		
Relationships		*Source*	
Pattern 12: Data security statement Pattern 13: Realization of the statements[†]		Benevolence	

Pattern 11: Privacy statement

12	Data security statement		
RE Activity: *Elicitation, Specification*	*Pattern Type:* *Product*		*Stakeholders:* *Users*
Goal	The users know how the provider ensures the data security.		
Template	The provider shall provide a data security statement.		
Relationships		*Source*	
Pattern 11: Privacy statement Pattern 13: Realization of the statements[†]		Benevolence	

Pattern 12: Data security statement

13	Realization of the statements		
RE Activity: *Elicitation, Specification*		*Pattern Type:* *Product*	*Stakeholders:* *Users*
Goal	The users know how they can control whether or not the providers follow their statements.		
Template	The provider shall provide information how the realization of the statements can be monitored.		
Relationships Pattern 11: Privacy statement Pattern 12: Data security statement		*Source* Benevolence, Control	

Pattern 13: Realization of the statements[†]

The users' perception that they are in control of the application should be addressed by providing information regarding different settings that users are able to define, as well as by being shown how they can influence the way the application operates (Pattern 13). Despite the fact that real control over the application needs to be experienced, this antecedent is suitable for building initial trust, since information regarding such as privacy issues can be presented prior to usage.

5 Evaluation Results and Discussion

This section presents the results of the experiment and the survey from the final evaluation in the use-step of the pattern lifecycle (Petter et al., 2010). Given the fact that one pattern can only be more or less useful - not more or less true - than another (Petter et al., 2010), our goal was to assess the viability of the pattern. We first report which patterns the subjects used to specify the application presentation and then show how the pattern collection was evaluated by the subjects.

We observed in the resulting requirement specifications for the website that 16 of the 17 teams used requirements that were variations of the templates provided in the requirement pattern. (One team specified only requirements about ease of use of the website.) Table 2 shows the requirement patterns in order of the uses. Due to the usages in less than one fourth of the teams, we excluded three requirement patterns from the final collection.

Requirement pattern	Uses	Requirement pattern	Uses
Pattern 11: Privacy statement	15	Pattern 2: Problem solving approach	8
Pattern 9: User feedback	13	Pattern 5: Recognize the provider	8
Pattern 4: Interaction preview	10	Pattern 3: Performance information	5
Pattern 6: Provider contact	10	Pattern 7: Reference use / users[†]	3
Pattern 12: Data security statement	10	Pattern 10: Provider motivation[†]	3
Pattern 1: Application purpose	9	Pattern 13: Realization of the statements[†]	3
Pattern 8: Independent certifications	9		

Table 2.   Number of uses of the requirement patterns in the experiment
[†](pattern was dropped after final evaluation)

To check the quality of the requirement pattern collection, we surveyed the members of 17 teams; however, five team members did not take part in the anonymous survey. In the survey all subjects answered that they had used the requirement patterns, and thus could answer the following questions regarding the patterns. Table 3 shows the results of the comprehensibility questions that were rated on a 5 point Likert response format (1 = absolutely agree; 5 = don't agree at all). We provided the average, the standard derivation (SD) and the results of the one sample t-test (t). All items are above the neutral value of 3, indicating, in general, a good comprehensibility of the pattern. The goal definitions are rated as very good, on average (1.76) showing that we met the trust related problems that the subjects had in mind. The stated relationships between the patterns, dependencies (average = 2.38) and linkages (2.24) received the lowest scores. This could be because we provided only references to other patterns but did not explain the relationship in detail.

Question	Average	SD	t
The names of the patterns are meaningful to me. I can figure out the main idea of the patterns.	2.03	0.823	6.318***
The stated goals are clear to me.	1.76	0.636	10.518***
The provided templates are concrete enough and don't impose new questions.	2.18	1.124	3.867***
The stated dependencies are comprehensible.	2.38	1.015	3.294**
The provided linkages to other patterns make sense.	2.24	0.786	5.196***
I know to which context the patterns are applicable.	2.07	0.884	5.674***

*Table 3.   Results of the comprehensibility questions (adopted from Wurhofer et al. (2010), 5 point Likert response format, *p<0.05, **p<0.01, ***p<0.001)*

We further asked questions about the understandability and helpfulness. Table 4 shows the scores that are all above the neutral value of 3, indicating, in general, a good understandability and helpfulness comprehensibility of the pattern. The subjects agree (average = 1.86) that the presented patterns help to specify better application presentations with regards to the users' initial trust. The results show that we should further improve the right balance between concreteness and abstractness (2.34). The results also suggest that we should extend the pattern collection for better completeness (2.28). This is in line with the requirement lists developed by the teams that used many other requirements for the application presentation. Some of them addressed ease of use (as stated before, we did not include the pattern for ease of use in the collection) or were related to the recommendations given by the application that were used in the experiment. Nevertheless, we will determine whether to develop requirement patterns for these additional requirements in future research.

Question	Average	SD	t
I would consider the patterns as complete, meaning that the necessary information is given in the pattern.	2.28	0.960	4.063***
The language of the patterns is clear to me. The style in which the pattern is written is well-readable to me.	2.00	0.757	7.124***
I think the patterns are problem-centered, i.e., all parts (e.g., name and template) are related to the problem description.	2.07	0.753	6.661***
I think that the balance between concreteness and abstractness is good.	2.34	0.721	4.894***
I think that the presented patterns help to specify better application presentations with regard to the user's initial trust.	1.86	0.693	8.842***
I think that the presented patterns increase the users' initial trust in the application.	2.07	0.753	6.661***
I think the presented patterns support the communication of requirements analysts, developers and researchers by providing a common basis.	2.00	0.756	7.124***
I think the presented patterns capture relevant knowledge about users' initial trust in applications.	2.10	0.724	6.666***

*Table 4.   Results of the questions for understandability and helpfulness (adopted from Wurhofer et al. (2010), 5 point Likert response format, *p<0.05, **p<0.01, ***p<0.001)*

Table 5 shows that 24 subjects (82.8%) accepted the requirement pattern in general. Therefore, we can say that the requirement pattern collection is a good starting point for requirements analysts if they try to increase the initial trust in an application by specifying a suitable presentation.

Question	Yes	No	Don't know
Overall. Do you "believe" the pattern?	24	2	3
Do you find yourself nodding in agreement as you read the pattern descriptions?	24	1	4

Table 5.   Results of acceptance questions (adopted from Wurhofer et al. (2010))

6 Limitations and Future Research

The study does not come without limitations. Due to the characteristics of trust, as discussed, there are several antecedents that were not addressed by requirement patterns for the application presentation. Other trust antecedents that focused on ease of use were excluded. Further, we point out that requirement patterns cannot give a guarantee for increasing the users' initial trust in applications.

While requirement patterns can be defined for some trust antecedents, other antecedents, such as expertise (Moorman et al., 1993), cannot be specified in advance, but will still enhance user trust. Many of these antecedents are characteristics of the provider that need to be built for a longer period of time. Other examples of antecedents that cannot be specified using patterns are a positive feedback profile (Ba and Pavlou, 2002) or a positive prior exchange history (Poppo et al., 2008), e.g., with a specific application provider. Therefore, if the provider appears to be trustworthy from past user experience, the user will probably trust the new application more easily; alternatively, all requirement patterns do not work if users distrust the provider from previous experiences.

Due to the characteristics of trust, there are overlaps with other characteristics, especially usability. Perceived ease-of-use is also seen as an antecedent of trust (Gefen et al., 2003). Therefore, every effort to enhance the usability can enhance initial trust. We further did not consider issues of graphical design, which will also foster trust, as a well-designed webpage suggests a professional owner/company (McKnight et al., 2002).

Another limitation is that we did not evaluate whether the requirements, fulfilled in a presentation of an application, really help increase initial trust. To fulfill a requirement, different designs are possible. Further, designs can be implemented in different ways and thus it is difficult to ensure whether an increase of users' initial trust results from the requirement patterns. To ensure the effectiveness of the requirement pattern, we developed them from trust theory using antecedents that are shown to increase trust. Furthermore, they were reviewed by a trust expert in the development step and peer reviewed by other trust researchers in the employment step. Nevertheless, we plan to prototype the specified websites by the teams and conduct an experiment with other participants to measure the perceived trustworthiness of the application.

The experiment for the final evaluation was conducted with students in one of our university courses that includes training in requirement engineering and prototyping. We hence think that the students are good surrogates for novice requirements analysts because they have the knowledge about requirement engineering activities and techniques, even though they have no practical experience. We focused on this particular group for the experiment, as experienced requirements analysts could have experience on how to foster initial trust – thus biasing our measurements. Nevertheless, we think that the domain knowledge about initial trust does help novice and experienced requirement analysts. This should be further evaluated in future research.

The questions for understandability and helpfulness indicate that there is potential to improve the balance between concreteness and abstractness. Since the template of the pattern is abstract, it is possible to provide extra-information or constraints in an extension to provide some advice to adjust the requirement patterns to the actual project (Renault et al., 2009). We plan to do this in future research.

7 Conclusion

The aim of this research was to show how application presentations can be specified to improve the formation of initial trust in the application and to provide requirement patterns that show how an application can be presented in a way that increases the users' initial trust in the application, thus leading to a higher intention to use the system.

In this paper we showed how requirement patterns can be developed from trust theory. We identified trust antecedents which are suitable for building initial trust and we showed how requirement patterns

can be developed addressing these antecedents. We further indicated that requirement patterns can be evaluated using the Petter et al. (2010) evaluation framework that was developed due to the fact that few patterns, if any, have been evaluated (Petter et al., 2010). We showed that experimental settings, in addition to other evaluation techniques, can be effectively used for pattern development. For our requirement patterns, we showed that they were highly accepted by the subjects in the experiments and that they were understandable and helpful.

With our patterns we provide a lightweight approach for requirements analysts to incorporate trust requirements into specifications of application presentations. This can improve the productivity of requirements analysts (Hoffmann et al., 2013), as they can start from a set of predefined requirements. The evaluation shows that the patterns were accepted by the participants and that they were used to specify the webpage to present an application.

To enhance the quality of the software requirement pattern, in future studies we will use the evaluation results to further improve the requirement patterns. We want to parameterize some parts to allow more detailed choices by each analyst applying the pattern and making it easier to adapt the pattern for different kinds of projects. Furthermore, we plan to develop a requirement pattern catalogue starting with the presented pattern collection, to which we would like to give suggestions as to which patterns are important for different types of applications.

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