

A Method for Multi-Context Boundary Profiling for Individual Communication Management

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Abstract. Permanent reachability via mobile communications technologies has become a ubiquitous phenomenon. The traditional boundaries between people's different contexts in their lives become blurry and begin to dissolve, if they are not actively maintained. Such boundary management activities allow to individually determine which communication request are considered acceptable in a particular context. Existing research in this field has used a fixed set of pre-specified contexts to examine boundary management activities and identify different boundary profiles. Based on results from context-aware computing and mental model research, we argue for an open-ended, individual set of contexts to be considered for boundary management. Consequently, we develop an open structure elaboration technique to allow for individual specification of contexts and the information necessary to create a boundary profile, as identified in related work. The method is validated in an exploratory study, which was designed to verify the hypothesis that boundary management should be based on individually specified contexts, and show the feasibility of the proposed method. The results indicatively confirm our assumptions and show that the method can be used to elicit the required information.

Keywords: Boundary Management, Structure Elaboration Technique, Context-sensitive Communication Management.

1 Introduction

Today's ubiquitous availability of networked information technology with the rapid advent of mobile communication devices over the last decades has significantly expanded the amount of time people are available for communication with others [1] and has also altered the ways people communicate with each other [2]. Permanent reachability allows to contact people anytime and independently of their current location. In particular, it enables other people to permeate a person's current communication context, such as being at the workplace or spending time with one's family or friends.

The persons experiencing such permeations might or might not perceive them to be annoying or problematic. In general, however, existing studies [3-5] have shown that many people deliberately manage their availability for communication with others. Such acts of considering and eventually deciding of whether one accepts an incoming

communication request and whether to be available for such requests at all is referred to as boundary management [6]. The number of occasions one must engage in boundary management activities have risen with the advent of mobile communication technologies [4]. The amount of time and cognitive resources spent on such activities consequently impacts the activities people are currently engaged in their current context. Avoiding boundary management, and consequently accepting any incoming communication attempt, is not an option, as it massively decreases performance of one's current activities [7] and has shown to create stress [8] and eventually negatively impact one's wellbeing [9].

Boundary management in the age of ubiquitous reachability thus should to be actively supported by the devices used for communication. In particular, those devices should be aware of a person's current context and should adapt the availability accordingly. While much research has been conducted in the field of technically identifying a person's current context [10], less focus has been put identifying the availability of a person in a particular context and the acceptability of communication requests by people from other contexts. Existing research in this area largely as relied on Clark's Boundary Theory [11], which relies on a binary distinction between a work domain and a family domain. Research on context-aware adaptability of systems, however, has shown, that the number of contexts people experience throughout their life are usually more diverse and dynamic [12]. Our working hypothesis is that deliberate boundary management needs to be based on a conscious distinction between a set of contexts, which not necessarily only contains two domains. Furthermore, we hypothesize that the willingness and necessity to accept permeations between these contexts are highly individual and dependent on the contexts the permeations originate from and target at.

Based on this working hypothesis, the present paper sets out to develop a method that allows to identify these context, the permeations that occur among them and the acceptability of those permeations. The contribution of the paper is twofold. First, we provide an elicitation method that can be used to gather data necessary for the design or individualization of personal communication systems. Second, in applying this method in a case-study setup, we demonstrate the relevancy of fine-grain context identification in boundary management.

The remainder of this paper is structured as follows: in the next section, we introduce the concept of boundary management as conceived by Clark [11]. Next, we discuss the state-of-the-art in methods for boundary profiling, i.e., for identifying permeations between different contexts and their acceptability for a person approached by a communication request. Section 4 describes the design of our method, which is based on structure elaboration techniques [13]. Section 5 presents the results of a study we have conducted to examine the validity of our method design and the underlying hypothesis. We close with a discussion of the identified shortcomings of our method and the limitations of our study design, and give an overview about our future research.

2 Boundary Management

This section gives a brief overview about the work/family border theory as introduced by Clark [11]. The theory and its fundamental concepts like domains, borders between them and permeations are explained below to provide context for the following sections.

The main idea of the work/family border theory is that there are two major contexts in a person's life, namely, work and family (referred to as "domains" by Clark [11]). These two domains influence each other and usually cannot be separated clearly from each other. A domain usually has unique properties like rules, thinking patterns, roles and behaviors that a person deploys when perceiving to be engaged in that particular domain. Clark introduces the concept of borders that separate the domains from each other and provide the fundamental information necessary to decide which domain is currently considered to be active. Borders can be physical (e.g., workplace), temporal (e.g., worktime) or psychological (i.e., a domain property expression like behavior). Furthermore, the type(s) of border(s) between domains, their flexibility (e.g., when working flexible hours) and their blending (e.g., when working from a home office), can have an impact on the border strength. The border strength determines how likely "permeations" are to occur and influences how they are perceived. The concept of "permeation" refers to the phenomenon that expressions of domain properties appear in a domain where they do not belong to originally. Such domain properties can manifest in a person's behavior but can also be members of a particular domain. Encountering a communication request by a member of a domain different from the one currently considered active consequently would be a permeation. An example for such a permeation would be a phone call from a member of the family domain when the person currently is in the work domain. Permeations are not necessarily dynamic phenomena, but can also manifest themselves (semi-)permanently in a particular domain. Putting up family pictures at one's workplace would be an example for such a permanent permeation. The quality of a permeation is also determined by its perceived intrusiveness. Some permeations might be perceived only peripherally and hardly influence one's current activities. Others, however, also can be highly intrusive and require one's full attention. Boundary management refers to how people deal with such perceived permeations, both, in-situ and ex-ante, i.e., whether they strive to proactively create settings that avoid or facilitate permeations.

In the context of the original work/family border theory [11], boundary management is situated in the area where the work domain and the family domain overlap. This area is referred to as "borderland", and its size is dependent on a person's preferences and proactive or in-situ strategies of dealing with permeations. People who do not strictly separate the domains are referred to as "border-crossers". These border-crossers usually engage in active boundary management, i.e., consciously decide on how to act in case of permeations in different domains. How people manage their boundaries when taking the border-crosser role has been active subject of research [4, 6, 14] and is usually described in boundary management profiles. We review the methods developed to elicit such profiles in the following section.

3 Related Work

This section discusses different approaches to create boundary management profiles based on the work/family theory [11]. The approaches proposed by Kossek et al. [6] and White & Thatcher [4] are based on the dual-domain-concept as originally devised by Clark [11], whereas Keeney et al. [14] extend the number of non-work domains.

Kossek et al. [6] propose to use a questionnaire to collect the required data for creating a boundary management profile that describes a person's behavior when encountering permeations. Methodologically, 17 items were developed to elicit information about a person's "non-work interrupting work behaviors", the "work interrupting non-work behaviors", one's "boundary control", as well as one's "work identity" and "family identity". The items are formulated as statements one can agree to or disagree with on a 5-point-Likert-scale. The answers are aggregated to values for each of the areas mentioned above, which form the basis for the boundary management profiles defined in a further step. When applying their method in a validation study with 591 participants, Kossek et al. [6] found 6 generic patterns of how people deal with permeations. Without going into detail on the differences between these profiles here, the distinguishing features are the perceived importance assigned to each of the contexts, the acceptability of permeations from one context into the other, and the likeliness to interrupt one's activities in the current context to accept a permeation from the other.

White & Thatcher [4] also build their work on the dual-domain concept introduced by Clark [11]. Their approach focuses on boundary management in the context of mobile communication, whereas Kossek et al. [15] do not focus on any particular area of application in their method. Methodologically, the authors propose to use questionnaires for collecting demographic data and then to pursue interviews for eliciting boundary management behavior in an open-ended way. The interviews are semi-structured along questions, which are domain-specific, covering the areas general usage of mobile phones, times and effects of communication, in which domain the communications occurred more frequently, facilitation or disruption in the domains, and whether there were external entities regulating mobile phone usage. The results are transcribed and analyzed using thematic content analysis. In a validation study, 27 persons participated in such interviews. The results were again used to identify generic boundary management profiles. One interesting finding was that the participants handle permeations differently depending on the role of the permeation initiator. Participants seemed not solely to decide on acceptance based on the context the permeation originates from, but used a more fine-grain approach focusing on distinct members of this context.

Unlike the approaches from Kossek et al. [15] and White & Thatcher [4], Keeney et al. [14] use a multi-domain model as the conceptual foundation of their study. Based on a literature review, the authors identify eight non-work contexts, namely health, family, household, friendships, education, romantic, community and leisure. Methodologically, Keeney et al. [14] propose a questionnaire consisting of 48 items to collect data on the perceptions of how much interference one observes from the work-context to either of the non-work contexts and whether these interferences are considered problematic, i.e., whether or not they are sources of stress. This is augmented with items assessing the perceived importance of each context and a person's involvement in this

context. The items are formulated as statements one can agree to or disagree with on a 5-point-Likert-scale. In a validation study, 1811 people used the developed instrument [14]. The results show that six of the eight proposed non-work contexts are considered relevant by 88% to 99% of the participants. This indicates that people usually distinguish between different more than one non-work contexts. Furthermore, the indicators of perceived interference and whether they are considered sources of stress vary across the different non-work context, which indicates their diversity and suggests that they should be treated separately when supporting boundary management activities.

The review of the validation studies present in related work has allowed to identify the main characteristics of boundary management profiles that need to be considered when engaging in elicitation activities. Kossek et al. [6] as well as White & Thatcher [4] identify the actual likeliness of acceptance of a permeation to be a constitutive element of boundary profiles. White & Thatcher [4] as well as Keeney et al. [14] focus on permeations originating from the work context, whereas [6] examine permeations in both directions, i.e. non-work interrupting work and work interrupting non-work. Keeney et al. [14] also provide evidence, that the non-work domain should be elaborated on in more detail and can be split in distinct contexts, in which people show different boundary management behaviors. Furthermore, White & Thatcher [4] found that the role of the permeations initiator is crucial to the boundary management behavior. Consequently, boundary management must not only consider the source contexts of permeations, but also explicitly allow to distinguish different members of the source context triggering such permeations. Results showing that the invasiveness of a permeation is perceived differently depending on the source and target context (cf. “facilitation vs. disruption” [4] and “time-based and strain-based interference” [14]) indicate that the level of acceptability of a permeation can and should be assessed as well. Finally, the results on the importance of different contexts and a person’s involvement therein, as described by Keeney et al. [14], show that different persons might perceive to have different non-work context and should be able to explicitly name them.

4 Method Engineering

The review of the methodological considerations present in related work has shown that boundary management can be supported by preparation activities, which elicit a person’s fundamental acceptance of permeations among different contexts and their way of dealing with such permeations. All existing methods, however, are based on a fixed set of contexts that are examined. While Keeney et al. [14] show that a binary work-family distinction appears to be insufficient, they still develop their instrument based on a set of 8 pre-specified contexts that they identified to be generically suitable from a literature review. Based on research in context-sensitive adaptive systems [12], our hypothesis is that contexts are highly individual constructs. Prescribing a set of contexts to be assessed thus might either oversimplify or over-structure a person’s perception of her/his communication contexts. We thus here take a different approach and base our approach on structure elaboration techniques. They have proven to be suitable to identify such individual constructs without any a-priori assumptions [16].

4.1 Background: Structure Elaboration Techniques

Structure-elaboration techniques have shown to be useful for the elicitation of mental models. Mental models are cognitive constructs that are used by persons to make plausible and assess their perceptions of phenomena in the real world [17]. An individual's conceptualization of a perceived situation as a particular communication context is an instance of such a mental model. Assessing whether an incoming communication request is regarded as a permeation of this context and whether the request is still acceptable or must be accepted puts this mental model to use. To support boundary management, the underlying mental models should be made explicit.

Structure-elaboration techniques are an effective means to create physical representations of mental models [16] to make them explicit. In a process moderated by an facilitator (referred to as the "dialogue-hermeneutic method" [13]), an articulating person creates a graphical representation of their mental models by placing labeled cards on a modeling surface. Subsequently, the articulating person and the facilitator put those cards into mutual relationship. Dann [16] has stressed the importance of the immediacy of representation in the structuring process. This immediacy is attained by the physical creation of the model. Both participants in the process can immediately refer to a physical representation rather than abstract items. They create and modify the model in a dialogue-based way until reaching consensus about what is represented. Mental models of individuals are thus externalized, questioned and modified at the same time. This is necessary, as a mental model might be incomplete or even be inherently contradictory. The dialogue-oriented process enables to reflect on these potential issues and resolve them. The articulation procedure ends once the articulating person feels confident that the result matches their individual mental model.

Structure-elaboration techniques usually are highly sophisticated approaches with respect to the specification of both, the methodology and the instruments to be used. However, their suitability for the externalization of mental models has already been evaluated empirically [13, 18]. Some researchers, e.g., Dann [16], have suggested structure elaboration techniques should always be adapted to the case at hand, e.g., in terms of prescribing model elements or a modeling procedure. In the following we thus introduce a structure-elaboration technique that is adapted to allow the elicitation and representation of information required for boundary management and is used in combination with the dialogue-hermeneutic method.

4.2 Identification of Contexts and Roles

In a first elaboration step, the articulating person specifies the different context he or she perceived to be relevant in daily life. These contexts form the foundation for the following elaboration steps. Initial tests of the method have shown that the concept of "context" appears to be quite abstract and non-self-explanatory. To provide a first anchor for orientation, we have thus introduced a context named "work", which is offered up-front. It, however, can be rejected to be irrelevant (e.g., for non-working persons) or refined to be more fine-grain (e.g., for people active in more than one job). The

number of contexts is not constrained. All contexts are named and written on cards of distinct colors (one color per context).

Following the findings of White and Thatcher [4], we not only assess permeations of one context into another, but also provide the possibility to differentiate the acceptability of permeations per role in a particular context. As an example, one might not generically reject permeations from a work-context into a family-context, but might want to differentiate between close co-workers, who are accepted to permeate this particular border, and other members of the context, whose communication requests might be rejected. In addition to specifying a context, the articulating person can also specify distinguished roles which are handled differently (in a positive or negative way) than members of the overall context. Those roles are again named and are written on cards matching the color of the context they belong to (using a differently shaped card to distinguish contexts and roles).

Figure 1 shows an example result of this first elaboration step. Here, two contexts, namely “Work” and “Family” have been specified. Each context has two distinguished roles, that are to be considered separately when assessing the potential of permeations and their acceptability in the next step.

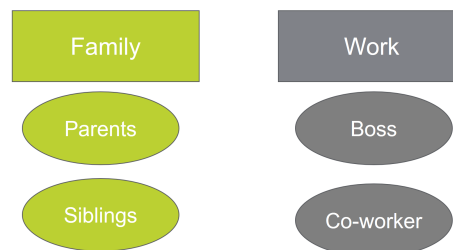


Fig. 1. Two contexts, each with two distinguished roles

4.3 Boundary Profiling

Based on the set of contexts and roles identified in the first step, the second step now elaborates the boundary profile of the articulating person. The boundary profile describes which permeations can happen from any context, or role therein, to any other context via different communication channels. It furthermore represents the acceptability of each potential permeation (or, expressed inversely, whether the permeation is a considered to be intrusive) and the likeliness of acceptance of the permeation. Distinguishing between acceptability and likeliness of acceptance is also rooted in the findings of White and Thatcher [4]. They describe the phenomenon that, although an incoming communication request might be considered a potential source of heavy irritation, it is still accepted, e.g., because of the perceived importance of the role the request originates from.

For this second step, another set of cards is introduced in the elaboration process to express potential communication channels that could create permeations, their acceptability and their likeliness of acceptance. Each type of card represents one communication channel used by the articulating person. The structure-elaboration technique itself

is not restricted to any particular set of channels. Still, as we focus on mobile communication settings, we provide participants with a set of three pre-specified channels, which are the most common ones on mobile devices based on existing research in the field [2, 4, 19]: phone, email, and messenger. As for contexts, this list of channels is not prescriptive - participants can opt to skip channels they do not use or add additional channels.

The articulating person now selects a first context to examine the boundary profile for. This is considered to be the first target context, i.e., the context the person is in, when experiencing an incoming communication request. Each other context and each role therein as specified in the first step are now potential sources on communication requests, which can be made via any of the available channels. Given the usually large number of potential sources, the contexts are reviewed pairwise to reduce the complexity of the initial elaboration setting. For each source context including the specified roles, the articulating person describes, how she/he experiences incoming communication requests via the different channels. For each channel, its acceptability is assessed and indicated via differently colored channel cards: green indicates low perceived intrusiveness, yellow indicates medium perceived intrusiveness, and red indicates a high level of perceived intrusiveness. Additionally, the likeliness of acceptance is assessed separately and indicated by making a mark on the respective channel card: a tick mark indicates almost sure acceptance, an “x” indicates almost sure rejection, and a “~” indicates situation-dependent acceptance, i.e., dynamic in-situ assessment of acceptance.

Figure 2 shows an example of such an assessment. “Family” is considered the target context here, while “Work” is considered the source context. The work-context has two distinguished roles, whose potential communication requests permeating the family domain have already been assessed. In this setting, co-workers would usually only use the phone for communication requests (as messenger and email are omitted as potential channels). Such requests are not considered intrusive and their acceptance is usually judged based on the currently perceived situation. Communication requests by the boss using the phone are considered to be highly intrusive, but are usually still accepted. Communication requests via email or messenger are perceived to be less intrusive and are usually ignored or deferred to a later point in time.

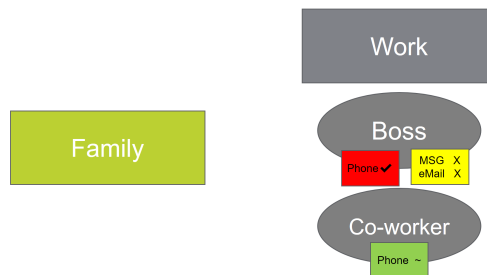


Fig. 2. Boundary Profiling for a source context “Work” permeating a target context “Family”

This pairwise review of contexts is repeated until each combination has been assessed. Each created structure is documented (e.g., via pictures) and the cards are reused for the next combination of contexts. There might be contexts that are not relevant as source contexts (i.e., contexts communication requests originate from), but are only potential target contexts. An example for such a context would be “Workout”, which designates a person’s physical training activities. While this would be a regular current context of a person, it hardly is the source of communication requests.

After the assessment of all relevant combinations the documented raw data is condensed in a final step to be re-visited and reflected on by the articulating person.

4.4 Representation of Boundary Profile

The collected data is transferred into a table format that provides a more condensed overview about the boundary profile. The table rows indicate the source contexts and roles, i.e., the sources of communication requests. The columns indicate the target context, i.e., the context a communication request is experienced in. Each cell is then filled with the color indicating the acceptability of the communication request and the mark indicating the likeliness of acceptance.

				Work	Family
Work	Boss	Phone		✓	
		MSG		X	
		eMail		X	
	Co-workers	Phone		~	
		MSG			
		eMail			
Family	Parents	Phone	✓		
		MSG	~		
		eMail	X		
	Siblings	Phone	✓		
		MSG			
		eMail			

Legend	
No permeation possible	
No permeation	
<i>Level of disturbance</i>	
low	
medium	
strong	
<i>regular communication acceptance</i>	
yes	✓
no	X
undecideable	~

Fig. 3. Condensed boundary profile with two contexts

Figure 3 shows an example for such a table with two contexts, which have two distinguished roles each. The table cells with a grey background indicate non-occurring permeations. Requests from a context a person currently is in are not considered to be permeations by definition (i.e., the cells where source and target context are identical are always greyed out). Communication channels that are not used by a particular role are also greyed out, as they cannot create permeations.

4.5 Summary and Example

In this section, we have introduced a structure-elaboration technique that is tailored to be used for boundary profiling. As can be seen from the description of the method above, the number of pairwise permeation assessments between contexts raises with the square of the number of specified contexts. Consequently, a full assessment of mutual permeations between all contexts causes considerable effort and requires both, the articulating person and the facilitator, to stay on task for quite some time.

Due to the number of potential permeations, constructing a single visualization of the full boundary profile during articulation appears to be unfeasible. The evolving complexity of mutual connections between contexts and the space required to construct such a model would lead to cognitive capacity drawn away from articulation toward maintaining the model state [20]. This problem is avoided when focusing on only two contexts at a time, as proposed above. It, however, causes a potential loss of overview about the overall state of articulation and might lead to inconsistencies. Furthermore, the need for permanent documentation of intermediate results might cause frequent interruptions, again leading to a non-optimal articulation process. One way to mitigate these frequent interruptions and maintain a more comprehensive overview about the profile is to create one model per target context, covering a potential source contexts.

Figure 4 shows an example of such a model, where the reviewed target context is placed at the center (“Uni”, representing university) and all potential source contexts including the involved roles are placed around it (contexts from left to right and top to bottom: “own start-up”, “work”, “family”, “friends”, “sport”, “cooking”). The contexts “sport” and “cooking” are notable, as they cannot act as source contexts for the articulating person. As described above, such contexts do not contain any members that could potentially create permeations and usually refer to situations the person is engaged in individually without any interaction with others.

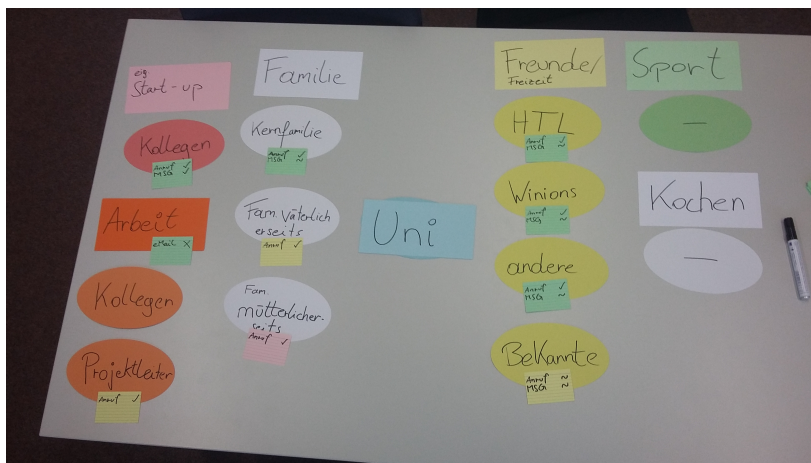


Fig. 4. Elaborated boundary profile for one target context and six source contexts

5 Validation of Method

This section reports on an exploratory study we have conducted to examine the applicability of the method developed above and to assess the working hypotheses this work is grounded on.

The fundamental hypothesis informing our method engineering process was that boundary management in a mobile communication setting is based on consciously distinguishing between a set of perceived contexts that are more fine grain than the distinction between work and family as proposed by Clark [11] (**H1**). This hypothesis could be confirmed, if studies showed that people tend to ground their boundary management on more these two fundamental contexts. Such behavior has already been observed by Keeney et al. [14] and is to be verified in our study.

Building on H1, we have further hypothesized that those multiple contexts are individual phenomena and cannot be determined generically (**H2**). This hypothesis could be confirmed, if we could show that different articulating persons create heterogeneous sets of context to base their boundary management on.

Finally, our method is based on the hypothesis that the acceptability and likeliness of acceptance of permeations are dependent on the respective source and target context (**H3a**), and also are influenced by specifically identifiable groups of people within the source context triggering the permeation (**H3b**). H3 thus goes beyond H2 in claiming that not only people distinguish between multiple contexts, but also adapt their boundary management behavior according to them. These hypotheses could be confirmed, if we could show that there are differences in acceptability and likeliness of acceptance of permeations from a particular source context depending on the target context (H3a) and that those differences are not consistent for a particular source context but are different depending on the role triggering the permeation (H3b).

If all these hypotheses could be confirmed, the proposed method should fundamentally be suitable to create individual boundary profiles. The aim of the study presented in the following is to confirm that the method indeed allows to elicit the information necessary to describe a boundary profile as specified in the related work section (**H4**).

5.1 Study Design

Our hypotheses require to apply the developed method in a real-world setting, i.e., conducting structure elaboration workshops with people creating their boundary profiles based on their perceptions of the real world. The data required to assess the hypotheses formulated above can be derived from the workshop results, i.e. the created models. In addition, observations from the process of articulation and elaboration possibly can inform the assessment of H4. Therefore, one of the authors acted as a facilitator in the workshops to gather observations on the feasibility of the method. The elaboration results were documented using a digital photo camera and then transcribed asynchronously into the table form described above. These tables are considered the raw data for our analysis.

H1 is assessed by counting the number of contexts specified by the articulating person. If any target contexts showed identical results for all other profiles, the distinction

between those contexts is validated with the articulating person and, in case no arguments for keeping them separate are provided, would eventually lead considering these identical contexts only once in the metric for H1. H1 can be confirmed, if the number of contexts exceeds two.

H2 is assessed by looking at the names of the contexts specified by the participants. Names provided by different persons seeming to refer to the same concepts (e.g., firm or company) are validated with the affected persons and are considered equal, if all of them agreed. The number of occurrences for each name is counted and related to the overall number of conducted workshops. A high number of distinct names with a low number of occurrences is an indication to confirm H2.

H3a and H3b are assessed by looking at the heterogeneity of the data provided for acceptability and likeliness of acceptance for permeations. We look at the occurring patterns of acceptability/likeliness of acceptance-values for permeations in each source-/target-context-combination. For **H3a**, we count the number of identical patterns occurring for each target context in any source context (cf. Figure 5 left) and normalize the resulting value with the number of potential source-/target-context-combinations. Lower values for this metric (i.e. heterogeneous patterns across contexts) indicate that H3a can be accepted. For **H3b**, we more closely examine the patterns for the source roles and count the number of identical patterns occurring for each source role across all target contexts per source context (cf. Figure 5 right) and normalize the resulting value with the overall number of specified roles. Lower values for this metric (i.e. heterogeneous patterns across roles) indicate that H3b can be accepted.

p.		F		eMail							
Family	Parents	Phone	✓	✓	✓	✓					✓
		MSG	~	~	~	~					~
		eMail									
	Nuclear Family	Phone	X	✓	~	~					X
		MSG	X	~	~	~					X
		eMail									X
	Other Family	Phone	X	X	X	X					X
		MSG	X	X	X	X					X
		eMail		X							X

p.		F		eMail							
Family	Parents	Phone	✓	✓	✓	✓					✓
		MSG	~	~	~	~					~
		eMail									
	Nuclear Family	Phone	X	✓	~	~					X
		MSG	X	~	~	~					X
		eMail									X
	Other Family	Phone	X	X	X	X					X
		MSG	X	X	X	X					X
		eMail		X							X

Fig. 5. Scope of pair-wise comparisons for calculating metrics in H3 - left: per target context for H3a, right: per role for H3b

For **H4**, we take a bird eye's view on the resulting data and qualitatively assess, whether the required data would be sufficient to be support boundary management. Furthermore, we augment these results with our observations of the elaboration processes.

5.2 Results

The study was conducted with a sample of 12 persons. All of them were students of business informatics at an Austrian University. They all were working students, with varying numbers of hours per week, ranging from 6 to 40 hours with a mean of 16.25 hours. Ten of them were male, 2 were female. They were aged between 21 and 36 years with a median of 26 years. 3 were living in a fixed partnership and 9 were considering themselves to be single.

The workshops were conducted over a duration of two weeks and were facilitated by one of the authors. The duration of the workshops, starting with a brief introduction and ending with the finalization of structure elaboration (excluding condensing the data in a table) lasted between 47 and 123 minutes, with an average duration of 80 minutes. We first summarize the metrics required for the assessment of the hypotheses for all participants. Afterwards, we give examples of the results, selecting two profiles that show complementary features for further discussion below.

Profile Metrics.

Table 1 summarizes the metrics described above for assessment of H1, H3a and H3b. The number of overall contexts is necessary to assess H1. The relative number of identical patterns identified on context-level is the metric used to assess H3a. H3b is assessed using the relative number of identical patterns identified on role level.

Table 1. Profile metrics used for assessment of hypotheses

Participant	overall number of contexts	number of target-only contexts	overall number of roles	identical patterns (scope: source/target context)		identical patterns (scope: source role)	
				absolute	relative	absolute	relative
1	6	0	14	0	0%	2	14%
2	6	0	11	7	19%	0	0%
3	5	0	10	5	20%	2	20%
4	5	0	16	7	28%	4	25%
5	6	0	16	9	25%	2	13%
6	7	0	14	24	49%	4	29%
7	6	0	9	3	8%	2	22%
8	7	2	12	5	10%	4	33%
9	6	0	11	3	8%	0	0%
10	8	0	18	20	31%	2	11%
11	5	1	10	2	8%	0	0%
12	5	0	12	0	0%	0	0%

Table 2 gives an overview about the used contexts and the number of their occurrences over all participants, as required for the assessment of H2. Names referring to identical concepts are already merged. The single occurrence of “spare time” is a conceptual merge of “family” and “friends”, which were considered by the articulating person to be in the same context, but to be different roles.

Table 2. Number of occurrences per concept

Context name	Occurrences	
	absolute	relative
Work	12	100%
University	12	100%
Family	11	92%
Friends	10	83%
Sports	5	42%
Partnership	4	33%
Student Union	3	25%
Shared Flat	2	17%
University Tutor (side job)	2	17%
Spare Time	1	8%
Ambulance Service	1	8%
Music Band	1	8%
Playing Computer Games	1	8%
Club	1	8%
Fitness Club	1	8%
Soccer	1	8%
Cooking	1	8%
own Start-Up (side job)	1	8%
Hobby	1	8%
Crackerbarrel	1	8%

The boundary profiles allow to calculate additional metrics that enable to assess the heterogeneity of the profile with respect to acceptability and likeliness of acceptance for permeations between different contexts and via different communication channels. Such metrics are not relevant for the hypotheses examined in the present paper and are thus omitted here for reasons of space. We, however, show their potential by calculating and describing them for the selected example profiles in the following.

Example 1.

Figure 6 shows the boundary profile for participant 2 (cf. metrics in Table 1 above) with 6 contexts and 14 explicitly specified roles.

		Work			University			Circle of friends			Partnership		Family			Sport	
		Co-worker			Fellow student			Best friends			Partner		Nuclear Family			Group	
		Phone	MSG	eMail	Phone	MSG	eMail	Phone	MSG	eMail	Phone	MSG	eMail	Phone	MSG	eMail	
		Work	University	Circle of friends	Partnership	Family	Sport	Work	University	Circle of friends	Partnership	Family	Sport	Work	University	Circle of friends	
Work	Co-worker	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Customer	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
	Boss	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
University	Project Partner	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
	Fellow student	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
	Others	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
Circle of friends	Best friends	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
	Uni. friends	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
	School friends	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
Partnership	Partner	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
	Parents	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
	Nuclear Family	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
Family	Other Family	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
	Group	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	
	Sport	✓	~	~	~	~	~	~	~	~	~	~	~	~	~	~	

Fig. 6. Example for boundary profile with 6 contexts

We here give a high-level overview about the results in the following to demonstrate the interpretation of the table. From a bird-eyes view, the overall pattern represents a more or less binary diversity profile, despite the rather fine-grain elaboration of contexts. With respect to the acceptability of permeations, there is a clear distinction between the “work”-context and the other contexts, which are largely oriented towards the participant’s private life. Permeations by members of the work context (as visualized in the top nine rows) to the other contexts are mostly considered to be not acceptable (i.e., colored red). Vice-versa, permeations from the other contexts into the work domain (as visualized in the first column) are also considered not or only somewhat acceptable. In contrast, permeations from and to the other domains are largely considered acceptable. The context “university” blurs the distinction between work and private life, and shown a more heterogeneous picture with respect to permeations originating from this context (rows under the label “university”) or entering this context (column labeled “university”).

The likeliness of acceptance of a permeation seems to be not only determined from its perceived acceptability. Only 41.2% of the permeations considered acceptable (marked green), the articulating person states a high likeliness of acceptance (marked with a tick). In 19.6% of the cases, a permeation is likely to be rejected (marked with an “x”) despite being considered acceptable. Permeations not considered acceptable (marked red) show a similarly heterogeneous picture. In this case, only 33.3% of the permeations are highly likely to be rejected, and 25.9% are still likely to be accepted.

Looking at the source and target contexts with respect to the likeliness of acceptance also gives a heterogeneous picture. A more consistent picture only evolves when considering the different roles. On this level of detail one can identify clear tendencies on whether a permeation is likely to be accepted or not. Permeations triggered by “other family” members, e.g., are very likely to be rejected in any other context, whereas permeations triggered by the “partner” are very likely to be accepted in any other context (although acceptability varies).

With respect to the used communications channels, there are indications that the articulation person hardly uses email as a means for communicating with others, as rows labeled “email” are largely show greyed-out cells (indicating that a permeation is not possible via this channel). This is only different for the work context, where email seems to be used as a means for contact by all identified roles. Aside that, no clear preference for any communication channel be found overall or in any context - acceptability and likeliness of acceptance largely seems to be dependent on the involved contexts and roles rather than the communication channels used.

Example 2.

Figure 7 shows the boundary profile for participant 8 (cf. metrics in Table 1 above) with 7 contexts and 12 explicitly specified roles. It has been selected to complement example 1 with respect to the identifiable patterns in the profile.

				Work	Family	own Start-Up	Cooking	University	Sport	Friends	
Work	Project manager	Phone		~	X	X	✓			X	
		MSG									
		eMail		X	X	X	X				X
	Co-workers	Phone									
		MSG									
		eMail		X	X	X	X				X
Family	Nuclear family	Phone	✓		✓	✓	✓			~	
		MSG	X		~	X	~			✓	
		eMail									
	Paternal family	Phone	X		✓	✓	✓				X
		MSG	X								
		eMail									
	Maternal family	Phone	X		✓	✓	✓				X
		MSG	X								
		eMail									
own Start-Up	Co-founders	Phone	✓	✓		✓	✓			✓	
		MSG	X	~		X	✓			~	
		eMail				X					
Cooking	-	Phone									
		MSG									
		eMail									
University	Project members	Phone	~	✓	X	✓				✓	
		MSG	X	~	~	X				~	
		eMail									
	Winions	Phone	~	✓	X	✓					✓
		MSG	X	~	~	X					~
		eMail									
Sport	-	Phone									
		MSG									
		eMail									
Friends	School friends	Phone	✓	✓	✓	✓	✓				
		MSG	X	~	X	X	~				
		eMail									
	Fellow students	Phone	~	✓	~	✓	✓				
		MSG	X	~	X	X	~				
		eMail									
	Others	Phone	✓	✓	✓	✓	✓				
		MSG	X	~	X	X	~				
		eMail									
	Known	Phone	X	X	X	X	~				
		MSG	X	X			~				
		eMail									

Fig. 7. Example for boundary profile with 7 contexts

From a bird-eyes view, the most distinct feature of the profile is its frugal use of different communication channels, as indicated by the large number of greyed-out cells. Furthermore, the profile contains two target-only channels (“cooking” and “sport”), which cannot trigger any permeations. This is indicated by the fully greyed-out rows for all communications channels. One of these contexts - “sport” - also cannot be used as a target context (indicated by the fully greyed-out column including this label). One might question the need for specifying such a context, where no communication can happen at all, in a boundary profile. The articulating person, however, considered it

important to express that there is a specific situation (namely during sports), where there is no reachability at all, likely because the mobile communication device is not carried along. This information, in turn, can be useful for boundary management, e.g., to direct incoming permeations to a mailbox.

In terms of acceptability of permeations, the articulating person appears to be rather open to accept permeations in any context, except from some particular roles and communication channels (e.g. for phone calls from maternal family members). Likelihood of acceptance does not seem to be mainly tied to particular roles or contexts, but rather to different communication channels. All potentially occurring permeations, 54.5% are likely to be accepted, when the used communication channel is a phone call. In contrast, only 5% of communication requests via a messenger application and 0% of potential permeations via email are likely to be accepted.

In combination with the first example, the patterns and metrics described above give an overview about the information that can be extracted from the elicitation of boundary profiles using the method introduced above. These results will provide the foundation to discuss the validity of hypothesis H4 in the next section.

5.3 Discussion

The results described above provide indicative evidence for the validity of our hypotheses. With respect to **H1**, we were able to confirm the results of Keeney et al. [14] that a binary distinction of contexts in “work” and “non-work” (or „family“) domain seems to be insufficient to describe a person’s boundary management strategies. The minimum number of contexts specified during structure elaboration and actively used to distinguish acceptability and likelihood of acceptance of permeations was five, clearly indicating the need for a non-binary context concept in boundary management.

With respect to **H2**, the results confirm that communication contexts should be considered to be individual constructs and cannot be pre-specified when aiming at capturing a person’s actual boundary management behavior. While Keeney et al. [14] consider a more fine-grain structure of the non-work domain only, our results suggest that a people also tend to identify distinct contexts in their work domain (e.g. when having side jobs, cf. Table 2). In general, the participants in the present study seem to have refrained from a binary assignment of contexts to either a work- or non-work-domain. This result, however, might be biased by the participant selection (all being working students). Still, the results show that generically considering the work domain to be a homogenous context is an invalid assumption.

For **H3a**, we could find indicative evidence that boundary management strategies are dependent on both, the source context of a permeation and the target context a person currently considers to be in. The number of identical patterns for both, acceptability and likelihood of acceptance, vary across the examined workshops. It appears to be a tendency that larger numbers of distinguished contexts lead to higher numbers of identical patterns (cf. Table 1, participants 6 and 10), indicating that there might be an upper border of how many contexts a person actually can distinguish. This border, however,

seems to be different for each person and cannot be determined upfront. This phenomenon rather indicates the need for another round of consolidation of the articulation results, during which such redundant contexts could be merged.

The results for the metrics calculated to examine **H3b** also show that distinguishing roles within contexts triggering permeations is a necessary part of a boundary management profile, as suggested by Keeney et al. [14]. The relative number of redundant patterns does not seem to be connected to the absolute number of roles or the ratio between the number of roles and contexts. The observed redundancies thus might again indicate to consolidate the results after the initial articulation phase, but do not fundamentally question the need for distinguishing roles within contexts when creating a boundary profile.

Taking a bird-eyes view on the deployment of the method with respect to the collected results and the process of articulation through structure elaboration allows to collect indicative evidence for the assessment of **H4**. Overall, the method has shown to collect most of the information types already identified in related work to be constituents of boundary profiles. The method currently lacks a way to express the perceived importance and the perceived involvement in a particular context as suggested by Keeney et al. [14]. While this appears to be a relevant aspect in a boundary profiles per se (i.e., for describing a person's behavior), its value for supporting boundary management activities appears to be limited, as support needs to be available independently of the importance of a context one currently is in. The importance of a source context is implicitly encoded in the information on the likeliness of acceptance of a permeation and thus does not need to be specified separately. With respect to the articulation process, the approach of conducting elaborations in multiple steps, focusing on one target context at a time and elaborating on permeations from all potential source contexts seems to be feasible. Overall, time effort required to conduct a full workshop appears to be one of the major obstacles for practical deployment. Depending on the number of contexts, workshops can be expected to last between 1 and 2 hours, which usually exceeds the amount of time people are willing to spend on configuring a boundary management support system. As such, the proposed method currently mostly is of academic value, but still has allowed to identify important aspects to be considered further when developing a practically applicable system for boundary management support.

6 Conclusion

In the present paper, we have introduced a method to create multi-context boundary profiles for managing communication requests based on individual perceptions of the structure of one's social environment. Such boundary profiles allow to reflect on one's strategy of dealing with permeations between different communications contexts. It eventually should provide the foundation to create technical support instruments that reduce the cognitive load and stress emerging from dealing with permanent reachability caused by today's ubiquitous communication infrastructures. We have identified the constituents of boundary profiles from related work and argued for considering communication context not to be stable, generically identifiable categories, as related work

has done so far, but to be individual constructs that are dependent on one's own mental models of how to deal with communication. Based on this assumption, we have proposed a method using a structure elaboration technique to elicit the necessary information in a dialogue-based way. We furthermore have conducted an exploratory study that has shown the feasibility of the method and could indicatively confirm the validity of our underlying hypotheses.

The external validity of our study suffers from the limited heterogeneity of the study participants, who all were working students with a rather technology-proficient background. Future work will need to broaden the scope of method applications to show its feasibility in a generalizable way. Furthermore, the study has pointed at potential metrics that could be used to describe the heterogeneity and consistency of a boundary profile. Such considerations, however, were out of scope for the present article and will be subject to further research.

With respect to the method itself, we found potential to extend its scope to non-social permeations, such as exploring the acceptability of notifications from non-human actors (e.g., from apps on a smartphone). Such sources of permeations have not been considered in the present study, but could easily be included in the structure elaboration technique. Furthermore, handling the complexity of the evolving elaboration structures could be made easier by technically supporting the articulation and elicitation process itself, e.g., by capturing intermediate results (as demonstrated in [21]) or by using an interactive surface guiding the articulation process (as demonstrated in [22]). Finally, our future research will also focus on putting the profiles to practical use by creating technical instruments that actively support boundary management activities as, e.g., outlined by Schneider et al. [23].

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