Norms for Electronic Partners in Socio-geographical Support
A Grounded Model *

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Abstract. Children as they grow up start to discover their neighborhood and surrounding areas and get increasingly involved in social interaction. We aim to support this process with intelligent technology. We call this “socio-geographical support”. Our proposed solution for providing socio-geographical support is to create a system of so-called electronic partners (ePartners), that function as teammates to their human users. In this paper, we propose a grounded model that describes how norms can enhance ePartners’ supportive function in the various social contexts in which they have to function.

1 Introduction

Children as they grow up start to discover their neighborhood and surrounding areas - and more so unsupervised the older they are -, and get increasingly involved in social interaction (e.g. at school or sports clubs). In this research we aim to support this process with intelligent technology. We call this socio-geographical support. This support can for example concern support for organization of neighbourhood events or birthday parties, assisting in keeping a child safe as it is learning to explore its surroundings, e.g., learning to cycle to school, and arranging play dates. Through this we help children form a better mental model of the socio-geographical structure of the neighborhood in which they live, which should enable them to feel more socially connected, safe, and secure.

In our study we focus on elementary school children (between 6 and 12 years old) as our target group, as well as important people in their social environment such as their parents and teachers. We choose this target group as this is the age where they start to explore their social and geographical environment on their own.

Our proposed solution for providing socio-geographical support is to create a system of so-called electronic partners (ePartners), that function as teammates

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to their human users as they navigate through their socio-geographical environment. ePartners in this setting may take the form of an application on a smartphone or a hand-held device. ePartners have already been investigated in several other contexts, e.g., within control systems, robots, applications that promotes positive lifestyle changes (see [12]), etc.

Since ePartners function as teammates to their human users and accompany them as they explore their socio-geographical environment, we view ePartners as playing a social role in the lives of people. We argue that to do this effectively, they need to adapt their behavior to the requirements of the social contexts in which they are functioning just as people do - e.g., when traveling to another culture or getting home from work. Social contexts that may be encountered by these ePartners are different family settings, school, church, etc. The ePartner would need to behave differently in the case of say, a 7 year old child walking alone in the neighborhood, depending on the specific child and his or her family. If a family is used to the child wandering around the area by themselves, an ePartner would only need to notify the parents in case the child has left the area considered familiar or secure. If a family lives in a relatively unsafe area, an ePartner would immediately give a warning in case the distance between child and parents has crossed a certain limit. In this way users can make individual agreement “contracts”, and ePartners can take the initiative to act in certain situations.

Varying social contexts also motivate our choice of software (i.e. intelligent context-aware agents) to provide socio-geographical support, as other methods (e.g. a social website, traditional software, maps, etc.) are not flexible enough to provide a tailored support (adapting to specific user needs) in a complex set of social environments, nor able to learn the needs and habits of their users through experience.

The question that we address first in creating such socially-adaptive ePartners is how to allow stakeholders to specify social requirements that ePartners should adhere to. Different people may have very different requirements on how the ePartner should behave, and so we aim for a rich and flexible specification language going significantly beyond the typical settings menu of today’s software applications. For this purpose we propose to view ePartners as functioning in a normative system, the idea being to express social requirements as norms.

As a step towards identifying which normative language is suitable for specifying social requirements in the context of socio-geographical support (as many normative languages have been proposed in the literature (see [8,16,31,27,30])), in this paper we investigate in more detail how norms can enhance ePartners’ supportive function in their social contexts. To ensure that our proposal is aligned with the needs of people concerning socio-geographical support, we perform user studies with parents and children to get a better understanding of the social contexts in which the ePartners should function. Our method for user data collection and analysis is described in Section 3. The analysis of this data has resulted in the identification of several main themes in the participants’ social contexts (Section 4). On the basis of this analysis we propose a grounded model
that describes how norms can enhance ePartners’ supportive function in social contexts described by the identified themes (Section 5). In this model the notion of \textit{values} is central as a crossover between the elements of the social context and norms. We discuss related work in Section 2 and conclude the paper in Section 6. We believe that the use of norms to support collaboration between humans and artificial teammates, in combination with our approach that emphasizes user studies to ensure that the developed techniques are in line with people’s needs, is novel in the context of normative systems research.

2 Background

In this section we give more background on important elements of our research, namely ePartners, normative systems and values.

2.1 ePartners

ePartners are defined as computerized entities that partner with a human (development of a relationship) and share tasks, activities, and experiences [7]. In that sense, as automation becomes sophisticated, ePartners will function less like tools and more like teammates [5]. They follow a paradigm shift from automation extending human capabilities to automation partnering with a human [7]. Examples of ePartners can be seen in various domains as critical as space missions [29], naval command and control [1], and virtual reality exposure therapy (VRET) [22], as well as other, less critical domains such as socio-cognitive robotics [13], and personal digital assistants [19,12].

The notion of an ePartner fits very well with the role that we envisage intelligent technology to play in socio-geographical support, namely as an intelligent entity able to partner with people. ePartners can form individual agreements (“contracts”) with their users and can take the initiative to act in specific situations. ePartners have not yet been investigated in the context of socio-geographical support nor with the emphasis on the social role that they are playing and the ensuing need for adaptation to norms in their social contexts.

2.2 Normative and organizational frameworks

Agents in a multi-agent system (MAS) are typically autonomous, self-regulating entities. In recent years, an increasing amount of research has proposed to assign an organization or a set of norms to a MAS with the aim of organizing and regulating it (see [8,16,31,27,30]), similar to the way social norms and conventions organize and regulate people’s behavior in society [31]. This should make agents more effective in attaining their purpose, or prevent undesired behavior from occurring. Organizational frameworks often incorporate norms as an element of the specification of an organization (see [15,8]). Research in this area has
yielded a wide range of frameworks and languages for expressing organizations and norms.

We aim to build on this work by using norms to allow people to define requirements of social contexts in which ePartners should function. To ensure that the normative framework allows to express those aspects that are important for people in the context of socio-geographical support, we perform user studies to derive requirements that an underlying normative framework for this type of application should adhere to.

To the best of our knowledge, the use of normative systems as the basis for supporting collaboration between humans and artificial teammates has been investigated only to a limited extent. KAoS [27], which is a framework that allows to specify policies for human-agent/robot teamwork, takes steps in this direction. To the best of our knowledge, the requirements for their policy framework are however not elicited based on user studies to understand the context in which these agents or robots should function, but rather on a general analysis of aspects of human-agent teamwork.

2.3 Value-sensitive design

As we propose values as an important concept in our model, here we briefly discuss work that has been done on understanding this notion and using it in developing technology. Particularly relevant is Value-sensitive design (VSD), which is an approach that seeks to design technology that accounts for human values in a principled and comprehensive manner throughout the design process. VSD at the core is an iterative process, and it investigates how values are supported or diminished by particular technological designs [9]. According to Cambridge Dictionary, a value is defined as “the importance or worth of something to someone”.

In [25], values are shown to be representable as sentences containing a subject matter, and a claim of “good/better/best” or “bad/worse/worst”, relating the subject matter to someone or something, or in general. Examples of that can be “too much cholesterol is bad for your health”, “my new can opener is better than my old one” and “pleasure is good”. Though the word “value” in itself seldom appears in a sentence of this form, the existence of the varieties of “good” and “bad” in the sentence signify how the value of the subject matter is seen. In his 1973 book, social-psychologist Milton Rokeach published a list of values (based on a survey he conducted) that has become popular and widely used. The list included 18 terminal values (end results, or what one seek to accomplish such as happiness, freedom, and a comfortable life) and 18 instrumental values (ways of seeking and accomplishing terminal values, such as ambition, self-control and honesty) [23].

3 User studies

In this section we describe the user studies that we have performed to get an understanding of the contexts in which ePartners for socio-geographical support
are expected to function. We describe the overall method we have used for performing the study (Section 3.1), and provide more details on how we collected the data (Section 3.2) and how we performed the data analysis (Section 3.3).

3.1 Method

We use situated Cognitive Engineering (sCE) as the general framework for choosing how to collect the relevant data from our user group [21]. sCE proposes to develop practical theories and methods that are situated in the domain, based on Cognitive Engineering (CE) approaches [14] that guide the iterative process of design and development of requirements and specifications that is now a common practice in software engineering. sCE combines work and domain analyses with the more event-driven engineering approach of scenario-based design, claims analysis and evaluation [20]. Our choice for this methodology is motivated by our aim to understand the social context in which ePartners will function.

Within this framework, we have conducted two types of user studies. The first type is cultural probing (CP), a methodology initiated by Gaver [10], consists of providing participants with packages of postcards, maps, disposable cameras, post-it notes, and other material, for them (without having detailed instructions) to use the contents of the packages to record spontaneous data related to their lives, over a period of several days or weeks (for a number of examples, see [24,4,3]). The aim of CP is not to reach a comprehensive view of the user’s requirements, but to rather use the collected material to inspire design. The second type of user studies we have used is focus groups, which are defined as “carefully planned series of discussions designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment” [17].

We use qualitative methods for data analysis as it fits our aims. Qualitative methods are used for obtaining an understanding of phenomena under consideration, whereas quantitative methods are used for obtaining generalizable results. In this case our aim is to get an understanding of the important themes in the social contexts in which the ePartner should function. Moreover, we are aiming to build a representation of a number of elements within the social context in a subset of potential users rather than a comprehensive model that spans the elements of the social life of all the members of our target group (for which a complete census would be required). We will use the resulting model to identify requirements for a normative framework to support ePartner functioning in socio-geographical support, which we will in turn use to build a first prototype. In future research, we are planning to conduct further user studies based on both qualitative and quantitative methodologies, to evaluate the prototype resulting from the first round of user studies. This iterative refinement process follows the ideas of sCE.

Within qualitative analysis methodologies we use an approach that is rooted in grounded theory. Grounded theory is a bottom-up approach whereby theory is derived from data, systematically gathered and analyzed throughout the research process. Researchers do not begin the project with a preconceived theory in mind [26]. In grounded theory, analysis comprises of four distinct steps [6]:
1. **Open coding** where data is examined line by line in case of pieces of text (or object by object for other types of data), and portions of text and other media are “coded” under various codes that represent key points in the data.
2. **Axial coding** or the creation of categories, whereby similar codes are grouped together to highlight the presence (or emergence) of a theme or a concept.
3. **Selective coding** (or to further refine the existing set of codes), to identify themes central to the research questions and aims, and several iterations of coding and re-coding of the data may take place until a satisfactory level is reached. Due to subjectivity of qualitative research methods, it is recommended [18] that at least one other researcher is involved in re-coding or coding evaluation of portions of the text, in order to investigate the degree of understandability, correctness, and completeness of the coding schema.
4. **Theory building** or the discussion and linking of emergent themes, and visual portrayal of connections that build up themes into a theory.

### 3.2 Data collection

We have conducted three focus group sessions and one cultural probe study to investigate user requirements. The participants in these studies were parents and (some of) their children in a town of approximately 30,000 inhabitants, located in the South-West of The Netherlands. Through a small ‘snowball sample’ we requested a group of 6 parents and another group of 6 children to participate in the studies. As [2] explains “In snowball sampling you locate one or more key individuals and ask them to name others who would be likely candidates for your research.” Our snowball sample started with a contact who participates in the school board, a youth centre and in a website for the local community.

The first focus group session included the six parents only. We introduced them to our project, research, and explained the aim of our user studies. To stimulate discussion, we displayed a few ePartner usage scenarios (created beforehand) and design claims (i.e. claims about a few positive and negative effects of the ePartner features within our scenarios) and asked the participants (individually) to rate to what extent they agree with our claims. After a short general discussion, we provided the parents with cultural probing kits (each kit contains a map, an instant camera, post it notes, post cards, pens, and some glue). The session ended with a brief explanation on the typical usage of the kit material.

The second session (three weeks later) included the same group as the first session. The parents brought back the material they (along with their children) collected during that period, and then proceeded (individually) to describe the data (e.g., pictures, map highlights, etc.) they collected with their kits. This process stimulated the discussion for a further 45 minutes in which many of the parents’ and their children’s life issues, values, and concerns were raised.

The third session included the six children only. The ages of the children ranged between six and eight years old. That session was led by an experienced elementary school teacher, and consisted of a discussion where the teacher asked

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1 The meaning of “coding” in this context is similar to “annotating.”
the children a number of open ended questions related to their knowledge and usage of current technology, what activities they are allowed to do, how they connect with other children at school, sport clubs, and other places. All sessions were audio-taped.

3.3 Data analysis

We transcribed the audio recordings from all three focus group sessions and imported these transcriptions and the scanned probe kit material into QSR NVivo\textsuperscript{2} to perform qualitative analysis.

First, thorough reading of the transcriptions allowed us to derive the preliminary coding schema from the data material. In the second round of analysis, each passage of text was annotated with the appropriate codes, and the relevant codes were grouped together which resulted in a tree of codes. Afterwards, the tree of codes was further refined (e.g., codes with similar or close meaning were merged, codes under the same topic were grouped, infrequent codes were removed, etc.). Coding was then re-done according to the new tree, and portions of it were rated by another researcher.

4 Results

In this section we describe the tree of codes that has resulted from our data analysis.

4.1 Tree of codes

The tree can be seen in Figure 1. The leaves of the tree represent the set of codes used in the analysis to mark relevant pieces of text in the transcriptions. Groups of codes represent the themes of social context within our user group that we have identified in the data, created through grouping together codes that are similar or related. Two groups (limitations and concerns) were split into sub-groups (in italic) for further clarification.

Second level nodes represent groupings of codes that together represent a theme within the participants’ social context. Activities includes codes relevant to activities participants engage in, such as playing with friends, church, or sports. Concerns represent issues raised by parents (and children) that are present in their current life or are a cause for a certain worry, such as “contact with strangers” and “misuse” of technology. Limitations covers a rather broad theme that consists of both imposed (overprotection, privacy) or natural (spatial, age) issues that present a specific barrier towards the performance of an action (whether related to technology or not). Perceptions include mental models

\textsuperscript{2} http://www.qsrinternational.com/products_nvivo.aspx
formed by an individual or a group (parents or children) of their understanding of certain concepts such as technology or social media, and *use-cases/ideas* represent suggestions that were given directly by focus group participants about ePartner features they believe to be useful.

To explain in more detail, a few passages and their related codes taken from the data are shown below:

- A: I think safety & security is important, also for the family, how do you handle this? If they can hack such an “ePartner” system, they will know everything about your child: Where they go, where they play their sports, how the routes are, and that’s a lot of data. When I drew these data for the probe kit, I realized: You now know how my kid goes to the football field. Security is extremely important.

Coded under (a) limitations:imposed:security, (b) limitations:imposed:privacy, and (c) activities:internet/social media

- M: You know everything about it, and I don’t feel like it, to be on something like Facebook, but I am forced to do this to follow the developments.
– K: We were wondering this week, do we have to make a Facebook account for ourselves to be prepared for when KK wants to have such an account?

Coded under (a) concerns: anxiety/worry, (b) concerns: trust: (child), (c) activities: internet/social-media, and (d) perceptions: parents’ mental model of kids understanding of technology.

– KK: (about her smartphone)... and that is something on which you can play all sorts of games, and you can also chat and listen to music.

Coded under (a) activities: gadgets, (b) activities: music, (c) activities: internet/social media, and (d) perceptions: kids’ understanding of technology.

4.2 Coding evaluation

As motivated in Section 3.1, randomly selected portions of the data (containing around 20% of the codes) were evaluated by a second researcher who has not been exposed to the data before. Evaluation consisted of (a) rating the codes present in the passages with “OK”, “questionable” or “reject”, and (b) answering a set of open-ended questions regarding the terminology used, consistency, completeness, placement and grouping of the codes.

The result of part (a) was that roughly 60% of the codes received an OK, 20% were rated as questionable and 20% were rejected. Out of the rejected 20%, we agree with the rejection in approximately half of the cases, for example:

– Coding “D: Maybe you can say: They will do things on Facebook etc., but you could let them get used to this in a controlled way”.

was classified under “misuse” (which falls under the theme concerns: tech-related), but we agree with the evaluator that this text is not related directly to misuse of technology. For these cases we have adapted our codings.

We disagree with the rejection in the rest of the cases, for example:

– Coding “So, where do you have to interfere? Maybe, do you have to give children their own responsibility not to do these kind of things?”

was coded under “overprotection” (which falls under the theme limitations: imposed), because the idea of overprotection is being discussed, especially considering the overall context of that part of the discussion.

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The answers to the questions in part (b) were:

– The current coding schema represents the data fairly well.
– Adding codes such as “future plans” and “playing outside” was suggested, seen to be useful in the third session with the children in specific.
A few changes to current codes were suggested, for example splitting “bullying/argumentation” into two separate codes, changing “trust (ePartner)” into the more specific “trust (social media)”, and renaming “distance/spatial limitations” to become more specific.

– No changes were suggested for the grouping (themes) of the codes.

A number of the previous suggestions were taken into account (in order to clarify certain terminology), such as the change suggested to the “trust(ePartner)” code, but changes with no implications on the final tree were discarded. Overall, relatively few implications for the hierarchy and placement of codes within the tree resulted from the evaluation, suggesting that the tree of codes resulting from the analysis has a good level of comprehensibility. Analyzing the evaluation as well as applying many of the suggested modifications to the codes and the tree contributed to a joint-view tree of codes in the final form.

5 Grounded Model

Having finalized the tree representation of themes and codes, the fourth and last step in our method is theory building (the discussion and linking of emergent themes, and visual portrayal of connections that build up themes into a theory, Section 3.1). In our case, we aim to build a model that describes the role of norms in regulating the behavior of ePartners to enhance support for the themes identified in the social contexts.

5.1 Values as a central concept

The way we approached this step is querying the data material with various combinations of codes within the different themes in the tree of codes, especially codes with a high density in the text. We realized that many of the passages of text that were returned could be see as referring to values in the “good/bad” form (mentioned in Section 2.3), and they could be linked with one or more of the values in Rokeach’s value survey.

For example, querying the data for passages containing both “internet/social media” and “safety”, would return several results, one of which is:

– “Parent C: Often I get why-questions from children, and on the Internet you can get really strange things if you Google some words. Can you have a child-friendly Internet, that is safe and enclosed?”

Transforming this passage into the “good/bad” form gives out the following value:

– “It is good to protect your children from the Internet’s unsafe side”.

Within Rokeach’s values, we can arguably link the previous sentence to both family security (terminal) and responsibility (instrumental).
5.2 Relationship between social context and values

Highlighting values as a central concept in the user data brought forth the idea for a unifying link that can be established among three of the five themes in the social context through the values of our user group: Activities are driven by their values, concerns pose a threat to their values, and limitations obstruct fulfillment of their values (or in the case of imposed limitations, pose a threat to their values). This relationship is depicted in Figure 2.

Fig. 2. Relationship between social context and values

5.3 Relationship between values and norms

Considering our aim of creating a model describing the role of norms in regulating the behavior of ePartners to enhance support for the themes identified in the social contexts, we proceeded by investigating the relationship between values and norms. This relationship has been established in literature. For example, in [11] it is investigated to what extent norms (obligations, permissions, and prohibitions) can be expressed in terms of value predicates (good, bad, better, etc.). In [28] norms represent the middle layer in a 3-layer hierarchy (Figure 3) which shows how design requirements in VSD can be elicited from values. Social norms (as an intermediary step in this model), can thus be derived from (or to be more specific, created to support) values.
Based on the previous literature examples, we propose that norms that influence the behavior of an ePartner can be created to support the values of our user group. Consider our last example of a sentence expressing a value:

– “It is good to protect your children from the Internet’s unsafe side”.

We suggest that ePartner norms can be created to support this value, for example:

– ePartner is obliged to block websites that are considered unsafe, or
– ePartner is obliged to inform parent if child is accessing unsafe websites.

### 5.4 How norms are created for social support

Having seen how several elements of the social context can be directly linked to the user group’s values, and that ePartner norms can be created to support these values, we can see how norms can be created to enhance the supportive function of the ePartner within the social context. Namely, norms for the ePartner can be created to promote activities (since activities are driven by values), alleviate concerns (since concerns pose a threat to values), and overcome limitations (since limitations obstruct the fulfillment of values).

The resulting grounded model that shows how norms can enhance the ePartner’s supportive function is shown in Figure 4.

### 6 Conclusion

In this paper, we have presented a grounded model that expresses the role of norms in enhancing the supportive function of an ePartner in socio-geographical support, and showed how to integrate user studies into the specification of a normative system (such as the ePartner). The model is grounded, meaning that it was constructed on the basis of user studies and corresponding data analysis,
and it provides a coherent and concise specification. We believe that taking users into account is crucial for developing this type of interactive technology. Values were identified as the crossover between the elements of the social context that emerged through the analysis and the norms required to enhance the ePartner’s functioning.

In future research, we are aiming to identify requirements that an underlying normative framework for this type of application should adhere to, by investigating in more detail which values play a role in this setting, and identifying norms for the ePartner that can support these values. We will investigate the extent to which existing normative frameworks fulfill these requirements. On the basis of this we will choose an existing or design a new normative framework which we will use to create a prototype on top of a mobile phone sensing platform. The prototype should allow users to express their requirements on ePartners behavior, supported by a normative specification language.

References


