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Fahri Yetim

Cologne University of Applied Sciences, yetim@acm.org

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A FRAMEWORK FOR ORGANIZING JUSTIFICATIONS FOR STRATEGIC USE IN ADAPTIVE INTERACTION CONTEXTS

Yetim, Fahri, Cologne University of Applied Sciences, Institute of Information Science,
Claudiusstrasse 1, 50678 Cologne, Germany, yetim@acm.org

Abstract

Literature on explanation has shown that explanations have a positive impact on users' acceptance of and trust in the advice provided, and that justification-type explanations give rise to more positive user perceptions of a system. This paper suggests a framework for organizing justifications, which is based on Toulmin's model of argument and Habermas' discourse theory. It justifies and illustrates with examples how Toulmin's schema and Habermas' discourse types can be integrated to represent and categorize justificatory knowledge. In addition, this paper briefly describes how the framework is implemented within the context of an adaptive recommender system to provide the basis for a strategic use of the justifications during product recommendations. This paper contributes to the literature on explanation in the context of Human-Computer Interaction (HCI) by suggesting a theory-based approach to the organization of justification-type explanations.

Keywords: Explanation, Justification, Adaptive Interaction, Recommender Systems, Argumentation, Discourse Theory, Human-Computer Interaction

1 INTRODUCTION

Explanation facilities are considered as essential in facilitating user interaction with knowledge-based systems or other intelligent systems (Swartout & Smoliar 1987, Yetim 1994, Gregor & Benbasat 1999). Empirical works on explanation have shown that explanations have a positive impact on users' acceptance of and trust in the advice provided, and that justification-type explanations give rise to more positive user perceptions of a system (Ye & Johnson 1995). User characteristics have also been investigated as influencing explanation use and the type of explanations preferred (Arnold et al. 2006). From a design perspective, earlier approaches to explanations were mainly concerned with explanations in narrow application domains. The tendency to move beyond closed systems to globally open systems (Arias et al. 2000, Markus et al. 2002) raises additional challenges such as how to cope with the dynamic and global nature of explanation knowledge represented in the system. For this purpose, the need for collaborative construction of explanations has already been emphasized (Turoff & Hiltz 1995), and deliberating on or critiquing explanations is regarded as a method to clarify the comprehensibility, validity, relevance or rationality of explanations (Yetim 2005). From this perspective, it may be of value when the design of explanations is informed by or consistent with some theories of deliberative practice. This applies not only to the design of the presentation of explanations to the users, but also to their representation/organization in the system.

The purpose of this paper is to propose a framework for organizing justification type explanations and also presents its application in the context of an adaptive recommender system. The framework is based on the integration of two deliberation theories, i.e., Toulmin's (1958) model of argument and Habermas' discourse theory (1984). Habermas' theory provides different types of discourses which are used to categorize justificatory knowledge for recommendations. Toulmin's model provides a set of relations for representing the logical structure of recommendations, particularly the justifications and their knowledge sources underlying a recommendation. By relating the types of justification of recommendations to specific discourses, the framework provides also the basis for deliberating on or critiquing the justifications in a manner compatible with philosophy of deliberative practice (Habermas 1984). Leaving out issues of deliberation, this paper focuses on the usage of both theories for the representation of justifications with the goal to provide the basis for their strategic use in adaptive interaction contexts. The term 'strategic' carries with it also a negative connotation involving deceptions (Habermas 1984). By 'strategic use' we mean choosing the most effective justification (means) to persuade users or customers to get what is desired (goals), that is, to persuade and motivate them to buy a product. The paper claims to contribute to the literature on explanation in human computer interaction by suggesting a theory-based approach to the organization of justification-type explanations.

The organization of this paper is as follows: The paper first presents the theoretical background of this work and then describes the proposed framework for organizing justification-type explanations. In addition, it briefly illustrates how the framework is implemented within the context of a recommender system and finally provides some conclusions and suggestions for future research issues.

2 THEORETICAL BACKGROUND

2.1 Purpose and types of explanations

Explanation facilities are typically included in knowledge-based systems or other types of intelligent systems to provide users with the underlying reasons why and how the system reaches a particular conclusion or makes a particular recommendation. Explanations have been shown to improve user's performance and learning and result in more positive user perceptions of the system (Ye & Johnson

1995, Gregor & Benbasat 1999). Empirical work confirms the positive impact of explanations on users' acceptance of and trust in the advice provided (Ye & Johnson 1995).

Based on the content of explanations, previous research on rule-based expert systems has distinguished between four types of explanations (Swartout & Smoliar 1987, Chandrasekaran et al. 1989, also see Gregor & Benbasat 1999): (1) *line of reasoning or trace explanations*, which show a record of inferential steps taken by a system to reach a conclusion; (2) *justification*, which describes the rationale behind each inferential step taken by the system; (3) *control or strategic explanations*, which display system's control behavior and problem-solving strategy; (4) *terminological explanations*, which supply definitional or terminological information.

It has been shown that justification-type explanations give rise to more positive user perceptions of a knowledge-based system than trace and strategic explanations (Ye & Johnson 1995). User characteristics, expertise of the user in particular, have been investigated as influencing explanation use and the type of explanations preferred (Mao & Benbasat 2000). The presentation of accessible and appropriate explanations implies that system-generated explanations have to be adapted to the user's knowledge and responsive to the user's needs. Therefore, many approaches address the issue of presenting user-adapted explanations (e.g., Cawsey 1993, Yetim 1993).

2.2 Challenges for designing useful explanations

The design of explanations is influential on the usability of explanations since users are unlikely to perceive them as useful when they have to expend too much effort to get them (Gregor & Benbasat 1999). Swartout and Moore (1993) defined some aspects of good explanations, including accuracy of the representation, sufficiency of the knowledge or comprehensibility of the content, etc. The use of explanations is also influenced by presentation format chosen (text-based or multimedia) as well as by explanation provision strategy (Gregor & Benbasat 1999).

In traditional approaches, the construction and coding of the knowledge base is performed after achieving agreement among all involved domain experts. Usually, a knowledge engineer or a team of knowledge engineers interfaces with domain experts and accomplishes this. However, the general tendency to move beyond closed systems to support open, constantly evolving contexts of complex problems raises challenges for explanation designers. As system developers cannot anticipate and design for every possible situation, systems must be designed for evolution (Arias et al. 2000). In addition, as emergent knowledge processes are characterized by highly unpredictable user types and work contexts, a system must accommodate complex, distributed, and evolving knowledge bases and support the dynamically changing process of deliberations and trade-off (Markus et al. 2002). Consequently, structuring explanations at the time of design so that they are understandable and appropriate at the time of use is a challenge. Explanations must evolve when the knowledge base of a system evolves.

Based on these insights, it has been argued that approaches to explanations cannot restrict themselves to well-established rules and agreements but rather, that they need to allow experts to assess their collective explanations (Yetim 2005). In global contexts, the aforementioned aspects of good explanations (e.g., comprehensibility, sufficiency, or validity) may be evaluated differently. Moreover, as the real world decisions and their explanations may have practical – financial, legal, and social – consequences for those affected, there is a need to link the individual explanations to the social world in order to check their validity as well as acceptability. Finally, there is not only incomplete agreement among experts, but also agreement and disagreement are evolving properties that change dynamically over time (Turoff & Hiltz 1995). These insights raise the issue to be addressed next: What guidance can discourse theory provide to deal with the dynamic and global nature of explanations?

2.3 On the relevance of Habermas' discourse theory and implications

In his discourse theory, Habermas (1984, 1996) regards discourse as a reflective form of communication, and differentiates between types of discourse such as explicative, theoretical or moral discourses. Each discourse deals with argumentative examination of different issues or validity claims related to utterances. For example, explicative discourses for the comprehensibility, theoretical discourse for the truth or moral discourse for the rightness of the utterances. Concerning the relationship between discourses and explanations, it is important to also note that explanations play a role in discourses when participants justify certain claims (e.g., justifying why a statement is relevant, trustworthy, normatively right). Yet, in a design context, more relevant is the role of discourse theory for designing explanation facilities. For this purpose, discourse theory provides structures and orientation (a) for the examination of the validity and acceptability of explanations and (b) for the management of explanation knowledge.

(a) When designing explanations, discourses can meet - as reality checks against unwarranted assertions - the requirement of consensual agreement about the validity of explanations. They provide means for reflective communication and validation of individual explanations, and thus help to reduce different types of uncertainty in the mind of experts, e.g. uncertainty due to incomplete domain knowledge or uncertainty in the communication concerning the appropriate expressions. In this way, discourses provide the confidence that corroborated explanation is to enter into the system. Moreover, discourses may create an awareness of ethical and moral issues and social responsibilities. Using discourse for the purpose of the critical reflection on explanations is beyond the focus of this paper. Readers may consult (Yetim 2006 & 2007) that describe how discourses can be used for critical examination of information (including explanations).

(b) Discourses can also be used for the organization of explanation knowledge, which is the focus of this paper. The rationale for using discourses is as follows: As discourses deal with the argumentative validation and legitimizing of different kinds of issues or validity claims, they involve different kinds of justificatory knowledge, so that each discourse can be used as a category to represent a specific type of justificatory knowledge (ethical, theoretical, etc.). This allows explanation designers to categorize explanation knowledge according to its epistemological nature. In addition, as mentioned above, one of our long term research goals is to promote reflective communication or deliberation on justificatory knowledge organized in the system, for example by linking the knowledge base to an external collaborative system such as mentioned above. Being open to argumentative challenge in discourses requires that the explanations are organized in a way consistent with discourse theory, in order to easily and consistently link them to the corresponding discourses for critical examination. This said, the remainder of this paper omits issues related to reflection on explanations, and focuses on the use of argument schema and discourse theory to organize justification-type explanations.

3 THE FRAMEWORK FOR ORGANIZING JUSTIFICATORY KNOWLEDGE

The organization of knowledge involves at least two aspects, representation of the 'chunks' of knowledge and categorization of them in meaningful units. This section first describes why and how explanation knowledge can be represented by using argument schema, and then presents how, additionally, different types of discourse can be used as distinct categories to manage them.

3.1 Representing explanation knowledge by argument schema

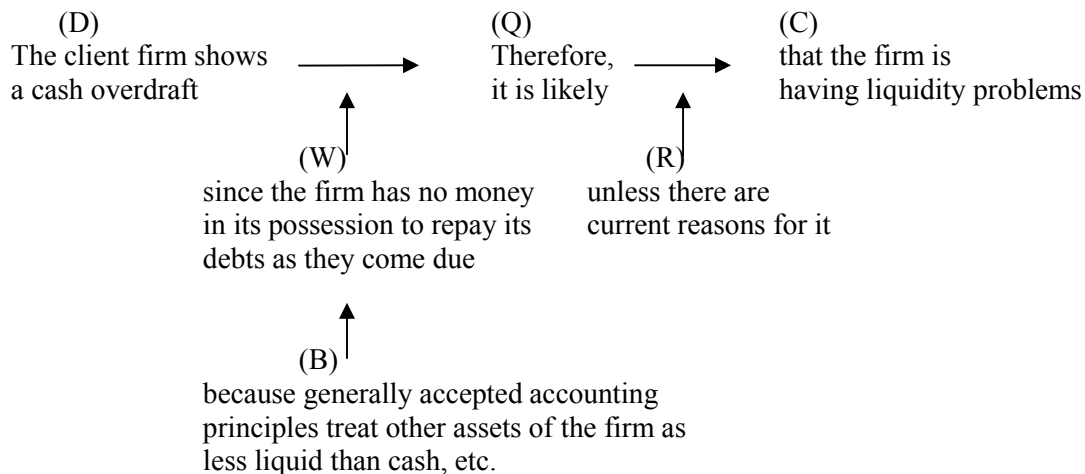
Explanation and argumentation are two relatively close notions and difficult to distinguish. Typically, explanations are initiated by a receiver of information to resolve misunderstandings or disagreements. Explanations may also be initiated by a speaker, or provider of information, with an aim of clarifying,

justifying, or convincing. In this sense, an explanation may be viewed in terms of rhetoric or argumentation (Toulmin et al. 1984). From a design perspective, a number of researchers make the case for using Toulmin's (1958) model of argumentation as a foundation for constructing explanation capabilities (Hahn 1991, Ye & Johnson 1995, Gregor & Benbasat 1999, also consult Moulin et al. (2002) for a review). For example, Ye and Johnson (1995) used the model for developing rule-trace, justification, and strategic explanations and find evidence to support their case. In addition, Gregor and Benbasat (1999) support the use of Toulmin's model in developing explanations and argue that justification explanations conforming to Toulmin's model should be more persuasive because they contain the elements that are present in convincing human-human arguments. Thus they should lead to greater trust, agreement, satisfaction, and acceptance.

Toulmin distinguishes between the 'field-invariant' and 'field-dependent' aspects of argument (Toulmin 1958, p.15). The field-invariant (or context-independent) aspect of an argument consists of six elements:

1. *Claims (C)* – the assertions or conclusions that are put forward for acceptance.
2. *Data (D)* – the statements specifying the particular facts or previously established beliefs about a situation based on which a claim is made.
3. *Warrants (W)* – the statements that justify the inference of the claim from data.
4. *Backing (B)* – the general body of information or experience that assures the trustworthiness of a warrant. Backing is not needed unless the validity of the warrant is challenged.
5. *Qualifiers (Q)* – phrases expressing the degree of certainty placed on a claim. No qualifier is needed if a claim is considered indisputable.
6. *Possible Rebuttals (R)* – extraordinary or exceptional circumstances that might defeat the warranted claim.

The following diagram taken from Ye and Johnson (1995, pp. 161) shows an example of Toulmin's argument schema at work.



Toulmin's model can be used as an explanation structure in rule-based systems (Ye & Johnson 1995). For example, a rule with data premise, certainty factor, and conclusion (e.g., "IF *Premise-X* (*certainty-factor-Y*), THEN *Conclusion-Z*") corresponds to a Data (D)-Qualifier (Q)-Claim(C) structure in Toulmin's model of argument. In a rule-based system, the *trace explanation* may consist of a chain of invoked rules. The rules encode problem-solving knowledge. They do not, however, provide background knowledge that leads a human expert to the rules, i.e. the justification of why a conclusion follows from its premises. In order to integrate knowledge for *justification*, a warrant (W) and possible a backing (B) can be added to the rules. Similarly, explanation knowledge for the system's problem solving strategy can be represented in order to provide justification or clarification of why the system solves a problem by following a specific procedure (Clancey 1993). Justification knowledge can also

be linked to terminological explanations, for example, in form of a textbook reference attached to show the authority from which it was drawn.

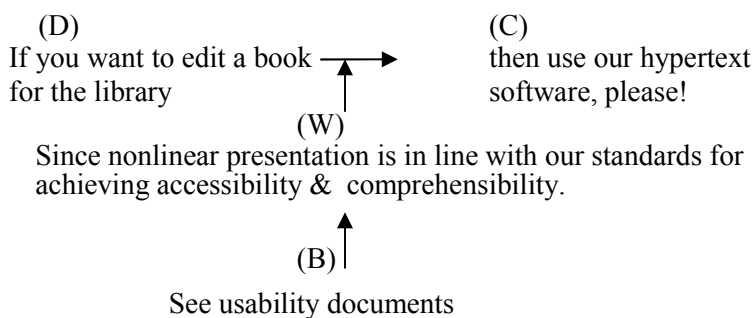
In sum, Toulmin's framework shows where justification for a line of reasoning should be focused, and provides orientation for explanation designers to identify the type of explanation knowledge that needs to be acquired from knowledgeable persons and represented in the system. During the user-system interaction, the argument structure also enables the production of explanations at different levels of detail. For example, the structure can be reduced to facts (*evidence, qualifier*) or can also include "deeper" domain knowledge (*warrant, backing*). Justifications require "deep" domain knowledge, causal knowledge or generally accepted rules or principles in the relevant field. The warrants and backings are drawn from the deep knowledge in a particular field. For example, in science, a warrant may be a law of nature and the backing may be the degree to which the law has been investigated and confirmed, whereas in law, a warrant may be a legal principle or statute and the backing the knowledge that the statute has been validly enacted (Gregor & Benbasat 1999).

3.2 Using Habermas' discourses for classifying justificatory knowledge

According to Toulmin (1958), in addition to the basic, context-free structure of any argument, there is also the field-dependent aspect of argument. The warrants derive their foundation and authority from backing of quite different sorts. The backing of any argument defines the field to which that argument belongs. For example, in business, science, politics or law there are differences in the degree of formality and precision that argument must satisfy in order to be acceptable. Thus, one option to classify and differentiate between arguments is to consider the argument-fields. However, Habermas (1984) who uses Toulmin's model of argumentation in his discourse theory, suggests another criterion as a basis for differentiating arguments. Habermas differentiates the forms of argument according to the validity claim involved. Habermas position is that in communication the context helps to select a validity claim and the validity claim determines the type of argumentation. Based on these, he proposes different types of discourses dealing with different validity claims.

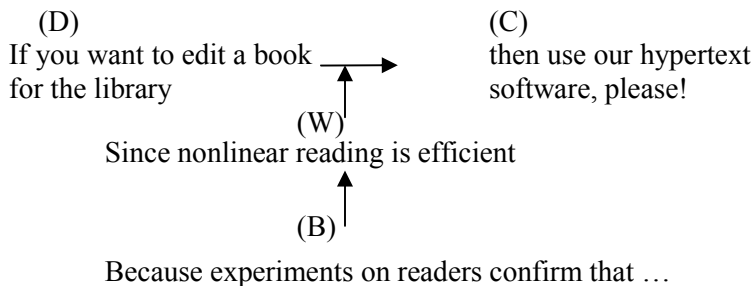
In what follows, we consider the discourses to classify justificatory knowledge, and use Toulmin's model of argument to illustrate how different knowledge types can be used as warrants to justify a system's actions or recommendations. Note that the examples below are chosen for explanatory reasons. In line with the philosophy of the proposed approach, they are open to critique or revision.

(1) Communication Knowledge (Explicative Discourse). Explicative discourse is the place where the comprehensibility of signs with respect to their physical, syntactic, and semantic aspects is discussed. We use the notion of communication knowledge to refer to knowledge about how to communicate perceivable, interpretable and thus comprehensible way. The following example illustrates the justification (*warrant*) of a recommendation from a communication point of view. In answering a user's question, *Why?* the system can provide the justification from this perspective by following the response steps.

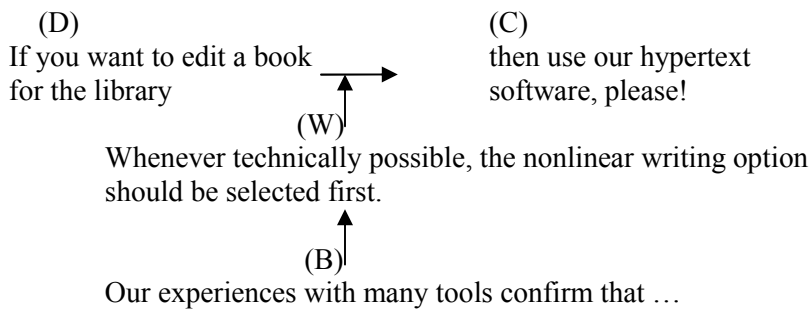


(2) Theoretical Knowledge (Theoretical Discourse). In theoretical discourse, the truth of propositions and the efficacy of actions are justified. We use the notion of theoretical knowledge to refer to scientific theories, laws of nature, mathematical structures, mechanistic principles, historical

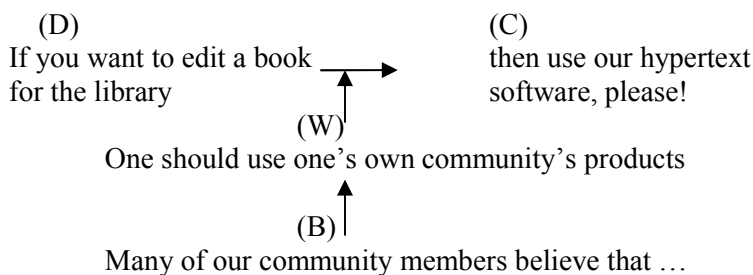
regularities or the like. They can serve as warrants and rest on adequate experimental evidence or other observations. The following example illustrates a scientific justification of the same recommendation.



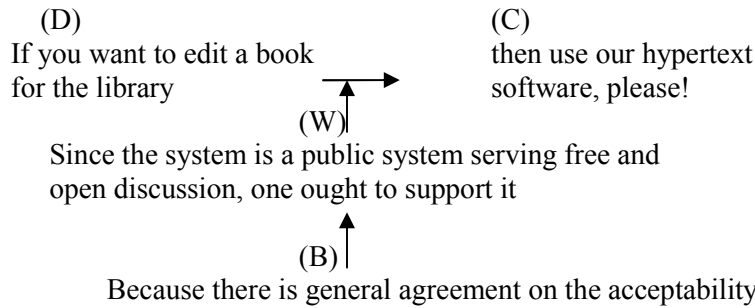
(3) Pragmatic Knowledge (Pragmatic Discourse). Pragmatic discourse deals with the rational assessment of means in the light of fixed goals or, if the goals themselves are problematic, with the rational assessment of goals in the light of existing value preferences. Thus pragmatic discourses justify and recommend appropriate techniques or strategies, i.e. specify what to do when faced with a particular problem. Typically, rules expressing purposive-rational choice of means (techniques, strategies) or value-oriented weighing of goals can serve as warrants. For example:



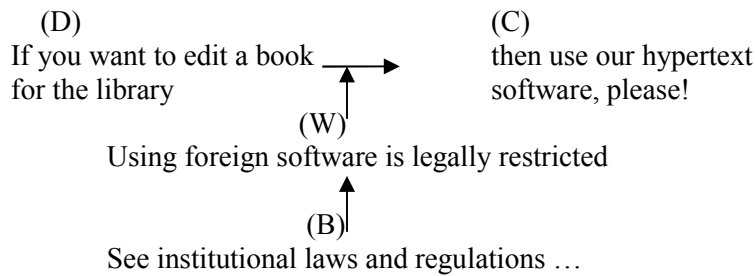
(4) Ethical Knowledge (Ethical Discourse). Ethical considerations deal with issues of “good” and “bad”. Ethical knowledge provides orientation in the social world, but only within the horizon of a specific culture. Every cultural community has its own particular ideas of good and bad. Certain kinds of actions and/or consequences are perceived as being desirable to a greater or lesser degree. Community-specific values can serve as warrants to justify a recommendation from an ethical point of view. For example:



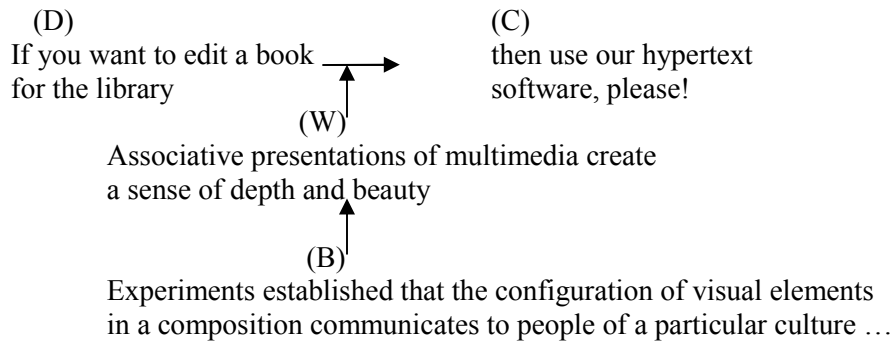
(5) Moral Knowledge (Moral Discourse). Moral discourse is concerned with justification of norms that stipulate reciprocal rights and duties. In contrast to ethical knowledge, moral knowledge raises a claim to universal validity. Moral knowledge is handed down in the form of ideals or maxims. In contrast to ethical considerations, which deal with issues of good and bad, moral issues are concerned with right and wrong, i.e. deal with considerations of justice (Habermas 1993). A heuristic for generating maxims can be guided by the question of whether an action is good for a group of users, and thus recommended (ethical perspective), or whether it ought to be followed by everyone, i.e. ruled in or out as being *categorically* acceptable or unacceptable (moral perspective). For example:



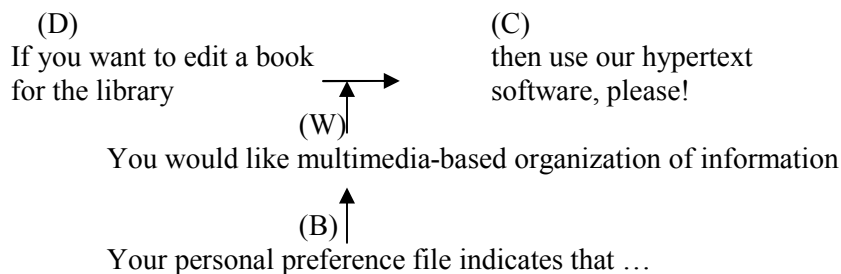
(6) Legal Knowledge (Legal Discourse). Legal discourse deals with the legitimacy of rules, laws etc. Hence, administrative regulations, laws, statutes, and so on can serve as warrants. For example:



(7) Aesthetic Knowledge (Aesthetic Criticism). Aesthetic criticism is concerned with the adequacy of the standards of value presented in works of art (Habermas 1984). Knowledge about people's aesthetic values, interpretations or expectations can serve as a warrant for justifying recommendations. For example:



(8) Personal Knowledge (Therapeutic Critique). Therapeutic critique addresses the sincerity of expressions. This knowledge is related to the subjective world of a person. Knowledge about private preferences, beliefs or assumptions of a single person can serve as warrants. In adaptive systems personal knowledge is usually captured in user models and can be used for justifications. For example:



To summarize, Toulmin's schema provides orientations in designing warrants to justify rules or recommendations and the different type of discourses proposed by Habermas provide orientation for the classification of justification knowledge according to the epistemological nature of the warrants or justificatory knowledge. By doing so, this paper provides the basis for a system to be able to deliver

justifications for its recommendations from different perspectives. Depending on the contexts, the most appropriate justification needs to be selected.

4 APPLICATION OF THE FRAMEWORK

4.1 Managing justificatory knowledge for recommendations

The framework has been integrated within the prototype *JustPro*, which aims to provide customer-oriented and justified product recommendations. It has two main components to achieve its objectives: (1) the administration and (2) the product shopping components (Figure 1).

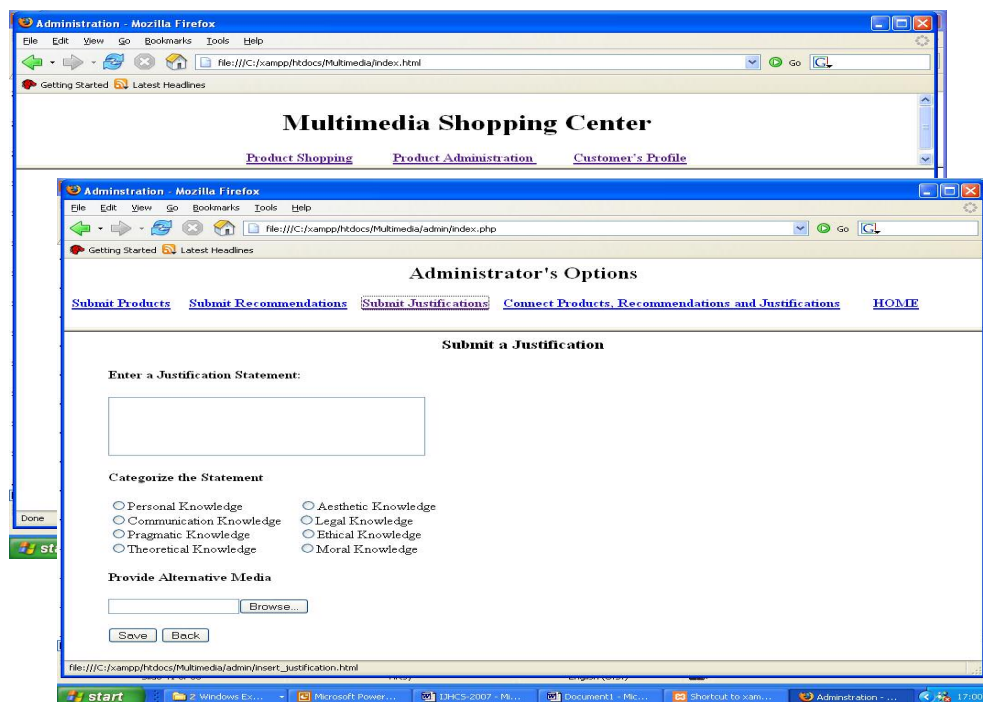


Figure 1. Screenshots from *JustPro*

The administration component allows administrators to enter separately (a) product descriptions in different medial form and (b) recommendation statements as well as (c) justifications to be used for many products. Figure 1 shows the template for submitting justification statements and the categories used to classify the justifications. It should be noted that while entering justification statements in the system warrants and backings are not separated in this application, the statements for both are merged to simplify the task.

In a next step, the administrator can have access to the text base and assign to each product an appropriate recommendation statement and many justifications for the selected recommendation statement. This provides the basis for the system to select the appropriate one in a product presentation time, by considering customer's data (preferences and values). In our prototype, we use a simple model and enter the customer's data manually. More intelligent systems may use other facilities to infer such information from customer's behaviour with the system.

4.2 Providing adaptive justifications

In interaction with the system, the product-shopping component allows customers to specify the type of product. The system then presents the recommended products using the media preferences of the

customer (e.g. text or audio). In addition, the system delivers different types of justification (ethical, aesthetic, etc.) for the recommendation depending on the customer's characteristics (preferences and values). Currently, the system presents customer-specific justifications only if customer preferences or values and rules exist that legitimize such a choice based on these data. Otherwise, a default justification is presented. Users can request the details of a product and also view all available justifications for it.

The justification of product recommendation is delivered with a strategic intention, i.e. for persuading costumers to buy a product. This is based on the assumption that the acceptance of the justification of the recommendation by the customers would have a positive effect on customers' perceptions of the products and that the acceptance of justification itself may also depend on the values and beliefs of the customers. In JustPro, we follow particularly one of the communication design principles, which states that "design should support adaptive behaviour, including the contingent use of alternative communication strategies, alternative message forms, and alternative media" (Te'eni 2006, p.67). The link between customer's data and the types of justifications has been established manually by the system developers and is not yet empirically founded. Rules expressing the relationship hypothetically are entered in the knowledge base. However, there is a considerable degree of support for our assumptions as much empirical research confirms the dependency of the effectiveness of adaptations on user's knowledge, beliefs, goals or interests (Brusilovsky et al. 2007). In addition, the basis for our model is that when customers receive a cognitively appealing rationale, they will be more convinced that the position argued is correct. This relationship is also acknowledged by other works on explanations (Gregor & Benbasat 1999, Arnold et al. 2006). We are not aware of empirical studies of (cultural) values and types of justifications. The relation between justifications and user's characteristics should be based on empirical data, which is one of our future research issues.

In sum, *JustPro* demonstrates the application of this theory-based categorization of justification knowledge in the context of product recommendations. The system uses the types of justification knowledge for strategic purposes, i.e., it communicates the appropriate justification by considering customer's preferences and values.

5 CONCLUSION

This paper has described a framework for organizing justifications based on Toulmin's model of argument and Habermas' discourse theory. Habermas' theory provided different types of discourses which are used to categorize justificatory knowledge for recommendations. Toulmin's model provided a set of relations for representing the logical structure of recommendations, particularly the justifications and their knowledge sources underlying a recommendation. The implementation of this framework within the context of a recommender system indicates its practicability for providing the basis for the strategic use of different justification knowledge in adaptive interaction contexts.

The system is still under development, and no evaluation has been carried out yet. Future research should deal with the improvement of adaptive features of the system and also with the justification of the empirical basis for the relationship between customer's values and the persuasiveness of different types of justification.

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