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## Improving Recommendations by Using Personality Traits in User Profiles

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**Abstract:** By storing Personality Traits in User Profiles we enable Recommender Systems to deduce more interesting recommendations for users acting pro-actively in order to offer them products/services as a consequence of a prediction of their future needs and behavior. This paper is proposed to improve the robustness of recommendations by using psychological aspects such as Personality Traits. This paper is a part of a PhD ongoing work.

**Key Words:** User Psychological Profile, Identity, Reputation, Personality Traits, Recommendation

**Category:** H.1.2, H.3.4, I.2

### 1 Introduction

Considering claims of the International Community of Knowledge Management, "*I-Knows*" stress the searching for researchers that include at least one of the following claims: the needs of individual people's knowledge for flexibility with the needs of communities for interconnectivity and the needs of organizations for standardization. They believe that "knowledge services have the potential to support and merge two roles within organizations and communities: on the one hand this concerns people's knowledge which needs support for executing their current task efficiently (also by using the help of community members) and to advance their competencies over time; on the other hand the knowledge engineer needs support for the identification, modeling and standardization of community knowledge patterns and organizational knowledge structures".

We propose to help to fill this gap by proposing relevant knowledge services which will be helpful mainly to develop people's knowledge (Profiles and Reputations) about themselves and their community. Research about psychological characteristics of people's knowledge and community is needed to inform what

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type of service should be given to ensure its usefulness. As a consequence of the use of psychological characteristics, people's knowledge will be able to dynamically integrate contextualized knowledge services such as recommendation of knowledge artifacts, community awareness and collaboration support into their work environment.

The World Wide Web is an enormous source of products and services available for people. There is a huge effort done by scientists towards the creation of effective strategies to personalize those products/services for each people interested to use them. The personalization may be provided by Recommender Systems able to match people's preferences and some specific product or service.

Scientists from research areas such as Psychology [Thagard 2006], Neurology [Damasio 1994] and Affective Computing [Picard 1997] [Trappl et al 2003] agree that human reasoning and decision-making are hardly affected by psychological aspects. Thus, to maintain the same level of personalized service provided by humans, computers also should "reason" taking into account user psychological aspects. Nevertheless, unfortunately, the psychological aspects are neglected by most of the models of User Profiles. By consequence, the existing Recommender Systems do not use the psychological aspects during their decision-making. We intend to improve Recommender Systems by storing psychological traits in User Profiles, in order to be able to deduce more interesting recommendations for users. In this approach, the system acts proactively towards the user needs, offering products/services in prediction to their future needs.

This paper is presented as follow: Firstly, we describe studies done in Psychology describing Personality, Traits and Tests in order to formalize how to define, to model and to extract Psychological aspects of users in order to extract their identities and to build their Profiles. Followed by the description of how the User Reputation is formalized and how Recommender Systems is described. Finally we present our experiment followed by results and conclusions.

## 2 Psychological Aspects

In this paper we define User Psychological Aspects by using the theory of Personality. While Personality have not yet a common definition, psychologists like Burger [Burger 2000] defines personality a "consistent behavior patterns and intrapersonal processes originating within the individual".

Personality is more than just superficial and physical appearances, it is relatively stable and predictable, however it is not rigid and unchanging (normally it remains stable over-45 years period beginning in young adulthood). Personality may be defined by many different approaches. We chose Traits approach because it can differ people psychologically by using a conceptualization and measurable traits, called Personality Traits. Indeed, Personality Traits are a cluster of human features able to be modeled and implemented in computers.

Personality Traits were first defined by Allport [Allport and Allport 1921]. Allport creates 17.953 traits (common traits and individual traits) to describe the personality of an individual. Because most of the individual differences are insignificant in people's daily interactions, in order to limit the definitions of traits in a exponential way researchers assume that all men are "like some other men". Considering this, researchers reduced more 99% of trait items because they conclude only five factor was replicable. As a result, the "Big Five" Model [John and Srivastava 1999] was created. Even if Big Five factors represent a broad level of personality structure, they not guarantee exhausting all significant personality dimensions. Facets are used by psychologists in order to enrich Big Five dimensions with more fine-grained characteristics.

In order to extract human traits (as Big Five factors and their respective facets) psychologists usually use computer based questionnaires which are called Personality Tests. We propose to use NEO-IPIP Personality Test. It allow to assess 5 factors of Big Five including also more 6 facets for each dimension (30 facets in total) using then a fine-grained descriptions of people's personality traits and a consequent bigger precision in those traits representation.

NEO-IPIP Inventory [Johnson 2000b] was created when Johnson chose from among the various personality inventories of a public domain scales called IPIP (The International Personality Item Pool [Goldberg 1999]) his 300 items proxy for the revised NEO Personality Inventory (NEO-PI-R) [Costa and McCrae 1992]. Johnson chooses to create a NEO-IPIP because it is a free of charge version of NEO-PI-R which is one of the most robust, used and well-validated commercial inventory in the world [Johnson 2000a].

Personality Test, is a computer narrative instrument able to measure person's individual differences. Those individual differences are named "Personality Traits" which generally reveal cues about person's Identity and person's Public Reputation and might be used in recommendation of knowledge artifacts and community awareness.

### 3 Identity, User Profile and Reputation

According to researchers of Personality theory, the Identity development receive an important influence of person's personality. Boyd [Boyd 2002] describes two different aspects of the individual Identity: the internalized notion of the self (Internal Identity) and the projected version of ones internalized self (Social Identity). Considering Identity as an important channel where people personality appears, their Personality Traits (Individual and/or Social) will give cues about their future behaviors and needs in a community.

In Computer Science, the technical and persistent way to formalize Identity in a Virtual Community (or Social Network) is using User Profile and User Reputation.

Donath [Donath 1999] affirms that ones own Identity (Internal) and ones reputation (Social) are fundamental to the formation of a community. In a Virtual Community the Virtual Identity of user is defined by him/herself similarly he/she does in the real world. The Identity is stored in User Profiles, like in e-commerce and e-communities areas for example.

User Profiles are approximate concepts, they reflect the interest of users toward several subjects at one particular moment. Each term a User Profile expresses is, in a certain degree, features of a particular user including all information directly requested from him/her and implicitly learned from web activity [Poo et al 2003]. Physically, the User Profile can be see as a database where the user information, interests and preferences are stored.

In order to define user Identity, together with User Profiles (Internal Identity), User Reputations (Social Identity) is also very relevant and, consequently, should also be presented.

Reputation can be defined as the social feedback opinion given about someone personality. The Reputation may agrees or not with the description done in the User Profile. Josang et al in [Josang et al 2007] describes Reputation as "the information generally said or believed about a person's or thing's character or standing".

In this work we define Reputation as an extension of a User Profile. It uses the same type of information stored in the User Profile but instead of the information to be filled by user it is filled by a friend. In this work the Identity are determined by the Personality Traits of user stored by him/herself physically in the User Profile and by his/her friends physically in User Reputation.

User Profiles and/or User Reputations are very important in order to define the user's Identity. That means, User Profile and Reputation can provide the prediction of user behavior and needs in a community while Reputation also allows the creation of relation of trustworthiness among community members. The user's Identity is very useful during social interaction inside a Community.

Unfortunately, Psychological aspects like Personality Traits have not yet been implemented in a current User Profiles/Reputations. That happens mainly because human psychological aspects are really hard to extract intentionally from user. Even if psychological aspects are difficult to extract, their relevance is quite significant in the recommendations<sup>2</sup> to be ignored by Recommender Systems, as we see next.

## 4 Recommendations

Recommendation is a deliberative social process done by ordinary people when they want to describe their degree of appreciation about someone or something.

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<sup>2</sup> used a posteriori for supporting the user decision making process in a context of Knowledge services.

In computers, Recommender Systems begin to appear in 90's, they are applications that provide personalized advice for users about products or services they might be interested in [Resnick and Varian 1997]. They are mainly used to recommend products or services.

In ordinary life, normally people trust in recommendations done by others. Those recommendations appear to them as word of mouth reputation, recommendation letters, movie and book reviews printed in newspapers and magazines. In digital life, Recommender Systems start to be used as a trustful information of people opinions (Reputation) about other people, services and products used by them.

Recommender System is a rich problem research area. It has abundant practical applications also defined as systems which promote recommendation of people (normally seen as service provider) as well promote recommendation of products/services. In 2005, Terveen [Terveen and McDonald 2005] redefined those specific Recommender Systems, called Social Matching Systems.

Unfortunately, Recommender Systems do not use psychological aspects in its recommendations. However, psychological aspects are a powerful features that improve significantly the recommendations.

In 2005 Gonzalez [Gonzalez et al 2007] proposed a first model based on psychological aspects, he uses Emotional Intelligence to improve on-line course recommendations. Next, in this work we propose an illustrative scenario in order to prove, actually, that the use of Personality Traits in User Profile/Reputation might definitively improve recommendations done by a Recommender System.

## 5 Experimentation

This paper addresses an experimentation in order to prove that Recommender Systems (or Social Matching Systems) can be more effective if they use Psychological Traits of people than just conventional ones (demographic information and competence, for instance) in order to recommend more adequate products, services or people.

This experimentation contemplates the Recommender System showing its ability to recommend people, in this case, considerate as a product to be delivered according to a product view<sup>3</sup>.

<sup>3</sup> The Recommender System generate a person as a product because, in this case, a person is considered as a packet closed, a person's name, for instance. In this case, the person is not considered as a service provider, as normally s/he is. The product view means, a person receives a recommendation of someone as a name to be took into account as a support in his/her decision making process. In a service view, people receive a name to be used as a service provider, who will execute some service in posteriori. In a product view, the Recommender System gives a passive answer, different from a service view where the answer is going to generate a dynamic interaction in order to generate a service.

Here the Recommender System is going to generate a product of its internal processing called recommendation. The generated product, in this case, is a person's name. This name could be used as knowledge support during the decision making process for a person and his community in a Knowledge management scenario.

### 5.1 Scenario

An illustrative scenario was presented by the "Elections for President in France" carried through april 2007. In this case a Recommender System was used to give a private recommendation considering a better choice of a president's candidate for a person to vote. This experimentation started to be applied in december 2006 and finished in july 2007.

This experimentation focus on User Psychological Reputation (User Psychological Profile according friends view) based on people's feedback of candidates on a specific case of the French presidential.

### 5.2 Method

In order to create a User Psychological Profile/Reputation we used the NEO-IPIP Inventory<sup>4</sup> based on 300 items.

About 100 people were invited to participate.

Each people who participated the experimentation was instructed to answer the NEO-IPIP(900 questions): thus, 300 (NEO-IPIP) for "The Ideal President", 300 for "Ségolène Royal" and 300 for "Nicolas Sarkozy". They are:

1. "The Ideal President" questionnaires. Questionnaires's answers reflects how each person thinks an Ideal President should be;
2. "Ségolène Royal" (one of the president's candidate) questionnaires. Questionnaires's answers reflects how each person feels and thinks about "Ségolène Royal"'s psychological traits.
3. "Nicolas Sarkozy" (one of the president's candidate). Questionnaires's answers reflects how each person feels and thinks about "Nicolas Sarkozy"'s psychological traits.

Through answers we were able to model psychological aspects of two French presidential candidates, Ségolène Royal, Nicolas Sarkozy and a imaginary "Ideal President". The recommendation done was based on those psychological aspects (reputation) of President's candidates and an imaginary personage who was his/her dreamed "Ideal President".

<sup>4</sup> The tool used to extract Reputations is partly described in [Nunes et al 2007] and can be found at <http://www.lirmm.fr/~nunes/big0.1/> .

In order to assess the validity of the questionnaire and the precision of our Recommender System, each person who answered seriously and completely the three questionnaires should confirm that the President's candidate recommended for him/her actually was the President who s/he, actually, *VOTED* (that's means, the candidate nearer psychologically of his/her own psychological definition of an imaginary "Ideal President").

Results and conclusions of the experimentation are presented next.

### 5.3 Results

10% of People answered the complete Personality Traits inventory (NEO-IPIP) in order to get the recommendation of *a better candidate to vote in a French Presidential*.

We did two different types of recommendations. The first one was based on 30 facets and then in 5 factors of Big Five, followed by the second one which was based only on 5 factors of big five.

Results of the recommendations were much more satisfying and representative than what we expected. The first recommendation was more fine-grained than the second one. The results are:

- If we consider the fine-grained answers, that means Personality Traits measurable by 30 facets, the recommendation was 100% correct. That means, 100% of cases recommended by the Recommender System was compatible with the *presidential candidate* that the user actually *VOTED* during the Election for President in France;
- If we consider the coarse-grained answers, that means Personality Traits measurable by 5 Big Five factors, the recommendation was 80% well correct. That means, 80% of cases recommended by the Recommender System was compatible with the *presidential candidate* that the user actually *VOTED*. However, 20% of cases recommended by the Recommender System was INCOMPATIBLE with the *presidential candidate* that the user actually *VOTED*.

Even if is difficult and tiring answer a fine-grained questionnaire (30 facets) the final result of a recommendation is 25 % better than if we use a coarse-grained questionnaire.

This experiment started to be applied in december 2006. Because we have a non massive participation (only 10% of people asked to answer the questionnaire effectively did it), the recommendation have been generated in july 2007, that means, after the French presidential (april 2007).

Considering this, the recommendation were not useful in order to influence the people's action (their vote). However, the recommendation have been very



useful in order to prove that the recommendation generated was actually very relevant because *people's effective vote* was 100% compatible with the recommendation. That means, if people had received the recommendation before the votation, at least, they would be influenced positively. Otherwise, the recommendation might be used as an instrument for the knowledge management service in order to predict the user behaviors and/or needs using it as those relevant information to be used during the decision making process.

## 6 Conclusions

This work contributes to state of the art by using Personality Traits to improve the recommendations in Recommender Systems and consequently for providing this recommendation as a support in a decision making process for the knowledge management community. We chose the Traits approach because it is the way that psychologists differentiate people from one another, conceptualizing and measuring their characteristics by using Personality Traits.

Results of this experimentation proved that user Personality Traits stored in User Profile and processed by Recommender Systems can provide, when using a fine-grained questionnaire, actually, optimal recommendations. In the context of our experimentation the recommendation generated was done in order to select some *compatible candidate to vote in a French Presidential*. However, the experimentation presented here is meant to be significant for a much wider spectrum of cases where the use of Personality Traits may be of importance to Recommender Systems. Those recommendations could be used in knowledge services as a support for helping, clarifying and guiding human/machine decision making processes, for instance.

**Research follow up Future Work:** Even if the fine-grained questionnaire gave optimal recommendation (100% of compatibility), it was very hard to find people with time available to answer NEO-IPIP Personality Traits questionnaire (900 items on that experimentation). Many times in real circumstances researchers have no choice other than to use a extremely brief instrument (or they use no instrument at all). Because of that, we decided to develop a second experimentation using a coarse-grained questionnaire to verify if we will get better results (more than 80% extracted from the first experimentation). The second experimentation is being applied in order to recommend an efficient work group based on Personality Traits of students from a programming course at "Instituto Superior Técnico" in Lisbon. The results from these experiments are the subject of ongoing reports.

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