

Personality and Information Behavior in Web Search

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ABSTRACT

In this paper, we describe a quantitative study of personality aspects and their relationship with web search information behavior. We start with introducing personality and give an overview of information behavior research concerning personality aspects. In our study of 30 participants, their personality traits were operationalized by using a version of the *Big 5*, the *B5T*, a psychometric questionnaire that maps personality on different dimensions. The participants performed search tasks in a web context and data concerning their information behavior was collected via search logs as well as questionnaires. We show that there are selective correlations of slight and intermediate strength between the variables of information behavior and the personality dimensions. Finally, we discuss possible explanations and implications as well as new impulses for information behavior and retrieval research.

Keywords

Information behavior, personality, Big 5, web search, personality models.

INTRODUCTION

Wilson (2000) claims a paradigmatic change in information science towards the recognition of the importance of the user in understanding information behavior: Different people will experience reality differently, which influences information behavior. The context of search as given, e.g. by the individual personal characteristics of the searcher, has become an important part of information behavior research (Solomon, 2002). This study explores whether the psychological concept of personality has an influence on information behavior and can thus explain individual differences. We employ the *Big 5* personality model. This paper is organized as follows: Section 2 introduces the psychological concept of personality, presents metrics for per-

sonality assessment and discusses relevant literature from information behavior studies. We develop our research question from this background (section 3). Methods, test design as well as details on the actual study are discussed in section 4. Results and their statistical analysis are given in section 5. Discussion of results follows in section 6. Finally, we show the limitations of the research presented here and suggest follow-up studies.


RELATED WORK

The work presented here combines two current strands of research, personality and information behavior. Wilson (1997), one of the forerunners of information behavior studies, judges personality to be one of the most important factors of understanding individual differences in search behavior. Sonnenwald & Iivonen (1999) include personality in their framework for studying human information activity.

As early as 1973, Kernan & Mojena state that people with a certain personality profile – willing to take risks, self-assured, dominant – are more efficient in using information and accordingly use less information than others. Persons with an excessive information use showed a consistent personality profile characterized by little confidence in themselves and others as well as emotions of doubt. Bellardo (1985) operationalizes personality with regard to masculinity and femininity using a standard test instrument, the *Interpersonal Disposition Inventory* (Berzins, Welling & Wetter 1978). She looks at the influence of these factors as well as of intelligence and creativity on using a search system. She maintains that personality is not apt as a predictor for quality of search results if measured for relevance of results. However, she is not looking at individual differences in search behavior. Quite to the contrary, Borgman (1989) maintains that such individual differences can be traced back to characteristics of personality using standard tests for operationalizing these features.

Heinström (2003) has looked at the direct influence of the five dimensions of the well-known *Big Five* model of personality (see section on methodology below) on the information behavior of college students. Personality was measured using a standard questionnaire, the *NEO-Five Factor Inventory* (Costa & McCrae, 1992). An additional questionnaire was used for collecting information on different aspects of information behavior. Bawden & Robinson (2011) give an overview of personality related approaches

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to information behavior, especially with respect to cognitive styles.

Research that is more recent starts from Heinström's work: Halder, Roy und Chakraborty (2010) use the NEO-Five-Factor-Inventory (Costa & McCrae, 1992) as well for operationalizing personality. For measuring information behavior, they use a questionnaire of their own. With 600 participants in their study they are able to gather quite significant results. They show that each of the five dimensions of personality is related to students' information behavior. Neuroticism correlates with having trouble surmounting barriers and problems during search. Extraverted students state that they employ different search strategies and resources. They also use libraries as a search option, have a positive stance towards searching, and are more content with their search history. Social agreeableness positively correlates with the urge to search and with the use of different search strategies, and negatively with encountering problematic obstacles during search. In general, social agreeableness is the dimension with the least relationships with information behavior while conscientiousness has the most. Conscientious students acknowledged using different search strategies, search modalities as well as resources. In addition, there is a relationship with effort and the cognitive investment. They do not regard search as an impediment and are more content with their results.

Hyldegard (2009) tried to reassess results in a real world context: She has observed pupils over a longer period of time and tried to find out if personality had an influence on information behavior. The research question in this case was if personality traits can be observed as an influence in group behavior. She observed that neuroticistic students had no more noticeable problems than others. She states that the social situation can have a great influence on the personality dimensions and advises not to generalize the influence of personality on information behavior.

More recent studies concentrate on college students again (Lee, 2009), also focusing on intercultural differences (Lee 2010), tourists' personality and information behavior (Jani et al., 2014) and personality traits in international students' everyday information behavior (Sin & Kim, 2013). None of these studies, though, employs actual observations in an experimental setting as presented in this study. A promising field for future research certainly is personality and information behavior on social networking sites (Hughes et al. 2012). Nie et al. (2014) present a study on search behavior and personality aspects using web log data but without a task-driven experimental setting.

Summing up, personality as an influence on information behavior has so far not been looked at concerning web search as a now dominant type of information behavior. Heinström (2005, 2006) and others have given important first impulses as they were able to show that there is a relationship between personality and information seeking at all.

RESEARCH QUESTION

Research so far has a focus on questionnaire-based methods. Heinström (2005) is aware of this when she observes that describing information behavior based on self-assessments given in questionnaires is not an adequate description of actual information behavior. She recommends observing actual behavior as directly as possible. In this study, we start taking up this recommendation and conduct a study in which web search as information behavior is directly observed and correlated with personality traits.¹ In analogy to previous studies, we formulate our research question in an exploratory way:

Is there a relationship between users' personality dimensions and their information behavior when searching for information on the web?

For operationalizing personality, psychometric tests are a well-accepted standard today. For this reason, we use the B5T test developed by Satow (2012) which is a German version of the well-established *Big 5* personality test.

We observe information behavior directly by measuring several parameters like clicks, query entries, activated web pages or results clicked at on search engine result pages (SERPs). For a full list of parameters, see Schmidt (2016, pp. 30-36). In addition, users comment their search experience in a post task questionnaire. Both, observed performance parameters as well as post task questionnaire data are the dependent variables for measuring information behavior in this study. Analyzing these data with respect to possible relationships with personality dimensions is meant to shed new light on existing research. At the same time we intend to introduce a new methodological perspective, as no prior personality-related studies with *direct measurement* of behavior in web search are known so far. Summing up, the study contributes toward understanding individual differences in information behavior. This may ultimately lead to better-designed and even individually adaptive information systems in the future.

METHODOLOGY

The study was conducted as a laboratory experiment. Participants had to perform web search tasks using *Google Chrome* on a laptop.

Tasks and test procedure

After a short introduction, participants were presented sequentially with each task and had to perform the task. Search tasks were formulated according to the *Simulated Work Task Situation* model (Borlund & Schneider, 2010) in order to achieve a realistic search behavior. In our study, two bookmarking tasks had to be performed: Participants had to mark relevant web documents as favorites and to store them in a "favorites" folder in their browser. Partici-

¹ The same argument holds for personality, which might also be observed with other instruments than questionnaires; we do not follow this thought any further, though.

pants could delete documents from the folder and add new documents to the folder. For each task, participants had a time limit of 15 minutes. There was an explicit instruction that each participant might work as slow or fast during that period as she wanted. Participants achieved task completion when either the participant was satisfied with her selection or the time limit was reached. Figure 1 shows the task text:

You have to prepare a presentation on the relationship between brain cancer and radio waves emitted from radio towers or cell phones.

1. In a first step, you are interested in web pages, articles, studies that generally introduce the topic and help in gaining a first overview. Add five pages, which describe the topic well to your bookmarking list. You may delete pages from this list and add others.
2. Next, you look for literature, which has been published in scientific journals and which deals with the topic. Find three relevant articles and bookmark the article's PDFs or web pages.

**Figure 1: Task Description Given to the Test Subjects
(Translated from German)**

For each run of the test four different questionnaires were used which were presented online. Participants had to fill in a questionnaire concerning demographics before the actual experiment started. After each task, a post task questionnaire (PTQ) was presented. PTQs should collect quantitative data on the subjects' personal judgment of their searches (e.g. how target-oriented the searches were, how satisfied subjects were with their searches, perceived complexity of the search task). On the other hand, PTQs contain questions that help control disturbances of the experiment through prior knowledge or specific expertise. Subjects also assess the tasks' realism. This questionnaire presents questions as selection options on a 7-point scale.

B5T Questionnaire

Finally, subjects had to fill in the B5T questionnaire as developed by Satow (2012). This questionnaire makes use of the well-established *Big 5* personality model and currently is one of the most widely used personality questionnaires in the German speaking countries. The reliability and validity of the questionnaire was confirmed on a sample of approximately 5000 persons, with values for Cronbach's Alpha ranging between .76 and .90. The test consists of 72 questions in a four-point Likert scale format ("very much" ... "not at all").² The questions themselves are presented as self-descriptions (e.g. "I am someone who is an anxious type", "I am someone who cares to treat others in a friendly way"). Using standard analysis algorithms, metric values for the five major dimensions of personality ("Big 5") can be calculated from the answers. In the following, we briefly describe the dimensions of the B5T test according to Satow (2012).

Neuroticism

This scale represents emotional stability. A high value indicates a person's emotional unstableness. People with high values for neuroticism are often tense and anxious. They can couple with stress to a lesser degree and are more worried, sometimes even concerning unrealistic problems. People with lesser values are calmer, more stable and relaxed. They experience negative emotions less intensively.

Extraversion

Extraverted people – having a high value on this scale – are sociable, talkative, and enthusiastic. Introverted people are generally more restrained concerning social interaction. They are shy, pensive, but also independent.

Conscientiousness

Persons with high values are dutiful, diligent, accurate and systematic in their behavior. People with low values are less precise, and less organized, but tend to be more spontaneous.

Openness to experience

People with a high value are more open for new experiences, tolerant and curious. They regard themselves as more intellectual and interested in culture. Persons with a low value are more traditional and grounded. They tend to prefer the well-known and well-tried to novel things.

Agreeableness

Socially agreeable people are friendly, cooperative and placable. They care for others and help fellow human beings in an unselfish way. People with a low value tend to be self-centered, direct, and uncooperative.

Data acquisition during task execution

Web search behavior was recorded in the *webm* format using screen-capturing software. With the help of a click-counter plug-in, quantitative data regarding search behavior could be recorded. Variable selection follows both, Wilson's definition of micro level information search (Wilson, 1997) as well as log data analysis methods that have successfully been employed in information retrieval research (Bilenko & White, 2008; White & Drucker, 2007; White & Morris, 2007). In the following, we describe the most important variables:

We have recorded task duration, number of clicks as well as the number of web pages that were activated. In order to make results comparable, click rates and page counts were normalized in the time domain (e.g. by calculating the clicks per minute ratio). Search engine results pages (SERPs) and content pages were treated differently. Following White and Morris (2007), the rank of clicked result page links was recorded using average, median as well as max values. Concerning query behavior, we have recorded the absolute number of queries as well as time-normalized query rates. Query length as well as number of query modifications was noted as well. In addition, browser navigation interaction (clicks on browser back button, interaction with

² Using four-point scales, a neutral position is excluded (Garland 1991, Satow 2012).

browser tabs) was captured. Additional variables gathered include information on search paths like number of search paths started as well as the average length of search paths. Each individual variable was recorded on a per task level as well as in an aggregated way for the whole experiment.

Description of our sample

30 persons took part in the experiment, 14 of them male, 16 female. The age range was between 21 and 34 years, most of them students (26). Task understanding for both tasks was quite high ($M=6.53$, $SD=0.681$ for task 1 and $M=6.37$, $SD=0.765$ for task 2 on a seven-point scale (see above)). There were no outliers. A larger data distortion caused by prior knowledge can be excluded as well ($M=2.6$, $SD=1.102$). A visual interpretation of the histograms of the personality dimensions shows a normal distribution in our sample.

Statistical analysis

The major goal of our analysis was finding correlations between some of the performance parameters described above and the dimensions of the personality metric. After analyzing the data set for its basic statistical parameters (normal distribution, outliers) we have used Spearman's rank correlation coefficient *Rho* for correlation analysis. We have investigated the correlation of all variables and the different personality dimensions. For a significance level of $p < 0.05$ a significant result can be stated, for $p < 0.1$ only marginal significance is evident. In the following, we restrict our discussion of results mostly to significant results. For a more detailed discussion, see Schmidt (2016, pp. 36-92).

RESULTS

In the following, we discuss the significant correlations for the different dimensions of personality as well as the additional basic motives in the order as introduced above.

Neuroticism

Neuroticism is a significant influence for task 1 and the number of websites visited ($r=.382$, $p<.05$) as well as for back button usage ($r=.380$, $p<.05$). Query length for both tasks shows a negative and significant correlation with neuroticism ($r=-.443$, $p<.05$). People with a high value of neuroticism use shorter queries on average.

Extraversion

For the extraversion dimension, significant results could be obtained for task 2 only: This task was special as users had to search for scientific literature and had to bring along competencies for doing so (information literacy). Extraversion correlates with complexity ratings for this task ($r=.412$, $p<.05$). In addition, extraverted persons judge their information literacy as rather low ($r=-.351$, $p<.1$).

Conscientiousness

Conscientious people have a high level of activity per time, but do not take more or less time overall than less conscientious people. This becomes evident for both tasks for the variables page clicks per minute ($r=.355$, $p<.1$), and here

especially for task 1 ($r=.573$, $p<0.01$). The same holds for result clicks per minute for task 2 ($r=.453$, $p<.05$). For this task a significant correlation with using the back button was observed ($r=.393$, $p<.05$).

Openness to experience

Open persons on average take longer for both tasks ($r=.431$, $p<.05$). In addition, there is a highly significant correlation between the median position of results clicked on SERPs and the openness values ($r=.488$, $p<.01$). This means that open people click on results further down in the ranked results list while less open people tend to stay with top results only.

Agreeableness

Only few significant results were obtained for agreeableness. A negative correlation with the highest rank position clicked (*maximum rank*) was observed, i. e. socially agreeable persons tend to click on results further up in the list ($r=-.444$, $p<.05$).

DISCUSSION OF RESULTS

In this study, we have shown that there are several correlations between personality dimensions and the variables observed in the test and collected during the post task questionnaire. The study is explorative and describes possible relationships between personality and web search information behavior. It is meant as a starting point for more in-depth studies. For now, we assume that personality indeed is a relevant factor influencing information behavior. In the following, we try to contextualize our results, identify patterns, and explain our observations in the light of research published so far.

Neuroticism

Neuroticistic persons visit many pages but interact little with them. A certain reservation is indeed typical for neuroticism (Satow, 2012), observed here in the click behavior (Schmidt 2016, p. 48). An additional indicator is a relatively short query length. The high level of back button usage hints at problems with relevance judgement, as results are clicked at first only to found irrelevant in the next step. This problem with relevance judgements can also be found in Heinström (2003). We did not find any correlation between neuroticism and high complexity ratings for the searches, though.

Extraversion

Extraverted persons had problems with executing task 2, which required (scientific) information literacy. They take longer for this task (Schmidt, 2016, p. 53) they judge this task as more complex and problematic, and have a less favorable opinion of their own search capabilities. Indeed, McCown and Johnson (1991) have shown that extraverted people concentrate on social interaction and tend to neglect their studies what may explain their lesser competencies. On the other hand, more introverted persons were fine with task 2 and had higher opinion of their skills. A clear pattern

for information behavior could not be identified for this dimension, though.

Conscientiousness

Conscientious people have a high level of activity and an exhaustive exploitation of the search space. As there is a high correlation with goal-orientation for task 1 (Schmidt, 2016, p. 56), one may assume that high activity level and the higher search effort is related to a directed search strategy. Conscientious people tend to search in a rather linear way and more carefully, as they use more back button clicks and avoid multi-tab usage in the browser. Heinström (2003, 2005, p. 240) classifies conscientious people as being strategic in their search behavior taking more time and investing more effort into search. This is consistent with our study as well as with general research into the relation between conscientiousness and effort (Blickle, 1996). Halder et al. (2010) state that conscientious students claim to invest more effort into their searches. Less conscientious people are less active, put less effort into search, click on less results and search rather randomly and less goal-oriented. This implies a search pattern that aims at finding results fast but with little reflection. It remains open whether this a problem for them, as no significant differences with respect to satisfaction was observed.

Openness to experience

The more open a person is, the longer she takes for searching. This may be connected to the fact that open people tend to click on results at higher rank positions, possibly on SERP two or three. This affinity to a broader search strategy has been observed by Heinström (2005) and is modeled by her as a typical search pattern. The readiness to look at results way down on the list may be related to the curiosity of open people (Satow, 2012). Less open people confine their search to the top positions which appears as a problem as they are also less satisfied with their search. Openness also correlates with a higher degree of satisfaction (Schmidt 2016, p. 64).

Agreeableness

This dimension has the least obvious correlations with the observed variables. Obviously social agreeableness leads to less obvious behavior in web search. This was stated by Halder et al. (2010) as well who showed in their study that agreeableness had the least predictive power for information behavior. Impatience of socially disagreeable persons as observed by Heinström (2005) was not identified in this study. We assume that this dimension has a strong influence on behavior in social networks and media.

LIMITATIONS

The experimental situation prevented testing a higher number of subjects. Furthermore, the sample consisted almost entirely of undergraduate students. With respect to the broad variety of variables observed, only few correlations can be observed, many of them only marginally significant. Still, we believe that our results show a certain connection

between personality and web search information behavior, which calls for more elaborate study designs in the future. Following the Big 5 model, personality dimensions were treated separately. While this is in line with typical personality studies, analyzing the interrelation between personality dimensions appears to be a promising approach. For the future, we plan to design more advanced studies of the interrelationship between personality and information behavior, e.g. using multiple regression analysis.

CONCLUSION

With this study, we want to contribute to exploring the role of individual differences like personality traits for explaining differences in information behavior. Within the limits of our experimental study, personality appears to be an influencing factor for different behavioral parameters observed in the context of web search.

Integrating known individual differences in the design of future information systems can be seen as a major challenge for information science: Not only personality, but also cognitive state (Ingwersen 1996), emotion (Kuhlthau, 1993, Nahl & Bilal, 2007) or motivation with respect to the situation (Weiler, 2012) are relevant forces and should be part of future systems' behavioral space. This may happen by actual adaption and support for different types of search patterns (in information seeking contexts). Today, many of the factors mentioned above have not yet been taken into account for the design methods used for system construction in information systems / Human-Computer Interaction.

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