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Paul L. Bowen
University of Queensland, p.bowen@business.uq.edu.au

Fiona H. Rohde
University of Queensland, f.rohde@business.uq.edu.au

Chiu Yueh Alice Wu
University of Queensland, a.wu@business.uq.edu.au

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Paul L. Bowen
University of Queensland
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Fiona H. Rohde
University of Queensland
f.rohde@business.uq.edu.au

Chiu Yueh Alice Wu
University of Queensland
a.wu@business.uq.edu.au

ABSTRACT

This paper investigates the effects of personality characteristics on individuals' abilities to resolve ambiguity in an information retrieval environment. In particular, this research examines the effects on query performance of the interaction of personality characteristics (as measured using the NEO PI-R) with information requests that contained extraneous, syntactic, or both extraneous and syntactic ambiguities. The results indicate that ambiguity affected performance. The results also show that various personality dimensions significantly affect end-users' abilities to compose accurate queries. Neuroticism, agreeableness, openness to experience, and conscientiousness affected the number of errors made in the query formulations. Conscientiousness affected the length of time taken to compose the queries and neuroticism affected the confidence end users had in the accuracy of their queries. In addition, the results indicated that, while the personality dimensions affected performance, there was no interaction between the personality dimensions and ambiguity.

Keywords

Personality, Information Retrieval, NEO PI-R, Ambiguity, Performance.

INTRODUCTION

In today's highly competitive business environments organizations are encouraging managers and other end users to query information repositories themselves. Frequently the queries these end users compose are to satisfy information requests, posed in natural language, they receive from stakeholders. Being in natural language, these information requests often contain ambiguities.

This paper investigates the effects of personality characteristics on individuals' abilities to resolve ambiguities in an information retrieval environment. In particular, this research examines the effects on query performance of the interaction of personality characteristics with information requests that contained extraneous, syntactic, or both extraneous and syntactic ambiguities. The personality dimensions examined are neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. These dimensions were measured using the revised NEO Personality Inventory (NEO PI-R).

THEORETICAL FOUNDATIONS AND HYPOTHESIS DEVELOPMENT

Ambiguity and Information Retrieval

Within the realm of information retrieval, a person receives an information request, interprets the information request, and prepares a query to retrieve the required information from a data repository, i.e., a database, data mart, or data warehouse. The presence of ambiguity in an information request is likely to lead to multiple valid interpretations of that information request. Because of the multiplicity of valid interpretations, the information retrieved may not be the information desired by the person initially making the request. Use of potentially inappropriate information can have significant negative ramifications on business decision-making processes.

Walton (1996) identified six ambiguity types: lexical, syntactical, inflective, pragmatic, emphatic, and suggestive. Axelsen et al. (2001) expanded Walton's taxonomy to include a seventh type of ambiguity, extraneous ambiguity. Their results indicate that syntactic and extraneous ambiguity strongly affect people's ability to correctly translate information requests into queries that extract the information desired by the requestor.

SYNTACTIC AMBIGUITY

Syntactic ambiguity, i.e., structural or grammatical ambiguity, often results in recipients being unclear or mistaken as to the subject or the object of a sentence. One of the most common forms of syntactic ambiguity is the use of indefinite pronouns where the pronoun's antecedent is not clear.

EXTRANEOUS AMBIGUITY

Extraneous ambiguity arises when information is included that is not necessary. Some extraneous communications are clearly not relevant to the task at hand and may even be misleading. Axelsen et al. (2001) found that excess information impairs people's ability to recognize critical elements of an information request. The extraneous information could, however, confuse other recipients and cause them to misinterpret the information request, e.g., by expanding the scope of the query.

This research extends the work undertaken by Axelsen et al. (2001) by examining whether some personality types can resolve the syntactic and extraneous ambiguity better than other personality types.

Personality

Personality refers to the cognitive and affective structures maintained by individuals to facilitate their adjustments to the events, people, and situations they encounter (Gough, 1976). Personality variables such as locus of control, ambiguity tolerance, cognitive behaviors, and attitude affect individual's ability to articulate and evaluate designated tasks and ultimately impact on MIS success (Zmud, 1979). When applied within the context of specific occupations and organizations, personality variables are also significant predictors of job performance (Day and Silverman, 1989; George, 1992). The Five Factor model categorizes personality traits into five major dimensions: Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A), and Conscientiousness (C). This model of personality has become the dominant basis for investigating the effects of personality traits (Goldberg, 1993) and has been used in studies of job performance (Barrick and Mount 1991, 1993), career success (Judge et al., 1999), job satisfaction and work adjustment (Tenopyr, 1993).

Ambiguity, Personality, and Information Retrieval

NEUROTICISM, AMBIGUITY, AND INFORMATION RETRIEVAL

Once an information request has been received, to formulate an accurate query, end-users interpret the components of the request relative to the tables and attributes in the data structure. When individuals undertake more demanding attentional tasks, higher levels of neuroticism are associated with worse task performance (Szymura and Wodniecka, 2003). Introducing ambiguity into an information request makes the query formulation task more demanding. This increased stress invokes a negative emotional response in persons with higher levels of neuroticism and negatively affects their performance. Thus:

> H1: End users with higher levels of neuroticism faced with ambiguity in information requests perform worse[1] when formulating queries than end users with lower levels of neuroticism.

EXTRAVERSION, AMBIGUITY, AND INFORMATION RETRIEVAL

The six facets of extraversion indicate that persons scoring highly on extraversion tend to be more outgoing, high-spirited, active, excitement seeking, and cheerful. The task of composing queries for particular information requires little use of these exuberant traits. To perform the task well and to resolve the ambiguity relies on people's ability to focus on concepts and ideas. Individuals exhibiting high levels of extraversion may find the task of composing a query more difficult and stressful, as they are required to suppress their enthusiasm for life and focus more intently on the task at hand. This increased stress is likely to have a negative effect on their performance. This analysis leads to the following hypothesis:

> H2: End users with higher levels of extraversion faced with ambiguity in information requests perform worse when formulating queries than end users with lower levels of extraversion.

OPENNESS, AMBIGUITY, AND INFORMATION RETRIEVAL

Traits in the openness to experience dimension reflect the process of using cognition, intelligence, and contemplativeness together with unconventionality (Judge et. al 1999). Individuals with low levels of openness to experience are more conventional and prefer familiar and recognizable items. Conversely, individuals with higher levels of openness to experience have the ability to expand potential innovation, have positive attitudes towards learning, and are more motivated (Barrick and Mount 1991). These individuals are also more willing to embrace novel ideas "as well as experience emotions more keenly" (Costa and McRae, 1992, pp15).

Determining and extracting the information required from an information system requires creative mapping of real world ideas and concepts to a database structures (Wand and Weber, 1990). Individuals with higher level of openness to experience possess traits of flexibility and creativity and hence, should find the task less demanding. When individuals are also confronted with ambiguity, the traits of flexibility and creativity allow such individuals to better resolve the ambiguity and ultimately perform better than individuals who do not possess such traits. This analysis leads to the following hypothesis:

> H3: End users with higher levels of openness to experience faced with ambiguity in information requests perform better[2] when formulating queries than end users with lower levels of openness to experience.

AGREEABLENESS, AMBIGUITY, AND INFORMATION RETRIEVAL

Individuals with high levels of agreeableness are compassionate and cooperative whereas individuals with low levels of agreeableness tend to be non-compliant, critical, sceptical, and more competitive. Individuals exhibiting a low level of agreeableness are better able to recognise, articulate, and evaluate the information necessary to make accurate analyses. Individuals with higher levels of agreeableness, i.e., straightforwardness, ingenuousness, and modesty, tend to misinterpret and overlook relevant information. The process of query

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[1] Perform worse is operationalized as making more errors, taking more time, and being less confident when formulating queries.

[2] Perform better refers to make less errors, take less time, and be more confident when end users formulate queries.

composition requires that essential information is recognised in the information request.

Following the execution of each query, end-users must evaluate, on an objective and logical level, the accuracy and relevance of the results generated. The difficulty of these tasks increases with excess information or structural request ambiguities. Individuals who are less agreeable with greater scepticism and possess critical thinking skills tend to be better able to recognise the presence of ambiguities and to be better equipped to resolve them. This analysis leads to the following hypothesis:

> H4: End users with higher levels of agreeableness faced with ambiguity in information requests perform worse when formulating queries than end users with lower levels of agreeableness.

CONSCIENTIOUSNESS, AMBIGUITY, AND INFORMATION RETRIEVAL

The process of composing queries from information requests is iterative. When presented with excess information or syntactical ambiguity in an information request, end users with higher levels of conscientiousness are able to carefully, logically, and persistently work through the request. Because they are more diligent when constructing queries, they are likely to produce more accurate queries and to be more confident in their query results. This discussion leads to the following hypothesis:

> H5: End users with higher levels of conscientiousness faced with ambiguity in information requests perform better[3] when formulating database queries than end users with lower levels of conscientiousness.

METHOD

Research design, participants, and data collection

In a laboratory experiment, 75 participants composed and executed queries in SQL for an Oracle database. All participants received a set of instructions containing the scenario, the details of tasks to be performed, the data dictionary, and the entity-relationship diagram. Participants were assigned to one of four groups according to their GPA in such a manner as to make the IS experience and training of the groups as equivalent as possible. The groups were then randomly assigned to a treatment sequence.

The ambiguity treatment was manipulated via the information requests. Each of the four groups received information requests in all four formulations: clear, extraneous, syntactic, and both extraneous and clear. Similarly, for each information request there were four different formulations (one for each different type of

ambiguity). This design required participants in all four groups to experience each type of ambiguity.

The participants had two hours to construct, as accurately as possible, appropriate queries for as many of the twelve information requests as they could. After each query attempt was executed, the system displayed the SQL result. Participants could revise their queries as many times as they wished. When they indicated that they were satisfied with the result they obtained for a particular request, participants were prompted to specify their confidence that the query results were correct. After indicating their confidence levels, participants proceeded to the next information request.

Operationalizing the Variables

The dependent variables were the number of semantic errors in each query, the time taken to compose each query, and the participant's confidence in each of their queries. The independent variables were the types of ambiguities present and each participant's scores on each of the five dimensions of the NEO personality inventory. To ensure that the effects of task complexity and end-user ability had been taken into account, two more variables, query complexity and grade point average (GPA), were used as covariates in the statistical analysis. The information requests were generally of increasing complexity and, thus, information request (query) number was used as a covariate.

RESULTS

Effects of Personality and Ambiguity on Semantic Errors Made By End Users During Query Composition

None of the interactions between the five personality dimensions and the four types of query formulations (clear and the three ambiguous) were significant. That is, individuals with various levels of the five different personality dimensions were neither more nor less successful in resolving ambiguities contained within the information requests. The results of an analysis of covariance (ANCOVA) (Table 1, Panel A) indicate, however, a significant association between four of the five personality dimensions and number of query errors made. In particular, the results indicate that neuroticism, openness, and agreeableness significantly affected the number of semantic errors. Conscientiousness had a marginal affect on the number of semantic errors. The parameter estimates show the direction of the effects of each of the personality dimensions on the number of semantic errors.

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[3] Perform better refers to make less errors and be more confident when end users formulate queries. They are, however, likely to take more time composing their queries, e.g., refining their query formulations when earlier query formulations produce results the user deems unreasonable.

Source	R^2	df	Mean Square	F Value	Pr > F	Parameter Estimate
Model	0.1501	10	348.99	10.65	0.0001	
Error		603	32.76			
Ambiguity		3	338.72	10.34	0.0001	
Neuroticism		1	134.75	4.11	0.0430	-0.0417
Extraversion		1	9.05	0.25	0.6203	-0.0116
Openness		1	155.52	4.75	0.0297	-0.0545
Agreeableness		1	171.17	5.23	0.0226	0.0626
Conscientiousness		1	94.10	2.87	0.0906	0.0399
Query Number		1	1957.83	59.77	0.0001	0.6664
GPA		1	165.18	5.04	0.0001	-0.7710

Panel A. Effect of Model on Number of Semantic Errors Made During Query Composition

Source	R^2	df	Mean Square	F Value	Pr > F	Parameter Estimate
Model	0.0757	10	270.57	4.49	0.0001	
Error		603	54.80			
Ambiguity		3	420.76	7.68	0.0001	
Neuroticism		1	5.89	0.11	0.7432	0.0087
Extraversion		1	10.98	0.20	0.6545	-0.0135
Openness		1	52.66	0.96	0.3274	-0.0317
Agreeableness		1	0.00	0.00	0.9951	0.0002
Conscientiousness		1	292.53	5.34	0.0212	0.0703
Query Number		1	200.84	3.66	0.0560	0.2134
GPA		1	990.63	18.08	0.0001	-1.8882

Panel B. Effect of Model on Amount of Time Taken During Query Composition

Source	R^2	df	Mean Square	F Value	Pr > F	Parameter Estimate
Model	0.0805	10	10.98	5.28	0.0001	
Error		603	2.08			
Ambiguity		3	6.60	3.17	0.0238	
Neuroticism		1	18.86	9.07	0.0027	-0.0156
Extraversion		1	0.44	0.21	0.6470	-0.0027
Openness		1	0.43	0.21	0.6496	0.0029
Agreeableness		1	0.63	0.30	0.5825	-0.0038
Conscientiousness		1	1.25	0.60	0.4387	0.0046
Query Number		1	63.53	30.56	0.0001	-0.1200
GPA		1	5.76	2.77	0.0965	0.1440

Panel C. Effect of Model End User Confidence During Query Composition

TABLE 1. Effect of Types of Personality and Ambiguity on Performance

Effects of Personality and Ambiguity on Time Taken By End Users During Query Composition

None of the interactions between the five personality dimensions and the four types of query formulations (clear and the three ambiguous) were significant. That is, individuals with various levels of the five different personality dimensions neither took more or less time to construct the queries from information requests containing different types of ambiguity. The results of an analysis of covariance (ANCOVA), reported in Table 1 Panel B, indicate, however, a significant association between conscientiousness and the time taken for the query composition task. The parameter estimate shows

that, as predicted, persons exhibiting higher levels of conscientiousness took longer to complete each query.

Effects of Personality and Ambiguity on End User Confidence During Query Composition

None of the interactions between the five personality dimensions and the four types of query formulations (clear and the three ambiguous) were significant. That is, individuals with various levels of the five different personality dimensions were neither more nor less confident in the queries they produced from information requests containing various types of ambiguity. The results of an analysis of covariance (ANCOVA), reported

in Table 1 Panel C, indicate, however, a significant association between one of the five personality dimensions and number of query errors made. In particular, the results indicate that neuroticism ($F_{1,603}$=9.07, p=0.0027, two-tail test) significantly affected the confidence that end users had in the accuracy of their queries. The parameter estimate shows that, as predicted, persons exhibiting higher levels of neuroticism were less confident in the accuracy of their queries.

CONTRIBUTIONS, LIMITATIONS, AND FUTURE RESEARCH

The results show that various personality dimensions significantly affect end-users' abilities to compose accurate queries. Neuroticism, agreeableness, openness to experience, and conscientiousness affected the number of query errors. Conscientiousness affected the length of time taken to compose the queries and neuroticism affected the confidence the end users had in the accuracy of their queries. The results indicate that, while the personality dimensions affected performance, the various subsets within each dimension did not vary significantly in their ability to resolve ambiguities.

These results have important implications for improving managerial end-user query performance. By analyzing the personality dimensions that lead to more accurate queries, training programs can be developed to help persons with other levels of that personality dimensions learn how to produce more accurate queries. This research would allow organizations to better match these short-term organizational needs with appropriate personality types. This matching should decrease the learning curve for contract personnel, as they would be better suited to querying, data mining, or other information retrieval tasks that require interaction with information repositories.

The usual caveats associated with laboratory experiments using student participants limit the generalizability of the results. Future research is needed to improve end-users' abilities to extract the information they need.

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