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Individually tailored client-focused reports for ubiquitous devices: An experimental analysis

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Abstract

We describe results of a test of a method for tailoring communications based on the recipient's preferred information processing style and dominant motivational attitude. Results indicate that the greater the match between the style of the report and the individual's attributes, the more informed the reader feels about the subject of the report. This research has been conducted as part of a study into methods to design patient-centred medical using diabetic patients as an exemplar of chronic disease. The long term aim is to use reports personalised to the recipient to better inform patients about their disease and strengthen their motivation to follow the treatment plan.

Keywords

Personalisation, cognitive style, functional theory, experiment.

INTRODUCTION

The quality of communication between a professional (such as a doctor) and a client (such as a patient) is a major determinant of whether the client will act on the advice provided (Klinge 1996). For example, in the financial services domain, better understanding of the relative risk and return of investment options tends to moderate risky investment behaviour (Vlaev, Chater et al. 2009). In the medical domain, patient understanding of treatment information is closely related to long-term compliance in self-managed treatment programs (Klinge 1996), with patients most effectively complying with instructions that they remember and understand following a consultation (Wilson and Wolf 2009). Unfortunately, professionals across a wide range of disciplines struggle to communicate adequately with clients for a variety of reasons, including lack of time and difficulty simplifying highly technical concepts (Chant, Jenkinson et al. 2002; Jiang, Klein et al. 2003).

Presenting information using terminology that is accessible to the recipient is an obvious first step towards helping clients to become more informed. For example, reports could include explanations of technical terms, and ensure that words and sentence structure are appropriate for the recipient. However, a more sophisticated approach, that takes advantage of readily available computing power and which is the basis for many mass-marketing campaigns, is to design reporting templates that structure information according to an individual's preferred information processing style, and allow the writer to emphasise consequences that are relevant to a person.

Tablets, smart phones, and other small form factor computing devices are widely used platforms for accessing news, emails, and other documents. Market research conducted by IDG indicates that, for the overwhelming majority of IT and business professionals, use of a tablet computing device, particularly Apple's iPad, is integral to daily work (IDG Connect 2012). In most cases, however, the screen is used as a direct replacement for the traditional paper document, with no attempt on the producer's part to harness the significant computing power of these devices to enhance the document in any way, let alone change the client's experience. In other words, the considerable computing power built into these devices, that could be used to tailor document content according to the abilities and preferences of the reader, is largely wasted when it comes to reports and other communications.

Structuring information to fit an individual's preferred information processing style should, in principle, make information easier to read and absorb (Epstein 1998; Evans 2008). This approach is the basis for the use of

multiple argument styles in many public health and public safety campaigns, because the dual-messaging strategy helps ensure coverage across multiple market segments (Novak and Hoffman 2008). Emphasising consequences that are relevant to the reader is also potentially an effective strategy because appealing to values important to an individual tends to be the basis for the most persuasive arguments and appeals for action (Roser 1990).

Assessing tailoring based on cognitive-style and personal relevance is the focus of this research paper. In the remainder of this paper, we describe a theory-based method for tailoring professional advice documents to make them more accessible to readers and the results of a laboratory test of those principles. The work is guided by theories of cognitive style and persuasion, specifically, Cognitive-Experiential Self Theory (Epstein 1998), and the Functional Theory of Attitude (Katz 1960; Johar and Sirgy 1991). In the next section we specify three hypotheses regarding the effects of preferred information processing style and attitude on perceived understanding, and the relationship between perceived understanding and engagement. We then explain the methods and measures used to test those hypotheses, and present results analysed using the Partial Least Squares (PLS) form of Structural Equation Modelling (SEM). Implications of these results for the design of reports for tablet computers, and patient-centred medical status reports in general, are then described.

THEORY AND HYPOTHESES

Preferred information processing style

Messages that are easy for an individual to interpret are more likely to be examined and understood. Making messages easy to understand, however, involves more than just using terminology that is appropriate for the audience. Education studies indicate that information is easiest to understand when the way it is presented is compatible with an individual's preferred information processing style (Sladek, Bond et al. 2010). By information processing style, we mean an individual's habitual mode of processing.

Dual-process theories provide a strong conceptual basis for designing information to suit an individual's dominant preferred information processing style. The defining feature of this class of theory is the idea that learning and reasoning occur through experience (observation and activity) and abstract rules via two parallel information processing systems (Evans 2008). In the specific theory we describe here, Cognitive Experiential Self Theory (CEST) (Epstein 1998), they are labelled the analytical-rational and experiential systems respectively.

CEST proposes that everyone uses both systems to learn how to adapt to the environment; however, an enduring trait of each individual is the extent to which we prefer one mode as the default mode of processing (Epstein 1998). A preference for the rational system leads to an analytical-rational processing style in which assessment is intentional, analytic, and primarily verbal. Using this system, reality is encoded and understood best using abstract symbols, words, and numbers (Epstein 1998). A preference for the experiential system, on the other hand, leads to an intuitive-experiential style in which assessment is holistic, associationistic, emotional, and image-based (non-verbal). Using this system, reality is encoded and understood via concrete images, metaphors, and narratives (Epstein 1998). So, for example, a logical argument would be preferred by someone with a rational processing style and a storytelling approach by one with an experiential processing style (Evans 2008).

Identifying individual preferences is potentially important because people tend to prefer messages that correspond to their preferred style (Novak and Hoffman 2008). Indeed, when instructional materials are congruent with an individual's preferred information processing style, people not only believe they learn more effectively, performance appears to be objectively superior (Hayes and Allinson 1998). These results are attributed to the environment being more supportive of the learner's style, which allows the reader to exploit the learning material more effectively (Workman 2004). On this basis, we should expect that an explanatory document prepared by a professional for a client, for example, may be more easily grasped if the messages emphasise experience and emotion for experiential processors, and affect-free logic and evidence for rational processors.

We therefore predict:

H1: The greater the match between a reader's preferred information processing style and the style emphasised in a report, the greater the reader's perceived understanding of the content.

Motivation

Structuring information according to an individual's preferred information processing style should make a message easy to comprehend but will not, of itself, make the content relevant to the reader. Ensuring personal relevance is critical because, as indicated by a substantial body of research work, the apparent relevance of the message influences how much the reader considers a response, and consideration, in turn, is the strongest influence on intentions to take action (see Briñol and Petty 2006, p. S84). That is, even when advice is easy to understand so that meaningful consideration can occur, it must appear personally relevant for the reader to consider options, form intentions, and take action (Roser 1990). It is important to note that making a message

personally relevant involves more than merely using the reader's name. Personal relevance actually means referring to values or issues that are personally important to the reader (Petty and Wegener 1998).

One way to understand what motivates people to take action on the basis of advice is to consider what function it serves that person to take that action (the dominant motive for the action). For example, to understand what motivates someone to adopt a treatment regime in response to a recommendation from a doctor, we can consider what function it serves that person to adopt and continue with a prescribed plan. This approach, known as the attitude-functions perspective, is based on the premise that one's attitude towards an action is dependent on an underlying motivational function (Katz 1960; Shavitt 1990; Johar and Sirgy 1991). This means that a request that is framed in terms of a motivation held by a person will be more effective at initiating action than any other way of expressing that request. Based on well-established taxonomies, attitudes are associated with four primary functions: utilitarian, value-expressive, knowledge, and ego-defensive (Snyder and DeBono 1985; Shavitt 1989).

- A utilitarian attitude is held when practical considerations such as money or time are regarded as important. Consumers with a utilitarian attitude respond to messages that emphasize functional impacts such as the cost of medications (cheapest price), time saved, or work productivity.
- An attitude performs a value-expressive function when related to an individual's sense of self. A person with this attitude responds not to objective product benefits, but to information concerning self-image or social outcomes (Johar and Sirgy 1991). Health issues that might appear in a diabetes treatment plan, for example, could include the risk of amputation if blood-sugar levels are not controlled adequately.
- Attitudes that serve a knowledge function fulfil a need for structure or meaning, which is often present when one is confronted with ambiguity. In these circumstances, feeling that we can better predict what will happen gives us a sense of control and helps us to better organise and structure our experience (Slama and Singley 1996). This function is served, in the diabetes treatment context, with information about the cause of the disease for the individual, and how it is likely to progress. Studies of indigenous Australian communities have found that fulfilling this motive is critically important for obtaining informed engagement with medical professionals (Anderson, Devitt et al. 2008).
- Finally, attitudes perform an ego-defensive function when they protect the person from internal insecurity or external threats to one's sense of self (Johar and Sirgy 1991). Building a treatment recommendation around this motive would involve identifying an issue that creates feelings of insecurity (excessive weight, for example) and outlining how the treatment plan can address that issue.

That motivational attitude towards an action has a moderating effect on preferences for information supporting a decision about that action is supported by a research findings in multiple disciplines including social psychology (DeBono 2006), and information systems (Smith, Johnston et al. 2011). Based on the above theory, we should expect that a document outlining professional advice for a non-expert client will be more relevant, and the decision choices and implications more readily understood, if the consequences of decision alternatives are congruent with the client's dominant motivational attitude towards the subject of the report (which will be one of utilitarian, value-expressive, knowledge, or ego-defensive).

This leads to our second hypothesis:

H2: The greater the match between a reader's dominant motivational attitude and the type of consequences emphasised in a report, the greater the reader's perceived understanding of the content.

RESEARCH MODEL

Collectively, the three hypotheses form the research model illustrated below in Figure 1. The essence of the model is that cognitive style and attitude interact with the way in which information is presented, and the types of issues emphasised, such that tailoring a report to match individual attributes should promote greater perceived understanding and greater interaction intentions.

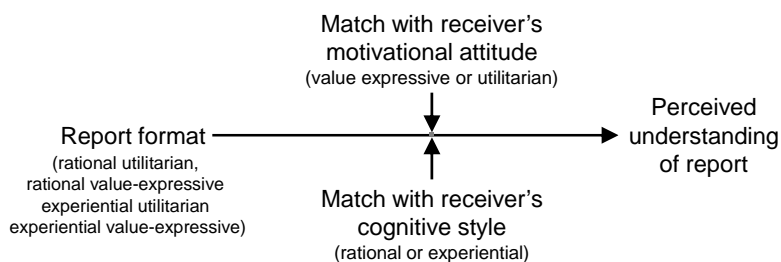


Figure 1: Research Model

METHOD

A post-test between-subjects quasi-experimental design with random assignment to treatments was used. The research assistant who ran each session worked with each participant separately to explain requirements in plain language, collect demographic data, and set up the treatment (a personalised report) beforehand, and to ensure all questions on the post-test questionnaire were completed afterwards. Each participant was paid equally, and each viewed only one report design. All sessions were conducted in the Monash Behavioural Research Laboratory on a computer monitor. After reading the plain language description of the project and signing a consent form, the display was set up for the participant and the following scenario, describing an imaginary disease, was presented:

A few months ago, you began to feel unusually tired and sick and went to your local doctor for a checkup. At the consultation, your doctor took a blood sample and sent it off to a pathology laboratory for testing. The test revealed that you have contracted Bell's disease. This disease is caused by exposure to rickettsia bacteria, a type of bacteria carried by fleas and transmitted via flea bites. This infection then damages the pancreas and affects the body's immune system. These effects are usually permanent because damage remains after the initial bacterial infection has been cured. As a result, people with Bell's disease tend to have elevated blood sugar levels, and are prone to colds and infections.

Since your initial diagnosis, a new blood test has been performed each month to track your progress. The sheet you are about to see has been sent by your doctor in preparation for the next visit.

Each participant then viewed one of four reports, each detailing blood test results to indicate the status of a fictitious disease. The disease was fictitious to help ensure that no participant had any prior knowledge, and results would therefore indicate the effect of the report on participants. Post-test interviews indicate that this manipulation appears to have been successful, with no participant indicating any prior knowledge.

Treatment groups

Each person was randomly allocated into one of four treatment groups to manipulate the message style and the type of consequences emphasised, while keeping the basic information transmitted as identical as possible between treatment groups. In accordance with the information processing styles described by CEST (Epstein 1998), each report was structured as either a fact-based argument or a case-study to conform to the needs of the rational and experiential styles, respectively. The consequences of major disease risks were similarly varied to conform to the utilitarian and value-expressive motivational attitudes. Based on extensive pre-testing, work and financial problems were emphasised in the utilitarian-oriented reports, and self-image and social issues were emphasised in the value-expressive reports. Figure 2 illustrates the different types of messages used. The top row contains messages designed to appeal to experiential learners, while the bottom row contains messages for rational learners. The left column describes consequences in terms that should resonate with those who have a highly value-expressive motivation, and the right describes issues that should be relevant to utilitarians.

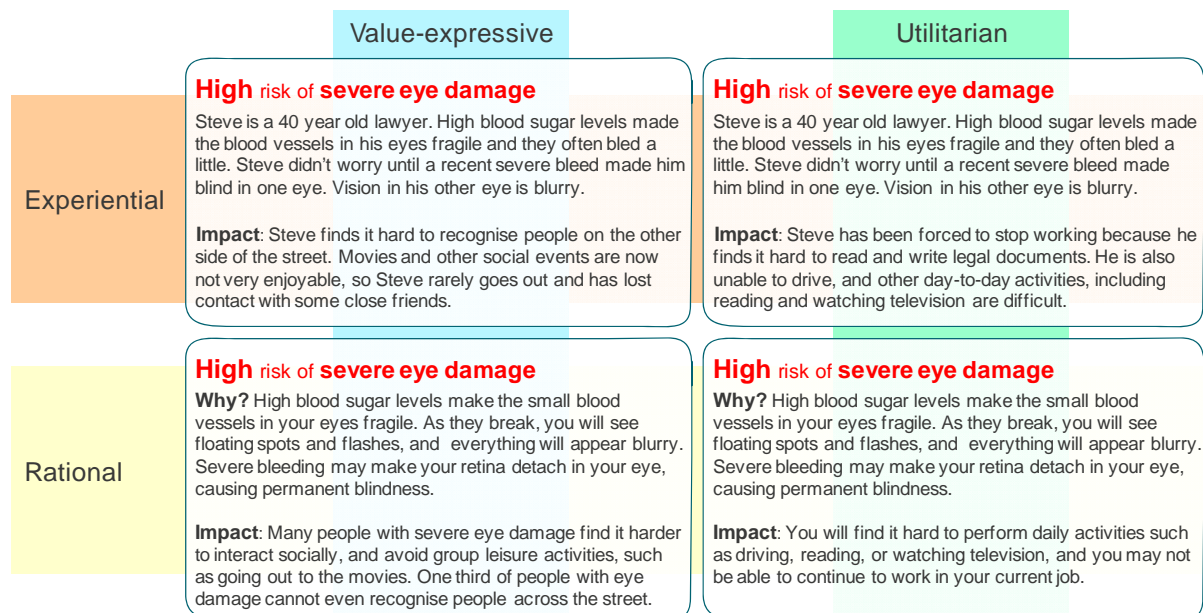


Figure 2: Message styles used in experiment

Participants

The conceptual population chosen was adults fluent in English and with no major chronic health issues. The health issue exclusion was to exclude diabetics because the scenario that participants responded to was a disease somewhat similar to diabetes. An effort was made to recruit as wide a range of ages as possible (to ensure a

diverse population) by dropping leafleting suburbs close to the testing laboratory, and advertising on a widely used Australian online forum. Table 1 shows that the sample comprises 43 females and 17 males and that the typical participant has completed a higher degree. The mean age of the sample is 35, and the median age is 30.

Table 1: Participant characteristics

Sex	Number	Education	Number	Age	Number
Female	43	High School only	17	18-24	8
Male	17	Diploma	9	25-35	22
		Undergraduate degree	18	36-45	13
		Master's degree or higher	16	46-55	7
				56-60	6
				61+	4

MEASURES

Motivational attitude

The motivational attitude scale (Table 2) is based on the measure used by Smith et al. (2011), but modified to fit the health context of this study. Additional items were added and validated using the Q-Sort procedure (Newman and Ramlo 2010), with the items most strongly clustering together used in the final measure. Note that even though only value-expressive and utilitarian motives are of concern in this study, the Q-Sort procedure also included items representing the knowledge and ego-defensive functions to ensure that the measures of each motivational attitude used were theoretically and empirically distinct.

Table 2: Motivational attitude scale

Utilitarian	Value-expressive
I will manage the condition if that helps me to...	I will manage the condition if that helps me to...
1. improve my health.	1. maintain an image I have of myself.
2. do more things in life.	2. manage what others think about me.
3. improve my quality of life.	3. maintain or increase my self-esteem.
4. avoid or reduce disease complications.	4. achieve an image I have of my ideal self.
5. cope better with the demands of everyday life.	5. fit in with how other people expect me to be.
	6. maintain a good relationship with family and friends.

Preferred information processing style

Pacini and Epstein's Rational-Experiential Inventory (Pacini and Epstein 1999) was used to measure the extent to which an individual's decision-style has a rational or intuitive orientation. This scale is a self-report measure and contains ten indicators, five of which assess ones preference for the analytical style (need for cognition), and five for the intuitive style (faith in intuition). The highest average value for each subscale indicates the dominant information processing preference. Validation studies have concluded that the measure demonstrates satisfactory psychometric properties: the hypothesized factor structure is found in empirical analysis, all factors show high reliability scores, factors correlate with conceptually related personality traits, and the measure predicts performance in a related task (Marks, Hine et al. 2008). The *faith in intuition* scale proved to be the more empirically reliable measure, and so it is this measure that is used in the structural equation model. The indicators are presented below in Table 3:

Table 3: Rational-Experiential Inventory

Need for Cognition	Faith in Intuition
1. I don't like to have to do a lot of thinking. (Reverse)	1. I trust my initial feelings about people.
2. I try to avoid situations that require thinking in-depth about something. (Reverse)	2. I believe in trusting my hunches.
3. I prefer to do something that challenges my thinking abilities rather than something that requires little thought.	3. My initial impressions of people are almost always right.
4. I prefer complex to simple problems.	4. When it comes to trusting people, I can usually rely on my "gut feelings."
5. Thinking hard and for a long time about something gives me little satisfaction.	5. I can usually feel when a person is right or wrong even if I can't explain how I know.

Perceived understanding

Perceived understanding (Table 4) is based on a measure of perceived understanding used by Smith et al. (2011), modified for the health context of this study. As with the other modified measures, a Q-Sort procedure was used

to ensure that all items represented the same underlying concept. This perceived understanding measure assesses issues of current and future concern, the general impact of the disease, and how it affects the person specifically.

Table 4: Perceived understanding

I feel informed about...
1. How the disease affects health over time.
2. How the disease is currently affecting my health.
3. How my lifestyle will change over time.
4. How my symptoms are likely to change over time.
5. How well I am currently managing the disease.

ANALYSIS

Inter-construct correlations, the coefficient of determination, composite reliability (ρ_c), Cronbach's alpha, average variance extracted (AVE), and redundancy are shown in Tables 4 and 5. All Cronbach alpha and composite reliability scores exceed the recommended thresholds of 0.7 and 0.8 respectively (measures are internally consistent), and AVE scores exceed 0.5, indicating a satisfactory level of convergent validity. Shaded diagonals in Table 5, showing the square root of the respective AVE, are greater than off-diagonal correlation scores, indicating that measures also demonstrate satisfactory discriminant validity (Fornell and Larcker 1981).

Table 5: Latent variable correlations (Figures in the shaded diagonals show the square root of the AVE)

	1	2	3	4	5	6	7	8
1. Individual learning style	0.82							
2. Style emphasised in report	-0.09	1.00						
3. Learning style x Report style	-0.06	0.00	0.82					
4. Individual's motivational attitude	-0.07	0.19	0.07	0.72				
5. Outcome emphasised in report	-0.06	-0.02	-0.20	0.01	1.00			
6. Individual attitude x report outcome	-0.14	0.07	-0.24	0.01	0.07	0.60		
7. Perceived understanding of condition	0.21	-0.01	0.30	0.50	-0.03	-0.29	0.84	

Indicators with loadings of less than 0.5 were excluded on the basis that even where an item was justified theoretically, a low loading indicated that the item (a) may not have been interpreted as intended, and (b) would add little or no explanatory power, and potentially even bias estimates (Hulland 1999). The sample size also constrained the number of indicators that could be used in any model. As a rule of thumb, the most complex construct should contain no more than one indicator for every ten observations (Chin 1998). Because the dataset contains only 60 observations, a maximum of six indicators per latent variable could be included.

Table 6: Latent variable reliability and validity statistics (PLS)

Latent construct	R ²	ρ_c	Cronbach's α	AVE	Communality	Redundancy
Individual's learning style	-	0.89	0.85	0.68	0.68	-
Style emphasised in report	-	1.00	1.00	1.00	1.00	-
Individual's attitude	-	0.85	0.77	0.53	0.53	-
Outcome emphasised in report	-	1.00	1.00	1.00	1.00	-
Perceived understanding	0.45	0.92	0.89	0.70	0.70	0.02

RESULTS

The research model in Figure 1 was operationalized in structural equation model format, and relationships between latent variables assessed using Partial Least Squares (PLS) analysis. Item loading scores are shown in Figure 4. Hypotheses are directional, so one tailed tests are employed. Hypothesis 1 predicts that people will feel more informed about the condition when the structure of the report matches the reader's preferred information processing style. Hypothesis 2 predicts that people will feel more informed about the condition when the report describes outcomes that are related to that person's dominant motivational attitude. The results shown in Table 7 indicate that both interactions produce a statistically significant increase in the r-squared statistic from the main-effects only model, with the two interactions jointly explaining 41 per cent of the variance in perceived understanding (see Figure 4). The positive individual difference coefficient and the negative interaction coefficient for both information processing style and motivational attitude together indicate that the interaction effects are X shaped. For the preferred information processing style interaction, people with a rational information processing style reported greater perceived understanding after viewing the rationally oriented report, and those with an experiential style reported greater perceived understanding after viewing the experiential report. The significant difference on the motivational attitude variable indicates that one attitude (value-expressive, in this

analysis) was associated with a significant change in perceived understanding across the two report types. These effects are illustrated below graphically in Figure 3. For rational and experiential information processing styles and utilitarian and value-expressive attitudes, mean values are shown for responses to the questionnaire items. Both interactions have a similar shape, but the difference between report effects is most pronounced for information processing style. Finally, Hypothesis 3 is also supported. As shown in Figure 4, perceived understanding is related to willingness to interact with the medical professional (r-square of 0.37).

Table 7: Hypothesis tests

Hypothesis	Effect Slopes			R ² main effect model	R ² interaction model	F statistic for R ² increase
	Report type	Individual difference	Interaction			
(1) Cognitive style	0.09	0.21 *	-0.219 *	0.305	0.367	5.49 *
(2) Motivational attitude	-0.03	0.51 **	-0.209	0.305	0.358	4.62 *
(1) and (2) combined	-	-	-	0.305	0.405	4.37 *

One-sided tests: * = p < .05, ** = p < .01, *** = p < .001 F test parameter F(1,57)

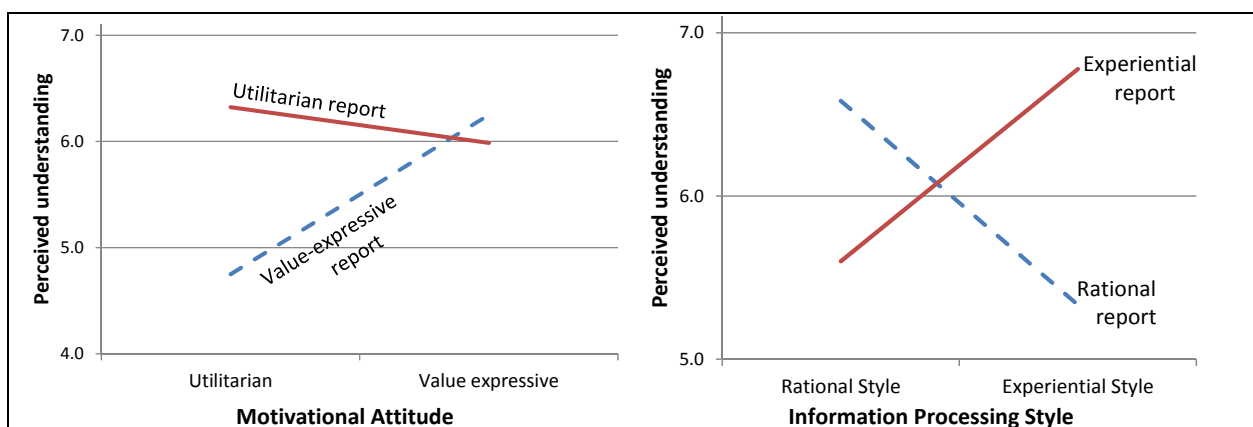


Figure 3: Graphs of interaction results

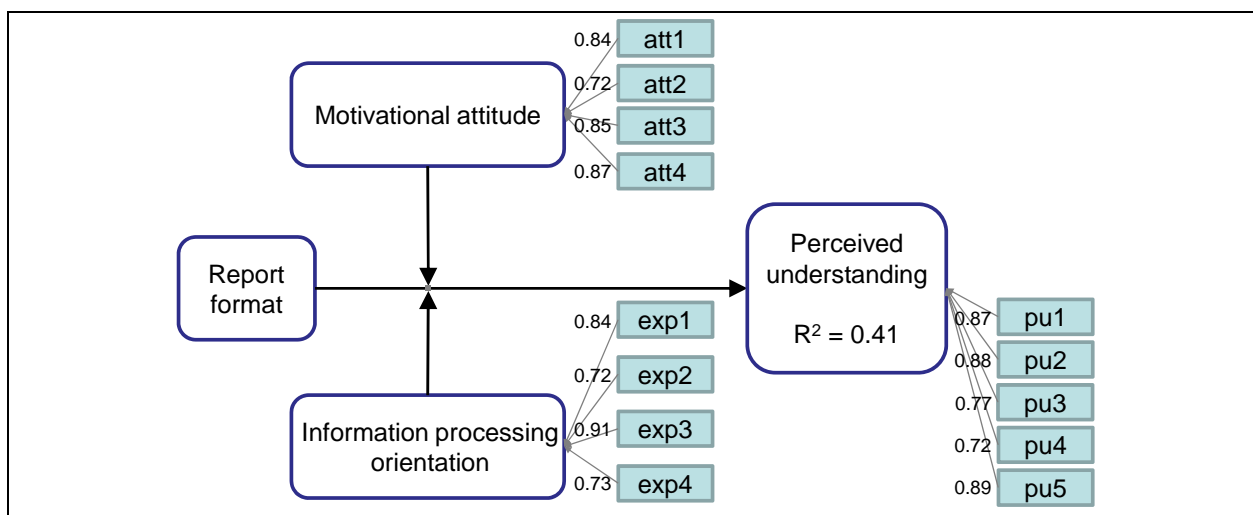


Figure 4: Path model results

CONCLUSION

Marketing is primarily concerned with convincing people that they need a product or service. Much research in this sphere has demonstrated that the key is understanding the attitudes of potential buyers, and appealing to those attitudes. This can be done at a population and an individual level. These principles are commonly used in mass market public health interventions. However, successful marketing principles have never been reported as being applied to the design of tailored reports for patients or other professional services consumers.

Currently, summary reports prepared by professionals for clients (such as the status reports that doctors share with

patients) are practitioner focused and so do not consider what information will be most relevant or how to help the recipient absorb that information. We envisage a scenario where a patient, for example, following a blood test, could receive a tailored report via email or SMS based on personal preferences. When discussing results with the patient the doctor could show this report on a tablet computer, and express the implications of results and the justification for adopting a recommended treatment in a style appropriate for that person.

The principles we describe here go some way to explaining why substantial efforts to improve rates of patient compliance with treatment directives have only resulted in small incremental improvements. We suggest that if treatment-related information were to be tailored according to a patient's dominant motivational attitude and thinking style, that information would be significantly more relevant, memorable, and likely to result in a positive behavioural response. A system to make this scenario a reality is easily achievable with current software development techniques. Implementing communication practices based on the technique described here might be exactly what professionals need to improve communication and obtain informed buy-in to recommendations.

Our longer term aim is to use personal attributes to create tailored text and images in reader-centred medical reports. In addition to the experimental results presented here, we have obtained feedback on prototypes of medical reports from patients and health professionals via surveys, focus groups and interviews. The results to date, although beyond the scope of this paper, have been overwhelmingly positive suggesting that individually tailored reports with richer content are likely to be embraced by the general public.

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