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Tailored Health Communication

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Within the field of public health (PH), much attention has been devoted to using health communication to modify attitudes, shape behavior, and persuade health consumers to better manage and protect their health. However, research indicates that although traditional channels such as newspapers, radio, brochures, and television have been proven capable of reaching and informing large audiences, they are not very effective in changing behavior. Interpersonal channels have been more successful in influencing attitudes and motivating behavior change, although their potential for delivering health communications that reach a large audience in a cost-effective manner is inadequate. The implication of this research is that mass media channels are appropriate for creating awareness, but interpersonal interactions are essential for persuading individuals to change their health behavior [1–3].

In the past few years, advances in technology have led to a new tailored approach to health communication that involves soliciting information from individuals, or alternatively querying information about individuals from existing records, to provide audible and visual feedback tailored to be responsive to the solicited information. This approach is consequential because it combines the potential for delivering cost-effective health communications to reach a large audience combined with the benefits of interpersonal communication. The reason is that communications that are tailored to be responsive to the solicited information can be used to mimic the transactional and response-dependent qualities of interpersonal communication. An interactive cycle of tailored feedback and response can be repeated over and over to facilitate an individual's movement through the persuasive process of motivating health behavior change. Along the way, both source and message factors can be dynamically modified to realize the advantages inherent in interpersonal channels, advantages proven essential for persuading individuals to change their health behavior.

This approach, known as *tailoring*, has been defined as "any combination of information or change strategies *intended to reach one specific person*, based on characteristics that are unique to that person, related to the outcome of interest, and have been *derived from an individual assessment*" [4,5]. This definition highlights the two features of a tailored approach that distinguishes it from other approaches: (1) its collection of messages or strategies is intended for a particular person rather than a group of people and (2) these messages or strategies are based on individual level factors that are related to the health or behavioral outcome of interest.

Although the tailoring approach has notable benefits, it is important to note that not all information needs to be tailored to different individuals [4]. When needs within a population are very similar, the variation between tailored messages will be minimal or nonexistent, and thus tailoring may not be justified. Instead, a targeted approach may be more appropriate to address that need. Targeting involves development of a single intervention approach for a defined population subgroup that takes into account characteristics shared by the subgroup's members. Targeting is based on the advertising principle of market segmentation, which aims to find the right kinds of consumers for a particular product of service. Readers interested in learning more about distinctions between tailoring and targeting are encouraged to review articles by Kreuter and Skinner [6] and others [7,8].

What Is the Rationale for Tailoring?

The rationale for a tailored approach is grounded in theory that explains how people process information. Petty and Cacioppo's (1981) Elaboration Likelihood Model (ELM) provides a theory for understanding this process [9]. They have proposed two routes to attitude formation and change: the *central* and *peripheral* routes. The *central route* involves a cognitive component in which the attitude is formed or revised after much thought. This involves effort on the part of the individual and is more likely to occur when the information is perceived to be personally relevant. Studies have shown that messages processed via the central route leads to more firmly held beliefs and attitudes and results in lasting attitude change. It is therefore considered to be more effective in changing attitudes than general information [10,11]. Subsequently, an attitude is likely to influence behavior [12]. From this theory, the rationale for using a tailored approach can be summarized according to the following logic [13]: (1) by tailoring materials, superfluous information is eliminated; (2) the information that remains is more personally relevant to the message recipient, (3) the message recipient will pay more attention to information he or she perceives to be personally relevant; (4) information that is attended to is more likely to have an effect than that which is not; and (5) when attended to, information that addresses the unique needs of a person will be useful in helping him or her enact and sustain the desired behavior change.

Innovative Uses of Tailoring

Throughout the last decade, tailoring systems have been developed for a very wide variety of applications, providing information for patients at high risk for developing chronic conditions; for patients who already have chronic conditions such as migraines, asthma, and diabetes that require long-term continuing treatment; as well as for patients undergoing more short-term intensive treatment such as for cancer. The goal of these systems have also been diverse, from supporting the patient's role in decisions, providing information to enable management of chronic conditions, and offering health promotion advise and behavior change interventions.

In general, published studies have demonstrated that tailored interventions are effective in changing intentions and behaviors for a number of health behaviors, such as physical activity [14], smoking [15–17], dietary habits [18–22], mammography [23–25], and weight loss [26]. However, it has been difficult to synthesize these studies to better understand the mechanism thought to underlie the tailoring process because studies to date have lacked standardization in data collection methods, theory, variable measurement, and assessment of effectiveness.

One effort to synthesize studies of first-generation tailored print communications (TPC) is provided by Skinner et al. [27]. Thirteen studies of tailored interventions are included in this review. Only 8 of the 13 studies specifically compared tailored and similar but nontailored printed communications. The studies varied by behavior topics (four studied diet, two studied mammography, and one each exercise and smoking cession). The studies also varied by outcomes measured and type of tailoring (i.e., whether tailoring was hidden or whether materials were personalized). However, several themes were noted by the reviewers. First, TPCs were found to be better remembered, read, and perceived as more relevant than nontailored communications. The studies in general provided evidence that in addition to enhanced recall and readership, TPCs are more effective than nontailored communications for influencing health behavior change. However, because some of the studies applied TPCs as only one component of a complex intervention strategy and failed to use a factorial design, it was difficult to isolate the relative contribution of the TPCs to the overall intervention effects. Still, studies in the review did suggest that TPCs can be an important adjunct to other intervention components, for example, self-help manuals and counseling.

Other projects around the world are using natural language generation techniques that enable the delivery of tailored communication via the Web, and thus enable more interactivity. Interactivity is defined as the capability of new communication systems to "talk back" to the user as do individuals participating in a conversation [28]. Although there is interest in producing tailoring systems that enable enhanced interactivity, few studies have been able to demonstrate effectiveness on health behavior. As a result, their usefulness in real-world settings remains uncertain. As an example of a tailoring system with enhanced interactivity, Cawsey and colleagues [29] developed a nutritional tailoring system based on a dialogue with the user centered on practical tips. In this tailoring system the users make a number of simple meal choices and then receive tips for improving the meal. They can respond to each tip in various ways—asking why it is recommended, stating objections to it, or rejecting it outright. The system is based on a simple conversational model emulating aspects of the conversation between human dieticians and advisees. Another example is the PEAS (**P**atient **E**ducation and **A**ctivation **S**ystem) project, which was designed to prepare people to take a more active role in healthcare decisions [30]. The project investigated strategies for helping people to identify their healthcare concerns, to learn what actions they can take on their own, and, if necessary, to be able to verbalize their concerns to healthcare professionals. These strategies combine a multimodal computer interface (including typed text and mouse inputs) with intelligent tutoring and intelligent discourse processing. As PEAS interacts with a patient, it varies the content and pace of the interaction and suggests relevant learning activities.

Bental et al. [31] review many of the projects that have experimented with more advanced techniques for generating tailored patient information. Included in this review is a system called Piglit [32] that uses computational techniques to create tailored information for diabetes patients, given information in their medical record. The goal was to ensure that patients had the information required to understand and manage their conditions. Other projects using similar advanced techniques are Migraine [33], Healthdoc [34], and OPADE [35]. Migraine used computational techniques to generate tailored pages of information for migraine patients. But, rather than use the patient's record for tailoring, an initial tailoring questionnaire was completed. Healthdoc and OPADE use similar techniques again, but to generate leaflets. Healthdoc generates health promotion leaflets, while OPADE creates leaflets to accompany prescriptions. The studies included in Brug's review were similar to those in the Skinner review in that their purpose was to tailor health communication to the needs of the individual; however, the collection of studies reviewed by Brug used tailoring systems that relied on more sophisticated technology and were not limited to generation of tailored print communications.

Developing a Tailoring System

In this next section we look at some of the common issues that emerge when developing any tailored system. As already noted, the goals of tailoring interventions are diverse and the tailoring systems developed vary from simple practical systems being evaluated in realistic context to more experimental systems that push the limits of technology. The more experimental systems, for example, those using software agents and user dialogue models to enhance interactivity, are nevertheless similar to those employing less sophisticated technologies, as when the goal is to change health behavior they both must rely on health behavior models to better understand how attitudes and beliefs inform the generation of tailored communication. Thus, the common ground for tailoring systems to change health behavior has been (1) their reliance on technology and (2) reliance on theory and health communication principles. However, within this common ground, differences exist in the extent to which developers have drawn on these two elements, and this distinction has for the most part varied by the developer's primary discipline. Health communication researchers rooted in the discipline of PH have relied greatly on health behavior models but generally have used simpler technological approaches to generate what has been referred to as *first-generation* TPCs whereas computer science employed more advanced technological approaches but integrated behavior theory to a lesser extent. For this reason, approaches to tailoring are discussed along the lines of these two disciplines.

Approaches to Tailoring in Public Health

Kreuter et al. identifies a five-step approach that is characteristic of the tailoring systems originating by developers from the discipline of PH [36]. Step 1, shown in Fig. 3.1, pertains to identifying the high-level goal that the tailoring system will be developed to influence. As shown, these goals typically have focused on a health behavior such as mammography screening, smoking cessation, or improving nutritional habits. Step 1 also involves analysis of the causal factors, frequently referred to as determinants of that behavior. Behavioral scientists understand that behavior is not caused by a single determinant, and they typically rely on sociocognitive theories to assist in identifying the determinants for a given behavior. In social and behavioral sciences, there are many established and empirically grounded theories and models that help guide the selection of these determinants. Theories such as Health Belief Model [37], Social-Cognitive Theory [38], Theory of Planned Behavior [39], and Transtheoretical Model [40] are examples of the most prominent theories. Examining the research literature for correlates of behavior change in cross-sectional studies and for effective health promotion strategies in intervention studies can provide further information about other determinants. Generally, these theories, combined with empirical data, provide the basis for elucidating the determinants related to a given behavior and it is these determinants that provide the basis for the selection of the tailoring variables.

(1) Analyzing the problem to be addressed and understanding its determinants

(2) Developing an assessment tool to measure a person's status on these determinants

(3) Creating tailored messages that address individual variation of determinants of the problem

(4) Developing algorithms and a computer program that link responses from the assessment into specific tailored messages

(5) Creating the final health communication

FIGURE 3.1. The tailoring process in public health.

Step 2 measures each individual's status on the tailoring variables. In most cases a tailoring questionnaire must be developed to assess each person's status on the tailoring variables [13,41]. The tailoring questionnaire requires that the developer predetermine a limited set of questions and response options that are most optimal to assessing each person's status on the tailoring variables. In Step 3, text and other content that may include visuals are developed for each question and possible response option in the tailoring questionnaire. Although this step is straightforward in principle, it requires that an extremely large number of bits and pieces of text be authored: each piece of text expressed in each possible way that is appropriate in content to a particular user. Next in this process (Step 4) is assembling these text chunks into a final health communication document (Step 5). Tailoring algorithms, usually developed by domain experts, are used to formalize the logic, or decision rules that link response options to the appropriate piece of authored content.

This process for tailoring is perhaps the simplest kind of tailoring and can be achieved using straightforward tools available with popular database, word processor, and multimedia authoring packages. Mail merge features available with most word processors or similar tools have been successfully used in most of the systems developed in PH to date that aim to produce tailored written materials. However, only limited kinds of tailoring are possible. Usually it is possible to fill in blanks in some template using information from a database, and include, or not, a chunk of text according to some criteria.

Furthermore, the developer of a tailoring system using this process faces two additional challenging requirements: (1) acquiring the expert knowledge needed to author the content, that is, the bits and pieces of text that the system uses to generate the tailored communication and (2) the task of assembling the bits and pieces of text into a structured health communication document that is coherent, cohesive, and effectively persuasive.

PH has employed the most obvious method of acquiring expert knowledge for message content by directly asking experts to write it. The experts (e.g., health educators, behavioral scientists, health communication specialists, etc.) write the content used for tailoring informed by a variety of cognitive and sociobehavioral theories, for example, Health Belief Model [42], Social–Cognitive Theory [43], Theory of Planned Behavior [44], and Transtheoretical Model [45]. To provide an illustration of how theory can inform the expert in writing content, we draw on Fishbein's guidance for applying the Integrative Model of Behavioral Prediction, which was developed to inform health communications that are intended to change behavioral intentions:

> If strong intentions to perform the behavior in question have not been formed, the model suggests that there are three primary determinants of intention: the attitude toward performing the behavior, perceived norms concerning performing the behavior, and one's self efficacy with respect to performing the behavior. It is important to recognize that the relative importance of these three psychosocial variables as determinants of intention will depend upon both the behavior and the population being considered. Thus, for example, one behavior may be primarily determined by attitudinal considerations while another may be primarily influenced by feelings of self-efficacy. Similarly, a behavior that is attitudinally driven in one population or culture may be normatively driven in another. Thus, before developing communications to change intentions, it is important to first determine the degree to which that intention is under attitudinal, normative, or self efficacy control in the population in question [46].

Thus, the theory informs the expert whose goal is to influence intention in a given population, or in the case of tailoring to a specific individual, to focus their writing on the three determinants of intention: the attitude toward performing the behavior, perceived norms concerning performing the behavior, and one's self-efficacy with respect to performing the behavior. Knowing which construct to focus on is dependent on both the behavior and the population or individual being considered. The empirically derived data from cross-sectional studies and behavior change intervention research provide further guidance regarding these latter issues.

Beyond this the PH literature is disappointingly scant in providing guidance on writing content for tailoring system. As stated, expert authoring typically relies on behavior change theories as well as empirically derived principles. However, this assumes that experts have the ability to integrate their theoretical knowledge with their actual practice. Findings from one of the few publications in the PH literature that examined this assumption raise concern. Kline [47] examined the extent to which theoretical knowledge is integrated in communications that focus on breast self-examination (BSE). The study was to quantify and describe the inclusion of four message variables: severity, susceptibility, response efficacy, and self-efficacy. Inclusion of these constructs, which are from the Health Belief Model, was an indicator used to measure the potential strength of the persuasive arguments in BSE pamphlets. The study found that messages rarely included communication that addressed these constructs and thus the persuasive arguments for BSE in these pamphlets were determined to be very weak.

However, even beyond acquiring knowledge to inform the content of the message, a second knowledge source necessary in any tailoring technique is that which could guide the assembly of message fragments, that is, chunks of text into a structured and cohesive document. Structure in this regard refers to optimally combining the chunks of text into paragraphs and to sentence structures. Simply pasting pieces of text together is unlikely to result in a coherent smooth document, unless the author painstakingly ensures that every possible combination of texts is coherent and smooth. Even when the author engages in this laborious task, the issue of persuasiveness remains. Communication studies emphasize the role that structure plays, because although the understanding of a message decreases smoothly as the same semantic information is presented in a less and less structured way, the persuasive effects vanish rapidly [48].

To guide the structure of assembling these chunks of text into a final document, one needs also a theory that would describe how messages could be put together in a coherent sequence and explains why certain multiargument structures are more persuasive than others. Although such theories are not considered in the PH five-step tailoring process, they have been prominent to the tailoring process employed among computer science researchers.

Approaches to Tailoring in Computer Science

Because of the limitations of existing tools and techniques, several of the more experimental projects attempt to use more complex techniques, taking ideas from computer science. Most of these projects have built their systems using Natural Language Generation (NLG) methods. Natural language generation systems are computer software systems that produce texts in English and other human languages, often from nonlinguistic input data [49]. NLG systems, like most linguistic systems, need substantial amounts of knowledge. The basic idea in most of these systems is to represent explicitly information about the patient (as a "user model"); to represent general rules about communication, such as "use simple language if patient has low educational level"; and to automatically "generate" text from some database of health-related information, given the rules and user model. Achieving this, with only limited knowledge of how humans tailor their communications (required for developing the user dialogue model), has proven to be very difficult, and in practice even the systems that have this approach as their goal have lacked access to a knowledge base that contains specific information about the determinants of the selected behavior in general (acquired using health behavior theory), and thus information about each user's status on these determinants specific to that behavior. Because of the complexity of this process, approaches in NLG that incorporate tailoring on determinants of health behavior have been limited and have been focused more on tailoring to factual information and medical history rather than the behavioral determinants that are elucidated using the sociocognitive theories previously discussed.

More frequently the tailoring systems developed using NLG draw on theories of argumentation to inform the structure of persuasive arguments that are fitting to the goal of promoting behavior change. The NLG community has fully embraced the understanding that the same semantic information can be conveyed through a variety of text, paragraph, and sentence structures, and that a multiargument structure is critical to developing communications in a domain as complex as health behavior change.

Two types of knowledge acquisition (KA) techniques are based on (1) working with experts in a structured fashion, such as structured interviews, think-aloud protocols, sorting, and laddered grids [50,51] and (2) learning from data sets of correct solutions (such as text corpora); the latter are currently very popular in natural language processing and used for many different types of knowledge, ranging from grammar rules to discourse models (for an overview, see [52]). There are of course other possible KA techniques as well, including the approach used in the PH tailoring process which is to simply ask experts how to write the texts in question.

Reiter et al. [53] used this direct approach in preliminary stages of developing the STOP, an NLG system to tailor smoking cessation letters based on the Stages of Change Model [22]. When experts (three doctors, one psychologist specializing in health behavior, one nurse) were asked to write example smoking cessation letters based on a Stages-of-Change tailoring questionnaire, they found that the specific example letters produced had a different structure from the "general" structure that the experts had initially proposed. The investigators pointed out this fact to the experts, and the experts subsequently attempted to revise the general structure to more closely conform to the example letter that they had actually written; in other words, to combine their "theoretical" and "practitioner" knowledge. It was relatively straightforward for the experts to state theoretical knowledge, or to use their practitioner knowledge to produce example letters, but attempting to integrate the two types of knowledge was far more difficult. This is a common finding in knowledge acquisition, and it is partially due to the fact that it is difficult for experts to examine introspectively the knowledge they use in practice [54].

Thus rather than relying on acquiring expert knowledge directly as a sole method, computational tailoring systems have given prominent attention to argumentation theories, which focus on persuading people to change their beliefs and desires. Mainly, the interest is on the rhetorical structure of arguments, and as a consequence, in the structure of rhetorical argumentative discourse. Several researchers have attempted to improve the construction of rhetorical discourse or persuasive argument through the use of formal representations. Stephen Toulmin pioneered this direction in 1958, creating a model of argumentation with a notation for depicting arguments graphically [55]. Perelman and Olbrechts-Tyteca further developed this approach in 1969, resulting in what has been termed the New Rhetoric, which provides a comprehensive typology of argument schemes [56]. Anscombre and Ducrot in 1983 developed a set of argumentative rules (called topoi) that capture common sense relationships between sections of text (primarily in French) [57]. Rhetorical structure theory (RST) developed a general set of functional relationships for understanding the structure of discourse. While RST covers much of the structures used in previous approaches to argumentation, Marcu has shown that it is inadequate as a model of persuasive argumentation [58,59]. Further work is required for notations and formal rules that can capture the structures employed in tailored health messages.

Future Directions

Applying persuasive argumentation theories to communication for behavioral change has been complex. Research in argumentation has been concerned only with the structure of single arguments, and likewise, NLG systems that provide explanation and advice do not explore the planning mechanisms that would account for the generation of text that consist of multiple arguments. To generate persuasive arguments, one needs also a theory that would describe how arguments could be put together in a coherent sequence and explains why certain multiargument structures are more persuasive than others [39].

Some of the computational tailoring systems (e.g., Daphne) have attempted to combine theories of argumentation with behavioral theories, realizing that if the aim of an intervention is to induce people to modify their behavior, specific theories of how and why people change behavior to guide the advising process is necessary. These interventions have used Stages of Change and the Health Belief Model in addition to linguistic and argumentation theories to develop their tailoring systems [60]. However, all of these systems have been difficult to move into real-world environments primarily because of the complexity of using NLG techniques to generate multiargument structures in domains as complex as health behavior. In addition, there is very little in

Table 3.1. Merging social–cognitive, linguistic, and argumentation theories for a next generation tailoring system.

	Public health (content)	Computer science (form)	Next generation system (content + form)
Theory (KR)	Social–cognitive models (e.g., HBM)	Discourse structure (e.g., RST)	Persuasive strategies
Methods (KA)	Empirically derived principles	Linguistic analysis	Empirically derived principles, linguistic analysis

the way of reusable NLG resources (software, grammars, lexicons, etc.), which means that most NLG developers still have to more or less start from scratch.

The nonlinguistic ("PH") tailoring approach has other limitations. This approach is done via manipulating character strings; the user writes a program that includes statements such as "include X if condition Y is true, and Z otherwise." The key difference between this approach and NLG is there is no attempt to represent the text in any deeper way, at either the syntactic or "text-planning" level.

It is conceivable that the integration of both PH and computer science approaches is important for developing tailored messages. To design a system whose ultimate aim is to try and influence the user's behavior, very diverse sources of knowledge have to be integrated. Knowledge about the specific domain, about how individual behavior is influenced by beliefs and attitudes, and about how argumentation techniques can be used all have a crucial role in producing effective and persuasive messages.

Table 3.1 proposes such an integrated approach that merges the theoretical perspective, thematic views and experiences from both PH and computer science communities. Knowledge about the specific domain and about how individual behavior is influenced by beliefs, attitudes, and knowledge is best gleamed from sociocognitive theories and empirically derived principles of health communication. Theories of argumentation and persuasive structure are best gleamed from linguistic and argumentation theories. Using this combined approach is perhaps what is needed to build on and extend current tailoring research, with a view to moving toward the next generation of tailoring studies.

In addition, one can anticipate that in the future, additional types of tailoring variables will be experimented with. Theory must inform the most parsimonious strategies that will enhance outcomes without omitting essential mechanisms or including redundant element. This will require the adoption of a common language and standard measures of the basic mechanism and processes thought to underlie tailored interventions.

For integration to occur between the more sophisticated technologies, theory and real-world applications, opportunities for multidisciplinary and collaborative basic research are needed. As such, it remains to be seen whether the advances in our understanding of the tailoring process en masse will deliver the tailored health communication approaches sufficient to engineer an impact on improved decision making, patient health behavior, and chronic disease management in a cost-effective manner.

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