AUTOMATED INDEXING OF STORIES FOR CONVERSATIONAL HEALTH INTERVENTION

A dissertation presented

by

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Abstract

Previous studies have shown that a large percentage of people search for someone else's experience with health behavior change. Previous studies have also shown that stories encoding health information are an effective tool for promoting health behavior change. By collecting health stories from blogs, social networks, public forums and other online resources we can create a database of stories that could be tailored to users for health interventions. In this thesis I explore the delivery of health stories tailored to users based on health behavior change theory, demographics and quality metrics. The medium of delivering these stories is also explored in a pilot study with 103 participants.

Chapter 1: Introduction

1.0. Motivation

Humans are storytelling creatures. Storytelling is used as a tool to make sense of the world and communicate; stories are an essential way we encode and share information with others. A story is any account that presents connected events(Oxford English Dictionary). We are constantly making and remaking the story of our life by telling it to ourselves and to others over the course of a lifetime (Bruner.J.S, 1991). In the vast collection of stories we generate, there are reports of our health experiences. We tell health experience to each other about how we failed in our diet or well, how we cope with emotional stress, and what we do to being healthier. Stories have the power to influence an individual, when told effectively. In the domain of health communication, personal stories are serves as a valuable source of information for health promotion. It also serves as a tools to catalyze and sustain health behavior change. Health information that is grounded in the personal experience of members of a community is more likely to be engaging and less likely to be dismissed. In a recent study by Houston, et al., videotaped narratives of individuals with hypertension and used these in a DVD-based intervention to help other individuals with hypertension maintain their chronic condition. In a randomized clinical trial with 299 participants, those receiving the story-based intervention had significantly lower blood pressure after 3 months, compared to a control group that received attention-control DVDs. (Houston.T .et.al ,2012)

Informal methods of obtaining health information are gaining in popularity. A recent poll by the Pew Internet and American Life project reported that 43% of respondents preferred practical advice about day-to-day health situations from medical professionals while a surprising 46% preferred to get this advice from other informal sources and sources such as family, friends, and fellow patients.(Fox.S, 2011) Social networking platforms, blogs, and mobile applications support and have normalized the practice of informally reporting and sharing personal health data diet, sleep habits, moods, exercise regimens, medications sometimes in astonishing detail. (Frost, J., M. Massagli, 2008) Patients Like Me (patientslikeme.com) offers patients a platform for tracking and

visualizing structured personal health data and sharing unstructured data stories, journal entries and comments–in forums with other patients who share similar conditions. One user amassed over 1000 peer-responses to a single health data entry. Peer responses provide stories of shared experiences such as, "I found that after I'd been taking hydrocodone for a while, it began to interfere with my sleep. I couldn't get to sleep in the first place, then once I got to sleep, I couldn't stay asleep for very long. I don't know if this could be happening for you or not." (Brownstein, C., et al.,2009) These platforms and practices are producing large, distributed corpora of useful health data that can serve as an adjunct support to formal health care.

Story indexing has its roots in early story understanding systems in which story indices were hand-coded (Mueller, 2002) for intelligent retrieval and inference. In the 90s a lot of story understanding focused on information extraction to identify the stories that contained topics(Rillof, E., 1999). More recently, researchers have employed statistical methods of text classification to collect and classify stories from large online data sets. Gordon et al., for example, created a classifier that was able to identify a million personal weblog entries from the Spinn3r dataset. Features of counseling and persuasion have also been used to index stories. Domeshek et al. developed system that described social aspects of stories using 500 indices to enable retrieval of stories as social advice. (Excerpt from the paper, Manuvinakurike. R, Barry .B, Bickmore T, 2012)

In this work I present my work on methods for indexing unstructured health stories from existing repositories of online health information, including blogs, support sites., and personal web pages and using the same for storytelling intervention. **My objective is to find the best possible story to tell an individual at a particular point in time, to help them through the next step of a long-term health behavior change program.** The story indices encompass constructs from health behavior change theories, expanded demographic information, and quality metrics. I seek to improve the utility of informal health stories by creating indexes that enable targeted, personalized delivery of story interventions to promote an individual's best possible health behavior change.

Given a database of successful health behavior change stories extracted from internet (blogs, social network, etc.), given a user in a some stage of health behavior change I attempt to answer these research questions in the present work:

Research Question 1 How to automatically index health stories such that the most relevant story is retrieved for most desired effects on health behavior change?

The indexing is defined as the process of organization, extraction or representation of the information to aid the process of retrieval. Automatic indexing is the process of achieving indexing with no/minimal supervision. I seek to answer the question of automatically organizing the unstructured text and extract indices which could be used for matching the stories to the individuals.

Research Question 2. Does the medium by which stories are delivered produce any significant effects on users? Does it make a difference if the stories are delivered as a text or narrated by a computer animated agent ?

Are health effects of users impacted if the story is rendered as a text on a computer screen or a text narrated by a computer agent ?

Houston et.al used storytelling via documentary style video recordings of the successful patients and achieved positive results. In this thesis I look at using two mediums to narrate stories. The text interface based system, where the users are made to read a story. The second medium involved computer animated agents reading the stories. The computer animated agent (relational agent) was developed by Bickmore et. al. at the Relational Agents group. The relational agents is shown in Figure 1.1. The agent has the ability to display emotions(happy, sad, concern and neutral) and exhibit conversation non-verbal behavior such as gazes, posture shifts, blinks, lip movements etc.
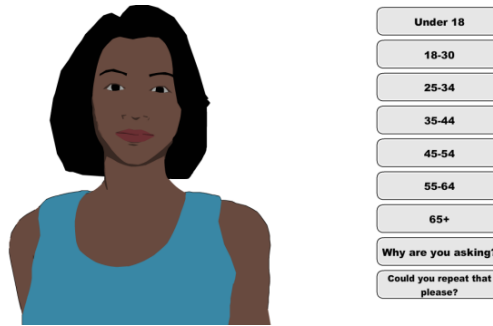
Figure 1.1: Conversational Agent used for the study.

1.1. Indexing Architecture

The main work is focused on leveraging existing stories of health behavior change that have been posted on Internet blogs, social networks, support sites, and personal web pages by individuals and use these stories to motivate health behavior change. The challenge is to determine the indices to use to find the optimal story to tell that will be the most effective at helping the listener through the next step of their behavior change program.
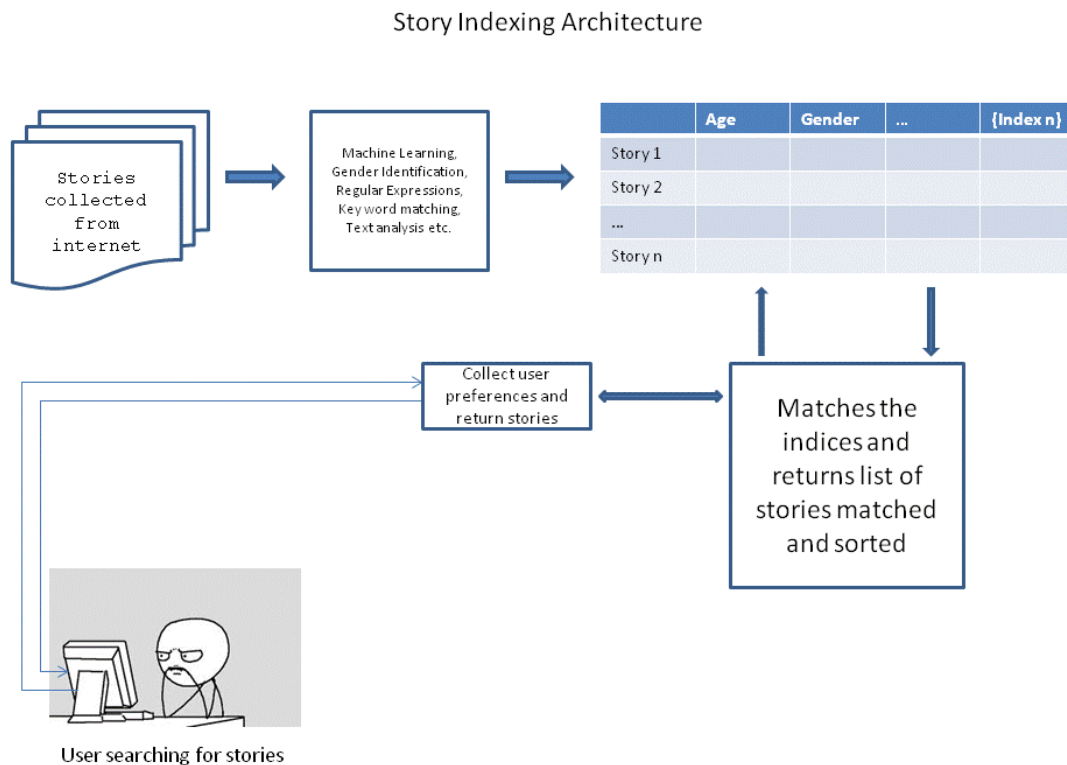
Figure 1.2: The system architecture

Figure 1.2 shows a high level architecture of the work. The stories of successful health behavior change authored by people are collected from the world wide web. The stories are extracted from websites such as patientslikeme, experienceproject, healthtalkonline, about.com and yahoo lifestyles, where people write about their experiences with health behavior change. These websites serve as a great resource for gathering health behavior change stories. In the current work I concentrate on weight loss success stories. The Centers for Disease Control and Prevention (CDC) reported that 35.7% of American adults and 17% of American children are obese.(National Obesity Trends, 2010) Obesity is one of the most prevalent problems responsible for nearly 100,000 to 400,000 deaths per year (Blackburn et.al, 2010). Hence, the weight loss stories are being focused in this thesis.

These stories collected are then passed through text processing modules which extracts the indices and stores these indexed stories in the database. The users preferences are obtained from the users through a series of questions. The answers to these questions are matched with the indices and most relevant stories are returned.

Indexing, can be defined as encoding key features of the text to aid retrieval. This thesis involves extracting meta-indices (Information not explicitly available such as Education level, Coherence, Gender, Processes of Change, etc.) and a few non-meta indexes (Information that could be extracted using key word matching/regular expressions such as Age, location, race etc.) from the story. These indices are used for matching and retrieving relevant stories to individuals. This work deals specifically with ways of extracting these indexes automatically and using these indexes for matching and retrieving the most relevant story. Figure 1.3 shows all the indexes that could be used for matching. Chapter 3 deals specifically with ways of extracting these indexes automatically. Chapter 2 speaks about the theories behind selecting the indexes.

INDEX	Description
THEORETICAL MODEL	
Processes of change (Transtheoretical model of change)	Processes of change used. (Please refer table 1.4)
Pros	Pros of changing the behavior

Cons	Cons of changing the behavior
Source of emotional support	People providing the support
Cues to Action	Motivational events to proceed from precontemplation/contemplation to action
Health Condition	Prior health condition the storyteller is suffering from
TAILORING VARIABLES	
Race/culture	Race and Culture of the storyteller
Gender	Male Female
Age	Age of the storyteller
Education level	Education level of the storyteller
Geography	Country
Profession	Enumeration of professions.
Cues to Action	Motivational events to proceed from precontemplation/ contemplation to action
Celebrity Status	Yes No
Stigmatized group	Groups stigmatized by the society like gays, lesbians etc.
Failed Actions	All the actions which failed to produce result
Successful Actions	All the actions which successfully produced results
QUALITY METRICS	
Coherence of the story	coh-metrix score
Emotions	Emotions conveyed in the story

Table 1.3: Indexing variables used to match the story to the users

1.2 Transtheoretical Model of Health Behavior Change

Indices mentioned above are based upon Transtheoretical model of Health behavior change. Selection of a relevant story for narration needs validation by a theory of the health behavior change. Transtheoretical Model(TTM) of Health Behavior change has been shown to be successful in weight loss interventions(Tuah N.A et.al, 2011; Prochaska, J. O., W. F. Velicer, et al., 1994; Rossi. S.R, et.al 1994). In this thesis I leverage the constructs of TTM. The TTM

views change in health behavior as a continuum from a stage of undesired health behavior to a stage where there is no relapse. Each of these stages is called as a Stage of change. The person progresses through these stages by involving in activities defined as processes of change. The Stages of change mentioned in the TTM are Precontemplation, Contemplation, Preparation, Action and Maintenance.

Precontemplation as the name suggests, is a stage which comes prior to the contemplation of a health behavior change. In this stage people are not intending to take action in the foreseeable future(usually measured as the next six months). People may be in this stage because they are uninformed or under-informed about the consequences of their behavior. It is also possible that they may have tried to change a number of times and become demoralized about their ability to change. (Velicer, W. F, Prochaska, J. O., Fava, J. L., Norman, G. J., & Redding, C. A. ,1998)

Contemplation is the stage in which people are intending to change their health behavior (usually in the next six months). In this stage people balance between the costs and benefits of changing and this can produce profound ambivalence that can keep people stuck in this stage for long periods of time. (Velicer, W. F, Prochaska, J. O., Fava, J. L., Norman, G. J., & Redding, C. A. ,1998)

Preparation is the stage in which people are intending to take action in the immediate future (usually measured as the next month). They have typically taken some significant action in the past year. These individuals have a plan of action, such as joining a health education class, consulting a counselor, talking to their physician, buying a self-help book or relying on a self-change approach. (Velicer, W. F, Prochaska, J. O., Fava, J. L., Norman, G. J., & Redding, C. A. ,1998)

Action is the stage in which people have made specific overt modifications in their lifestyles (usually within the past six months). Since action is observable, behavior change often has been equated with action. But in the TTM, Action is only one of five stages. Not all modifications of behavior count as action in this model. People must attain a criterion that scientists and professionals agree is sufficient to reduce risks for disease. In the area of diet, there is some consensus that less than 30% of calories should be consumed from fat. The Action stage is

also the stage where vigilance against relapse is critical. (Velicer, W. F, Prochaska, J. O., Fava, J. L., Norman, G. J., & Redding, C. A. ,1998)

Maintenance is the stage in which people are working to prevent relapse but they do not apply change processes as frequently as do people in action. They are less tempted to relapse and increasingly more confident that they can continue their change. It is important to note that the individuals sometimes revert to an earlier stage of change resulting in regression. (Velicer, W. F, Prochaska, J. O., Fava, J. L., Norman, G. J., & Redding, C. A. ,1998)

Another important construct that TTM provides is called Processes of change. Processes of Change are the covert and overt activities that people use to progress through the stages. Processes of change provide important guides for intervention programs, since the processes are the independent variables that people need to apply, or be engaged in, to move from stage to stage. Ten to twelve processes have been consistently replicated across time, problem behaviors, sex, age, geographical region, and response formats (Prochasks & DiClemente, 1985; Prochaska, Velicer, DiClemente, & Fava, 1988; Rossi, 1992; Rossi & Bellis, 1993). For weight control, 12 processes of change have been identified: consciousness raising, counterconditioning, dramatic relief, environmental reevaluation, helping relationships, interpersonal systems control, reinforcement management (sometimes termed contingency management), self liberation, self reevaluation, social liberation, stimulus control, and substance use (sometimes called medication).

Processes of change	Description
1. Consciousness Raising	attempt to seek out information concerning their problem behavior
2. Dramatic Relief	increased emotional experiences followed by reduced affect if appropriate action can be taken
3. Substance Use	Use of Medication
4. Social Liberation	increase in social opportunities
5. Self Reevaluation	cognitive and affective assessments of one's self-image
6. Stimulus Control	removes cues for unhealthy habits and adds prompts for healthier alternatives

7. Helping Relationship	combine caring, trust, openness and acceptance as well as support for the healthy behavior change
8. Counter Conditioning	learning of healthier behaviors that can substitute for problem behaviors
9. Reinforcement Management	consequences for taking steps in a particular direction
10. Self Liberation	belief that one can change and the commitment and recommitment to act on that belief
11. Environmental Reevaluation	affective and cognitive assessments of how the presence or absence of a personal habit affects one's social environment
12. Interpersonal Systems Control	avoiding other people who encourage unfavorable health behavior.

Table 1.4: Processes of change (Velicer, W. F, Prochaska, J. O., Fava, J. L., Norman, G. J., & Redding, C. A. ,1998)

The processes of change and the stage of change are integrally related. Transitions between stages are mediated by the use of distinct subsets of change processes (DiClemente et al., 1991; Prochaska & DiClemente, 1983; Prochaska, DiClemente, Velicer, Ginpil, & Norcross, 1985; Prochaska, Velicer et al., 1991). Consideration of the processes of change and their relationship to the stages of change is thus important from the standpoint of providing guidance for the development of successful intervention programs applicable not only for individuals who are ready to change a problem behavior but for the vast majority of people who are neither prepared nor motivated to change. Figure 1.5 shows this relation between the stages and processes of change. TTM include Self-efficacy and Decisional balance as the key determinants.(Criteria measurement model, Velicer.W.F, et.al, 1996)

In this work I aim at identifying the processes of changes mentioned in the stories gathered. These stories are from people who have successfully changed their health behavior over time. The processes of change adopted by these people are identified automatically using Machine Learning algorithms. Machine Learning algorithms have proven to be very effective in classification of various forms of unstructured text such as blogs, emails, stories etc. into predefined categories.

Hence, Machine Learning algorithms are used to classify the stories into the Processes of change mentioned in the stories gathered. This approach is dealt in detail in Chapter 3.

```
Stage of
Change    Precontemplation Contemplation  Preparation         Action          Maintanence

Processes
of change  ← --- Consciousness Raising --- →
           ← Environmental Reevaluation→
           ← ------- Dramatic Relief ------ →
                              ← -----------Helping Relationships ----------- →
                              ← ----------- Social Liberation -------------- →
                                        ←  Self Liberation  →
                                        ← Self-Reevaluation →
                                        ← Stimulus Control →
                                        ←  Substance Use  →
                                          ← -----Counterconditioning ----- →
                                        ← Reinforcement Management →
```
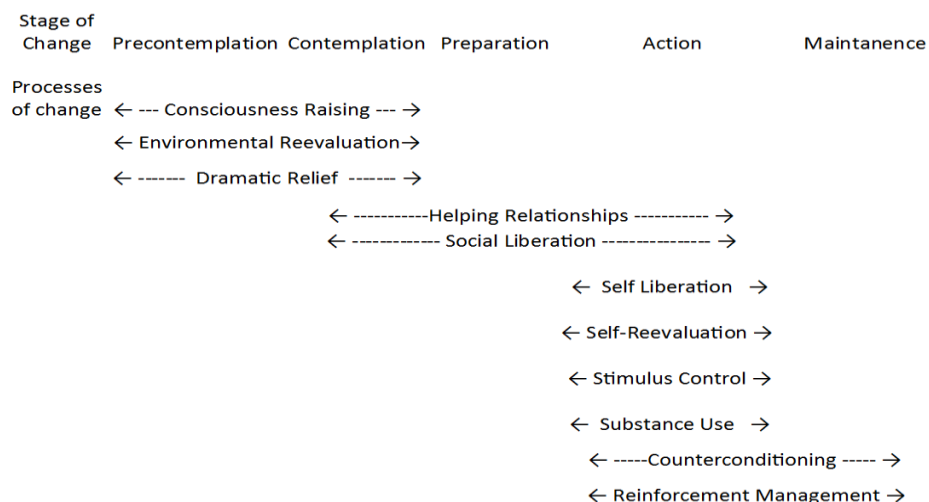
Figure 1.5: Relation between stages and processes of change for weight loss(prochaska et. al, 1992)

1.3 Corpus

I developed a corpus of health behavior change stories for my research. The stories are collected from the websites mentioned above and are described here. The type of stories used in this work are short weight loss health stories, typically less than 1000 words. The stories are about people talking about successful modification to their health behavior. The successful modification of health behavior is progress through a stage of change. Typically precontemplation or contemplation to preparation through action or maintenance. Occasionally stories also speak about relapse and avoidance of relapse.

An example story from the corpus is shown below.

" My name is XXXX and I am 32 years old. Worst moment was seeing my son, pick up my bad eating habits. As a 1-year-old,he was having fries at McDonald's because that's what he saw me putting in my mouth. I read an article in my husband's health magazine about BMI

and life expectancy it said that being obese can shorten your life by five to 10 years. That was scary. I didn't want to miss out on any moments with my son just because of poor eating patterns. After that, every time I was tempted to have a fry ,I'd think, I could be here a little bit longer if I just eat better. My Biggest payoff: In February 2005,I was on the cover of Good Housekeeping for a Half Her Size! story. And my husband constantly brags that I look better after 15 years of marriage than on my wedding day. I eat 100-calorie Hostess cakes for a one-point snack. Pizzafree.com makes pizzas that are only four points. Weigh yourself twice a day every morning and night. It's the best way to stay on track. Exercise,even if it's only for 10 minutes. Anything is better than nothing. I also lift weights to boost my metabolism. "

The is a typical story obtained from one such website called experienceproject.com. In story shown above the author speaks about her motivation to lose weight. She is disappointed with her actions as it was having a bad influence on people around(her 1-year old son). To add to that she reads an article that increases her consciousness about the behavior (unhealthy eating) she wants to change. Here she clearly mentions that every time she was tempted to indulge in the behavior she wants to change, she recollects information she had gathered earlier by reading the magazine. This is an example of a person engaging in the 'Consciousness Raising' process of change. She increases her consciousness about her unfavorable health behavior by engaging in an activity that involves gaining information from articles. The author in the story engages in an activity that involves increasing awareness about a particular problem behavior. The gender of the storyteller is yet another index that could be identified from the story. We will look at the examples in detail in chapter 3 and see ways to index the stories.

Hence, Indices extracted for the story would be

Processes of Change   : {ConsciousnessRaising, CounterConditioning}
Gender   : Female
Age   : 32 Years
....
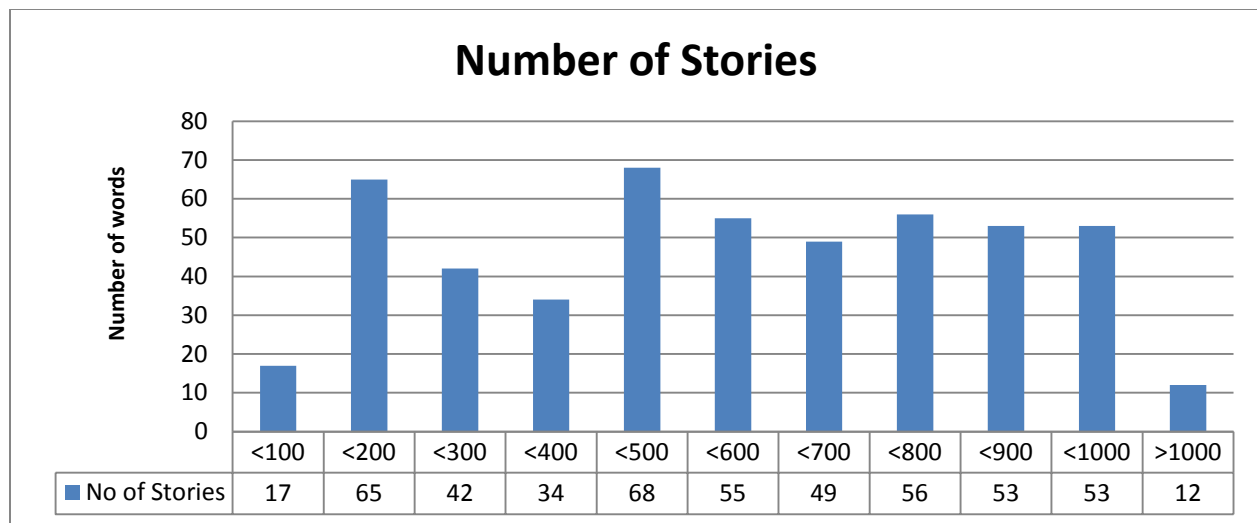
Figure 1.6 : Number of stories and word counts in the stories in the corpus

1.4 Summary

In the rest of the thesis is organized a follows.

- In the Chapter 2, I speak about the related works. The related work section includes previous work in the field of health behavior changes and indexing. I summarize some of the important works in these domains including Transtheoretical Model, Tailoring theory and other works on indexing and health behavior change.
- In Chapter 3, I speak about Indexing stories automatically using Machine Learning and other algorithms. I also speak briefly about how the training data was obtained when required.
- Chapter 4, deals with evaluative study. In this chapter I describe the protocol followed to conduct a 2 X 2 full factorial design experiment.
- In chapter 5 I discuss the results obtained from the experiment conducted and which lay out a path for the future work which I discuss in the final chapter.

Chapter 2: Related Work

This chapter speaks about the related works such as theories on Health Behavior Changes ,Transtheoretical Model of Health Behavior change and Tailoring theory. Some related works done in the field of using Embodied conversational agents for Health Interventions. I also speak briefly about Amazon Mechanical Turk which was used for participant recruitment.

2.1 Transtheoretical Model of Health Behavior Change

The Transtheoretical model of health behavior change or the TTM views change in health behavior as a continuum from a stage of undesired health behavior to a stage where there is no relapse. The person progresses through these stages by involving in activities defined as processes of change. In the previous chapter we briefly looked at distinction between stages of change and processes of change. The tables below summarize the stages of change of TTM.

Stage of Change	Description
Precontemplation	is the stage in which people are not intending to take action in the foreseeable future , usually measured as the next six months.
Contemplation	is the stage in which people are intending to change in the next six months.
Preparation	is the stage in which people are intending to take action in the immediate future, usually measured as the next month.
Action	is the stage in which people have made specific overt modifications in their life-styles within the past six months.
Maintenance	is the stage in which people are working to prevent relapse.

Table 2.1 Processes of change of Transtheoretical Model of Health Behavior Change

In the previous chapter we briefly saw the 12 processes of change which people use to progress through the stages of change. Processes of Change are the covert and overt activities that people use to progress through the stages. The processes are the independent variables that people need to apply, or be engaged in, to move from stage to stage. 10-12 processes (Prochaska & DiClemente, 1983; Prochaska, Velicer, DiClemente, & Fava, 1988) have received the most empirical support. They are classified as Experiential Processes and are used primarily for the early stage transitions. The Behavioral Processes and are used primarily for later stage

transitions. In this section we look at the processes of change in TTM. The table below shows the processes of change and their description.

Experiential	Consciousness Raising	involves increased awareness about the causes, consequences and cures for a particular problem behavior. Interventions that can increase awareness include feedback, education, confrontation, interpretation, bibliotherapy and media campaigns.
	Dramatic Relief	initially produces increased emotional experiences followed by reduced affect if appropriate action can be taken. Psychodrama, role playing, grieving, personal testimonies and media campaigns are examples of techniques that can move people emotionally.
	Environmental Reevaluation	combines both affective and cognitive assessments of how the presence or absence of a personal habit affects one's social environment such as the effect of smoking on others. It can also include the awareness that one can serve as a positive or negative role model for others. Empathy training, documentaries, and family interventions can lead to such re-assessments.
	Social Liberation	requires an increase in social opportunities or alternatives especially for people who are relatively deprived or oppressed. Advocacy, empowerment procedures, and appropriate policies can produce increased opportunities for minority health promotion, gay health promotion, and health promotion for impoverished people. These same procedures can also be used to help all people change such as smoke-free zones, salad bars in school lunches, and easy access to condoms and other contraceptives.
	Self Reevaluation	combines both cognitive and affective assessments of one's self-image with and without a particular unhealthy habit, such as one's image as a couch potato or an active person. Value clarification, healthy role models, and imagery are techniques that can move people evaluatively.
Behavioral	Stimulus Control	removes cues for unhealthy habits and adds prompts for healthier alternatives. Avoidance, environmental re-engineering, and self-help groups can provide stimuli that support change and reduce risks for relapse. Planning parking lots with a two-minute walk to the office and putting art displays in stairwells are examples of reengineering that can encourage more exercise.
	Reinforcement Management	provides consequences for taking steps in a particular direction. While reinforcement management can include the use of punishments, we found that self-

		changers rely on rewards much more than punishments. So reinforcements are emphasized, since a philosophy of the stage model is to work in harmony with how people change naturally. Contingency contracts, overt and covert reinforcements, positive self-statements and group recognition are procedures for increasing reinforcement and the probability that healthier responses will be repeated.
	Self Liberation	is both the belief that one can change and the commitment and recommitment to act on that belief. New Year's resolutions, public testimonies, and multiple rather than single choices can enhance self-liberation or what the public calls willpower. Motivation research indicates that people with two choices have greater commitment than people with one choice; those with three choices have even greater commitment; four choices does not further enhance will power. So with smokers, for example, three excellent action choices they can be given are cold turkey, nicotine fading and nicotine replacement
	Interpersonal Systems Control	Interpersonal systems control involves avoiding other people who encourage unfavorable health behavior.
	Counter Conditioning	requires the learning of healthier behaviors that can substitute for problem behaviors. Relaxation can counter stress; assertion can counter peer pressure; nicotine replacement can substitute for cigarettes, and fat free foods can be safer substitutes.
	Helping Relationship	combine caring, trust, openness and acceptance as well as support for the healthy behavior change. Rapport building, a therapeutic alliance, counselor calls and buddy systems can be sources of social support.
	Substance Use	Use of Medication to progress through the stages.

Table 2.2: Processes of change and explanation(Velicer, W. F, Prochaska, J. O., Fava, J. L., Norman, G. J., & Redding, C. A. ,1998)

Another important construct of TTM is the decisional balance. The Decisional Balance scale involves weighting the importance of the Pros and Cons. The Decisional Balance construct reflects the individual's relative weighing of the pros and cons of changing. The roots of the decisional balance can be traced back to Janis and Mann's model of decision making. The Janis and Mann's model of decision making (Janis and Mann, 1985) included four categories of pros (instrumental gains for self and others and approval for self and others). The four categories of cons were instrumental costs to self and others and disapproval from self and others. However, an empirical test of the model resulted in a much simpler structure. Only two factors, the Pros and Cons, were found in a long series

of studies (Prochaska, et al. 1994; Velicer, DiClemente, Prochaska, & Brandenberg, 1985). Figure 3 illustrates this pattern of pros and cons for exercise. The patterns are similar across the first three stages. However, for the last two stages, the Pros of exercising remain high. This probably reflects the fact that maintaining a program of regular exercise requires a continual series of decisions. These two scales capture some of the cognitive changes that are required for progress in the early stages of change. *(Velicer, W. F, Prochaska, J. O., Fava, J. L., Norman, G. J., & Redding, C. A. ,1998)*
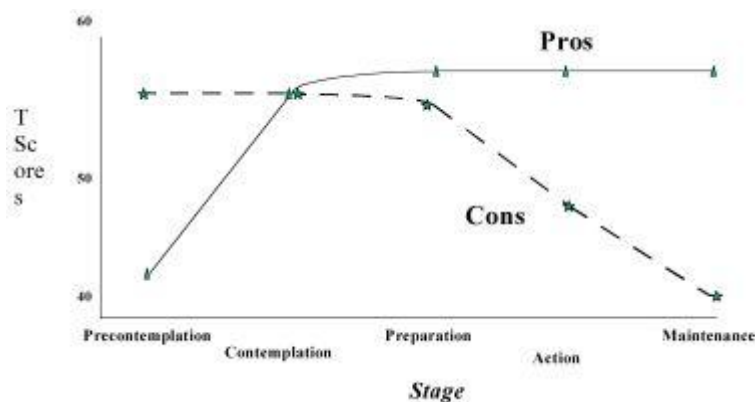
Figure 2.3. The Relationship between Stage and the Decisional Balance for exercise . (Velicer.W , et.al ,1998)

As individuals progress through the Stages of Change, decisional balance shifts in critical ways. When an individual is in the Precontemplation stage, the pros in favor of behavioral change are outweighed by the relative cons for change and in favor of maintaining the existing behavior. In the Precontemplation stage, the pros and cons tend to carry equal weight, leaving the individual ambivalent toward change. If the decisional balance is tipped however, such that the pros in favor of changing outweigh the cons for maintaining the unhealthy behavior, many individuals move to the Preparation or even Action stage. As individuals enter the Maintenance stage, the pros in favor of maintaining the behavioral change should outweigh the cons of maintaining the change in order to decrease the risk of relapse.(Habits Lab) Self-efficacy/Temptations: The Self-efficacy construct represents the situation specific confidence that people have that they can cope with high-risk situations without relapsing to their unhealthy or high-risk habit.

2.2 Tailoring Theory

Another important theory that will be discussed is the Tailoring theory. A common thread that runs through all of this research has to do with effective health communication. Noar et. al explain three different ways of delivering health communication messages. These four ways are Generic, Personalized, Targeted and Tailored ways of communication. The table below explains three different ways of delivering health communication messages.

Type of Communication	Explanation
Generic	communication that is not individualized or based on any kind of individual assessment (such as Brochures with health messages informing about danger of obesity)
Personalized	virtually the same as generic communication, except that it uses a characteristic, such as one's name, to personalize the message (Mails with health information)
Targeted	messages that are developed with a certain segment of the population in mind, and the practice of message targeting is one that has been widely applied in the health education and health communication literature.
Tailored	creating communications in which information about a given individual is used to determine what specific content he or she will receive, the contexts or frames surrounding the content, by whom it will be presented and even through which channels it will be delivered [1, 2]. Overall, tailoring aims to enhance the relevance of the in- formation presented [3] and thus to produce greater desired changes in response to the communications.

Table 2.4 : Different ways of delivering health communication message (Noar et.al, 2007; Hawkins, Kreuter et.al, 2008)

From the table above it can be seen that the tailored communication is uniquely individualized to each person. In addition, although interpersonal communication is the most individualized form of communication and is used in a variety of health education interventions, the potential ability to reach large audiences through computer-based tailoring of messages gives this approach major promise(Noar et.al, 2007). Tailored health message interventions have the potential to be both efficacious and through the use of computer based tailoring

they have potential of reaching a lot of individuals (Abrams, Mills, & Bulger, 1999; Prochaska, Velicer, Fava, Rossi, & Tsoh, 2001). Thus, the ultimate impact of such interventions could be quite large.(Noar et.al , 2007).

Hawkins, Kreuter et.al explain three steps of achieving tailored health message communications, Personalization, Feedback and Content matching. Personalization could be achieved by Identification, contextualization and raising expectation of customization. Identification includes addressing the message using names. Addressing by the names is said to increase the attention paid to the information. However, this remains largely untested. Messages contextualized within a person's subjective reality may be perceived as personally relevant and the tailoring agent as more familiar and credible. Contextualization has taken many forms in tailored health communication programs, from fairly superficial strategies to consideration of complex contextual variables like culture, demographics, age, family structure, residential status, personal interests etc. Raising expectation of customization involves making overt claims of customization. Feedback involves presenting individuals with information about themselves, obtained during assessment or elsewhere. Content matching, often thought of as the essence of tailoring, attempts to direct messages to individuals status on key theoretical determinants (knowledge, outcome expectations, normative beliefs, efficacy and/or skills) of the behavior of interest.(Hawkins, Kreuter et.al, 2008).

In our current work we aim to achieve tailoring by personalizing information using Personalization and Content matching. We achieve personalization by matching the users against the variables mentioned to achieve contextualization (age, gender, culture, demographics). By matching the processes of change of the stories and the stage of change of TTM of the individual we aim to achieve content matching mentioned above.

2.3 Storytelling in Health Interventions

Storytelling is an emerging form of persuasive communication used in health interventions and education. Narrative communication, informally known as storytelling, is based on recollections of actual events told by the person who experienced them and may be specifically valuable for overcoming resistance to health messages by engaging the viewer and reducing counter arguing (Kreuter et

al., 2007). Viewers develop a parasocial relationship, "a sense of friendship, attraction, and involvement with the person or character" (Kreuter et al., 2007, p. 226). By engaging in the experiences of the storyteller, those exposed to the intervention are ''transported'' into the narrative. Transportation can be a mediating factor between exposure to the intervention and acceptance of health beliefs in the story message (Green, 2004; Green & Brock, 2000). Storytelling that maximizes transportation and creates a sense of homophily, relatedness between the storyteller and recipient, is most effective and persuasive to the viewer. Similarly, realism, or whether the story is perceived to be authentic and similar to the real world, is an important factor that increases the likelihood a particular story is engaging or transporting to the viewer (Busselle & Bilandzic, 2008). Using real, unscripted, personal narratives from members of the same community as the intended recipients could enhance the likelihood that transportation, homophily, and realism are achieved. (Taylor , Houston et.al , 2012).

There have been many works that have looked at interventions using stories. The works by Houston et al are particularly interesting. Houston et. al have looked at using stories for health interventions for Smoking Cessation and Hypertension control. These studies involved using the experiences of the people who have successfully modified their health behavior as narratives. These narratives were collected through open-ended interviews. The interviewers, using a prepared, open-ended interview guide with optional prompts based on focus group content and the Health Belief Model , encouraged the patients to tell their stories. About 80 hours of interview videos were amassed. Each interview was broken into discrete story units of 1 to 3 minutes each that focused on a single message. Two research assistants rated each story unit for strength and clarity of behavior-change content on the basis of the Health Belief Model. These stories were later converted into documentary style videos through professionals. Once, the stories were collected as documentaries, they were put into a DVD and were sent out to the patients for interventions. The control group received videos on general health message, while the intervention group received patient stories. The users could watch the video from their home, after the first session at the Hospital. More videos were mailed to the patients at a gap of 3months and 6 months. They found that the intervention group which received the videos from the patients had controlled Hypertension. Intervention produced greater changes than many

behavioral interventions and performed similarly to non-pharmaceutical and pharmaceutical interventions. Another similar study by Houston et.al included using the storytelling for Smoking cessation which shows that storytelling has the potential to cause health behavior changes.

In yet another study by Kretuer et.al who looked at analyzing the emotional responses in African/American women while watching Narrative vs Informational videos. They found that the women who watched the narrative video were more likely to experience their strongest emotions during parts of the video that presented contextual information about characters rather than during key health messages about breast cancer. Previous research by them has also shown that health information framed in the context of cultural values like these can help increase cancer prevention and screening behaviors.
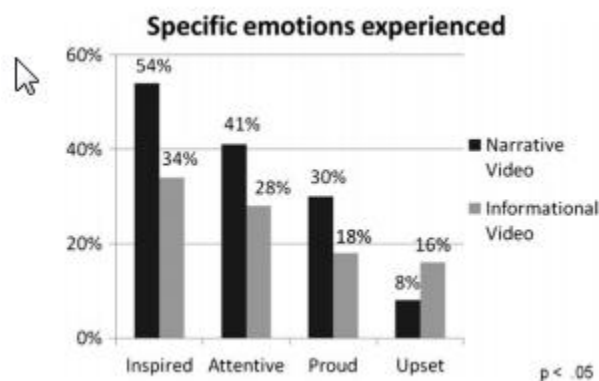
Figure 2.4: Shows the importance of narrative content evoking more emotions.

2.4 Embodied Conversational Agents

Bickmore et.al have worked on automated health behavior change interventions, using animated conversational agents to simulate counseling sessions with a health provider. They have explored the use of storytelling in several of these agent-based health interventions. Because storytelling can serve multiple conversational functions including informing, motivating, and engaging as well as relational functions, such as establishing trust and rapport among interlocutors, there are many roles stories can play in dialogue-based health interventions.

2.4.1 Storytelling to Increase Engagement and Retention

One of the most basic functions of conversational storytelling is to engage and entertain listeners, by relating interesting or humorous events. Bickmore et.al have

used such stories in engaging users in order to increase adherence to health intervention protocols and retention in longitudinal health behavior change interventions.

In the "RAISE" project (Relational Agent Intervention for Sun and Exercise) a conversational agent delivered a year-long, daily contact intervention for exercise promotion and ultraviolet (sunlight) avoidance, in order to reduce cancer risk. The agents in this intervention use unique daily stories including humorous anecdotes, serial story segments, and stories containing health trivia doled out in a pre-specified sequence, in addition to other relational behavior, to maintain user adherence and retention over the year. A randomized trial compared a state-of-the-art web-based behavior change intervention with the same website augmented with this agent. A national sample of 914 participants were randomized to the two conditions, with those in the agent group completing significantly more interactions per week over the year (0.142 vs. 0.048) (Velicer, Bickmore et.al, 2009).

Conversational storytelling by an agent has also been used as a mechanism to provide companionship and social support to users. The goal of the Hospital Buddy project was to develop a hospital bedside companion agent to provide information and support to patients throughout their hospital stay. The Hospital Buddy is an animated conversational agent to which the patient responds using a touch screen attached to a flexible articulated arm at the bedside. The agent chats with patients about their hospital experience providing empathetic feedback and emotional support in addition to discussing a range of medical topics. The agent can also tell the patient stories to provide emotional support and companionship. A preliminary pilot study to gauge acceptance and use of the system by three hospital patients were conducted. They(patients) were left in their rooms for 24 hours each. All patients used the storytelling function (in addition to the other functions), scored the agent highly on a standardized measure of therapeutic alliance, and indicated that the agent was effective at providing companionship during their hospital stay ("The best thing about the system, like, you know, when you don't have anyone here with you…it was actually nice to have her. I mean it kept me company.") (Bickmore, Bhukari et.al, 2012).

Another study to determine if the type of conversational stories used by agent first vs. third person biographical had an impact on user engagement. The evaluation of the use of autobiographical stories told by a conversational exercise promotion agent were carried out. The agent acted as if it were a person, for example, talking about its childhood. In this system, conversational stories were dynamically generated from autobiographical story fragments transcribed from interviews with a human exercise trainer. In the study, half of the 26 participants were randomized to hear the stories told in first-person (as if the agent were talking about its own personal history) while the other half heard the same stories told in third-person (as if the agent were talking about the history of another user it had), in order to control for the content of the stories. We found that users reported significantly greater satisfaction when the stories were told in first person compared to third person. More importantly, users in the first person condition were observed to log in more frequently over the 37 days of the study, compared to those in the third person group(Bickmore, Schulamn & Yin, 2010)

2.4.2 Storytelling to Promote Health Behavior Change

Conversational storytelling has also been used as a mechanism to provide motivation and information to users attempting to change their health behavior, and systems in which these stories are elicited from other users as a means of bootstrapping the development of relevant and culturally tailored story content. In the Preconception Care system, an agent screens women on 120 health risks related to low infant birth weight and infant mortality, then counsels them on addressing these risks using techniques based on the Transtheoretical model of behavior change, motivational interviewing, shared decision making, and other techniques. In addition to scripted counseling dialogue, the agent elicits stories of successful change from users once they have reported addressing a health risk, and retells these stories to other users who are struggling with the same risks. An authoring system to let users write their stories and specify the nonverbal and prosodic behavior the agent would use in retelling their story, without having to program . Pilot studies of the system were promising. A first study involving 24 users indicated that it was effective at screening for risks: users reported an average of 23 preconception risks to the system. In a longitudinal follow up pilot with 6 women, participants agreed to work on 64% of their identified risks, and

successfully addressed 83% of the risks they agreed to work on(Gardiner, Hempstead et.al, 2012).

In the present work I aim to use the conversational agent developed by Bickmore et.al as a medium for storytelling. Comparison of story listening with conversational agent is carried out against the text based storytelling and the results are analyzed. Chapter 4 & 5 deal specifically with this topic.

2.5 Other related works

Early works on indexing stories was carried out by Domeshek. This work was based on works of Schank & Abelson. The main focus was on story understanding systems. Their work focused on understanding paragraphs and stories rather than sentences in isolation. They attempted to identify the similarities in the structure of the stories. Scripts, Plans, Goals and Understanding (SPGU) was an early work in cognitive science by Schank and Abelson. Their view of a story following a repetitive structure is called a script. The most detailed analysis of knowledge about persuasion within a cognitive framework has been developed by Schank and Abelson (1977) in the area of artificial intelligence. They identified a persuade package as being essential to understanding behavior of characters in stories. Although their theory is about the process of story understanding, the ideas and constructs embodied in it provide the basis of a general theory for understanding human actions. Within their framework, understanding actions is a two-part process of ascertaining (a) an individual's goal and (b) the particular method being used to achieve that goal. The persuasion schema is represented in the theory by a set of methods (termed plan boxes) and an associated set of goals. These goals all share the characteristic that individuals who hold them want to effect a change of state (hence the term delta goals). Similar works have been carried out in understanding news stories(Low, Tian & Zhang, 1996) and other unstructured text. However, in this current work we look at indexing the stories based on health behavior change theories rather than words and semantic based approach.

2.6 Mechanical Turks

The two empirical studies I conducted as part of this research—to collect training data for the machine-learning based story indexing (Chapter 3), and to conduct a summative evaluation of the indexing system (Chapter 4)—were conducted using Amazon's Mechanical Turk. Mechanical Turk is a crowdsourcing Internet

marketplace that enables employers to coordinate the use of employees ("Turkers") to perform small knowledge tasks, known as Human Intelligence Tasks (HITs) for micropayments (wikipedia).

People registered with Amazon for an account with the Turk can search for, review, and accept HITs to work on. Their completed HIT can be reviewed and either approved or rejected by the creator of the HIT. Beginning in 2010, numerous researchers have explored the viability of Mechanical Turk to recruit subjects of social-science experiments. In general, researchers found that while the sample of respondents obtained through Mechanical Turk does not perfectly match characteristics of the U.S. population, it doesn't present a wildly inaccurate view either(Paolacci & Gabriele, 2010). They determined that the service works best for random population sampling; it is less successful with studies that require more precisely defined populations. Overall, the US Mechanical Turk population mostly female and white, and is somewhat younger and more educated than the US population overall. Amazon publicly announced that there are over 500,000 registered workers from over 190 countries worldwide and precise demographics information are not available. There have been multiple clinical and psychological studies over the Mechanical Turk and have shown that the data gathered over the Mechanical Turk is reliable and is representative of the American Internet Users (Shapiro et.al, 2012;Paolacci 2010).

2.7 Summary

In this chapter we looked at the theories on which the indexes are based on. The main theories on which the indexes are based on are TTM and Tailoring theory. We also briefly looked at the related works on using storytelling using conversational agent for health intervention. Agent based storytelling has been successfully used in various studies. However, all these works have used random or pre-scripted stories. In subsequent chapter we will look at the methods of extracting theses indexes and ways of matching the stories to the users and delivering a tailored story based intervention.

Chapter 3: Indexing Health Stories

This chapter develops and evaluates indices needed for relevant storytelling. This chapter begins with discussion of algorithms needed for indexing the Transtheoretical Model of change and Tailoring theory constructs. Later sections evaluate these indices constructed.

3.1 Processes of Change

The processes of change identification is the first index I will focus on. The Processes of Change of TTM are covert and overt activities that people use to progress through the stages of behavior change. The processes of change for weight loss used are shown below in Table 3.1.

Processes of change	Description
1. Consciousness Raising	seek out information concerning their problem behavior
2. Dramatic Relief	increased emotional experiences followed by reduced affect if appropriate action can be taken
3. Substance Use	Use of Medication
4. Social Liberation	increase in social opportunities
5. Self Reevaluation	cognitive and affective assessments of one's self-image
6. Stimulus Control	removes cues for unhealthy habits and adds prompts for healthier alternatives
7. Helping Relationship	combine caring, trust, openness and acceptance as well as support for the healthy behavior change
8. Counter Conditioning	learning of healthier behaviors that can substitute for problem behaviors
9. Reinforcement Management	consequences for taking steps in a particular direction
10. Self Liberation	belief that one can change and the commitment and recommitment to act on that belief
11. Environmental Reevaluation	affective and cognitive assessments of how the presence or absence of a personal habit affects one's social environment

12. Interpersonal Systems Control	avoiding other people who encourage unfavorable health behavior.

Table 3.1: Processes of change

Let's take a look at a few example stories and identify the processes of change in these stories. Here is an excerpt from a story of a person who has lost weight successfully. She is speaking about her motivation to lose weight.

> *".... Worst moment was seeing my son, pick up my bad eating habits. As a 1-year-old,he was having fries at McDonald's because that's what he saw me putting in my mouth. I read an article in my husband's health magazine about BMI and life expectancy it said that being obese can shorten your life by five to 10 years. That was scary. I didn't want to miss out on any moments with my son just because of poor eating patterns. After that, every time I was tempted to have a fry ,I'd think, I could be here a little bit longer if I just eat better......"*

Figure 3.2: Excerpt from the Health Behavior Story 1

In story shown above(Figure 3.2) the author speaks about her motivation to lose weight. She reads an article that increases her consciousness about the unfavorable behavior (unhealthy eating) . She mentions that every time she was tempted to indulge in the unfavorable behavior, she recollects information she had gathered earlier by reading the magazine. She increases her consciousness about her unfavorable health behavior by engaging in an activity that involves gaining information from external sources such as articles. This is an example of a person engaging in the 'Consciousness Raising' process of change. The author in the story engages in an activity that involves increasing awareness about a particular problem behavior. The challenge is to identify this meta-information from the stories.

Let's take a look at another example:

> *"... When you're doing shift work and having lunch at nine in the morning it doesn't give you many options, he says. The only places open are fast food chains and kebab shops. The irregular hours also*

encouraged his soft drink habit.........Do it yourself. You can eat the food you like but just make it yourself instead, he says. <u>Instead of buying a kebab, cook some chicken and put it in a wrap with lettuce and chilli sauce</u>..."

Figure 3.3: Excerpt from the Health Behavior Story 2

In this excerpt (Figure 3.3) the author speaks about the activities he engages in for health behavior change. He substitutes his unfavorable health behavior of eating fast food with a more favorable alternative which helped him achieve the goal of weight loss. Such activities which involve substituting the old undesired behavior with an alternative is 'Counter conditioning'.

In the above examples we saw examples of processes of change that could be identified from the stories. The author of the first story(Figure 3.2) uses keywords such as 'read', 'article', 'magazine', 'BMI', 'obese' and 'shorten life' which hinted that the person engaged in an activity involving reading an article about health. The second story author uses a template like 'instead of <unfavorable activity> <favorable activity>'. Looking for these 'unfavorable activities', 'favorable activities' and 'substitution' like phrases in the stories may help identify this process of change. It is possible to extract standard set of information, called Features or Attributes from the stories and use these attributes to train the classification algorithms. I build a set of attributes and probabilistically calculate the possibility of a story involving a given process of change.

3.1.1 Text classification (Machine Learning) Introduction

In the paradigm of Machine Learning, text classification involves learning the characteristics of categories of interest from pre-classified documents, (Sebastiani, 2002). Sebastiani in his work defines text classification as follows:

Text categorization is the task of assigning a value to each pair (d_j, c_j), D X C where D is a domain of documents(Stories) and C = {c_1, ... , c_n} is a set of predefined categories(processes of change). A value of T assigned to (d_j, c_j) categories indicates a decision to file d_j under c_i. More formally, the task is to approximate the unknown target function $\Phi : D \ x \ C \ \to \{T, F\}$ (that describes how documents ought to be classified) by means of a function $\Phi' : D \ x \ C \ \to \{T, F\}$

called the classifier (aka rule, or hypothesis, or model) such that 'Φ
and Φ "coincide as much as possible".

Figure 3.4: Definition on Classification by Sebastiani(2002)

In the present work the set D referred will be the set of stories of successful health behavior change. The set C is the predefined set of categories that defines the document. These category values help the classifier learn about the documents and classify them. The function Φ refers to the documents that are pre classified, also called training data. The set Φ' refers to the function that the classifier builds using the training data. Figure 3.5 shows the process of classification. The figure above shows, the Story (D_n) input to a property extractor. The function of the property extractor is to extract the attributes needed for the classifier. These attributes extracted are put in the set C. The binary classifier takes this story and applies the classification function Φ, which it has already learnt from the pre classified stories. The output is the story tagged with Processes of change.

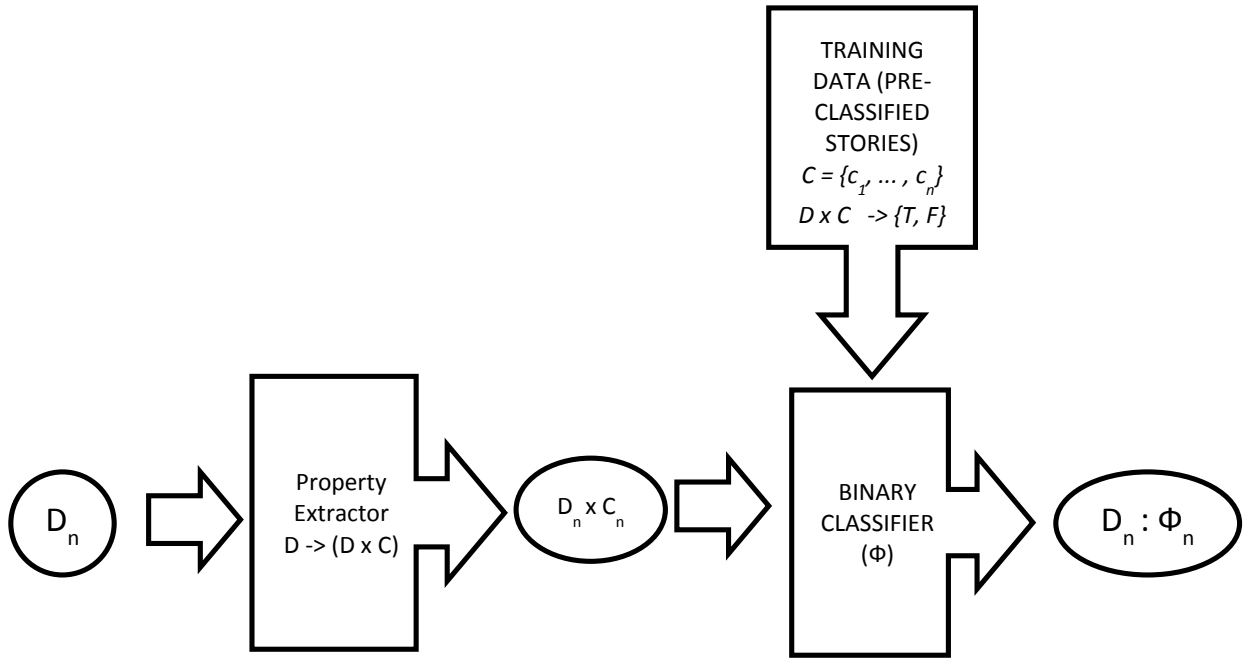*Figure 3.5: Block diagram of indexing(Binary Classifier), processes of change*

It is possible that a single story can have multiple processes of change. The above mentioned classifier can classify stories into two classes. We need a classifier which can identify all the processes of change mentioned in the story. A multi-class classifier C is able to extract the set of classes from a given Document. **&&**

30

Hence, we use a multi-class classifier which will be able to distinguish the set of processes of change in a given story.

A given a story can have multiple process of change associated with them. For example

> *"... Just as every other overweight person who is in denial, I never stepped on a scale unless it was required through something like a physical at the doctor's office. The day came that I realized that as much as I tried to fool myself, I could no longer consider my weight as normal. I stepped onto the balance board for Wii Fit, a game designed for people to lose weight, only to come to the conclusion that I was not allowed to play the game because I surpassed the 330lb limit that is designed by the software. Not being able to play a video game, now that is definitely NOT normal. This event triggered my journey towards weight loss. In April of 2011, I took the first steps in losing weight by finally addressing the major cause towards my weight, my diet. I began researching and looking and obsessing about how to lose weight, weight loss success stories, and the keys to losing weight. I began to change my diet and starting to seriously start looking at calories, nutrition, and activity. I started pushing myself towards taking things one step at a time with the simple goal of wanting to become "normal". At this point in time, I have lost close to 170lbs. I still have some more work to do but a lot of my focus has now shifted towards keeping my fitness up while trying to build muscle and tone up. I want to continue to challenge myself, continue to push myself in doing things I never dreamed of doing, leading me to make the decision to challenge myself through entering a half marathon.."*

Figure 3.6:Health Behavior change story with multiple processes of change

In the story above (Figure 3.6) the author feels she is an object of social discrimination due to her overweight problems. The author's weight is much above the weight allowed by the Wii Fit and as a consequence of which it triggers a behavior change. The author engages in favorable activities which include dieting and paying more attention to activities and self. Some of the processes

that the author engages in are 'Social Liberation', 'Self Reevaluation', 'Counter Conditioning' and even 'Dramatic Relief'. A typical health behavior change story generally begins with the author speaking about the unfavorable health behavior, the event triggering the health behavior change and the activities leading to a favorable health behavior. Most of the stories generally involve multiple processes of change such as the story in the Figure 3.6. The classifier for this purpose should be able to list all the processes of change in the story. The solution to identifying multiple processes of change is mentioned in figure 3.7. The Binary classifier is replaced with a multi-class classifier.

The Figure 3.7 shows the process of multi-class classification.
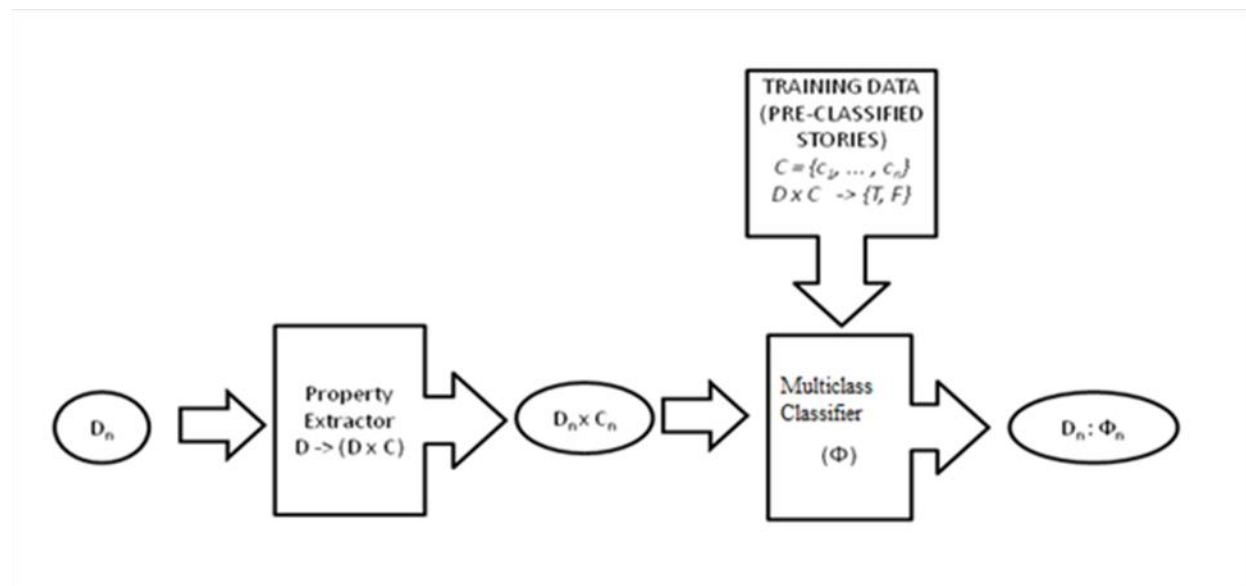
Figure 3.7: Block diagram of indexing(Multiclass Classifier), processes of change

3.1.2 Multi Class Classification using Binary classifiers

The classification of the 12 processes of change can be done using 12 independent Binary classifiers, and combining the results of each classifier in the end. These individual classifiers identify the process of change that they are trained to identify. This can be done due to the fact that the processes of change are mutually exclusive.

The problem of classifying n mutually independent classes $\{C_1, C_2, C_3, ... C_n\}$ is achieved using Binary classification $\{C_i, \sim C_i\}$ i.e if the classes are either C_i or not C_i. The figure 3.8 shows the process of achieving multi-class classification using simple binary classifiers Φ.

BINARY CLASSIFIERS
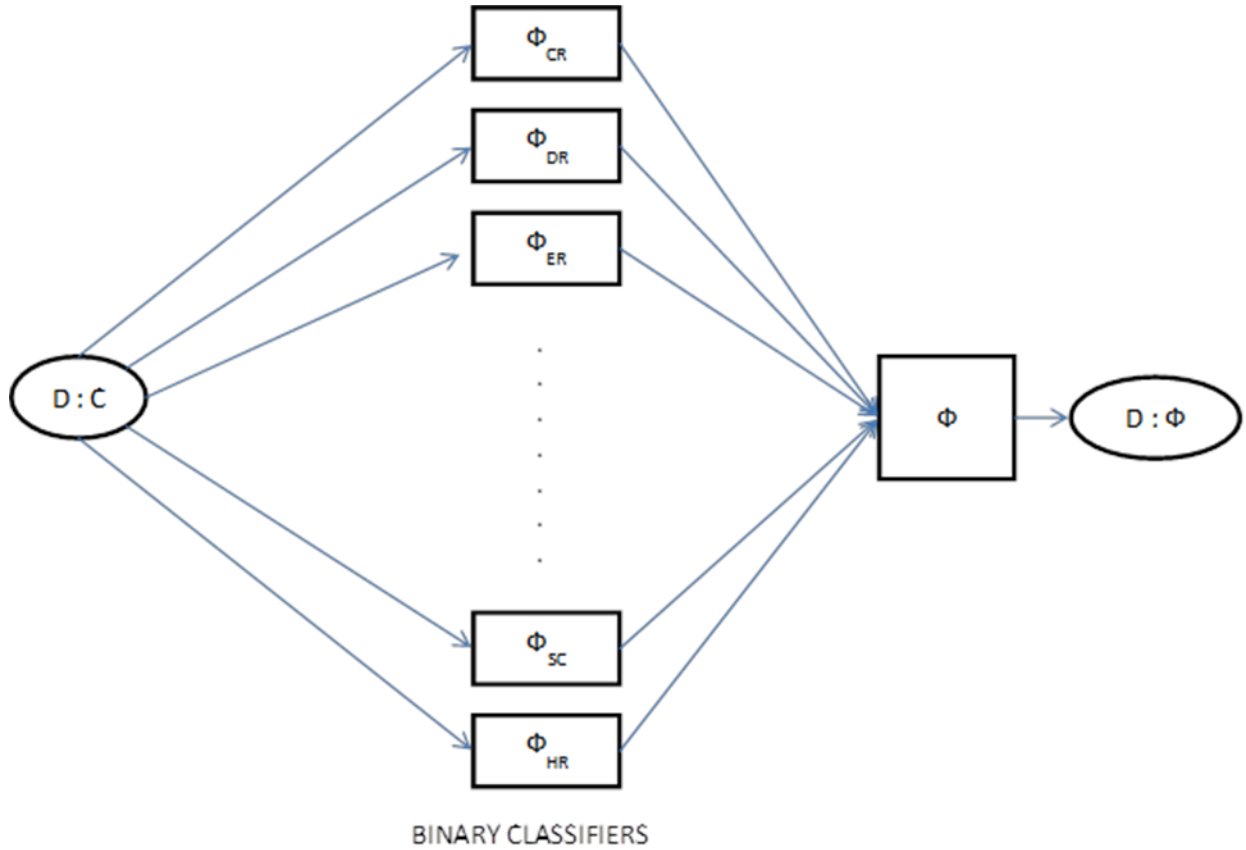
Figure 3.8: Multiclass classification using the binary classifiers

The Figure 3.8 shows the Binary classifiers which classify the given story as either a process of change Φ_k or not. The Unifier module does the union operation on the outputs of each binary classifier as shown in figure 3.9:

$$\Phi_{final} = \{\Phi` \cup \Phi n\} \ \forall \ n \in \{POCs\}$$

Figure 3.9: Multiclass classification output achieved by union operation

While there are different ways of achieving the same desired results, the above method was used in the present work to identify the processes of change from the documents. Another approach of achieving multi-class classification would be to rank the scores of each classifier, set a threshold and select the processes which score higher than the threshold. In the next section we will take a look at building the set of attributes needed for the classifiers.

3.1.3 Attributes (Class C)

The attributes defines the performance of the classifier. The attributes are a set of standard features that can be extracted automatically from the stories and those which are indicative of the output in some combination. The attributes for each of the classifiers are explained here. The key idea here is identification of the keywords occurring more frequently in the documents for a given Process of Change. The attributes that I extracted from the stories are enumerated below.

The attributes (Features)	Effect
*attr1_consciousness_raising_sources	Matches with sources by which the consciousness raising can be achieved (Blogs, newspapers, magazines etc.)
*attr2_consciousness_raising_methods	The methods by which the consciousness raising can be achieved (reasing, listening, working etc.)
*attr3_counter_conditioning_habits	The habits which are intended to conditioned (eating, laziness, sleeping etc.)
*attr4_counter_conditioning_methods	The methods by which the conditioning was achieved (running, swimming, gym etc.)
*attr5_dramatic_relief_sentiment_scores	The sentiment scores of the story.
*attr6_environmental_reevaluation_env_affected	The environments which are affected due to the behavior (family, forest, food supplies, etc.)
*attr7_environmental_reevaluation_env_relation	The ways by which the environment factors are affected (harmful, shortage, shares etc.)
*attr8_helping_relationships_relations	The relations by which the support can be

	obtained from (doctor, son, husband, nurse etc.)
*attr9_helping_relationships_helps	The ways by which the relations helped (help, support, shoulder to cry on, listened, advice etc.)
*attr10_inter_personal_systems_relation_changes	The ways by which the relations were changed to achieve the required health behavior (divorced, broke up, replaced etc.)
*attr11_reinforcement_managements_reinforcements	The ways by which a positive behavior was reinforced (gift, prize, honor etc.)
*attr12_self_liberations_liberations	The commitments or the ways liberation was achieved (commit, resolve, decide etc.)
*atr13_social_liberations_society_syn	The society synonyms (people, society, friends, thin people etc.)
*attr14_social_liberations_discriminations	Though the name of this attribute is discriminations, it is the ways by which the society aids behavior changes (not allowed, discriminated, no support, supportive etc.)
attr14_ stimulus_controls_stimuli_keys	The stimulus which needs to be controlled (food, bad habits, cakes, junk food etc.)
attr15_ stimulus_controls_control_keys	The ways by which the stimuli were controlled (replaced, stopped, instead of, replace with

	etc.)
*attr16_ substance_use_substances	The medicines/substances used to progress (Weight loss pills, surgery etc.)
attr_17_spatial_positioning_experiential_processes	The positions of the matching keyword in the story. If the experiential processes were present in the first half of the story
attr_18_spatial_positioning_behavioral_processes	The positions of the matching keyword in the story. If the behavioral processes were present in the second half of the story

Table 3.10: List of attributes used for classification

It is important to note that usage of too many attributes or too less attributes could potentially be harmful. As Jakulin in his work on interaction between the attributes for Naive Bayes Classifier shows that the loss increases with more attributes. The attributes with * prefix were used to train the classifier in the current work.

3.1.4 Classification Training Set

The section 3.7 explains in detail about the process of obtaining the necessary training set which is essential for any Machine Learning Algorithm. At this point let's assume that the training set is ready. The training set consists of columns of data attributes constructed using the descriptions shown above. Each of these attributes are constructed automatically using algorithms mentioned above. Once, the training set is constructed, the algorithms for binary classifications is applied. We use WEKA for classification of the text contents. 12 independent binary classifiers are constructed for each of the processes of change. These classifiers are later used to predict the process of change in the stories. The process explained here is shown as an algorithm below.

Step 1: Construct the training set consisting of attributes and the process of change in the story.

Step 2: Convert the Dataset above for Binary classifications.

Step 3: Train each binary classifier to classify each process of change

Step 4: For each new story construct the attributes and run the classifiers

Figure 3.11: Algorithm for Classification

The classification algorithms were run on the data and the results are tabulated as shown below. The training set consisted of 260 stories(explained in Section 3.7). 10-cross fold validation was performed to obtain the performance results of the classifiers. 10-cross fold validation includes splitting the training set into 10 groups. 9 of these groups were used to training and the remaining group was used to test.

As shown below for the classification for the Helping Relationship (HR) we can see below that the HR process of change from the story was identified with 63.08% accuracy. The area under the ROC which is indicative of the performance of the classification algorithm shows below that this area was also 0.6372. The figure below(Figure 3.12) also shows the summary of the classification results.

```
=== Summary ===

Correctly Classified Instances        164            63.0769 %
Incorrectly Classified Instances       96            36.9231 %
Kappa statistic                       0.2443
Mean absolute error                    0.4518
Root mean squared error               0.483
Relative absolute error               91.01   %
Root relative squared error           96.9383 %
Total Number of Instances             260

=== Detailed Accuracy By Class ===

            TP Rate  FP Rate  Precision  Recall  F-Measure  ROC Area  Class
            0.745    0.504    0.636      0.745   0.686      0.637     1
            0.496    0.255    0.621      0.496   0.551      0.637     0
Weighted Avg.  0.631  0.39    0.629      0.631   0.625      0.637

=== Confusion Matrix ===

  a    b   <-- classified as
```

```
105  36 |  a = 1
 60  59 |  b = 0
```

Figure 3.12: Classification of the Helping Relationship process of change

However, the performance of processes of change classification algorithms is not the final accuracy we desire. According to the TTM, the person to progress from precontemplation to the contemplation stage of change, he engages in one of the Consciousness Raising, Environmental Reevaluation or the Dramatic Relief. For each stage there are certain processes of change which are used to progress to the next stage. Hence, the final accuracy that we are aiming at is not the performance of each process of change, but rather the performance of classes of processes of change.

```
Stage of
Change   Precontemplation Contemplation  Preparation        Action        Maintanence

Processes
of change  ← --- Consciousness Raising --- →
           ← Environmental Reevaluation→
           ← ------- Dramatic Relief ------ →
                         ← -----------Helping Relationships ----------- →
                         ← ------------- Social Liberation -------------- →
                                           ← Self Liberation  →
                                          ← Self-Reevaluation →
                                          ← Stimulus Control →
                                          ← Substance Use  →
                                            ← -----Counterconditioning ----- →
                                          ← Reinforcement Management →
```
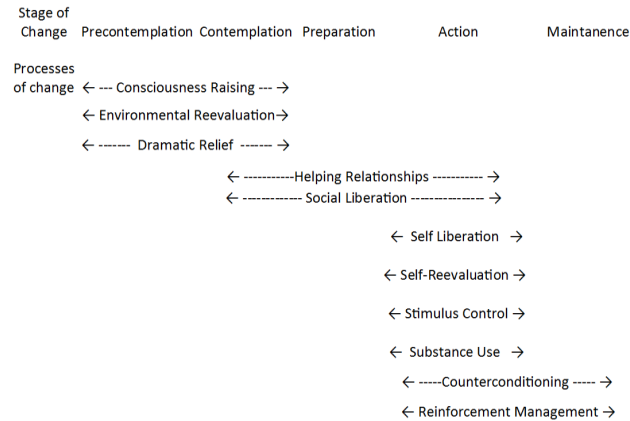
Figure 3.13: Relation between stages and processes of change

With these modifications, the 12 class classification problem becomes a 5 class classification problem, where the outcome to check is, if the story could be narrated to person in a given stage of change

ALGORITHM:

Step 1: Define the 5 classes. These classes define the stages of change to processes of change mapping.

class_1 = {Consciousness Raising, Environmental Reevaluation, Dramatic Relief} -> Precontemplation

class_2 = {Consciousness Raising, Environmental Reevaluation, Dramatic Relief, Helping Relationship, Social Liberation}-> contemplation

class_3 = {Helping Relationship, Social Liberation} -> Preparation

class_4 = {Helping Relationship, Social Liberation, Self Liberation, Self Reevaluation, Stimulus Control, Substance Use, Counter Conditioning, Reinforcement Management} -> Action

class_5 = { Counter Conditioning, Reinforcement Management}-> Maintenance

Step 2: Modify the training data to classify the story into the classes.

Step 3: Train each binary classifier to classify each class. (instead of processes of change)

Step 4: For each new story construct the attributes and run the classifiers and obtain the classes for the story.

Figure 3.14: Algorithm for multi class classification

When the classifiers are run with these modifications the accuracy of the algorithms increases. In the above case, for the Class 1 the accuracy is 87.7% as shown below. This means that the class 1 is classified at an accuracy of 87.7% on training set of 260 stories, for a 10 fold validations. Similarly classification for class 2 gives accuracy of 93.46%. The class 5 performed well but with a comparatively low value of ROC curve(Figure 3.18). This low value of the ROC is due to the algorithm not being able to detect true negatives with high accuracy. One reason that might be causing very high false positives is due to relatively less data points to get the algorithm trained itself. The algorithm used for trained in all the above examples is Ada Boosting using decision stumps.

```
=== Summary ===

Correctly Classified Instances        228            87.6923 %
```

```
Incorrectly Classified Instances        32              12.3077 %
Mean absolute error                     0.174
Root mean squared error                 0.3126
Total Number of Instances               260


=== Detailed Accuracy By Class ===
```

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.987	0.967	0.887	0.987	0.934	0.847	1
	0.033	0.013	0.25	0.033	0.059	0.847	0
Weighted Avg.	0.877	0.857	0.813	0.877	0.833	0.847	

```
=== Confusion Matrix ===
  a   b   <-- classified as
217   3 |  a = 1
 29  19 |  b = 0
```

Figure 3.15: Classification results of the collective processes of change in class 1

```
=== Summary ===

Correctly Classified Instances          243             93.4615 %
Incorrectly Classified Instances        17              6.5385 %
Mean absolute error                     0.1093
Root mean squared error                 0.2408
Total Number of Instances               260


=== Detailed Accuracy By Class ===
```

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.996	1	0.938	0.996	0.966	0.92	1
	0	0.004	0	0	0	0.92	0
Weighted Avg.	0.935	0.939	0.88	0.935	0.907	0.92	

```
=== Confusion Matrix ===

  a   b   <-- classified as
143   1 |  a = 1
 16 100 |  b = 0
```

Figure 3.16: Classification results of the collective processes of change in class 2

```
=== Summary ===

Correctly Classified Instances          227             87.3077 %
Incorrectly Classified Instances        33              12.6923 %
Mean absolute error                     0.228
Root mean squared error                 0.3345
Total Number of Instances               260


=== Detailed Accuracy By Class ===
```

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.974	0.9	0.892	0.974	0.931	0.873	1
	0.1	0.026	0.333	0.1	0.154	0.873	0
Weighted Avg.	0.873	0.799	0.828	0.873	0.842	0.873	

=== Confusion Matrix ===

```
  a    b   <-- classified as
 201  29 |  a = 1
  4   13 |  b = 0
```

Figure 3.17: Classification results of the collective processes of change in class 3

=== Summary ===

Correctly Classified Instances	218	83.8462 %
Incorrectly Classified Instances	42	16.1538 %
Mean absolute error	0.2239	
Root mean squared error	0.3517	
Total Number of Instances	260	

=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.96	0.917	0.867	0.96	0.911	0.765	1
	0.083	0.04	0.25	0.083	0.125	0.765	0
Weighted Avg.	0.838	0.795	0.782	0.838	0.802	0.765	

=== Confusion Matrix ===

```
  a   b   <-- classified as
 195  29 |  a = 1
 13  23  |  b = 0
```

Figure 3.18: Classification results of the collective processes of change in class 5

We can clearly see from the above results that the classification of the stories into the classes defined above appears to happen at a high accuracy. However, one should keep in mind that the database of stories were relatively small compared to the usual amount of data used train the classifiers. Hence, using more data could improve the performance.
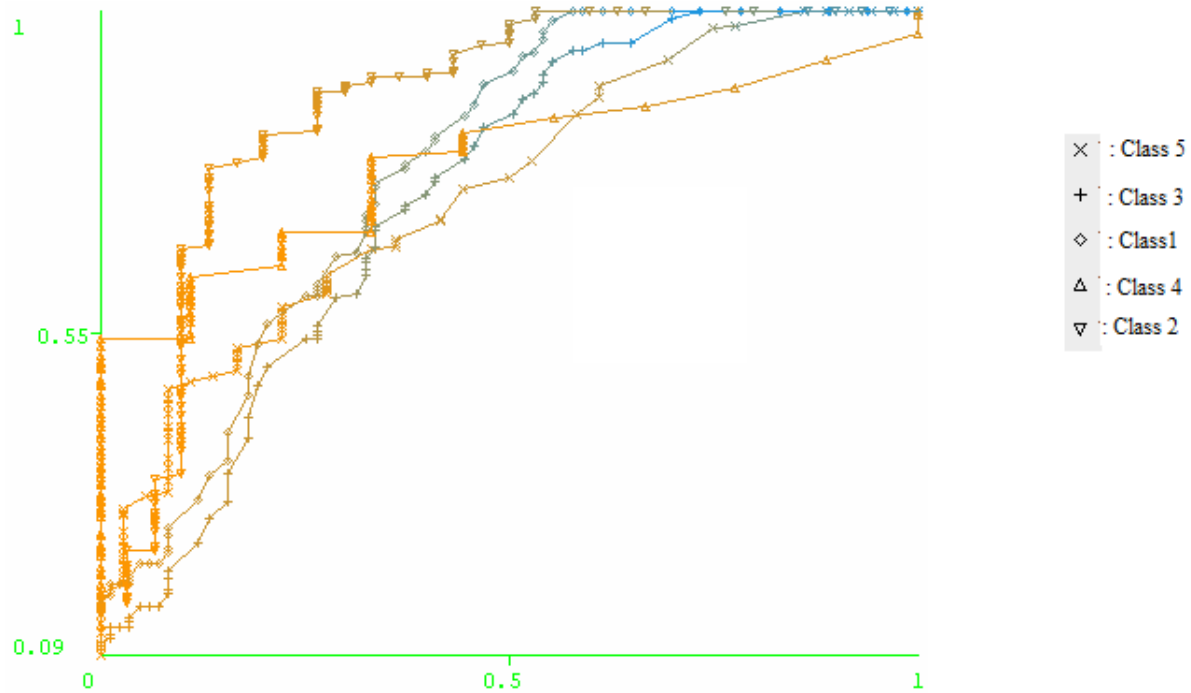
Figure 3.19: Shows the ROC curves for the classes

The ROC curves are obtained by plotting the True Positive Rate(TPR) vs the False Positive Rate(FPR)(Figure 3.20). The class 2 (Contemplation) performed the best on the training set. The Class 5 (Maintenance) and Class 4(Action) were the least performing. There could be many reasons for this. The limited training set could be a problem or the attributes for these two classes might be inadequate. Further work needs to be done to determine the cause behind the accuracies of the above two classes.

$$TPR = TP/P = TP/(TP + FN)$$

$$FPR = FP/N = FP/(FP + TN)$$

Where,
TPR = True Positive Rate
TP = True Positives (Number of Processes of Change correctly Identified as process of change)
FP = False Positives (Number of Processes of Change incorrectly Identified as the given process of change)

TN = True Negatives (Number of Processes of Change correctly Identified as not a given process of change)
FN = False Negatives (Number of Processes of Change incorrectly Identified as not a given process of change when the given process of change was true)

Figure 3.20: Calculating ROC curves

3.2 Gender

Gender concordance between the author and the user reading the story is important based on Tailoring theory. Gender has been looked into as one of the important indexing parameters. The difference between the Men and Women are really quite different (Schank.R, 1986). The men and women share different beliefs, different ways of processing information, different styles of reasoning, different value systems. Men and women also possibly share different processes of evaluation and understanding empathy. Also there are physical differences between the genders resulting in different stories. For instance, one such story would be discussing about loss of pregnancy weight.

> *".......the weight seems to bounce back in no time after having a baby,but it took me years to lose weight after each of my pregnancies.*
> *At age 21,I was a "curvy" 175 pounds before I had my daughter,Taylor....."*

Narrating stories about loss of weight after pregnancy would make more sense to female gender rather than the male gender.

The algorithm used for gender identification of the stories is based on the works of Cheng et.al (Cheng et.al, 2010). In their work they use classifiers for identification of the gender of the authors of the text contents such as emails, blogs, articles etc. They identify the syntactic differences in the text such as differences in the number of uppercases, punctuations, uppercases, word frequencies etc. They also look at the psycho-linguistic cues shown below in Figure 3.21.

Feature Words included in the feature
Negations : no, not, never
Positive emotion : love, nice, sweet
Negative emotion : hurt, ugly, nasty
Anxiety   : worried, fearful, nervous
Anger   : hate, kill, annoyed
Sadness   : Crying, grief, sad
Insight   : think, know, consider
Tentative : Maybe, perhaps, guess
Certainty : Always, never
Inhibition : block, constrain, stop
Assent   : agree, OK, yes

Figure 3.21: psycho linguistic cues used to identify the gender

We use a similar algorithm to identify the gender of the storyteller from the text. Along with these cues we also perform an additional validation of names. If the initial 10 sentences of the story contains a name then we do another validation of the gender detection. The name and gender databases were obtained from the U.S census database. The combination of these algorithms resulted in a total accuracy of 72.7% accuracy in detection of the gender from the stories. The evaluation of the algorithm was performed on 100 stories from the database.

3.3 Age

Age concordance has been shown to be effective in tailoring. The age of the storyteller which is another one of the indexing variables that we look at. It is natural to observe that the human body changes with age. The experiences of weight loss of teenagers differs significantly from those of middle aged person. The human body ages with time. Hence, the age of the people were also used as an indexing parameter. As an example

"..... I could no longer exercise. My knees were killing me. I had to find a different way to lose weight ....." (64 years Female)

"... From doing it tough on the treadmill, I have become a serious runner, completing a couple of half-marathons and running a full marathon in January this year in a very respectable three hours and 23 minutes. I now run up to 80km a week and ...."(24 year Female)

To get the maximum benefits from the stories for a person who is 60 years old, the story of a 64 years old would be more beneficial compared to a 24 year old person who started running to lose weights. The identification of the age of the storytellers were made by using regular expressions. The regular expressions were used in the stories to identify the age of the storyteller. No validations were performed to check how well the regular expressions performed.

The regular expressions used were

[0-9]?[0-9]? Years

Age is [0-9]?[0-9]?

Age [0-9]?[0-9]?

I am [0-9]?[0-9]?

\\, [0-9]?[0-9]?

I am only [0-9]?[0-9]?

A few examples of how people speak about their age in their stories is given below.

".... I am only 24 when the scale hit 253 pounds. As a grad...."

".... I am only 24 when the scale hit 253 pounds. As a grad...."

"... Charles is a teenager,age 16,who became.... "

These regular expressions were checked with an OR condition and the age was extracted. However, these regular expression could only extract the age from the stories where they were mentioned.

3.4 Race

Race is one of the indexing parameter that were extracted from the stories. However, we failed to extract the race from of the storyteller from the stories in our database as the storytellers have not mentioned their race in any of the stories. This information was extracted from the story using the key word matching.

3.5 Education Levels

The language level of the storyteller is also important indexing parameter. The complexity of the language used is another important indexing parameter. The Flesch Kincaid readability scores were calculated using the formula shown in Figure 3.22 for every story. These scores once calculated were matched using the logic shown in the table 3.23.

$$206.835 - 1.015 \left(\frac{\text{total words}}{\text{total sentences}} \right) - 84.6 \left(\frac{\text{total syllables}}{\text{total words}} \right)$$

Figure 3.22: Flesch Kincaid readability score calculations

These scores were calculated for the stories and the stories were matched based on the table given below.

Score	Notes
> 70.0	High School
30.0 - 70.0	College graduates.
0.0–30.0	University graduates

Table 3.23: Using Flesh Kincaid scores for assigning education levels(kincaid et.al, 1982)

3.6 Emotions and Coherence : Quality Metrics

justify what is meant by quality metrics. Other than the indices I use these things to. Linking the optimism between the stories. Although not indexing variables, the emotions and the coherence scores were calculated for the stories. Pennebaker(2000) work has shown that the story which convey more positive emotions convey induce more optimistic thoughts in the listeners which may be associated with increased self-efficacy. The sentiment scores for the stories were calculated using the sentiwordnet database, which contains the words to sentiment score mappings. The sentiwordnet database contains the mapping as shown below.

The quality of a story can be estimated by a Cohesion metric. Cohesion is an objective property of the explicit language and text, such as words, phrases, or

sentences that guide the reader in interpreting the substantive ideas in the text, in connecting ideas with other ideas, and in connecting ideas to higher level global units (e.g., topics and themes). Coh-Metrix is a computer program that analyzes various text features relevant to text comprehension by incorporating techniques informed by theories of text processing, cognitive psychology, and computational linguistics. (Graesser. A, et al; McNamara et.al, 2004)

```
(POS) (WORDID(POSITIVE SCORE)(NEGATIVE SCORE)(WORD)
.
a        00017782     0.625   0       acceptable#1
a        00018069     0.25    0       bankable#2
a        00018222     0.25    0.625   unimpeachable#3
a        00018435     0       0.5     unobjectionable#3
a        00018584     0.125   0.375   unacceptable#2
a        00018850     0       0.375   objectionable#2
a        00019131     0.625   0       accessible#1
.
.
.
```

Figure 3.24: Sentiwordnet database with words and mapping to sentiment scores.

The stories were later sorted based on these scores and presented it to the user. Stories which scored higher (more positive) were sorted above the stories which performed lower within the relevant scores.

3.7 Matching the indexed stories

Once, the stories are indexed, the next step is to match the indexes to the user preferences. If the story was stage matched successfully it received a score of 5. This was done on purpose to assign a high weight age for stage matched compared to other indexing variables. All the other matches received a score of 1. The matching scores of all the stories were calculated and the stories were sorted based on these scores. The story which received the highest score were narrated/displayed higher than the stories which received lower scores.
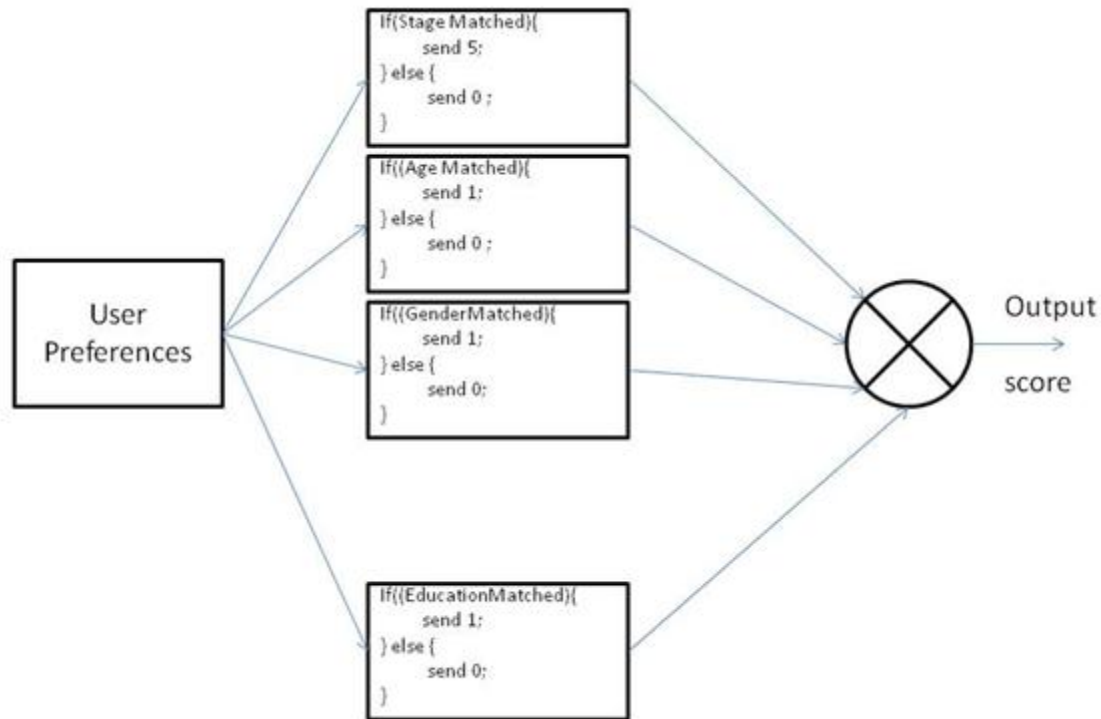
Figure 3.24 Matching algorithm. Assign final scores.

3.8 Building the training set

The training set required for the study was built using Amazon Mechanical Turk explained in Chapter 2. The stories were put up on the mechanical turk and the participants were asked to answer 44 simple yes/no questions about the same. These questions were constructed based on processes of change questionnaire (Appendix). 260 stories were put up on the Mechnical turk. Any users with acceptance rate(explained in detail in Chapter 4) greater than 80% were allowed to participate in the survey. The instructions were made clear, where they had to read a story and answer questions about the activities that the storyteller engages in. The responses to the 44 questions were logged and the processes of changes for these stories were calculated. The questions were based on the standard processes of change questionnaire for weight loss. This was later used as a training set for the algorithm.

To validate the processes of change, Inter rater Reliability tests were conducted on the responses. The processes of change for 10 different stories were obtained from 2 group of users. Users from Group 1and 2 answered the question on the processes of change in the stories. The processes of change identified by the user

1 were compared with the processes of change marked by the users from Group 2. The final inter rater reliability score(Weighted Kappa) was found to be 0.801. The figure 3.25 shows the final score.

| Observer A | Group_1 |
| Observer B | Group_2 |

Observer B	Observer A		
	0	1	
0	84	4	88 (77.2%)
1	4	22	26 (22.8%)
	88 (77.2%)	26 (22.8%)	114

Weighted Kappa[a]	0.801
Standard error	0.068
95% CI	0.668 to 0.933

[a] Linear weights

Figure:3.25: Inter rater reliability showing agreement between the raters on processes of change

3.9 Indexing

Before discussing about the Future work section I will briefly discuss the results of automated indexing in this section. The classification and trainings were performed using Weka, a machine learning tool. The results of the classification algorithms were promising as the stories were classified with very good accuracies. This would mean that automated classification of the stories into different classes would happen reliably. However, one should keep in mind that the training set used to train the classifiers were limited to n=260. Using more stories would improve the performance of the classification algorithm. The classification algorithm used in this study was AdaBoosting using weak learners. We were also using short patient stories for analysis. It would be interesting to observe how a lengthier stories are classified. Identifying more attributes to improve the classification will be a challenge. It will be also interesting to observe how the classification algorithms perform on stories other than the weight loss stories. The indexing framework supports identification of the Processes and Stages of change for stories on other health conditions. However, the attributes needed for the processes of change would need recalculations and adjustments.

Though the framework supports identification of the indexing parameters for other health conditions, it will be interesting to see how they perform on short stories dealing with other health conditions.

Identification and matching short stories has worked well in the current work. The short stories generally concentrate on a very limited number of processes of change and stages of change (Example: How a person progressed from preparation to maintenance, precontemplation to contemplation etc.), However, it will be interesting to observe the processes and stages of change mentioned in lengthier stories.

3.10 Summary

In this chapter we saw the methods of obtaining the index automatically from the stories using classification algorithms. We also saw automated ways of obtaining other indices such as Gender, Age, Race, Education Levels, Emotions and Coherence. Once the indexes are built matching logic was established. We also saw the way the training set for the classification algorithm was built. The results obtained could be reliable as the average Kappa score was found to be 0.80. In the subsequent chapters we will see the study protocol, results, discussion and the conclusion.

Chapter 4 : Evaluation of Story Indexing

Does relevant storytelling based on index matching have measurable effects on users ? Does the medium used to tell stories matter ? This chapter presents an evaluation study conducted to answer these questions.

4.1 Introduction

The main goal of conducting the study is to evaluate how well relevant storytelling performs, using the automated indexing presented in the previous chatper. To do this, I compare the effect of indexed stories on changes in attitude towards a health behavior, compared to stories selected at random. I also intend to see if using a conversational agent telling the stories has any effects on these outcomes compared to having people simply read the stories in text form, given prior successes in using embodied conversational agents for health counseling (Bickmore, T., Picard, R., 2005; Bickmore, T., Yin, L., 2010). I conduct a full factorial 2 X 2 between subjects experimental study. Subsequent sections explain the protocol in detail. Figure 4.1 shows the 4 different conditions of the study.

	Medium		
		Agent	Text
Story Retrieval	Random	GROUP I	GROUP II
	Relevant	GROUP III	GROUP IV

Figure 4.1: Different branches of the study

My hypotheses were:

H1: Indexed stories will have significantly greater impact than randomly selected stories on increases in self-efficacy and decisional balance, and significantly higher ratings of story understandability, enjoyment, and identification with the story author.

H2: Stories told by an embodied conversational agent will have significantly greater impact than read stories on increases in self-efficacy and decisional balance, and significantly higher ratings of story understandability, enjoyment, and identification.

4.2 Experimental method

This study was a multivariate, between subjects 2 X 2 full factorial experimental design. Figure 4.2 shows the overview of the study. Participants were randomized into four groups as shown in Figure 4.1.
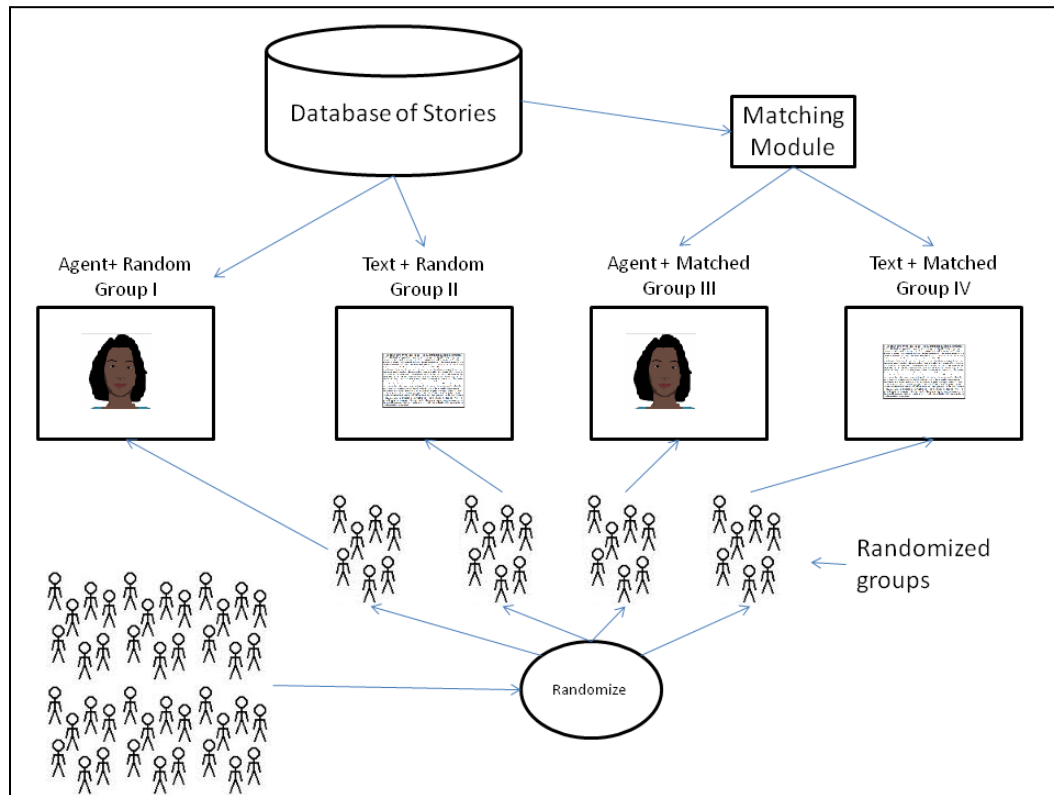

Figure 4.2 Experiment design

4.2.1 Subjects

The experiment was conducted over Amazon's Mechanical Turk™. Mechanical Turk is a crowdsourcing Internet marketplace that enables employers to coordinate the use of employees ("Turkers") to perform small knowledge tasks, known as Human Intelligence Tasks (HITs) for micropayments (wikipedia).

In the current study Turkers were used as study participants, and were made to undergo a screening test before they could participate. Eligibility requirements included:

1. US-based Master Turkers. A significant number of Turkers try to collect payment without expending appropriate effort, and there are many computer programs ("bots") that have also been created to simulate Turkers in an attempt to

collect payment without human effort. To avoid these problems, I required that all participants be "Master Turkers", which are Turkers who have the highest level of past experience and employer ratings. In addition, the conversational agent tell stories using an American English voice, and the stories of health behavior change are mostly from people in the U.S. Hence, the study was limited to Turkers from the U.S.

2. In Contemplation, Preparation, or Action stage of change for Weight Loss. Since the stories in my corpus were about weight loss, it was important to include only turkers who were overweight or those who thought they needed to lose weight. This screening was performed using Mechanical Turk's "Qualification Tests", comprised of the following three questions.

Q1. How much weight do you expect to lose? Enter the amount of weight you would want to lose(in lbs). _____

Q2. Do you consider yourself overweight ? Yes No

Q3. Has anyone ever told you that you need to lose weight ? Yes No

Question Q1 is a free text answer that users typed in the text box provided. Questions 2 and 3 were simple yes/no questions. Turkers were eligible only if they either responded to Q1 with a non zero and a non-negative number, or answered 'Yes' to Q2 or Q3. Eligible turkers were provided a link to an unsigned consent form approved by the Northeastern IRB. Participants were informed that they could withdraw from the study at any time. Participants were paid $3.00 for the 30 minute experiment session. Although many studies have shown that the median hourly wage for Turkers is $1.38 (Horton & Chilton, 2010), I decided to compensate according to Amazon's recommended $6.00 per hour.

4.2.2 Study Protocol

All eligible Turkers viewed a common description of the study, were told they would either be reading a story or listening to a story narrated by an embodied conversational agent, and that the stories were about weight loss   (Figure 4.3). Participants were also required to have a flash enabled browser and an audio enabled computer. If their computer did not have either flash or the audio components the participants were asked not to participate in the HIT (this was also

validated in software). Figure 4.3 shows the description of the ad posted for recruitment.

Answer a few questions about self and your habits. Then you will be either reading a story or listening to a story narrated by our animated computer agent.

---

1. The Links DO NOT contain malwares, adwares popups or spam.
2. You will not be identified individually after answering the questions. IP address, username or emails will not be stored or published. So, please be as honest as possible.
3. It is *very important to have "audio" and flash enabled.*
4. Please do no mute. You may have to listen to a computer agent speaking.
5. Please be as honest as possible
6. It is recommended you have high speed internet.
7. Please do not keep the link open for a long time. They time out.

Here is what you will be doing. Please pay attention:
- You will follow the 1st link given below and answer a few questions. Please open the link in a new window. You will have to come back to this HIT later.
- The instructions on pages are made clear. If in doubt please email me at [rameshd]r@ccs.neu.edu.
- You may be conversing with a computer animated agent. Please keep the audio/speakers/headphones and flash enabled on your computer all the time. Our system has a validation mechanism built in to check flash and audio.
- Instructions will be provided to return back to turk. Please return only at that time.
- Go the 2nd link only after the interaction.
- Answer the questions there. Paste the code given to you in the space shown below.
- Random answering will result in HIT rejection. We time the events. Please go in a sequence.
- Do not hit the back button on the browser when navigating the pages.

STEP 1 : COPY THE 1st LINK GIVEN BELOW IN A NEW WINDOW
[http://wonder.ccs.neu.edu:8085/index-study/test.jsp?id=]

(Go to step 2 only after the system asks you to.)
STEP 2: COPY THE 2nd LINK GIVEN BELOW IN A NEW WINDOW AND ANSWER THE QUESTIONS
[http://wonder.ccs.neu.edu:8085/index-study/final_questionnaire.jsp?id=]

STEP 3: USE THE KEY THAT WILL BE BE GIVEN TO YOU AT THE END AND PASTE IT HERE

[   ]

STEP 3: Feedbacks are greatly appreciated. (Your experiences, comments, anything ..)

_____

_____

Figure 4.3 : Description of the task as seen by the participants

The participants were then randomized into one of the four study conditions. Figure 4.4 provides an overview of the protocol. Participants had to open a web page in a separate window or a tab on their browsers containing a web form with standard questions on stage of change (Weight loss Stage of Change Questionnaire), demographics (Demographics Questionnaire), motivation and decisional balance (Decisional Balance Questionnaire) data from the users. The demographic questions had an option of "I'd prefer not to answer" wherever applicable. Participants were free to choose this option if they did not want to disclose personal information. However, they had to answer remaining questions. All questionnaires are provided in the Appendix. The responses are stored in a MySQL relational database and stories are provided to participants depending on their study condition (Indexed vs Non-Indexed, Agent vs Non-Agent).

Participants then read or listened to a story, after which they were presented with questions about enjoyment, relevancy, likeability and identification with the characters mentioned in the story. A second story was then provided to the participants and, after reading or listening to the second story, they answered these questions again. After this, they were given the option of hearing or reading additional stories, or to take a final questionnaire. The final questionnaire assessed motivation, self efficacy and decisional balance. Once the participants answered these final questions they were provided a textbox to provide feedback or comments about the study (see Figure 4.4 for procedure overview).

Figure 4.5 shows the text and embodied conversational agent story presentation interfaces. Grammatical errors and other mistakes in the stories were not corrected. However, the text-to-speech engine supported by the agent cannot decode any special characters (such as smileys, foreign language characters etc.), and thus these were removed from the story text read by the agent.
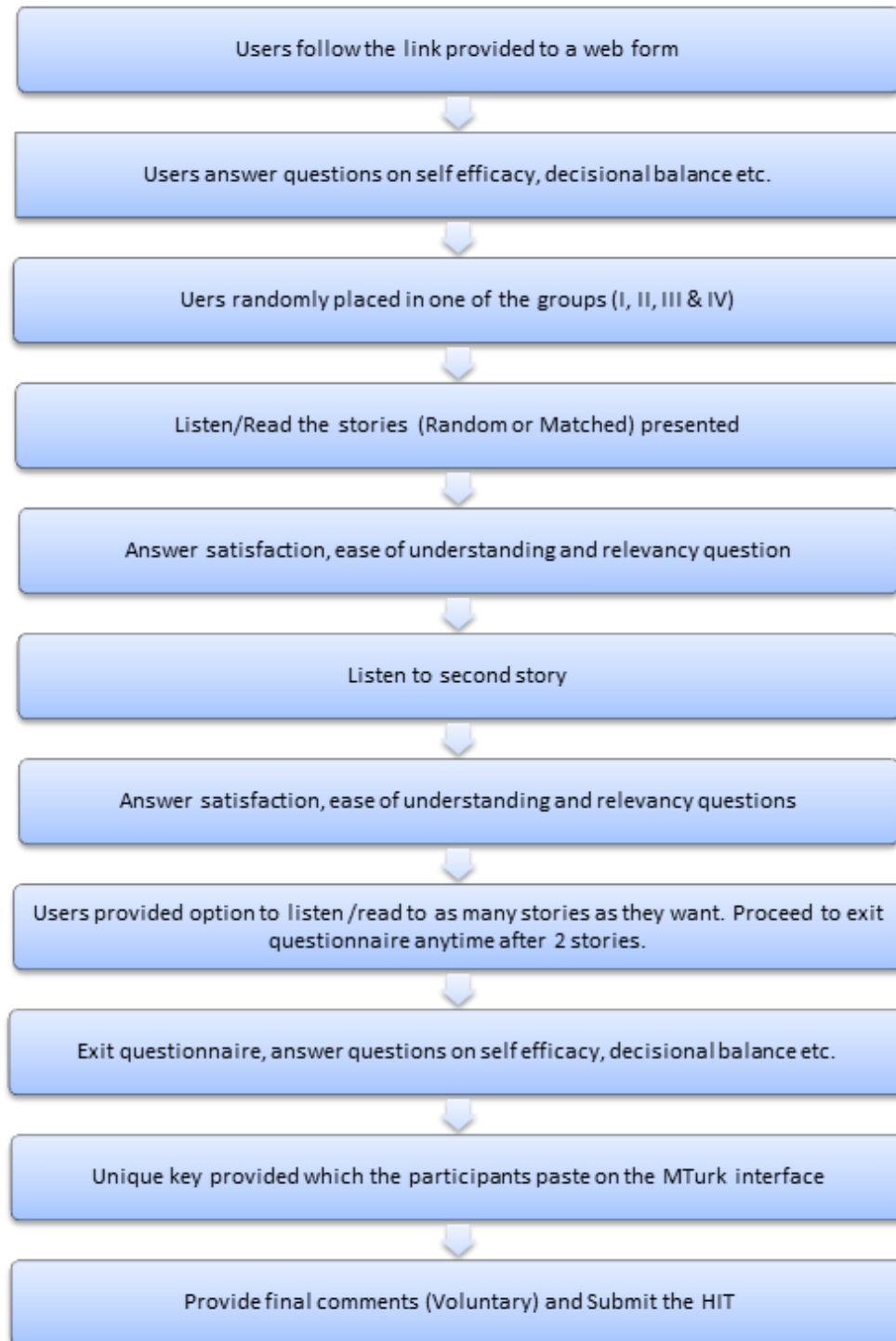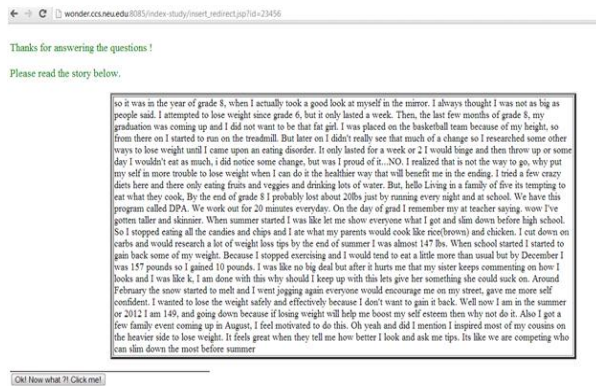
Figure 4.4: Protocol of the Amazon turk study

Figure 4.5 a: Text interface with the story

Figure 4.5 b: Agent interface with agent narrating the story. Buttons on the right to interact with the agent.

4.3 Measures

Change in Weight Loss Self-Efficacy. The concept of self-efficacy is fundamental to behavior change interventions. Self-efficacy refers to an individual's beliefs regarding their ability and competence to make the behavior changes required to achieve goals such as weight loss. The standard 10-item 5-point self-efficacy questionnaire was used to measure the self efficacy scores (Luszczynska, A et.al, 2005). Some literature suggests that change in self-efficacy may be a more significant predictor of weight loss success than baseline self-efficacy scores. Larger improvements in self-efficacy during treatment were associated with greater weight loss (Byrne.S et.al, 2012). Hence, I look at the difference in the sum of weight loss self-efficacy scores before and after the storytelling intervention as the outcome measure.

Change in Weight Loss Decisional Balance. The decision to move from one stage to the next is based on the relative weight given to the pros and cons of changing behavior. The decisional balance was measured using a standard 20-item 5 point scale questionnaire (O'Connell, d., & Velicer, W.F.,1988). To measure the change in decisional balance the difference between the pros and cons before and after the storytelling intervention were measured.

Enjoyment of Stories. Another outcome that was measured was the enjoyability of the stories. Questionnaire on enjoyability developed by Hoonhut was used(Vermeeren, Arnold POS, et al, 2010).

Understandability of Stories. The ease of use and understanding was measured using the questionnaire developed by Adams et.al (Adams, B. D. A., et.al, 1992).

Identification with Story. To see how well participants could identify with a story, two 5-point scale questions were asked:

1. How much can you identify with the story author?
2. How close were the experiences of the person in the story with yourself ?

4.4 Results

4.4.1 Subjects

A total of 103 Turkers participated in the study (Figure 4.6).

Condition	Agent + Indexed Storytelling	Agent + Random Storytelling	Non - Agent + Indexed Storytelling	Non - Agent + Random Storytelling
Number of Subjects (N =103)	35	19	26	23

Figure 4.6 The participant distribution among the four groups

4.4.2 Demographics

Participants were 45 males and 55 females, of which 85 were Caucasians, 8 Asians, 5 Hispanic/Latino and 3 African Americans (3 participants chose not to disclose their race). Participants were well-educated: 18 reported their highest education level as High school, 34 reported some college, 28 reported having an undergraduate degree, 11 had graduate degrees and 3 had doctoral degrees (10 participants chose not to report their highest education level). Participants spanned a wide range of ages (all over 18): 35 were under 30, 32 were 30-40, 21 were 40-50, 10 in 50-60 and 2 were over 60 (4 participants chose to not disclose their age). The geographical distribution of the participants over US is shown below. The participants were spread across different parts of US.
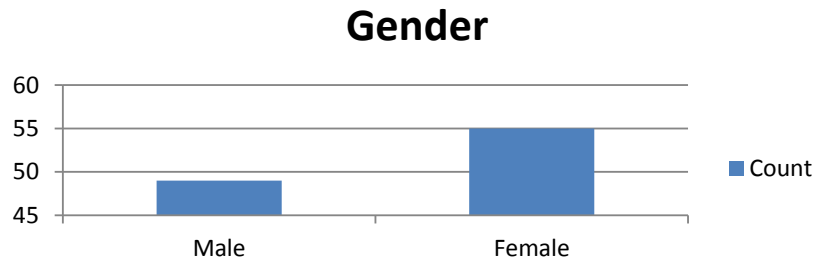
Gender

Gender	Count
Male	48
Female	55

Figure 4.7 Gender distribution

Race

Race	Count
White/Caucasian	85
Asian	8
Hispanic	5
African/American	3
Undisclosed	2
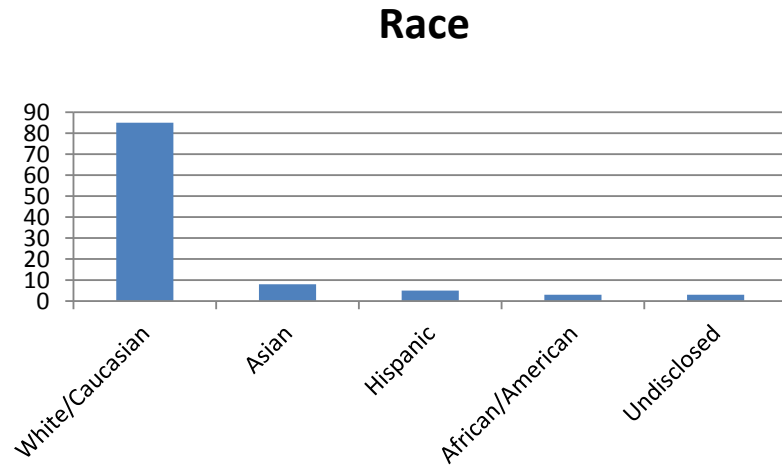
Figure 4.8 Distribution of race

Education

Education	Count
High School	18
Some College	34
Undergraduate Degree	28
Graduate Degree	11
Doctoral Degree	3
Undisclosed	9
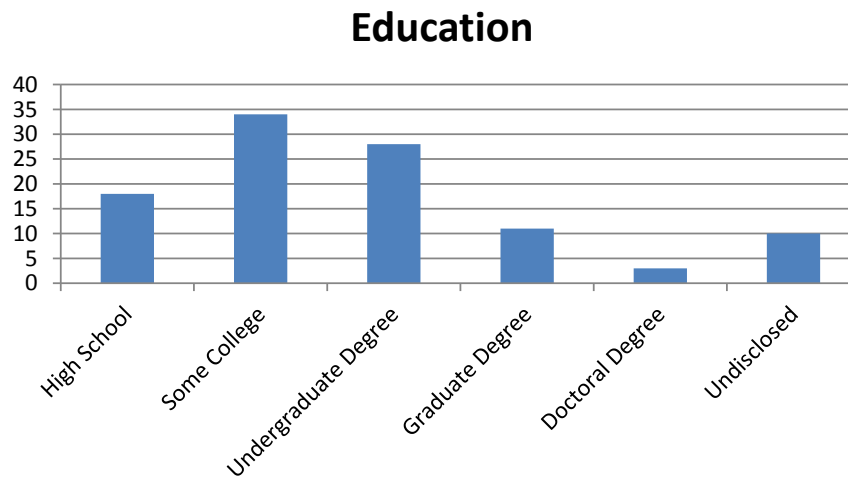
Figure 4.9 Education levels of the participants

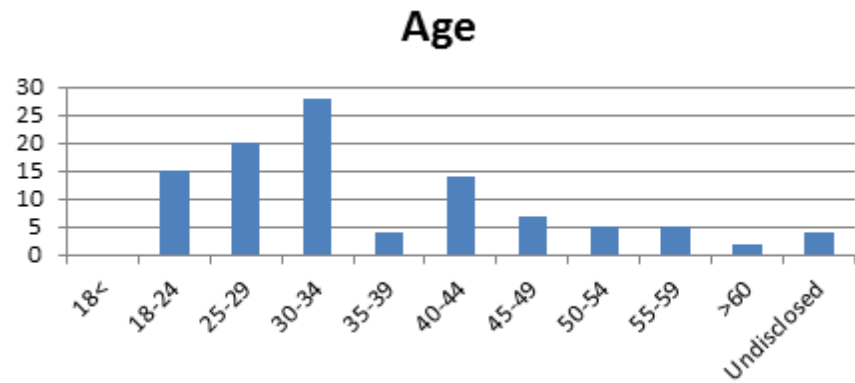| Age	Count
18<	0
18-24	15
25-29	20
30-34	27
35-39	4
40-44	14
45-49	7
50-54	5
55-59	5
>60	2
Undisclosed	4
Total	**103**

Figure 4.10 Distribution of Age

Figure 4.11: Geographical distribution of the participants in the study.

4.4.3 Stages of change

Based on the standard stage-of-change for weight loss assessment, 66 participants were in precontemplation, 20 in contemplation, 12 in preparation, 4 in action and 1 in maintenance(Figure 4.12).

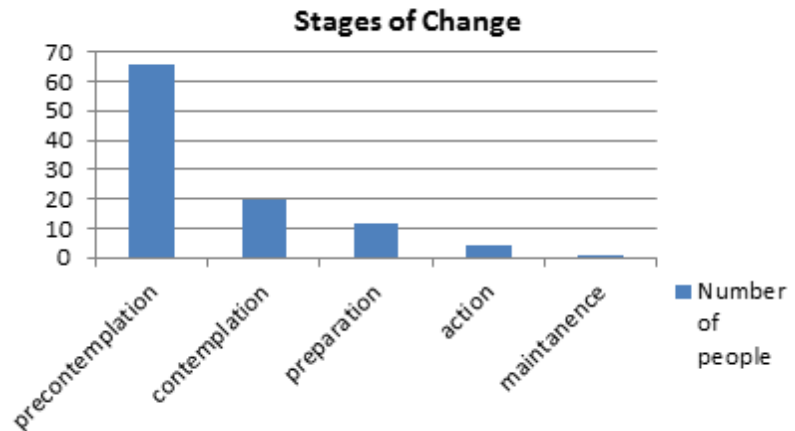| Stage of Change	Number of people
precontemplation	66
contemplation	20
preparation	12
action	4
maintenance	1

Figure 4.12 Distribution of Stage of change

4.5 Primary Outcomes

Histograms of the primary measures are shown in Figure 4.13.

Outcome measure	Mean	Standard Deviation
Change in Self efficacy	2.13	5.054
Ease of Understanding	2.21	1.075
Enjoyability	2.7	0.923
Identify with the users	2.09	0.903
Decisional Balance	1.5	4.619

Table 4.13: Means and Standard deviations of the outcome measures

Data was analyzed using 2 X 2 ANOVAs in SPSS, with matched/non-matched and agent/text as the independent factors.
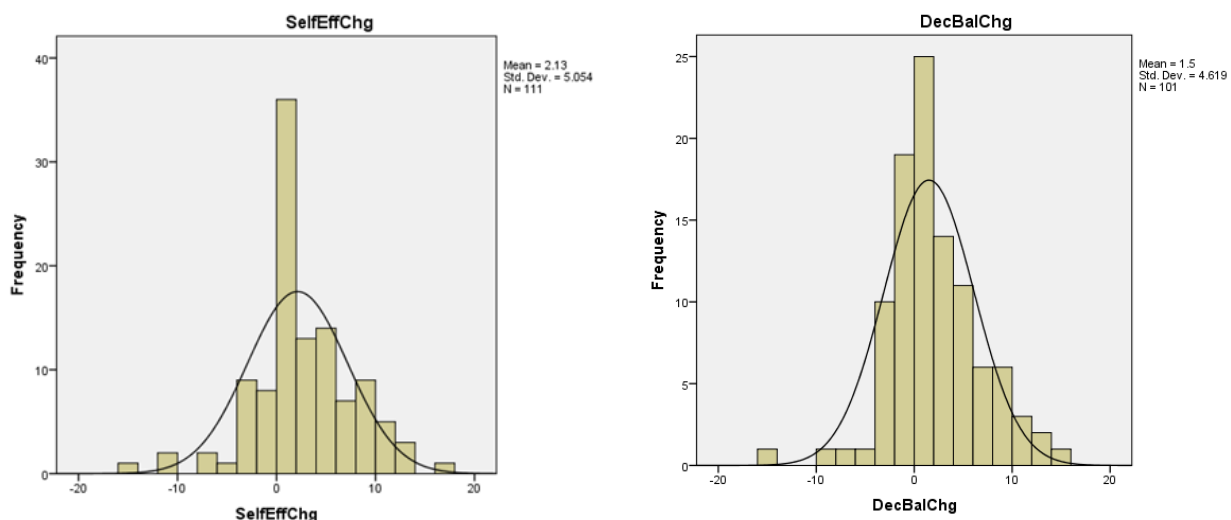
There was a main effect of matched/non-matched stories on change in self efficacy for weight loss, $F(1,107)=5.5 < 0.05$, with matched stories leading to significantly greater increases in self efficacy compared to randomly selected stories. The mean difference in self efficacy in the matched group was 3.254 (50 point scale) compared to 0.792 in the random group. There was no effect of medium on change in self-efficacy, $F(1,107)=.04$, n.s., and no significant interaction.

There were no significant effects of study conditions on change in decisional balance for weight loss.

There was a significant main effect of medium on enjoyment of stories, $F(1,98)=22.3$, $p<.001$, such that participants enjoyed reading stories themselves significantly more compared to stories read by the agent. There was no significant main effect of matching on enjoyment, nor an interaction effect.

There was a significant main effect of medium on identification with the story, $F(1,98)=47.2$, $p<.001$, such that participants identified significantly more with text-based stories compared to stories read by the agent. There was a trending main effect of matching on identification, $F(1,98)=3.0$, $p=.09$, with participants identifying more with matched stories compared to those selected at random.

There was a significant interaction of matching and medium on the rated understandability of stories, $F(1,98)=4.5$, $p<.05$, such that participants who heard stories read by the agent rated matched stories as more understandable, whereas those who read their stories rated randomly-selected stories as more understandable. However, there was also a strong main effect of medium on understandability, $F(1,98)=82.8$, $p<.001$, with participants in the agent group rating the understandability of their stories more highly overall compared to those in the text group.
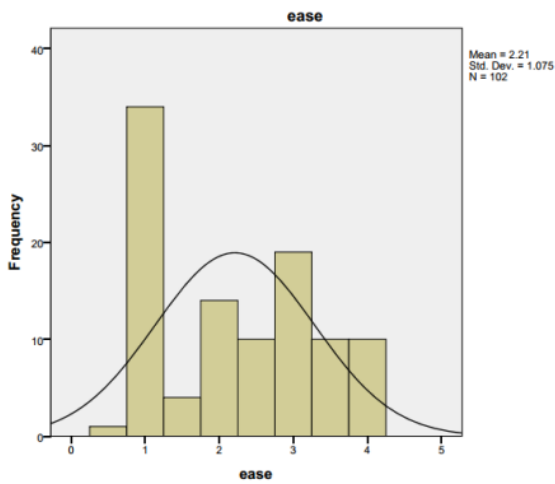

SelfEffChg

Mean = 2.13
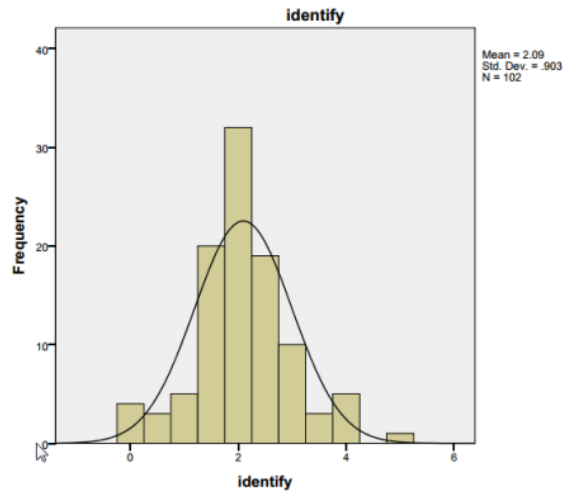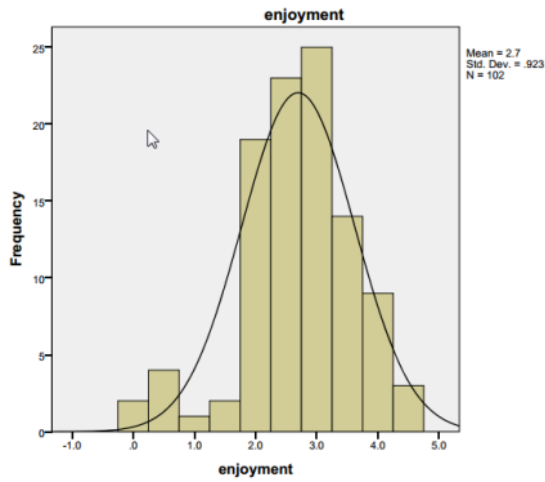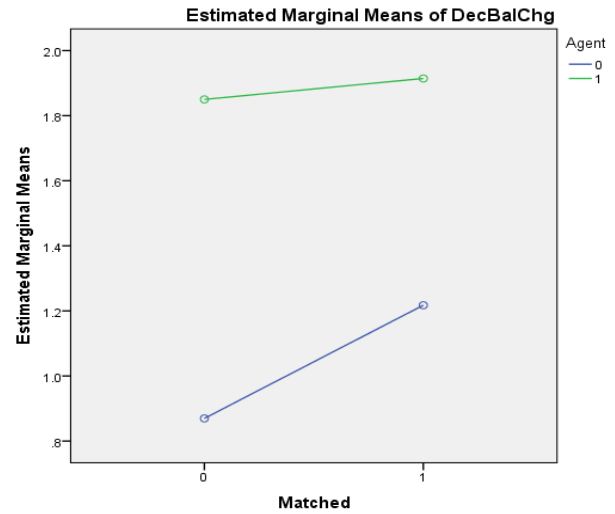Std. Dev. = 5.054
N = 111

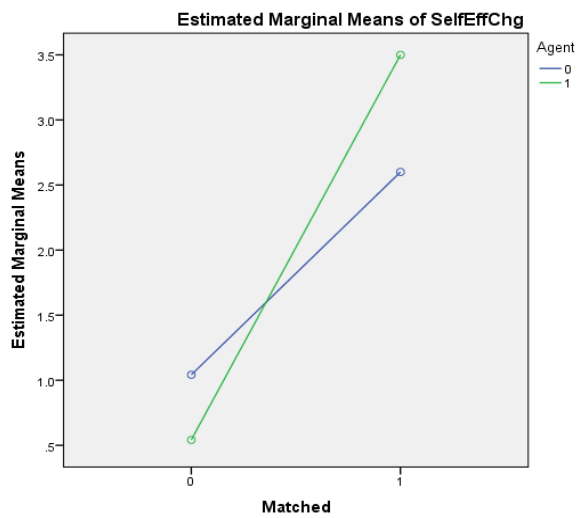DecBalChg

Mean = 1.5
Std. Dev. = 4.619
N = 101

Figure 4.13 Histograms of the outcome measures
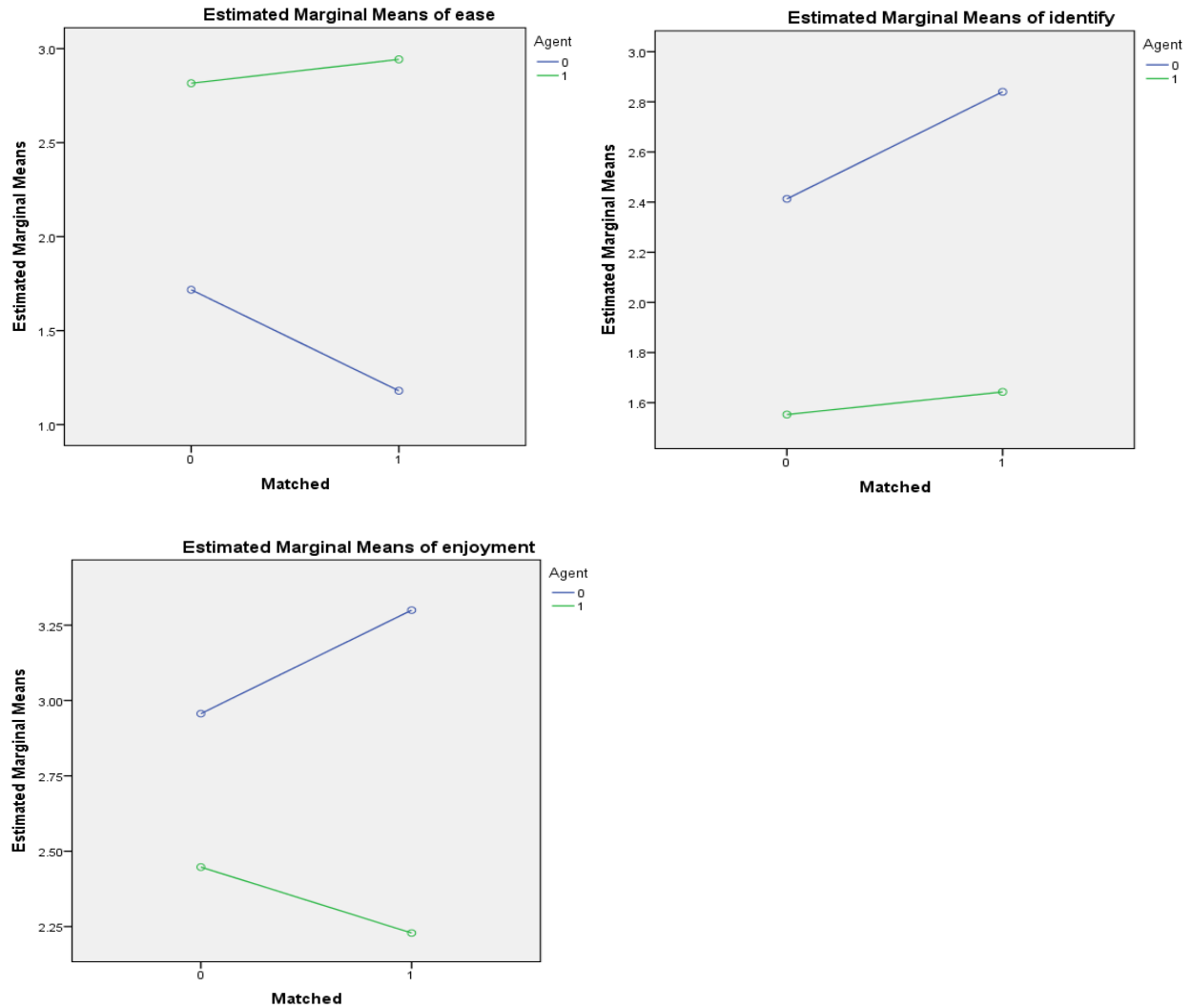
Figure 4.14 Estimated Marginal means of the outcome measures.(SelfEffChg is the change in self efficacy from before to after reading stories, DecBalChg is the change in Decisional Balance, ease is ease of understanding(understandability),identify means identity with user, enjoyment is enjoyment of the stories).

4.6 Discussion

Hypothesis H1 received partial support, with matched stories leading to significantly greater increases in self efficacy and higher ratings of story understandability compared to randomly selected stories. Matched stories also appeared to lead to greater identification ratings.

However, hypothesis H2 received mixed support from the experiment. While participants rated the understandability of stories more highly when read by the

agent, they enjoyed them more and identified with them more when they read the stories from text.

4.7 Summary

In this chapter I presented a 2 X 2 randomized full factorial study. From the data we could observe that the participants who were exposed to the matched story (Group IIII and Group IV) case had a better self-efficacy than the other groups. The ease of understanding stories was greater with the Agent, but enjoyment was higher in the text group. There were no differences in the decisional balance observed. The ability to identify with the story author was also higher in the matched group. In the next chapter we discuss the results briefly and lay out a ground work for the Future work and directions. relevant stories (using both the conversation agent and text) produce changes in self-efficacy, higher understandability compared to non-relevant stories. Understandability of stories were rated more highly when read by the agent. Participants enjoyed stories more and identified with them more when they read the stories.

Chapter 5 : Conclusion and Future work

In the Chapter 2, I discussed important theories on health behavior change such as TTM ,Tailoring theories and their constructs. In Chapter 3, I built automated ways of extracting these indices from the stories. This was achieved through Machine Learning, Gender extraction and key word matching algorithms. In chapter 4 we saw the evaluative study and the results. In this chapter I discuss results and future work before concluding.

5.1 Discussion

Using the experiment described in the Chapter 4 we have successfully demonstrated that

a) relevant stories (using both the conversation agent and text) produce changes in self-efficacy, higher understandability compared to non-relevant stories.

b) Understandability of stories were rated more highly when read by the agent.

c) Participants enjoyed stories more and identified with them more when they read the stories from text.

5.1.1 Mechanical Turk Subjects

 The demographics of the participants was found to be consistent with findings with previous studies (Paolacci et al, 2010; Shapiro.et.al 2013;) on Mechanical Turk. The participants were found to be on the younger side (~61% of participants, <35 years). Many studies have shown that the Turker population is more educated than the average U.S population. Earlier research have shown that the studies conducted over Turk have to be carefully designed. Special care was taken to design the study carefully. The target population was carefully selected using the Qualification Types features of the Mechanical Turk.

The timestamps of the user activities such as the user entry times to web forms, exit times and time spent reading/listening to the stories were logged. The users spent average of 17.8 minutes answering the questionnaires 14.1 minutes reading the stories, 18.1 minutes listening to the stories. The dropout rates were found to be very low (4 out of 107 participants). At this time it cannot be ascertained if the users voluntarily dropped out from the study or due to other factors (loss of internet connection etc.). All the four who dropped out were from the Agent

narrated story branches (2 in indexed, 2 in Random). 38 out of 103 participants chose to provide comments about the system voluntarily for no additional benefits.

5.1.2 Results

Stories have been shown to be an effective tool for health behavior change. Houston. et.al have successfully used stories for Controlling Hypertension, and Diabetes and, Smoking cessations. The results have shown that relevant stories can be used successfully to increase the self-efficacy in the individuals. Self-efficacy measurements reflect the degree of confidence an individual has in maintaining the desired behavioral change in situations that often trigger relapse. It is also a measure of the degree to which the individual feels tempted to return to their problem behavior. This means that the stories could help in increasing the confidence in avoiding relapse, maintaining the desired behavior or abstaining from the undesired health behavior. With relevant storytelling the users develop a sense of homophily and this results in reduction in counter-arguing and increases susceptibility to behavior changes (Kreuter et.al, 2007). The results show that the users in the matched group report better understandability of the story compared to the Random group, when the story is read by the Agent. This could have resulted in a feeling of homophily. Participants in the Text based group enjoyed reading the story and identify themselves with the story more than the Agent group.

Enjoyed the stories, will continue reading more. (18-24 yrs, White Female, Precontemplation, Text indexed branch)

Thank you. Didn't know being overweight causes gall bladder problems. (45-49 yrs, White Female, Contemplation, Text indexed branch).

Figure 5.1: User comments for the Text interface.

However, we failed to achieve significant difference between the Agent and Text based interfaces for self efficacy. The participants who listened to the stories reported higher Understandability. One of the reasons for lack of significant differences in enjoyability of the agent based system could be the story narration itself. Since there were no grammar checks or any additional processing (grammar, phonetic check etc.) on the story text before using them for speech content

generation, many words were not clearly audible. Missing punctuation marks or additional punctuation marks make the sentences sometimes more complex to understand or incomprehensible. However, understandability was less which meant that the users understood the story well, but did not enjoy listening the same from the Agent. We can see that in some of the review comments posted by the users:

> *I honestly prefer just to read instead of listening "Tanya" tell me the story out loud.(24-25 Male, Precontemplation, Agent Indexed)*

> *The second story did not make a lot of sense, as if it was translated poorly from another language. I also had a couple misspellings but I don't remember what they were. (18-24 Male, Contemplation, Agent Random)*

> *Well done! The only trouble (and not really a problem) was the computer generated speech had trouble with contractions. For example, she'd was pronounced she D. No biggie, everything is good. Thank you for the opportunity to participate. (Undisclosed, Precontemplation, Agent Indexed)*

> *better english please.. (Agent Indexed)*

> *The audio was choppy, glitchy, and had errors such as saying "lbs" instead of pounds.(Agent Indexed)*

> *Figure 5.2: User comments for the Agent interface.*

However, there were some positive review comments for the Agent. It will be interesting to observe the results after the stories are fixed for grammatical errors , pronunciation of the words changed. However, this could potentially be the reason which might have resulted in people not enjoying the stories as much as the participants in the Text group.

The computer Agent was named as Tanya:

> *"I enjoyed the stories. The first story reminded me of myself, and the character in the second story reminded me of my daughter. Thank you for allowing me to participate in your survey. I have just begun*

to try to get back into shape, and your stories gave me an extra jolt of enthusiasm." (30-34 yrs, White Female, Preparation Stage, Agent Indexed Branch)

keep up the good work! Loved Tanya. (20-24 yrs, White Female, Precontemplation Stage, Agent Indexed Branch)

Tanya was a cute way to help along the survey, thanks! :) (24-29 yrs, White Female, Precontemplation Stage, Agent Indexed Branch)

Figure 5.3: Positive user comments for the Agent interface.

We failed to observe any significant differences in the decisional balance of the participants. Observation of change in decisional balance is usually associated with change in stages of change in TTM. Failure to observe changes in decisional balance could mean that the progress through the stages were not observed. This could be due to many reasons. The length of the stories could be a factor. The stories were short health behavior change stories. These stories could have failed to include enough motivational contents to help motivate people to progress through the stages. Another factor could be that number of stories read (2) were not enough to help progress through the stages.

5.4 Future Works

5.4.1 Indexing
The list of attributes mentioned for the indexing algorithms are not exhaustive. It will be interesting to use other linguistic cues into the attributes which may improve the performance of the classification algorithms. In this current work the identification of the classes of processes of change are used. It will also be interesting to use multi-class classification for identification of individual processes of change.

From the list of indexes we have not achieved complete automated indexing for all the parameters. It will be challenging to extract the indices mentioned in the figure 5.1. automatically.

INDEX	Description
Pros	Pros of changing the behavior
Cons	Cons of changing the behavior
Source of emotional support	People providing the support
Cues to Action	Motivational events to proceed from precontemplation/contemplation to action
Health Condition	Prior health condition the storyteller is suffering from
Geography	Country
Profession	Enumeration of professions.
Cues to Action	Motivational events to proceed from precontemplation/ contemplation to action
Celebrity Status	Yes No
Stigmatized group	Groups stigmatized by the society like gays, lesbians etc.
Failed Actions	All the actions which failed to produce result
Successful Actions	All the actions which successfully produced results

Table 5.4 Indexes which can be constructed in the future to achieve more relevancy

5.4.2 Storytelling

This current work has shown a lot of promise and the majority of participants in the Amazon Mechanical Turk™ liked it, by making it evident in their comments (Figure 5.5). It will be interesting to expand the database to include more stories of weight loss and different health conditions. Expanding the framework to extract other indices (pros and cons, failed attempts etc.) and doing so automatically will be a challenge. It will also be interesting to see if storytelling can be used for longitudinal health interventions.

" I enjoyed reading the stories. It would be nice if you provided weight loss resources on the last page also, just a few helpful links. :)" (24-29, Female)

" This was a very interesting process, and got me to thinking about what I want to do. Thank you." (44-49, Male)

"Thank you! I hope this will be the incentive I need to try again to lose weight." (35-39, Female)

" Very interesting hit! The talking woman had some realistic mannerisms while she spoke. Thanks!" (54-59, Male)

"Tanya was cute! Will look forward for more HITs from you." (>60, Female)

"Enjoyed the stories, will continue reading more"(40-44, Female)

Figure 5.5: User comments for the Agent interface.

5.5 Summary

The major findings from this study are

- Personal stories of successful health behavior change can be indexed automatically and used successfully for health interventions.
- Given that self-efficacy is one of the strongest predictors of successful health behavior change, the primary result from my summative evaluation indicates that a story-based health behavior change system could be effective at actually promoting change in users.
- The entire process from story collection, indexing, matching and discourse can be automated.

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Appendix A: Questionnaire for Processes of change

(CPRC, Weight: Decisional Balance Questionnaire)

The Questionnaire used for Identifying the processes of change

1. Does the author read about people who have successfully lost weight ?
2. Does the author engage in some other weight loss activity instead of eating/playing games/sleeping/watching TV/Driving ?
3. Does warnings about the health hazards of being overweight move the author emotionally ?
4. Does the author considers the belief that people who lose weight will help to improve the world ?
5. Is the author open with at least one special person about his weight problems ?
6. Does the author avoid places where people are eating a lot ?
7. Is the author rewarded by others when he loses/lost weight ?
8. Is author the object of discrimination because of his being overweight ?
9. Does the author take some type of medication/drugs/diet aids/diet pills/surgery to help him control/lose his weight ?
10. Does the author think about information from articles or ads concerning the benefits of losing weight ?
11. Does dramatic portrayals of the problems of overweight people affects the author emotionally ?
12. Does author have someone who listens when he needs to talk about losing weight ?
13. Does the author tell himself that he will be able to lose weight if he wants to ?
14. Does the author notice overweight people having a hard time buying attractive clothes ?
15. Does the author use information from articles and advertisements on how to lose weight ?
16. Does the author react emotionally to warnings about gaining too much weight ?
17. Does the author have someone whom he can count on when he has problems with overeating ?

18. Does the author feel that society is more supportive of thin people ?
19. Does the author recall information people have personally given him on how to lose weight ?
20. Does remembering studies about illnesses caused by being overweight upsets the author ?
21. Does the author make commitments to lose weight ?
22. Does the author struggle to alter his view of himself as an overweight person ?
23. Does the author's overweight makes him feel disappointed in himself ?
24. Does the author stop to think that overeating is taking more than his share of the world's food supply ?
25. Does the author change his personal relationships which contributes to his overweight ?
26. Does the author get upset when he thinks about his overweight/overeating/physical inactivity ?
27. Does the author considers the view that overeating/being overweight can be harmful to the environment or people around ?
28. Does the author relate less to people who contribute to his overweight ?
29. Does the author reward himself when he loses weight ?
30. Does the author tell himself that if he tries hard enough he can lose weight ?
31. Does the author reassess the fact that being content with himself includes losing weight/changing lifestyle(eating, exercise etc.) ?
32. Does the author put things around his home that reminds him to lose weight ?
33. Does the author have someone who understands his problems with his weight ?
34. Do other people in the author's daily life try to make him feel good when he loses weight ?
35. Does the author removes things from his place of work which contributes to his weight(Ex: Things that remind him of eating, television, vending machines etc.) ?
36. Does the author finds that doing other things (swimming, exercise, run, jog, working etc.) is a good substitute for activities contributing to his overweight (eating while watching TV, when tensed, etc.) ?

37. Does the author expect to be rewarded by others when he does physical work ?
38. When the author is tempted to eat, does he thinks about something else ?
39. Does the author keep things around his place of work that reminds him to lose weight ?
40. Does the author considers the idea that overeating could be harmful to world food supplies ?
41. Does the author ask people not to overeat in his presence ?
42. Does the author remove things from his home that remind him of eating ?
43. Does the author do something else instead of eating/watching TV/other activities contributing to overweight, when he needs to relax or deal with tension ?
44. Does the author removes things from his home that remind him of eating ?

Appendix B: Questionnaires for the Indexing evaluations

I. *SELF EFFICACY QUESTIONNAIRE

Imagine a situation where you've started/ are on weight loss journey. For each of the statements below, please indicate to what extent the statement reflects your opinion by circling one of the numbers.

I can always manage to solve difficult problems encountered in the weight loss if I try hard enough.

1	2	3	4	5	6	7
not at all			somewhat		very much	

On unforeseen circumstance during weight loss, I can find the means and ways to get what I want.

1	2	3	4	5	6	7
not at all			somewhat		very much	

I am certain that I can accomplish my goals of weight loss.

1	2	3	4	5	6	7
not at all			somewhat		very much	

I am confident that I could deal efficiently with unexpected events during weight loss.

1	2	3	4	5	6	7
not at all			somewhat		very much	

Thanks to my resourcefulness, I can handle unforeseen situations during my weight loss journey.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

not at all   somewhat   very much

I can solve most problems of weight loss if I invest the necessary effort.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

not at all   somewhat   very much

I can remain calm when facing difficulties during weight loss because I can rely on my coping abilities.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

not at all   somewhat   very much

When I am confronted with a problem during weight loss, I can find several solutions.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

not at all   somewhat   very much

If I'm in trouble during my weight loss journey, I can think of a good solution.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

not at all   somewhat   very much

I can handle whatever comes my way during my weight loss journey.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

not at all   somewhat   very much

II. *Decisional Balance (Pros and Cons Questionnaire)

(CPRC, Weight: Decisional Balance Questionnaire)

Scoring
Pros = all even numbered questions
Cons = all odd numbered questions

Each questions is a 5 point scale questions.

        1 = Not important at all
        2 = Slightly important
        3 = Moderately important
        4 = Very important
        5 = Extremely important

1. The exercises needed for me to lose weight would be a drudgery.

2. I would feel more optimistic if I lost weight.

3. I would be less productive.

4. I would feel sexier if I lost weight.

5. In order to lose weight I would be forced to eat less appetizing foods.

6. My self-respect would be greater if I lost weight.

7. My dieting could make meal planning more difficult for my family or housemates.

8. My family would be proud of me if I lost weight.

9. I would not be able to eat some of my favorite foods if I were trying to lose weight.

10. I would be less self-conscious if I lost weight.

11. Dieting would take the pleasure out of meals.

12. Others would have more respect for me if I lost weight.

13. I would have to cut down on some of my favorite activities if I try to lose weight.

14. I could wear more attractive clothing if I lost weight.

15. I would have to avoid some of my favorite places if I were trying to lose weight.

16. My health would improve if I lost weight.

17. Trying to lose weight could end up being expensive when everything is taken into account.

18. I would feel more energetic if I lost weight.

19. I would have to cut down on my favorite snacks while I was dieting.

20. I would be able to accomplish more if I carried fewer pounds.

III. Motivation and Support

1. How important is that you lose weight at this time ?

Not Important   Very Important

0   1   2   3   4   5

2. Have you tried to lose weight before ?

Yes   No

3. What factors have led you to successful weight loss ?

4. What factors have made weight loss difficult ?

5. Is your decision to lose weight your own or for someone else ?

My Own   Someone else

6. Is your family supportive ? If yes how much support can your family provide ?

Yes   No

No support   Much support

0   1   2   3   4   5

7. What are your interests in losing weight ?

Not Interested   Very Interested

0   1   2   3   4   5

8. Are you ready for lifestyle changes to be a part of your weight control program ?

Not Ready   Very Ready

0   1   2   3   4   5

9 . How confident are you that you can lose weight at this time ?

Not Confident   Very Confident

0   1   2   3   4   5

10. How much weight do you expect to lose ? _____

11. How fast do you expect to lose weight ? _____

12. What is your current weight ? _____

**13. What do you consider are benefits of weight loss program ?

_____
_____

_____
_____

_____
_____

**14. What do you think are the downsides of weight loss program ?

_____
_____

_____
_____

_____
_____

** These questions are asked during entry and exit of study.

IV. Exit Questionnaire

Enjoyability

1. Please rate how enjoyable was the story ?

Not at all enjoyable   Very Enjoyable

0   1   2   3   4   5

2. Was the story informative ?

Not at all informative   Very informative

0   1   2   3   4   5

3. (If the story was informative) Why was the story informative ?
_____ (Helped me learn new ways to lose weight, motivated me to begin weight loss etc.)

Identification

4. Could you identify yourself with the story/storyteller ?

Not at all   Very much

0   1   2   3   4   5

3. How close were the experiences of the person in the story with yourself ?

Not at all   Very much

0   1   2   3   4   5

5. Will you listen to another story if you weren't paid ?

    a. Yes

    b. No

    c. I am not sure

5. Will you have listen to another story if you were paid ?

    a. Yes

b. No

c. I am not sure

6. Would you prefer reading the story instead of listening ?

a. Yes

b. No

c. I don't mind either

d. I don't like either

Understability

7. How easy was the story to understand?

Not Much   Very Much

0   1   2   3   4   5

10. Would you tell your friends (or those who want to lose weight) this story ?

1. Definitely Yes
2. May be Yes
3. May be No
4. Definitely No

11. Would you like a copy of the story for reading again ?

1. Yes
2. May be later
3. No

V. Demographics Questionnaire

1. Can you tell me your age ?

10-20
20-30
30-40
40-50
50-60
60+

2. What is your gender ?

a. Male

b. Female

3. Where do you stay (City, State, Country)? _____

4. what is your race ? _____

5. Can you tell me your education levels ?

      a.   Some school
      b.   High school
      c.   Some College
      d.   Undergraduate Degree
      e.   Graduate Degree
      f.   Doctoral Degree

VI. Transtheoretical Model Stages of Change

1. Do you currently exercise at least once a week on a regular basis ?

    Yes => 2
     No => 4

2. On average, how many days per week do you exercise ?

    1 => 3
    2 => 3
    3 => 3
    4 => 3
    5 => 3
    6 => 3
    7 => 3

3. On average, how many minutes do you exercise each day ?

    10 => 5
    20 => 5
    30 => 5
    40 => 6
    50 => 6
    60 => 6
    70 => 6
    80 => 6
    90 => 6

100 => 6
110 => 6
>= 120 => 6

4. During the next 30 days, do you intend to begin exercising 5 or more days a week for at least 30 minutes each time ?

Yes => END

No => 5

5. During the next 6 months, do you intend to begin exercising 5 or more days a week for at least 30 minutes each time?

Yes => END

No => END

6.It's great that you are getting so much exercise. Have you been exercising at least 5 days per week for 30 minutes per day on a regular

basis for more than 6 months ??

Yes => END

No => END

Appendix C: CPRC (Cancer Prevention Research Center) questionnaire for processes of change

(All measures are copyright Cancer Prevention Research Center, 1991. Dr. James O. Prochaska, Director of the CPRC)

The following experiences can affect the weight of some people. Think of any similar experiences you may have in trying to lose weight or keep from gaining weight. Please rate how FREQUENTLY you use(d) each of these during the past month. There are FIVE possible responses to each of the questionnaire items. Please circle the number that best describes your experience.

1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Repeatedly (always)

1. I read about people who have successfully lost weight.

2. Instead of eating I engage in some physical activity.

3. Warnings about the health hazards of being overweight move me emotionally.

4. I consider the belief that people who lose weight will help to improve the world.

5. I can be open with at least one special person about my experience with overeating behavior.

6. I leave places where people are eating a lot.

7. I am rewarded by others when I lost weight.

8. I tell myself I can choose to over-eat or not.

9. My dependency on food makes me feel disappointed in myself.

10. I am the object of discrimination because of my being overweight.

11. I remove things from my place of work that remind me of eating.

12. I take some type of medication to help me control my weight.

13. I think about information from articles or ads concerning the benefits of losing weight.

14. I find that doing other things with my hands is a good substitute for eating.

15. Dramatic portrayals of the problems of overweight people affect me emotionally.

16. I stop to think that overeating is taking more than my share of the world's food supply.

17. I have someone who listens when I need to talk about my losing weight.

18. I change personal relationships which contribute to my overeating.

19. I expect to be rewarded by others when I don't overeat.

20. I tell myself that I am able to lose weight if I want to.

21. I get upset when I think about my overeating.

22. I notice that overweight people have a hard time buying attractive clothes.

23. I keep things around my place of work that remind me not to eat.

24. I use diet aids to help me lose weight.

25. I think about information from articles and advertisements on how to lose weight.

26. When I am tempted to eat, I think about something else.

27. I react emotionally to warnings about gaining too much weight.

28. I consider the view that overeating can be harmful to the environment.

29. I have someone whom I can count on when I am having problems with overeating.

30. I relate less often to people who contribute to my overeating.

31. I reward myself when I do not overeat.

32. I tell myself that if I try hard enough I can keep from overeating.

33. I reasses the fact that being content with myself includes changing my overeating.

34. I find society more supportive of thin people.

35. I put things around my home that remind me not to overeat.

36. I take drugs to help me control my weight.

37. I recall information people have personally given me on how to lose weight.

38. I do something else instead of eating when I need to relax or deal with tension.

39. Remembering studies about illnesses caused by being overweight upsets me.

40. I consider the idea that overeating could be harmful to world food supplies.

41. I have someone who understands my problems with eating.

42. I ask people not to overeat in my presence.

43. Other people in my daily life try to make me feel good when I do not overeat.

44. I make commitments to lose weight.

45. I struggle to alter my view of myself as an overweight person.

46. I notice the world's poor are asserting their rights to a greater share of the food supplies.

47. I remove things from my home that remind me of eating.

48. I take diet pills to help me lose weight.

Scoring

Consciousness Raising = 1, 13, 25, 37
Countercoditioning = 2, 14, 26, 38
Dramatic Relief = 3, 15, 27, 39
Environmental Reevaluation = 4, 16, 28, 40
Helping Relationships = 5, 17, 29, 41
Interpersonal Systems Control = 6, 18, 30, 42
Reinforcement Management = 7, 19, 31, 43
Self Liberation = 8, 20, 32, 44
Self Reevaluation = 9, 21, 33, 45
Social Liberation = 10, 22, 34, 46
Stimulus Control = 11, 23, 35, 47
Substance Use = 12, 24, 36, 48