Design for social-based reflection in Health Behavior Change

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1. Introduction

We all know, change in our life is unavoidable. As the Greek philosopher Heraclitus observed over 2,500 years ago, life itself is also change. One reason for human beings to change is to seek an approach to improve quality of life. For example, some people change their eating habits to lose weight then they could be much confident and get a better self-image; some people walk much more than before to increase their physical activities, and by doing so they could practice their body and become more healthy; some people start caring about water usage to save money and make contribution to green planet. All those changes are not only good for human beings but also for the whole planet, however, change is not so easy and always painful. Therefore, we need technology to help us achieve those changes.

reflection as a tool for behavior change has not been well studied before. However, since behavior change could be viewed as a process of learning, we could borrow a lot of theories and models from learning area to see what is reflection, how reflection works and how to support it in practice. Those researches in learning area could therefore provide cues for design reflection in behavior change. Furthermore, reflection is not just personal activity but a social activity which means reflection requires social support just as behavior change does. And previous researchers in health behavior change like Fish'n' steps, UbiFit, Houston already tried to provide social support features in their designs. For example, UbiFit allow user to share their step counts to peers so others could comment on it and give suggestion. But unfortunately there is no detail researches on what strategy and technology should be applied to facilitate social based reflection in behavior change. Therefore, I think this is a potential area that I could investigate and make contribution to the community.

In this report, I would firstly introduce related work about health behavior change and reflection. Via introducing the theories, models and designs developed before in health behavior change and reflection separately, I establish a well knowledge system of what have been done and not done. And therefore in next chapter I would first discuss the relation between reflection and behavior change then propose potential opportunities and challenges for design social-based reflection in health behavior change.
2. Related Work

2.1 health behavior change

2.1.1 The Transtheoretical Model of Behavior Change

Designing system to help individuals change their everyday behaviors is challenging. To well understand the process of changing, in psychology community, a lot of theories have already been developed. The most important and often used theory is Transtheoretical model of behavior change (Prochaska, Norcross et al. 1995), which describes a five-stage model (see Figure. 1) to define at each stage how people think and act to achieve the final change.

![Transtheoretical Model of Behavior Change](image)

Figure. 1 Transtheoretical Model of Behavior Change

The first stage is *precontemplation*. This is a stage meaning individual has no intention to do any change in the foreseeable future. At this stage, individual is no aware of problems in their life or underware of problems. People around the individual like friends, employee, parents perhaps know the problem and would exert pressure on the individual to force him/her to change. However, such change would not last for a long time and once the pressure is off, the individual would give up changing. Therefore, at this stage, the main work would focus on education. People need receive education to be aware of the problems in their life and understand why it is important to change.

Once the individual starts feeling uncomfortable to those problems in life, he/she would get to the new stage named *contemplation*. At this stage, the individual would accept the problems and start seeking the solution for it. However, people would not make commitment to take real action at this stage. They just draw the big picture about how to change in their mind and many people
would be stuck at this stage for a very long time. The main work at this stage is to explain the the pros and cons of the problem and provide the solution to the problem.

After contemplation, people would do preparation. This is a stage between contemplation and action, which gives people a transition period to create a climate where positive change would happen. People would try some small change like "I'll start drinking 2 cups of wine instead of 3 cups a day" to test whether it is possible to change and whether the solution they have is efficient. Action is the stage following preparation. At this stage, the individual would modify his/her behavior and change the attitude to overcome problems. They would follow the instructions to set goals and try to keep meeting goals to achieve change. For this two stage, people need positive feedback to encourage them keep changing and not give up, and progress report to tell them how is going. Instructions and appropriate goals should also be given to help users have a clear plan on how to change.

Maintenance is a stage in which people need support to avoid relapse and consolidate their achievement. Usually, if the individual could keep changing to a new behavior pattern for longer than six month, he/she would be considered at this stage. At this stage, the individual would need support for preventing relapse and reviewing the history of change then summarizing the strategy of change.

Although this model is widely recognized and used, some researchers like (Adams and White 2005) suggest that by focusing solely on the individual, contributing factors such as gender and income are consequently ignored by the TTM. Despite its limitations, the model remains a useful tool to identify where in the process of change an individual is at any one time. Rather than assess stage of change using stage-based questioning or questionnaire responses, we chose to categorise participants based on evidence of their behaviour and behavioural intent that arose during the interviews.

2.1.2 Theories on Behavior Change

2.1.2.1 Learning Theory

Learning theories emphasize that learning a new, complex pattern of behavior, like changing from a sedentary to an active lifestyle, normally requires modifying many of the small behaviors that compose an overall complex behavior. Principles of behavior modification suggest that a complex-pattern behavior, such as walking continuously for 30 minutes daily, can be learned by first breaking it down into smaller segments (e.g., walking for 10 minutes daily). Behaviors that are steps toward a final goal need to be reinforced and established first, with rewards given for partial accomplishment if necessary. Incremental increases, such as adding 5 minutes to the daily walking each week, are then made as the complex pattern of behavior is "shaped" toward the targeted goal. A further complication to the change process is that new patterns of physical activity behavior must replace or compete with former patterns of inactive behaviors that are often satisfying (e.g., watching television), habitual behaviors (e.g., parking close to the door), or behaviors cued by the environment (e.g., the presence of an elevator).
2.1.2.2 Social Learning Theory

Social learning theory, later renamed social cognitive theory, proposes that behavior change is affected by environmental influences, personal factors, and attributes of the behavior itself. Each may affect or be affected by either of the other two. A central tenet of social cognitive theory is the concept of self-efficacy. A person must believe in his or her capability to perform the behavior (i.e., the person must possess self-efficacy) and must perceive an incentive to do so (i.e., the person's positive expectations from performing the behavior must outweigh the negative expectations). Additionally, a person must value the outcomes or consequences that he or she believes will occur as a result of performing a specific behavior or action. Outcomes may be classified as having immediate benefits (e.g., feeling energized following physical activity) or long-term benefits (e.g., experiencing improvements in cardiovascular health as a result of physical activity). But because these expected outcomes are filtered through a person's expectations or perceptions of being able to perform the behavior in the first place, self-efficacy is believed to be the single most important characteristic that determines a person's behavior change. Self-efficacy can be increased in several ways, among them by providing clear instructions, providing the opportunity for skill development or training, and modeling the desired behavior. To be effective, models must evoke trust, admiration, and respect from the observer; models must not, however, appear to represent a level of behavior that the observer is unable to visualize attaining.

2.1.2.3 Reasoned/Planned Action

The theory of reasoned action states that individual performance of a given behavior is primarily determined by a person's intention to perform that behavior. This intention is determined by two major factors: the person's attitude toward the behavior (i.e., beliefs about the outcomes of the behavior and the value of these outcomes) and the influence of the person's social environment or subjective norm (i.e., beliefs about what other people think the person should do, as well as the person's motivation to comply with the opinions of others). The theory of planned behavior adds to the theory of reasoned action the concept of perceived control over the opportunities, resources, and skills necessary to perform a behavior. The concept of perceived behavioral control is similar to the concept of self-efficacy -- person's perception of his or her ability to perform the behavior. Perceived behavioral control over opportunities, resources, and skills necessary to perform a behavior is believed to be a critical aspect of behavior change processes.

2.1.3 Behavior Change and Computer Science

In computer science, the most important and widely recognized work for behavior change is persuasive technology. As defined by B.J. Fogg, persuasive technology is designed to persuade users into changing attitudes or behaviors through the support from various technologies, including mobile, web, physical interactive objects and so on (Fogg 2002). Technology, in persuasive technology, could play three roles:

- First of all, it could work as a tool to provide information and facilitate human beings' change via making tasks much easier to do.
Secondly, technology could work as media to allow people rehearsing experience and exploring causal relationships.

Finally, technology functions as social actors. This means technologies are able to deliver social influence like human beings do.

However, B.J. Fogg excludes the situation that technology work as mediation to convey persuasion between human beings. Such so-called computer-mediated communication solution is another type of system which could help people change behavior. It is used as a platform for human beings to share their own experience and receive feedback, deliver and amplify persuasive messages, and restructure communication processes to support behavior change.

Looking back previous research projects in health behavior change, they could be categorized into two groups according to different design purpose and method. The first group is mainly designed for supporting how to change which subscribes to monitor-feedback model. The monitor-feedback model means the system would provide monitoring tool to help user keep track user's own status or progress and deliver feedback either via computerized agents or social networks. Fish’n’Steps (Lin, Mamykina et al. 2006) is such an system designed as interactive game to encourage physical activity. In this project, each user is assigned a pedometer to monitor daily step count and this step count is linked to the emotional state, growth, and activity of a virtual fish displayed in a virtual fish tank with the fishes of other users on a kiosk in a common area of the user’s workplace. Individual progress is accessible through a website and this progress toward the user’s step count goal affects the growth of fishes (the higher the step count, the larger the fish) and the fish’s facial expression (happy for sufficient, angry for near-sufficient, and sad for insufficient progress). Insufficient progress from any user in the tank may result in murky water and the removal of decorations. In this design, the art representation (fishes) is used as feedback to user’s progress (monitored by user via pedometer). Similar research project like UbiFit (Consolvo, McDonald et al. 2009) also uses art representation (flowers and butterflies) to give feedback to users. Both of these two projects also employ social features to share own status with others and receive feedback from peers either via face-to-face communication or built-in communication channel.

Another group of design mainly aim to design interaction to motivate users' change. Such designs always take into account the combination of aesthetic and physical objects in daily environment. The Persuasive Mirror (Valle and Opalach 2005) is such a project aiming to motivate a lifestyle change by showing user the possible future based on user's current status. For example, if the user is a smoker, the mirror would show in the future the user is ill. Through showing unpleasant future, the mirror trigger the user to reflect on own lifestyle and seriously think starting to change. Breakaway (JafarINAimi, Forlizzi et al. 2005), another example in this group, uses a sculpture to reflect user's degree of fatigue. If the user sits on chair for a long period without break, then the sculpture would slump. It provides peripheral awareness to the user and motivate the user to plan having a break.
2.2 Reflection

As discussed above, for behavior change, researchers develop learning theories and social cognitive theory to explain how individual would finally change behavior through a process of learning either via practicing repeatedly based on guidelines or observing others and duplicate the behavior. The process of behavior change therefore is very similar with the idea "experiential learning" which is defined as making learning from direct experience. Therefore, a strong connection between behavior change and learning is established, and in this section, I would summarize theories and models on reflection from learning area to explain reflection in behavior change.

2.2.1 What is Reflection

For the term reflection, from physical sense, we would connect it with the mirror, viewing it as a reflected images of looking and seeing a parallel version of the world. From human view, reflection means think quietly, going through what we experienced before in our mind. And from group view, chatting with each other on previous experience like happy holiday, painful exams and graduation, or discussion on recent events are also refered to the term reflection.

Therefore, we see reflection is really common in our life and we all recognize it as important activity or phenomenon in our world. We need space and time to go over what happened before to us, think about the impact of those experience on ourselves, and maybe share and discuss those experience with our loved ones or even strangers. Reflection for us, human being, could be viewed as so common and nature as breathing. we know intuitively that we need reflection regularly to look back our life and learn from those experience in order to modify or improve our behavior and ability to match our expectations.

![Figure 2 Model of Reflection(Boud)](image-url)
In learning area, the term reflection is a very old term, which was widely used and discussed by many early educators like Aristotle, Plato, and Confucius. John Dewey, who is recognized as the one key originator of the the modern concept of reflection, viewed reflection as a method to solve problem via constructing an idea chain which links each piece of previous experience carefully with its predecessor (Dewey 1933). Based on Dewey's backbone work, Boud and his colleagues (Boud, Keogh et al. 1985) defined reflection as a form of response of the learner to experience. In their theory, the experience and the reflective activity based upon that experience comprise the reflection model (Figure 2). Experience here is defined as the total response, including feelings, thinks, does and concludes at the time and immediately thereafter, of a person to a situation or event, which from learning perspective could be a course or workshop you attend, or from behavior change perspective, could be the work you do to make change. After the experience, reflective activity would occur and this is a intellectual and affective process in which individual could engage to explore experiences in order to lead to new understandings and appreciations (which in the figure is the outcome of reflective process).

2.2.2 Time and Reflection

Considering how to connect reflection with time, the researcher Schön proposed reflection-on-action and reflection-in-action (Schön 1983). The former one describes reflection which occurs after practice happened. This type of reflection is the common one everyone knows and accepts. This is a way to re-think previous method which was used to solve a problem, and give people a chance to evaluate the method then next time some changes could happen. The other type of reflection is reflection-in-action. It's much more complex than the reflection-on-action because it occurs simultaneously while practice is happening. Such reflection could help people to re-think their decision making process and evaluate the decision based on current context and problem then modify the decision if needed. Later, based on Schön's work, McAlpine proposed reflection-for-action (McAlpine and Weston 2000), which means reflection could occur prior to practice. This sounds very similar with planning, however, they are different. Planning could happen without any connection with previous experience, but the reflection-for-action would take into account previous experience and then plan the future.

2.2.3 The Link Between Reflection and Action

While reflection is itself an experience, it is not, of course, an end in itself. The purpose of reflection is to making new outcome of experience which means reflection could always lead to new understandings, new actions and new feelings. Such changes in thought, behavior, and feeling may be very small or large. The new understandings on experience could build a new link between previous isolated experience and would lead to changes in behavior which make the individual improve the skill or ability to solve problem. The emotion outcome also involves changes in behavior. The positive feelings could increase confidence and make the individual challenge self to make new achievement, in contrast, negative feelings would make the individual uncomfortable and stop making efforts.
Also as Kemmis stated the reflection is not a purely internal psychological process but it's action oriented. We do reflection because we need to stop to think in order to plan how to do before to do something, choose right method and make decision while doing something, and go over something has happened. The reflection is a dialectical process which means it look inward at our thoughts and outward at the situation in which we find ourselves. We could link thought and action with each other via reflection because it connect the internal thought with external situation. Reflection therefore is such meta-thinking(thinking about thinking) in which we could understand the relationship between thought and action in a particular context.

2.2.4 How Reflection Works

To explain how individual links previous experience and reflect on experience, Boud and his colleagues break down the reflective process which described above into three major elements(stages): returning to the experience, attending to feelings and re-evaluating the experience. These three elements of reflective process even though they are separate but they are not distinct. In general, they would proceed in a sequence and may involve many cycles between stages.

2.2.4.1 Returning to experience

The first element in the reflective process is simply recollecting previous experience and replaying the whole experience in the mind. This element is so called returning to experience. Individual could do it via keeping a journal recording what happened or chatting with others to describe own story. It's a useful method to go over previous experience and look into every details about what you did and how you did it. Those things ignored before could be noted through this process and it create a chance for individual to reconsider and examine previous behaviors. Returning to experience ensure individual would reflect on what actually happened instead of what individual imaged or expected in the mind, and it could assist individual in continuing the reflective activity and move forward to next stage, attending to feelings.

One important thing at this stage is when individual returns to previous experience either via writing or talking, he or she should try avoid add any judgements into this process. Any personal judgements on previous experience would prevent individual noticing every details and make individual be fixed on a previous understanding on previous experience. The purpose of writing or talking previous experience, therefore, is to ensure individual could reflect on previous experience without being influenced by judgements.

2.2.4.2 Attending to Feelings

Emotions and feelings are always linked to experience and play an important role in learning. Depending on circumstances and our intentions, we should either work with emotional responses, find ways to enhance positive emotion or if it's negative emotion which could be barrier to reflection, we should try to recognize and remove it before we proceed reflective activity.

Positive emotion could work as catalyst to increase our own ability and confidence to cope with challenges. Once we return to experience, if we feel good and appreciate things what we did
before, we would be able to pursue both cognitive learning and to develop emotional lives. We could therefore see events more sharply and succeed in extract things available to us in any given situation to solve problems.

Except positive emotion, we would also feel sad, painful, and frustrated. Such negative emotions and feelings would be barrier to reflection and stop us from looking into details when we return to experience. We would refuse to change our understandings on previous experience and think we have already reached final correct interpretation on our experience. Heron(Heron J.1982) suggested such negative emotions stop our human capacities to respond flexibly and creatively to the current situation. Once this happened, we should try to either discharge or transform negative emotions and regain our flexibility and creativity to handle current situations.

2.2.4.3 Re-evaluating Experience
Re-evaluating experience is the most common stage we know about reflection. Usually most of people believe reflection is equal to re-evaluating previous experience, and it means people usually reflect on previous experience without returning to experience and attending to feelings. However, failing to do those two elements in reflective process would make us lose a great deal of value. We may find ourselves reflect on false experience which may affected by negative emotion or what we imaged in mind and we would also comprehend experience incorrectly.

For re-evaluating experience, it is broken into four elements:

- **Association**: connecting ideas and feelings that are part of the original experience with existing knowledge and attitudes
- **Integration**: integrating associations into a new whole or pattern, synthesis, discrimination, drawing conclusions
- **Validation**: subjecting integrated insights or meanings to reality tests, validation as rehearsal
- **Appropriation**: the new information/insight must be appropriated in a personal way if it is to be our own

These four elements are not stages people should pass through, but they are viewed as a whole and maybe some elements would tend to follow others.

2.2.5 Nature of Reflection - another model of reflection
The model developed by McAlpine(McAlpine, Weston et al. 1999) and his colleagues defines six components for reflection: goals, knowledge, action, monitoring, decision making, and corridor of tolerance(figure 3). This means reflection is driven by goals, resulting in plans drawn from knowledge, leading to actions that are constantly being revised and updated as feedback is monitored through the corridor of tolerance and decisions lead to adjustments in actions.
The reflection therefore could be viewed as an ongoing conversation between present action, past experience, and intentions for the future (Yinger 1990). It could work in different time frames and in different spheres or foci of reflection as defined above.

2.2.5.1 Action and Knowledge

Action and knowledge are two interrelated components which interact with each other. The action is an external arena in which plans are made, knowledge is transformed into behaviors, and goals are implemented. In contrast, the knowledge is an internal arena. It consists of both explicit knowledge which can be written down and learned from literature and emerging knowledge which is not explicit and can only be learned from experience. Knowledge provides the basic structure to guide how individuals do action and action could reverse update knowledge.

2.2.5.2 Goals

The goal, in this model of reflection, works as a core component which directs and constrains other components. As (Hays 1989; NeWell and Simon 1992) defined goal could direct behavior and also suggested by (Cranton 1989; Dick and Crey 1990; Gagne and Briggs 1979), goal works as a catalyst to drive instructional decisions. Hence, the interaction between knowledge and action is
linked to a specific goal that drive this thinking and action. Furthermore, other components may also work as feedback to goals therefore goals would not remain constant but change through time depend upon the interaction between other components.

2.2.5.3 Monitoring and Decision Making
Through observing the external environment and feedback, individual could know what is happening(has happened) then understand own action's impact on either external or internal objects. Such process is called monitoring and the information gained through this process is used to compared with goals to update knowledge. Another component discussed here is decision making. It allows knowledge to flow to and influence action. Individual makes decision based upon knowledge to match the preset goal. Thus the decision making is to maintain, initiate, adjust or terminate the plan as a result of monitoring or other feedbacks. Therefore, we could see this two components are visualized as mechanisms linking knowledge and action, but also directed and constained by goals.

2.2.5.4 Corridor of Tolerance
The corridor of tolerance means when individual assess behaviors through monitoring, if those behaviors fall within what the individual deems to be at least acceptable progress, the individual would not decide to change anything. There is no constant size or shape of this corridor of tolerance and the diameter and permeability of the corridor would vary depending on a range of factors.

2.2.6 Reflecton in HCI
Looking back the history in HCI area, reflection once was used as a tool to assist designers in designing interaction. It required both designers and users proceed reflective process to re-consider about the needs and design strategies in order to get a good design result. Later, researchers extend the concept of reflection and focus on how to use emotion and artistic representations to invite reflection. As example, Casual Information Visualization (Pousman, Stasko et al. 2007) and Slow Technology (Hallnas and Redstrom 2001) are such technology developed to help people reflect on everyday patterns. Casual Information Visualization aims to expand the definition of Information Visualization beyond work-related and analytical tasks to include nonexperts. Slow Technology is a design agenda aimed at encouraging the development of systems that foster users to slow down to reflect, rather than speeding up performance.

Recently, a workshop named "Designing for Reflection on Experience" was organized by Corina Sas and Alan Dix in CHI 2009(Sas and Dix 2009). This workshop was organized for the purpose of addressing the importance of designing interactive system which could support user's reflection on experience directly related to users' lives. It aims to explore the movement from designing for experience as interaction with technology, towards designing for reflection on felt-life experience captured by technology. By taking advantage of various sensor technology, we now could capture and record our life experience in detail and how to design system to invite reflection on those experience and assist sense making is a potential research area which is understudied yet. In
addition, reflective skill is largely underdeveloped, and reflection seldom happens frequently, therefore, reflection should be encouraged and supported via technology.

### 2.2.7 Reflection and Social

While reflection is always viewed as individual process some researchers like (Collier, 1999; Ward and Mc Cotter, 2004; Lee, 2005) point out that reflection is a developmental process which could be assisted by other people, and learned from other people. In Kemmis's central thesis work (Kemmis 1985), he proposed seven points for developing and studying reflection, in which he mentioned the reflection is not a purely individual process, and it should occur in a social context, just like language as a social process. It's a quite interesting point because before most researchers focused on how reflection occur individually, and viewed reflection as a pure individual process without considering it in a big social context. Here, Kemmis start this new research direction of reflection that focuses on social context and discusses how reflection is connected to social.

In Kemmis's theory, three observations are sufficient to convince us that reflection is not pure individual but social process:

First of all, even we all agree that reflection is kind of mind's conversation with itself, which means there is no explicitly language-based communication, instead it just happens in mind, very quiet and not visible for others. But at least we should admit such conversation prefigures language.

Secondly, the ideas and understandings which trigger reflection and give contents and forms for reflection are from outside of our mind. It's the social context provide those information and create the opportunity for reflection.

Thirdly, the fruit of reflection-action have their meaning and significance in social world, where others could understand us through the behaviors we do.

This insight theory of Kemmis states that reflection is not purely individual so it needs social theory to explain it and help others to understand it. The view of social life and social action could therefore build a rich social context in which reflection could be understood and studied beyond individualistically. And Kemmis's work also implies that not only the thinking of the individual is shaped by a social and cultural context, but also the social and cultural context itself is shaped by the thought and action of individuals. Therefore, well understanding of the dialetical relationship between individual and society would be helpful for the study of reflection.

In CSCL area, Hawkes and Romiszowski (Hawkes and Romiszowski 2001) identified several characteristics of computer-mediated communication as the potential avenue for reflective discourse:
(a) the speed, time, and place independence of the medium allows people to engage in dis-course, investigate related information, and construct, communicate, and refine ideas in which the thinking aspect of knowledge building is fully maximised;
(b) interaction on multiple conversational topics;
(c) the storage capacity of technology allows users to retrieve segments of a previous dis-cussions, to focus on ongoing dialogue, to challenge the accuracy of documented messages, and to eliminate the pressure and tedious note taking; and
(d) the text orientation tends to heavily omit unnecessary linguistic material to better orient and organise the structure and sequence of decision-making.

Moreover, computer networks offer new vistas for reflection and enable a greater degree of social reflection. Heng and Moor (Heng, Moor, 2003) explored the added value of technology to social reflection in light of Habermas’ communicative theory, noting that:
The advent of the Internet provides its users with a platform to conduct potentially open discussion, debate and exchange of information, which gives equal opportunity to the participants, and is free from constraints of power relations. It is a kind of communication infrastructure that approaches the requirements of a Habermasian communication, at least potentially.
In the Habermasian scheme of social life, there should be no obstruction to equal communicative exchange between social actors (participants/subjects) so as to allow them to challenge anything they deem important. In the technological sense, the infrastructure provided by the Internet and related networks helps to meet this requirement. Neutrality and transparency have been highlighted as the main strengths in the computer-mediated reflective discourse process (Heng, Moor, 2003). The neutral discourse procedures, and thus the supporting technologies, should ensure that equal weight is given to all opinions, while not forcing participants into accepting false consensus. Transparency of the discourse process allows participants and third parties to see not only the end results of discussion, but also how these outcomes come to be. The Internet and its associated technology thus provide us with the potential for developmental tools for building a fair playing field for an open forum.

3. Discussion: From Theories to Practice

In the previous chapter, the main theories and models in health behavior change and reflection are presented. Based upon those, in this chapter, I would firstly discuss how reflection and behavior change are related, and then analyze previous designs for fostering or facilitating social-based reflection in behavior change to discuss what lesson could be learned and discuss the challenges in design for reflection (from HCI perspective) would also be depicted.

3.1 The connection between reflection and health behavior change
In chapter 2, reflection and health behavior change are discussed separately. However, in their theories and practices also overlap. This means they two are also related with each other, with similarity and difference between them. I would explain this from three points of view:

First of all, both of them are goal-driven. For reflection, according to McAlpine's model, the goal is the core component of reflection. This means reflection would work driven and constrained by the goal one individual set. For instance, in learning area, researchers developed various interventions to support new teacher's reflection. The reason for foster or support such reflection is to help new teachers achieve their goals which is improving own teaching skills. Through their practice, they set the long-term goal or short-term goal for themselves and reflect on own practice to update teaching knowledge and skills. Similarly, for behavior change, one individual also set a goal either the final goal for a long-term change like losing weight or a small goal for a short-term change like walking more 1000 steps today.

Secondly, both designs for reflection and health behavior change value the monitoring. Monitoring in reflection provides the feedback to the individual decision based upon the goal. It is used to judge whether the decision the individual made, making, or will make is appropriate for the goal he or she want to achieve. Through observing the environment, other people, and own action, reflection help the individual evaluate the decision via using own knowledge and update the knowledge and shape the behavior. In design for reflection, monitoring could be achieved by either writing it down on a journal book or capturing photos or videos. Furthermore, in a social context, monitoring also means observing others just as social learning theory described. Similarly, for health behavior change, monitoring also is used as a key tool. Except for traditional monitoring tools like journal books, photos and videos, various sensors are used to monitor the individual physical status like body weight, blood sugar level and heart rate and those records from sensors provide the individual with cues about own healthy status and support tracking healthy progress. And thus monitoring help the individual to make appropriate decision on how to change own behavior to get a better and healthy life. The difference between monitoring in reflection and monitoring in health behavior change may be the difference in objects which the individual monitor. In reflection, what the individual monitor is the whole experience like the whole lecture one teacher delivered. In contrast, for health behavior change, the object monitored is one piece of data which comprise the whole experience(changing behavior). Therefore, when we apply the design method for reflection from learning area into health behavior change, we should notice such difference.

Finally, reflection could be viewed as the key tool to encourage self-motivated behavior change. As discussed above, reflection is goal-driven and through monitoring people would update their knowledge and shape own behaviors. I view such reflection process as self-motivated behavior change as opposite to the behavior change persuaded. For persuasive technology, the key idea is persuasion and it means people change behavior though interacting and being influenced by external elements. However, for reflection(or maybe called reflection technology), people themselves involve in the thinking process. Through monitoring the external environment, people and own actions, people could finally make new decisions to change their behavior to make
themselves much perfect. And I believe such behavior change which is driven by reflection, is much sustainable than behavior change motivated by persuasion.

3.2 Lesson learned: Model, Opportunities and Challenges

3.2.1 The Design Model

Via analyzing previous design for fostering or supporting reflection in social context, there is a design model could be summarized. The "monitor-share-feedback" model which is based on the "monitor-feedback" model described above depicts the process that one individual would monitor own action and share what is monitored with others to receive feedback from others in order to reflect. Followings I would introduce each component in this model to explain how to design interaction for reflection in behavior change.

For monitoring, at first, researchers use journal books in their study and point out journal book is the primary tool for recording experience. Later, researchers try to use photos (Frost and Smith 2003; Fleck and Fitzpatrick 2009) and videos to record much rich content. Compared with journal book, such multimedia monitoring technology has several advantages. First, it support returning to experience as mentioned in boud's model. Since multimedia technology could provide much detail information than the text written down and it therefore could help people return to experience much precisely. Secondly, multimedia provides context information such as time, place and other environment information which would be useful for later discussion. Thirdly, multimedia allow people notice things missed before. Since when using journal book, one individual would just write down things he or she could remember or highlight, but multimedia like photos and videos could record those information without missing them.

For feedback, previous designs mainly focus on guidance reflection. This means in a social context, people would be grouped and some experts involved in then experts would guide people in group to reflect through providing cue questions or suggestion as feedback to shared experience. The guidance reflection is a method widely used in learning area and is viewed as important tool for fostering or supporting reflection (Donaghy and Morss 2000). The project in HCI area named MAHI (Mamykina, Mynatt et al. 2008) also provides such guidance reflection through assigning diabetes experts to patients. In the study, experts comment on patients' food photo log to ask questions like why you eat this, why you do not get enough fruit in order to help patients reflect on their eating behavior. Another type of feedback is discussion. It's different from guidance reflection because it may not involve any cue questions that would trigger reflection. Instead, discussion means peers or experts would comment on experience to express their own opinions.

In the last, the sharing component in the design model focus on what type of communication channel it use. In learning area, sharing always happens in face-to-face form. However, in HCI area, experience are shared via website, social network sites (Li, Dey et al. 2009), built-in communication channel (ubifit), ambient display (Wisneski, Ishii et al. 1998) and face-to-face.
3.2.2 Opportunities and Challenges

Through discussing in chapter 2 and previous section, I summarize potential opportunities and challenges in design for social-based reflection in behavior change.

3.2.2.1. Link practice with theory

In health behavior change, less studies explicitly state the design take into account reflection. However, I still view those projects using "monitor-share-feedback" model as reflection-driven behavior change. But the problem in their design is designs for reflection actually lack the support from theories. In their study, there is no theory stated to explain why they design the interaction in that way and why it is possible to support reflection. The drawback of lacking theory is once the design fails we could not know whether it's because researchers use wrong theory or the theory has drawbacks or whether they apply the theory in a wrong way. Furthermore, there is also not link between health behavior change model and reflection theory. Considering about the transtheoretical model, it points out people at different stage would need different support. But whether it is true that people at different stage also need different technology and strategies to support reflection is another question researchers should investigate.

3.2.2.2. Beyond Reflection-on-Action

Previous designs are always targeted to reflection-on-action, however, there are also other two types of reflection called reflection-in-action and reflection-for-action. Projects like reflectons(Sadi 2008) conducted by MIT investigate the possibility to support reflection during eating via installing a sensor on the folk. Via using the folk, individual would get feedback from it to know how fast he or she is eating and reflect on such eating behavior. The design for reflection-in-action and reflection-for-action would be useful since for some behavior change like increasing physical activity, if we could provide reflection-in-action, then users could better understand what’s the barrier for them to walk much more or run much further when they are practicing.

Moreover, reflection-for-action support the view I described above that reflection could lead to behavior change and motivate individual to start changing. One example may be the breakaway project mentioned before, that the sculpture is used to stimulate the individual to think about whether I am tired and whether I should get a break. This is a design therefore so-called reflection for break(reflection-for-action).

3.2.2.3. Investigate Different Communication Channels for Sharing

In previous designs for health behavior change in HCI, most of them provide the social support via establishing a light-weight built-in communication channel or stand-alone new websites. Like in UbiFit, users could share their own step count via built-in communication channel to other peers and get feedback. And also in Fish'n'Steps, there is a new stand-alone website was developed in study. However, the drawback of such design are:
1) the log-on rate is very low. One research done by (Christensen, Griffiths et al. 2009) showed that the adherence to stand-alone website intervention for depression and anxiety is as low as 1%, and

2) it can not keep user active in the web community. Even though at start, users would feel excited to log-on the site frequently, the log-on rate would decrease over time. (Norman, Zabinski et al. 2007)

In contrast, social support could be built into a existed popular social network like Facebook. There are several reasons to do it. First, users could reuse their social networks instead of establishing and maintaining a new social network. It's much easier to share information with people who users already known instead of strangers. Second, people log on those existed social network site more frequently. Research shows nearly 50% active users visit Facebook every day (Facebook 2010). And the third, it's much easier for user to use the existed social network instead of being familiar with a new one. It's very convenient for a user to understand how to use twiter to type into information and control it visibility. But for a new social site, it means users are required to learn it.

However, design social support in a existed social network also requires designers consider several issues. (Munson, Lauterbach et al. 2010) have ran a study to investigate whether deploying a intervention in Facebook is better than deploying it in a stand-alone site. In their study, they developed one facebook application and one stand-alone site to require users report the good things they experienced. Among total 55 active users in whole study, they found that averagely participants in stand-alone website posted 0.83 good things per day and it's higher than those in the Facebook condition who posted good things from 0.38 to 0.47 per day averagely. Even though it's disappointed that Facebook does not increase the post rate, they still found there is very low dropout rate in Facebook condition compared with stand-alone condition. The result of the study thus showed two valuable points:

1) Users prefer Facebook to the stand-alone site, and they would keep active in such existed network. The idea of integrating intervention into existed network therefore is shown viable.

2) Users do not want to pollute friends newfeed. This the reason why participants in Facebook condition posted less. Since once participant post the good things, it would be set visible to every one he or she is connected. Therefore, it is possible that if one user update the good things too frequently, some guys who do not want to see it would be disturbed. There should be a mechanism to allow user control the visibility of their post to limit just people who are not only in Facebook connection but also in intervention connection could see the information they shared, so they could do not worry about over-posting in a existed network.

Except for social networks, other communication channels like ambient display is also valuable. And there is still less studies done to determine which channel with what strategies is much efficient for one particular type of reflection and behavior change. Therefore, it would be great opportunity for researchers to run study to find out the answer.

3.2.2.4 Evaluation of Design
Most research projects for health behavior change in HCI area subscribe to the monitor-share-feedback model I describe before. However, there is less study investigating whether providing those basic sharing and feedback component in the design help the user develop reflective thinking skill and support the user reflect on own behavior change. In learning area, those interventions designed for teachers or students to reflect on their practice investigate either quantitative evidence or qualitative evidence that would

For any design in any discipline, the evaluation is conducted to check whether the design works as researchers expected and measure the outcome to see its effectiveness. However, since the design for reflection in behavior change actually is a combination of design for health, design for HCI, and design for learning, it makes the evaluation become complex. Thus two challenges for evaluation should be taken into account:

1) what outcomes/evidences should be expected and measured?
From HCI perspective, the evaluation always focus on whether the technology/interaction is acceptable, whether the technology is usable and engaging and also whether the technology change the behavior. The prior two questions are common in HCI evaluation and have already been well-studied. The final evidence is new for HCI and usually, it is measured via self-report achievement as same as the method used in health area.
Moreover, sometimes both areas would also use objective data like BMI to measure the outcome to prove there is really changes in behavior and such change has succeeded.

2) How to run the study?
For study in health area, usually a study would last for months. As shown in a review paper(), among 13 studies for physical activities, 8 studies last 2months or less and others last more than 3 months. However, studies in HCI area would last less than 3 month and usually just last 2-3 weeks. In addition, the number of participants in health area seems always larger than number of participants in HCI area. Therefore, the challenge here is if we design for health behavior change, whether we should run study like researchers in health area do? if not, could short evaluation be significant to prove our intervention work? and what's the possibility that we HCI researcher could cooperate with researchers in health area to evaluate the design? At which point that we HCI researcher could hand the work off to health researchers to continue?

5 Future Plan

Although there is the potential for a great deal of work in the design for social-based reflection in health behavior change, I would mainly focus on investigating how to support three different types of reflection for health behavior change through different communication channels. Through this work, it would provide further research with the solid background and guidance that how to choose right technology with right strategies to deliver social support for reflection in behavior change. In addition, this study would also investigate the evaluation for reflection in behavior change, and potential contribution would be new evaluation method or study design method. Finally this study would also provide researchers in HCI area with the knowledge in relationships between practice and theories developed in psychology, health, and learning area.
5.1 Pre-Mini Thesis Work Packages

5.1.1 WP1: Design for Reflection-on-action in Health Behavior Change

Method (Total 24 weeks)
The first work package would focus on design for reflection-on-action. Firstly, I would investigate whether reflection truly make better behavior change via running a small study. Then, I would revisit literature and update my own skills to develop prototype for next study. The next study would try to compare three different communication channels and do both quantitative and qualitative data analysis to understand the user’s characteristic and interaction features in each condition.

Tasks
• Literature Search (3 weeks)
I will revisit literature in the area of supporting reflection in learning area to re-summarize the technologies used before and investigating previous researchs on different social communication channels.
• Skills Update (3 weeks)
I will update my programming skills, particularly focusing on improving my knowledge of web programming.
• Prototype Implementation (estimate 4 weeks)
Prototype for study will be implemented.
• Field Study (estimate 4 weeks)
Deploy the prototype and run the field study to collect both quantitative and qualitative data
• Data Analysis (2 weeks)
Analyze the data collected
• Re-design prototype and re-evaluate(estimate 8 weeks)
Based on result of data analysis I would try to re-design prototype and re-run the study to see whether new design could fix problems.

5.1.2 WP2 Revisiting Literature

Method (Total 6 weeks)
There would be a new issue of International Journal of Human—Computer Studies (IJHCS) in Feb 2011. This new issue would be a special Issue on Designing for Reflection on Personal Experience. Therefore I would like to read those journal articals and related papers. Then I would link those projects with my previous work in work package 1 to find out similarity and difference. And this work would provide me the cue for the work after mini-thesis.
5.2 Post-Mini Thesis Work Packages

5.2.1 WP3: Design for Reflection-in-action and Reflection-for-action

Method
Based upon the WP1 and WP2, I plan to design for reflection-in-action and reflection-for-action at this stage. I expect the physical interactive method would be best choice for this two reflection. So in this work package, I would firstly run a similar study in WP1 to verify my hypothesis and then mainly focus on what the characteristic of physical interaction (as mediator for communication) would be valuable to support these two types of reflection.

5.2.2 WP4: Summarizing Research

Method
At the final stage of my PhD work, I would summarize the work done in WP1 and WP3. A expected guidance for designing social-based reflection in behavior change would be presented. This work would finally presented as design implications for future application and also it would summarize the evaluation issues discovered through the whole study.
Reference


