Contemplative Interactions: Exploring the Use of Defamiliarization in a Serious Game to Promote Reflective Thinking about Personal Health

Joshua Wong
joshuawewong@gmail.com
Saw Swee Hock School of Public
Health, National University of
Singapore
Singapore

Pin Sym Foong
pinsym@nus.edu.sg
Telehealth Core, National University
Health System
Singapore

Alex Mitchell
alexm@nus.edu.sg
Department of Communications and
New Media, National University of
Singapore
Singapore

ABSTRACT

Counsellors use Motivational Interviewing (MI) to boost intrinsic motivation for healthier lifestyles by supporting 1) the identification of personal values and 2) the linking of these values to personal reasons for change. Research is needed to increase the reach of such interventions through the use of online tools. Thus, we explored the use of defamiliarization and poetic gameplay in a serious game, to make habitual health choices difficult and ‘unfamiliar’ in order to promote players’ contemplation about their personal reasons for health. Our evaluation indicates that the players demonstrated evidence of processes of change such as *self-reevaluation*, *environmental reevaluation*, and *improving decisional clarity*. We observed that these methods could promote dialogic reflection with different points of view, but was less effective at promoting transformative reflection that would lead to change. We conclude with a discussion of promising future directions for research.

CCS CONCEPTS

• **Applied computing** → **Consumer health**.

KEYWORDS

motivational interviewing, chronic disease, serious games, reflection

ACM Reference Format:

Joshua Wong, Pin Sym Foong, and Alex Mitchell. 2021. Contemplative Interactions: Exploring the Use of Defamiliarization in a Serious Game to Promote Reflective Thinking about Personal Health. In *Designing Interactive Systems Conference 2021 (DIS '21)*, June 28–July 2, 2021, Virtual Event, USA. ACM, New York, NY, USA, 15 pages. <https://doi.org/10.1145/3461778.3462046>

1 INTRODUCTION

The incidence of chronic disease is growing. Globally, an estimated 463 million adults live with diabetes [55], and cardiovascular diseases are the number one cause of death [54]. Although lifestyle change can improve health outcomes, it is difficult to change habits

without help. Personal health coaches for lifestyle change can be effective agents for change [46], but this option is limited in reach due to the cost and need for trained personnel who can support and motivate people on this journey.

To improve reach, researchers have studied how to use motivational interviewing (MI) in more scalable online tools. MI is an evidence-based method that has been successful in promoting behaviour change in stubborn habits such as substance abuse and health-related behaviours [28]. MI is delivered over multiple therapist-client conversations about change, often structured using the Trans Theoretical Model of Change (TTM) [47]. During these conversations, therapists use various techniques to listen and support in order to move clients from not being ready for change, to making behaviour plans and executing them.

When MI is used in designing persuasive health systems, the focus has thus far been on using MI’s behavioural counselling methods when designing for reflection on quantified, tracked behaviour, e.g. [22]. This is an important and necessary step, which can support behaviour change by objective documentation of behavioural results such as step counts or diet choices [3, 22, 30, 43]. This focus on tracking data maps to the stages of Preparation, Action and Maintenance of the TTM (Fig.1). In these active stages, the patient has already started on the target behaviour, and therefore the systems that track these behaviours may also be employed in supporting motivational efforts.

In contrast, less attention has been paid to the use of persuasive health systems for people at earlier, less motivated stages of the TTM (Fig.1, Precontemplation and Contemplation). People in these stages may not have manifested the target health behaviour, have minimal intrinsic motivation to change target behaviours, and are certainly not ready to be actively tracking the desired health behaviours.

In fact, in a counselling session, a therapist who recognizes that a client is not quite ready for change would avoid focus on the target behaviours, to avoid the risk of alienating the patient [34]. Instead the therapist would employ a series of techniques to support the clients, such as *self re-evaluation* (reappraisal of values by the individual with respect to the problem behavior) and *consciousness raising* (increasing awareness of the problem behaviour). The goal would be to 1) elicit or clarify personal life values or goals and 2) connect these goals to the advantages and disadvantages of healthier life choices.

This work is licensed under a Creative Commons Attribution International 4.0 License.

DIS '21, June 28–July 2, 2021, Virtual Event, USA
© 2021 Copyright held by the owner/author(s).
ACM ISBN 978-1-4503-8476-6/21/06.
<https://doi.org/10.1145/3461778.3462046>

Figure 1: The 5 stages of change in the Trans Theoretical Model (dark green) and the 10 (light green) processes of change, as described in [1]. The * indicates the techniques discussed in this study.

For example, imagine that a client, Siti, has worked with her therapist to consider carefully what her life value or goal might be. Eventually, she realizes her personal life value lies in caring for her extended family. In MI, her therapist might then help her to connect “exercising for a healthier body” with “energy to care for her loved ones.” By connecting healthier daily habits with meaningful personal goals, the therapist can strengthen Siti’s conviction and intrinsic motivation for change. However, such insight about oneself usually requires introspective and contemplative thought.

Earlier work on incorporating contemplation in the MI sense into an online tool has met with the challenge of promoting reflective, sustained thought while avoiding loading the user with a too high burden of input which can reduce satisfaction with the engagement [15]. Our review of the literature suggests that there is a need for more engaging methods of interaction that help the user to re-evaluate their values and their social environment in ways that can help them strengthen their motivation for change. Hence, we turned to interactive narrative research to draw on methods to defamiliarize habitual thought, in order to encourage what we call *contemplative interactions*. By using research through design (RtD) methods, we iteratively explored techniques to support defamiliarization of health choices - that is, to make habitual health choices difficult and ‘unfamiliar’, in order to call attention to the thought processes by which those choices are made.

Using these insights, we developed a serious game, *Family Priorities*, where the user plays the role of Siti, a 55 year old housewife. The player explores Siti’s health choices in a role-playing format. We conducted a formative evaluation of *Family Priorities* with 15 players above 40 years old with experience of chronic disease, using a retrospective think aloud method. We also interviewed players post-game. Analysis of the content showed that playing *Family Priorities* led to contemplation about health choices in insightful, reflective, but not yet transformative ways.

With this study, we contribute 1) an exploration of the use of interactive narrative devices for designing defamiliarization towards promoting contemplation, and 2) an interactive, persuasive health

game designed to promote contemplation. Finally, we discuss issues encountered during the design process and suggest future areas of research towards designing tools for contemplation of personal motivation for health behaviours.

2 BACKGROUND AND RELATED WORK

In this section we will review the literature on behaviour change, using the more action-based and more contemplation-based stages of the TTM to contextualize the methods and outcomes of the previous work. We then summarize previous uses of web-based tools for contemplation, and briefly survey the related work in interactive life stories that we draw upon to develop our approach.

2.1 Promoting Behaviour Change through Action

Previous research that draws on motivational interviewing and its mechanism of reflection on health behaviours have taken on two forms: conversational techniques, and reflection on health data.

Firstly, there is the development of conversational techniques, usually (but not always) based on conversational agents. In this body of work, researchers select from the plethora of MI and counselling techniques and strive to recreate these conversational techniques in an interactive system. Earlier work began with the use of open ended questions and answer web-forms to support this process [14, 15, 40, 41]. Friederichs et al. [15] tested a mix of multiple-choice questions and open-ended text questions for this purpose. They concluded that the addition of open-ended questions with text-box input could stimulate more thinking about the users’ priorities, but that this approach should be balanced with multiple-choice questions for ease of use. Their evaluation of this mixed approach within a health promotion program resulted in improved motivation scores and increased physical activity compared to the control group [14]. However, they suggest that more work is needed to determined an optimal balance between open and close-ended questions.

More recent efforts have pushed the boundaries of the conversational nature of the persuasive health system, turning to conversational agents to further simulate key elements of therapeutic dialogue. This body of work has contributed the use of conversational agents that simulate active listening techniques [45], identify change talk and sustain talk in client responses [44], coerce change talk [44], and create more empathetic conversational agent responses [26]. The progress here has been promising, but the authenticity of responses by conversational agents continues to be challenged by issues of following the rules of human speech [10], particularly where bonding and trust are needed. More work is needed to place the use of conversational agents within the spectrum of needs that a patient has [13], and we conclude that for now it remains complex to apply conversational agents within sensitive interventions such as motivational interviewing.

A second body of work supports reflection on health data. In this area, there have been many contributions on shaping the presentation of health data for the user to reflect upon, with the goal of motivating behaviour change. Li et al.'s stage-based model emphasizes the role of reflection as a key component of change [24]. Mamykina et al.'s work studied sensemaking and showed that learning from one's own experiences is a valuable promoter of reflection on health behaviours [30]. Kocielnik's work furthered the field by questioning the presentation of behavioural data alone as sufficient to promote reflection and behaviour change [21]. Instead, by utilizing evocative questions to promote reflection on health data Kocielnik's work has shown improved outcomes in motivation, empowerment and adoption of new behaviours compared to the control condition, a behavioural data only system that did not have explicit scaffolding for reflection [22].

However, as mentioned above, this body of research is based on the assumption that users have already made some move toward collecting data on their health behaviours. Such users fit the description of being in one of the more motivated stages of the Trans-Theoretical model of Behavioural change (TTM): Preparation - where they feel ready for change, and may be starting to make small steps toward changing the target behaviour; Action - actually undertaking the targeted health behaviour; or Maintenance - having undertaken lifestyle change, they are working to prevent relapse. In other words, this research is mainly applicable to users who have undertaken change, have data on behaviour, and can reflect on such data.

2.2 Promoting Behaviour Change through Contemplation

A key implication of the TTM is that each stage requires different processes of change to move people to the next stage (see Fig. 1). These drivers of change may overlap or may be completely exclusive. For example, in the action and maintenance stages, *reinforcement management* or *stimulus control* are key processes that lead to change. Based on this, it is appropriate for the persuasive health system to focus on clearly documenting successes, or scaffolding reflection on areas where the target behaviour has lapsed.

On the other hand, in the stages of change before Preparation, the TTM describes people as not being ready for change and not being interested in any kind of behaviour change (Pre-Contemplative),

or considering behaviour change but not having embarked on the matter (Contemplative) [47]. In face-to-face MI for these clients, therapists would focus on helping clients to discover what their personal reasons for change might be. When doing so, it is critical that the therapist "does not argue in favour of change or restraint, but helps the patients do this for themselves." [29].

So, for example, the therapist may pose the question of what the client prioritises in their lives, or what it means for them to have a high quality of life. People who are low in intrinsic motivation to change often do not have ready answers, and may require considerable introspection to be able to state these priorities. The MI techniques used here aim to encourage the processes of change such as *consciousness raising* (seeking new information about target behaviour), *dramatic relief* (experiencing feelings about the target behaviour), or *self-reevaluation* (emotional and cognitive reappraisal of values surrounding the target behaviour) [47]. The therapist may also move to focus on *decisional balance*, a concept from MI, where clients are led to discover their personal pros and cons of change. Both MI and the TTM emphasize the importance of this journey for increasing intrinsic motivation [33].

When successful, this process leads to each client finding their personal reasons for change. For example, Client A may discern that her life goal is to have a long and productive career, whereas Client B may discover fulfillment in his appearance. These two clients may be considering a new exercise routine, but the personal meaning of that behaviour might be quite different. Client A might say: "I want to walk more every day so that I am healthy enough to be in the office every morning". In contrast, Client B might say: "I want to walk more every day so that I can continue to be slim enough to dress well."

In persuasive systems research, there have been a handful of attempts at creating systems that explicitly promote contemplation of personal choices in lifestyle change behaviour. While a large body of work exists in mindfulness and slow interactions [32, 51] that promote slowing down and being contemplative, these have not yet been used within a health promotion agenda.

2.3 MI health programs that use web-based tools for contemplation

Liu et al. [27] developed iNTouch, a web-based e-therapy system to promote self-awareness and resolve ambivalence. Targeted at youth, the system supports them in tracking observations of daily living with the goal of reducing obesity. One component of the system enabled contemplation of values via the explicit selection from a deck of youth-centric values. iNTouch's human counsellors could then use these discerned values to help youth develop motivation for healthier behaviour.

Lim et al.'s work among people with multiple chronic diseases [25] sheds light on the process of contemplating health choices. After having scaffolded conversations with the researchers over their personal values in chronic care choices, the participants of the study reported that the study activities themselves were opportunities to "slow down and think" about the link between values and self-care, evolve perspectives, recognize misalignments and consider changes. These are all important processes of change in the contemplative stages of MI. In particular, the authors identified

the defamiliarization of everyday routines as supportive of identifying values that may be subconscious, and not easy to state clearly. They further cautioned that the presence of the researchers during the interviews facilitated these conversations, and that it would be challenging to create a system without such support.

One such attempt to create an automated online counseling system was a project our research collaborators developed. Nolan et al. [42] delivered an e-counseling program via weekly web-based sessions, structured around the trans-theoretical model of change (TTM). In the MI counselling weeks, users view narrative videos of characters undergoing change, read the accompanying counselling content in weekly sessions, and respond to questions posed in online forms (open-text input), probing their motivations for change. The program has a whole resulted in better health outcomes for some sub-groups and overall quality of life improvements [42]. Unfortunately, the authors had not studied the particular research question of how users were responding to the online forms as tools for promoting contemplation.

For insight into this question, we turned to Friedrich et al.'s randomized trial study comparing user responses to open-ended questions versus multiple choice versus a combination of these input techniques. The authors show that open-ended questions may enhance the users' sense of autonomy and should be favored in MI-type applications for this reason. However, users also appreciated the open-ended questions less than the combination of open-ended and multiple choice questions. The authors speculate that this may be due to input burden, but were unable to confirm this conclusion. They suggest that a combination of open-ended questions and multiple choice questions is desirable, but further work is needed on how to optimally combine these input techniques within an MI program.

2.4 Turn to Interactive Narratives and Poetic Gameplay

Our work leverages previous findings that suggest the defamiliarization of daily living habits can work towards creating a personal narrative for change [22, 25, 27]. However, such personal insight is not easily gained. Even in face to face MI counselling, these breakthroughs are gained through multiple soul-searching conversations with a trained therapist. For guidance, we turned to research on interactive narratives that are engaging, thought-provoking, and yet have a low burden of input. In the following section, we detail the progress made in interactive narratives and serious games for provoking reflection, and focus in particular on the work on computer-mediated interactive life stories.

There has been significant work to explore the potential of serious games and interactive narrative systems to encourage behaviour change and reflection. For example, work has been done to explore the use of narrative simulations to teach problem-solving skills to the parents of pediatric cancer patients [31], improve recognition of heart attack symptoms and change behaviour to reduce delay in seeking treatment [49], reduce risky behaviour of men who have sex with men [53], and improve daily living abilities of people caring for relatives with Alzheimer's disease [7] or traumatic brain injury [6]. The key learning from this work is that role-playing and avatar identification can be carefully designed to create a

connection or empathy between the player and the character being played within the simulation or game, with the intention of using this to encourage insight, learning and/or behaviour change.

There has also been work in the design of persuasive games to encourage attitudinal and behavioral change. Of note is work done by Kaufman and colleagues [18, 19] where they experimented with different methods such as hiding the persuasive intent of the game through intermixing serious and light-hearted content, obfuscating the topic that was to be addressed, and creating a psychological distance from the game scenarios to real life for safe exploration. By employing these methods, they showed that paradoxically, creating persuasive games that were not directly addressing the issues but instead had values 'embedded' in them were able to effect attitudinal change to a much greater extent than if games were designed to overtly address the issues through a mix of factual or informational content. On the other hand, when Khaled [20] proposed a framework for Reflective Game Design, she suggested that unlike serious games or games built for entertainment, games designed for reflection needed to privilege certain values that run counter to existing design trends. Specifically, reflective games needed to privilege Questions over Answers, Clarity over Stealth, Disruption over Comfort, and Reflection over Immersion. Work has also been done by Mitgutsch and Weise [39] to explore the use of subversive design patterns to force players to rethink their expectations and interpretations.

Closely linked to interactive narrative systems is the field of computer-mediated interactive life stories. The key difference is that interactive life stories aim for the player to explore and understand the life story of another *person*, as opposed to exploring a fictional world alone. Chew and Mitchell [8] studied interactive life stories, and identified particular, deliberate manipulations of a game's interactive feedback loop that can be used to evoke a game character's subjective experience for the player, such as the experience of psychological depression as viewed from the inside. This can be seen as a form of "defamiliarization".

According to Tsur [52], defamiliarization involves "prolonging the process of perception" through the "systematic disturbance of the categorization process". In other words, by disturbing the ways that people categorize scenarios, standard forms and processes, we can make them pay attention to their perceptions of the text they are interacting with. Mitchell [35] in turn used this definition to describe a new concept called "poetic gameplay", which he defines as "the structuring of the actions the player takes within a game, and the responses the game provides to those actions, in a way that draws attention to the form of the game, and by doing so encourages the player to reflect upon and see that structure in a new way". Chew and Mitchell [9] then proceeded to develop a taxonomy of methods previously used to create such poetic gameplay. These literary devices "not only draw attention to the form of the work through defamiliarization but also... subsequently draw the player back into the narrative by foregrounding the emotions provoked as part of the story" (p.3). Defamiliarization can be seen as conceptually similar to the process of *breakdown*, or disrupting people's routinized actions or thought patterns with an encounter of surprise [23] as a means of encouraging reflection. This suggests that exploring the use of defamiliarization and poetic gameplay as a means to encourage reflection on health habits is a promising

direction to explore, one that has not been investigated in the existing literature on persuasive health systems.

2.5 Research Question

In persuasive health systems, more work is needed to develop scalable online tools that support people in the less motivated stages of health behaviour change. It may be possible to design interactive narratives that make use of poetic gameplay techniques to trigger contemplation about health behaviours, and offer opportunities to defamiliarize habitual thought about health choices. Thus, our research question is as follows:

How can defamiliarization and poetic gameplay be used to design narrative-focused serious games, in order to promote contemplation about the players' personal reasons for health?

3 DEVELOPMENT

To address this research question, we carried out two phases of research. First, we engaged in research-through-design (RtD) [16, 56] to generatively explore and understand the design space. Using the insights gained, we implemented a serious game, *Family Priorities*. In the following sections, we describe the process and outcome of each of these phases.

3.1 Design Exploration Phase

We developed a series of low-fi prototypes based on poetic gameplay devices (Fig.2) in order to explore how defamiliarization could encourage reflection about health behaviour change. The first author developed the ideas, and two other authors and one student playtested them in our group meetings. The two playtesting authors are above 40 years old and have experiences with chronic disease among immediate family members, and so can be considered to be roughly within the target group.

In the course of our design explorations, we investigated all the poetic gameplay devices identified by Chew and Mitchell [9]. However, not all the game ideas we created were appropriate or useful. We profile the three most formative explorations below. Full details of the remaining explorations are provided in the Supplementary Materials.

3.1.1 Exploration 1: Limitation on Choice: All Undesirable Options. This Exploration uses the device All Undesirable Options - where the best choice would be unselectable, and all of the other options are undesirable. A player is presented with daily office worker scenarios. In each scenario, the player must make choices that would maximize three health outcomes (mood, energy and reasoning). In each scenario, there would be an 'ideal' option - one where all impacts are positive. However, this option would be non-selectable/greyed-out, despite it being on the list. (Fig 3).

During playtesting, we found that there was a sense of frustration when the obvious choices were not available. At the same time, it forced the players to consider how to make choices among the second-best options. In order to optimize the health outcomes of each choice, the players began considering what they were personally willing to trade off when picking the non-ideal choices. This frustration and the potential for reflection is similar to

observations made by Mitgutsch and Weise [39], involving what Mitgutsch [37, 38] refers to as "recursive learning".

3.1.2 Exploration 2: Using Variations on Expected System Response: Ineffectual Agency. In this exploration, we continued experimenting with non-ideal choices, this time with the addition of Ineffectual Agency as a poetic gameplay device.

Players are informed at the start that their character would die at an unknown age, and are then given a series of choices that seem like they could potentially affect the ending (Fig. 4, right). However, at the end, it is revealed that the player's first set of choices seemed to have resulted in a disappointingly young age of death and no habit change. Then, the players would be offered a chance to replay and reconsider their seemingly poor choices.

During the replay, we found ourselves reconsidering the tradeoffs from each choice. Ideal answers were present, but the presence of the death age outcome seemed to take precedence as a score to pursue. Our focus was on how to gain longevity. While there was no likelihood of increasing the age in this game, we observed that the idea of a target, even if uncertain, seemed to motivate the bargaining. Hence, ineffectual agency itself might not be a productive device, but the presence of a target goal might be.

We were excited to see that the effect of a target goal might serve the intent of surfacing and exploring decisional balance in MI. Decisional balance is a term to describe the situation where the client is considering the pros versus the cons of change. For example, a therapist might ask "If you were to quit smoking, what are some not-so-good things that can happen?" By answering this question, clients may discover that what they fear about change is not as important as they might have thought. Similarly, when playtesting this design exploration we found we were reviewing choices to think about the pros and cons of each choice.

3.1.3 Exploration 3: When Devices in the Game Affect Goal Rules: Winning is Losing. In this exploration, we expanded on the idea of 'winning is losing': players are required to achieve a goal in the game, and then it is revealed that the actual goal they achieved led to a loss in health.

First players are asked to pursue stopping the flow of water in a river (Fig. 5, left) by dragging and dropping rocks onto a branching figure. Once the person has attained the goal, the branching figure is revealed to be a human body, the rocks to be fatty food, and the river to be the arteries of the body. The aim was to connect the winning behaviour of obstructing (within the game), with the hidden consequences of a common but unhealthy act of obstructing arteries by eating fatty foods. This is similar to the use of this technique in interactive life stories, where the technique acts as a dramatic plot twist, making the player realize that although they thought they were able to take action and "win", actually their actions were leading to a negative outcome. It also held parallels to the prevailing idea of obfuscating the purpose of the games initially, somewhat similar to Kaufman and Flanagan's embedded design strategies [18]. However, during playtesting, we found that this resulted in too explicit a statement about the destructiveness of 'bad' health behaviours. By deciding *a priori* what constitutes a loss or a win, we were pushing our values on the player. This runs contrary to how MI promotes intrinsic motivation by helping clients find their own reasons for actions. We found ourselves privileging

Figure 2: Summary of Poetic Gameplay Devices relating to alteration rules and manipulation rules in interactive narratives, adapted from Chew and Mitchell [9].

Figure 3: Conceptual diagram of gameplay for limiting choice by excluding the ‘best’ choice, Exercise (greyed out), and offering only less ideal options: Coffee, Rest or Snack.

Figure 4: Conceptual diagram of gameplay for ineffectual agency where a series of choices reveals a premature death age.

Figure 5: Paper prototype of exploration, showing the first branching figure (left), and the revealed body (right).

Answers over Questions, which was against Khaled’s [20] principles for reflective game design.

3.1.4 Insights from Design Explorations. Upon reflection on our efforts, we developed three key learning points for a serious game to promote contemplation. These were:

- (1) Choosing between non-ideal options can promote deeper evaluation of each choice.
- (2) The presence of a goal might promote re-consideration about the value of each choice.
- (3) We should avoid enforcing values on the player.

In the following section, we develop these insights further and detail how they were incorporated into a serious game.

3.2 Implementation Phase: Features of *Family Priorities*

We iteratively developed *Family Priorities* (Fig. 6), a digital game where the player encounters health-related scenarios and has to make choices which always involve tradeoffs. The player roleplays

Figure 6: Introduction screen of *Family Priorities* showing instructions and introducing the characters in Siti's family.

as Siti, a 55-year-old widowed housewife of Malay ethnicity, who has an adult son (Ali), daughter (Aidah) and grandson (Hafiz). The player would be presented with 5 scenarios in total, each with multiple choice answers, that would result in multiple sources of feedback from the members of the family. Since the target group for chronic disease prevention are people above 40 in our country, we developed scenarios in the game to reflect health dilemmas that working adults with families may face. While we could have designed scenarios that would have been more obscure and only indirectly related to health, we instead chose to privilege Clarity over Stealth, as per [20], in ensuring that players would be able to directly connect the decisions made in-game with real-life scenarios for maximum potential for reflection.

3.2.1 No perfect choices. In *Family Priorities*, each scenario has no perfect choice. In Exploration 3, we had previously found that games that advocate too obviously "right" answers were somewhat unpalatable. When we did not have an expected "right" choice during Exploration 1, we found we could be put in a position of having to experiment with the personal pros and cons of each choice. Hence, by offering only poorer choices, we could encourage the player to use their own values to make each choice. This technique bears some resemblance to how MI therapists strive to avoid the "righting reflex", even if they are convinced what is "right" or are worried about the client's behaviour [47]. Otherwise, therapists risk jeopardizing the client's ability to find their own reasons to undertake behaviour change. Since a key process of change is to explore decisional balance, we believed that supporting the exploration of imperfect choices could support this goal.

Hence, in *Family Priorities*, each choice has varying feedback in the form of 1) text comments 2) facial expressions and 3) happiness and health meter changes. The lack of ideal choice happens when no one choice can improve all outcomes. For example, Figure 7 shows the varying family responses when the player chooses for everyone to have an additional serving at dinner.

3.2.2 Offer Authentic, Complex Considerations. In discussions, we had the insight that the contemplation of personal goals and health is a multi-factor process. We saw that over-simplified scenarios such as what we had introduced in Exploration 3 (fatty foods hurt the body) can reduce both the quality of reflective thinking engendered by a game, as well as the transferability of any insights gained into real life. Studies on diet choices show that besides health, there are often multiple, conflicting drivers of choice that are practical, social and biological [17, 48]. We concluded that the scenarios should have an **authentic complexity** that reflects the multi-faceted nature of everyday health decisions.

In *Family Priorities*, we drew on a script that had been developed for a localized version of an existing web-based MI program [42]. In the video script, Siti considers her recipe options when required to change to a more heart healthy diet. For the game, we expanded the number of scenarios and developed various dilemmas that might invite the player to draw from their personal experience of balancing multiple demands. The goal was to encourage the player to find their own answers to the presented dilemma. We wanted to create a space to explore options when breaking away from habitual behaviour. Example scenarios include: encountering social reasons to eat more, selecting menus that would please everyone; or picking between going to exercise or meeting other family obligations.

Our explorations also suggested that a **tradeoff** was useful. It could help to promote a bargaining approach, where the player considers how each choice and how it contributes to a better result. We believed that this could support the player in assessing how important an unhealthy choice was in comparison with a longer-term outcome.

3.2.3 Foregrounding longer-term values. Since a key goal of MI is to help the client to elucidate what they value using processes such as self-re-evaluation, we believed it was important to have a similar function in the game. This, in combination with Exploration 2's insight about the dynamic introduced by having a goal, led us to a

While visiting your daughter's house for a dinner that she cooked, your daughter keeps urging everyone to eat much more than they usually do. What do you do?

- > Tell your family to stop once they eat their usual amount, ignore your daughter
- > Let them eat one extra portion
- > Let them eat as much as possible to please your daughter

Figure 7: Siti's family members showing both happy and unhappy comments, facial expressions and feedback meters changing.

Figure 8: The panel that appears during the second playthrough, showing the effect of subsequent choices on efficacy age (magnified).

device to connect goals and values. We decided to label this device a "priority". This device consists of two parts - a value specification and an age of efficacy for this value.

In the first feature, we introduced a priority setting exercise after the first three scenarios. There are a plethora of possible priorities, but we picked just a few for prototyping that might offer a reasonable range of options for the player. The choice of priority was between the following options: 1) I want to fulfill my roles and responsibilities to support my family, 2) I want to stay looking young and healthy as long as possible, and 3) I want to have an active social life and take part in community activities.

The player goes on to play 2 more scenarios after explicitly choosing a life value. This would constitute the first playthrough. After this, the players are once again presented with a life priority setting exercise, offering them an option to change the priority to something else they might want to explore. However, for the second playthrough, a panel appears (Fig. 8, magnified), reminding players about the life priority and stating how long they might be able to pursue this priority. For ease of reference, we call this the "efficacy age". The intent here is to bridge the gap of how health choices made today have long-term effects on our lives.

4 FORMATIVE EVALUATION

We now report on the evaluation of *Family Priorities*. For this evaluation, the key questions were:

- (1) How would players experience the three main gameplay features of *no perfect choice*, *authentic complex considerations* and the *foregrounding of a long-term value*?
- (2) To what extent did these gameplay devices lead to reflection on personal values and the pros and cons of various health choices?

Since the use of interactive narratives for motivational interviewing had not been attempted before, the goal of this study was to understand the potential of the mechanisms we built into the serious game. We wanted to understand the experience of gameplay, and then to explore and describe the potential of these mechanisms to stimulate thoughts about healthy lifestyles and health-related practices, as well as the nature of those thoughts.

4.1 Method

4.1.1 Implementation. We used Ren'Py¹, a platform for developing interactive stories, to build *Family Priorities*. We then installed

¹<https://www.renpy.org/>

the game on a Windows laptop for playing during the evaluation session. We recorded the screen events for the retrospective walk-through.

4.1.2 Participant Recruitment. We sought players who had some experience with their own health risk factors (e.g. elevated blood pressure or blood sugar) or have had people close to them experience concerns about these risk factors. This would help increase the appropriateness of the scenarios in the game. Since national guidelines encourage screening for risk factors for people aged above 40, we used this as a likely indicator of chronic disease experience. Hence, we used convenience sampling to recruit adults above 40 years old, who either had health risk factors or had experienced concerns about health. We chose not to set out to only recruit participants who were in pre-contemplative or contemplative stages for the following reasons: Firstly, a known criticism of the TTM is “stage instability” [5]. This is because health behaviours are multi-dimensional and can consist of various specific behaviours. The model also does not satisfactorily explain how long a person stays in one stage. Additionally, the concept of a healthy behaviour is also difficult to define. For example, “physical activity” can be broken into work-related activities, transport behaviour, and explicit exercise events. Thus, a given participant may well be in the contemplation stage for taking exercise classes, while being able to maintain a routine of daily walks. Secondly, given the issues of stage instability, we took a stance in this study to be exploratory, and to be open to all possible responses to the proposed interaction mechanisms of interactive storytelling. We did not want to prematurely narrow the possible range of player responses to game interactions.

4.1.3 Participants. 15 people participated in the study, 9 male and 6 female. The sample was 80% Chinese, 20% Malay, roughly analogous to our country’s demographics of 76.2% Chinese, 15% Malay, 7.4% Indians and 1.4% Other. The average age of the study participants was 55.8 years (min 45, max 77). Full details are in the Supplementary Materials.

4.1.4 Outcome Measure. Mitchell et al. [36], in a study on defamiliarization in games, suggested that aspects of the resulting user interface difficulty could be at the level where it is “interfering with the player’s ability to appreciate those poetic effects”. This would be an undesirable outcome if the challenging game mechanics distracted from the goal of contemplating personal health values. To assess if this might be the case in our study, all the participants filled out the System Usability Scale (SUS) [4] immediately after their playthrough.

4.1.5 Procedure. At the start of the session, participants were briefed that the session would involve them playing games for health and that their on-screen actions would be video-recorded. After they had given their consent to the procedure, they played through *Family Priorities*, while the researcher remained in the background and took notes unobtrusively (see Fig. 9).

At the end of their first playthrough, the game presented them the option to “replay the game and re-do their choices”, after choosing long-term goals for Siti. Then we asked why they did or did not choose to replay. After recording their answers, the researcher would request that the player playthrough the game one more time,

to see if they would make any different choices now that they were more aware of the long-term consequences present in the game.

After playing the game, study participants completed the SUS. Then the researcher used retrospective protocol analysis [11], where the player was shown the video playback of their playthrough and the choices they made, and asked to comment on what they were thinking at the time. A semi-structured interview was also conducted to ask about their current thoughts and practice of personal health habits.

4.1.6 Analysis. The interviews were transcribed using a professional service. After the transcription was proofread, we used both inductive and deductive analysis to read through the interviews. Three authors and one student coded 2 interviews separately. Any coding differences were resolved into a central codebook. Once this was completed, one author and one student proceeded to complete the coding of the remaining 13 interviews, with any uncertainties resolved among all authors.

4.2 Results

We now describe the results of the evaluation. We observed that there were a number of ways in which participants responded to the gameplay, including generating possible solutions and drawing on the personal life experiences when faced with no perfect choices, shifting to more detailed thinking during replay, and connecting the scenario to a variety of contextual issues in response to complex considerations. Responses to long term value specification and efficacy age were somewhat mixed, as we discuss below.

4.2.1 Players’ overall response to the game. The combined average usability score of the game was 74/100, indicating a good level of usability [2]. This suggests that the elements of defamiliarization did not seem to have interfered with the learnability or usability of the game. It also suggests that the cognitive burden of the game, if any, did not arise from issues of usability.

When asked about their responses to the info bars indicating the changing health and happiness of their family members, as well as the opinions voiced out by the characters, a surprisingly high number of participants either said they did not notice the changing bars (4/15), or they noticed but didn’t pay attention to the feedback when making choices (6/15). 5/15 participants (P1, P9, P10, P11, P15) paid attention to it. However all participants were responding to the word bubble comments of the various family members.

The following excerpt from P1 shows how participants were mostly using the text as feedback on their choices. This was how P1 was able to detail the various interests of the adult child and grandchild in the game. He also experienced the intended dilemma of trying to resolve the family’s responses with Siti’s values.

Interviewer: What do you think of the family’s responses? Like all these little dialogues?

P1: Yeah, they got their own thinking. Maybe the son, they want this, they don’t want that. Maybe for the grandson, they always like the fast food, fast food better. Then the daughter - okay anything, anything goes. Only the son and the grandson, the appetite is different.

Interviewer: Okay. Right. As you were playing the

Figure 9: Procedure of study showing first playthrough, opportunity for change in long-term goals and second playthrough

game, did you- was there any point where you found it really difficult to make a choice?

P1: Mm.... about, about myself, whether I want to do the exercise or, doing more on the family's matter.

The oldest study participant P8 (77, retired nurse) only noticed the verbal feedback that the family members were making, but did not pay much attention to the Happiness or Health bars associated with each character, and how they were changing:

Interviewer: What prompted you to start looking at the bottom?

P6: I just happened to read the comments.

Interviewer: ...did you pay attention to anything else besides the comments... their facial expressions or like these bar and arrows?

P6: Mostly the comments. I didn't pay attention... but the second time then I did notice their facial expressions.

4.2.2 Players' response to No Perfect Choices. When no correct answers were available, P5 (47, business trainer) first expressed frustration. Then she turned to **generating possible solutions**. In the following excerpt, she's exploring the dilemma where Siti is asked to choose between attending an exercise program versus attending to conflicting events of the other characters.

P5: That's why I asked 'Can I not just go by myself?' But that's obviously not a choice. Because getting the mum to go herself would be the better choice. Like, is it because she doesn't know how to go? Is it that? Because if she can get to the fitness class, she jolly well can take the public transport, right? Yeah. [Looks at other options] This is a no-brainer, "don't sign up for the class". I mean, you already said this is a health-related application. ...'Don't sign up for class' means, don't lah, that one sure is a negative score.

To make these choices, the players were often **drawing on their personal life experiences** to find suitable answers. P9 (45, homemaker) explains:

P9: And this one, yea. I choose not to sign up for the class simply because, not because I don't value fitness but because I feel that ... my experience as a homemaker is that we can tweak our time when the kids are at school or so, we have a window to tweak our time. But people that is working and people with school-going kids, their timing is rigid.

This seemed to have been caused by the lack of full context around Siti and her family members. Due to the scarcity of information, the players seemed to be filling in the blanks with their own lives. As P9 (45, homemaker) states: "This is very reflective of my role right now as a homemaker and I have chosen to be in this role hence that is also reflective in my answer."

4.2.3 Players' response to Choices during Replay. After the first playthrough, 10 out of 15 players did not want to replay the game. Of these, 3 were not interested to continue the playtesting, and the remaining 7 felt as if they had already given the best answer they could, or were already sure of their answers and felt no point in re-assessing their choices.

P15 is representative of this position of having nothing to change because he was operating from the best possible value position already. In his case, his stated value was to pick the middle ground and keep everyone happy.

P15: Oh, then I kind of am able to understand both sides. You know, to look at the feedback then from there I answer because, uh then you wanted to (be fair) to all the family members, right. ...let's say for example, if I am Siti, how do I balance such a way that, you know everybody's happy, you know? ... That's how I'm looking at (this).

During the second playthrough that was requested of them, 2 (P1 and P8) of the 10 who did not want to replay still changed at least one of their choices. Of the 5 who wanted to replay, 3 (P5, P10 and P11) changed their choices. We now take a closer look at their responses with respect to the difficulty of choosing among conflicting outcomes.

P5 illustrates how replaying can lead to **more detailed thinking** about the consequences of each decision. In this case, P5 was using a satisficing strategy that satisfies shorter term happiness (of others) and sacrifices longer term health (of self), and elucidating her reasons why.

Interviewer: Okay. So I remember the first time you asked your daughter to drive you up before dropping off your grandson.

P5: Yes. And then after that, the next round, I saw that it's an impact. That's a critical thing, because now he cannot play. There. It's not just a compromise, it's a direct loss too. Right? If it was a matter of everyone going just a little bit later- if it was a matter of inconvenience, I would still have stuck to the first choice. It's okay to inconvenience ourselves, to help

another member. But this is more than inconvenience. He cannot get to play. [watches video] There. 'Enter the game half an hour late' – that was not clear in the first decision. Now that I've seen it in the next decision – the repercussion – I've changed my decision. Interviewer: Right. So that was what led you to change your decision the second time you played?

P5: Yup. 'cause this is too costly a price.

Some players ended up rethinking the choices made. P8 (77, retired nurse), for example, initially describes his guiding value as "choose the middle path", but later during the interview decides that he should be choosing health instead.

P8: Because I choose the middle path. the first one I think...To please both sides. Not to offend the daughter and, and, okay...One meal doesn't kill you. ...So I'm adopting the middle path...But when you think of it, it's going to go on. This habit is going to go on and on. So I think it's better lah to face it... to displace it. Interviewer: Oh, that's why, in the second time around when you played this, you had chosen the first one, right?

P8: Yes, yes. ...Second time (round) I was thinking better to knock everything off. So (the choice) is for the family, for healthy eating.

4.2.4 Players' response to Complex Considerations. In the following excerpt, P6 (44, dietitian) was asked about which scenarios stood out for her. She talks about the different kinds of considerations that go into a decision about how much to eat and when it might be appropriate at festive periods (Hari Raya).

Interviewer: So were there any particular situations that stood out to you in terms of the choices that you have to make?

P6: Ya. Like this one right, like I said, is it a weekly thing or a yearly thing? I mean if it was a yearly thing, I would just let them eat whatever they wanted to eat. But if it was a weekly thing, then I would say just eat however much you want to eat. You don't have to eat everything. Because from her response, it sounds like a weekly... I mean it's not like once a year, it's not like Hari Raya once a year right? It sounds like either it's a monthly or ... it's a regular thing.

Though she does not come to a conclusion, she shows that she has **connected the scenario to a variety of contextual issues** such as occasion, frequency and parental oversight. This was the intent of not including perfect choices, which was intended to lead the player to draw on personal experience to try to find the right answer. However, as a dietitian, P9 might have a more nuanced view because she has counselled others about the social pressure to eat more during a celebration.

4.2.5 Player's response to Long Term Value Specification. We now turn to the features related to the opportunity to specify a value choice during the first playthrough, and to change that value choice before the second playthrough. Among 15 participants, 11 chose *family* as their priority, 3 chose *community* and 1 chose *personal appearance*. For the second playthrough 6 of 15 players changed

their priority. Those who did not change their priority said that the only priority that mattered to them was family.

Most who changed their value choice explained that the family and community priorities were equally valued, but since the game chooses just one, they chose the alternative in the second playthrough. 2 were also curious about the game mechanisms, and wanted to see how choosing a different life priority would affect efficacy age as a score. Finally, we observed that 3 players were reflecting on their changing relationship with family members as their children were grown up, and so decided to explore having *community* as a main priority.

P11 (53, admin manager who went from *family* to *community*) was asked what strategy she was using to make these value choices and why. She first explains how she was using her own experience as a mother to make the decisions. Towards the end of the conversation, there is a sense that a related thought has also become important - about personal efficacy and perhaps how much longer she can be "productive". This is how she responded to being asked why she liked the game:

P11: Maybe because, female-female ah... And the role.

Interviewer: Okay. As a homemaker, mother, or housewife?

P11: Mother.

[...]

Interviewer: Okay. And what sort of things did it make you reflect about?

P11: Mmm... Health. And the active years.

Interviewer: Active years, okay. So you start to wonder, how much more years you have-?

P11: To be productive. Because, with this one [gestures at bandaged foot], I realise that it's 50% productivity down. [laughs]

Making explicit priority settings seemed to be causing some players to think about what their true priorities might be. P4 (retiree, 71) switched from *family* to *community* priorities. He explains how this new focus may be linked to the stage of his life, after family responsibilities fade.

Interviewer: ... But you changed later on, second time around you changed from family to community activity.

P4: Yeah yeah. Because, my thinking is that when you're old, you know, you're old, but after that, you know, you need to uh, engage with the society as you know, active in the social life. And take part in community where you would, you know, when a person (becomes) old ah, nobody to talk to, (is) very scary. You know, you need to communicate, you need activities around. If not, you stay at home alone, cham². These two actually is quite important to me. This is honestly (how) I think.

Nevertheless, he did not change any of his earlier responses to the scenarios. Overall, P4's interview gives the impression that he already has an elaborated sense of how healthy behaviours are

²terrible, tragic

already part of his life. For example, until recently P4 had a regular exercise (running) schedule.

Overall, the players who already had a routine of healthier habits were those who could elaborate long-term values and how they are associated with behavioural choices. For example, P6 is a dietitian who explained at the beginning of the interview that she exercises every day. In the following excerpt, she explains how she made decisions for Siti, and did not seem to experience dilemma in the choices she made.

P6: Ya. The long-term... not so... I mean the long-term does affect the current decision because its my health that I'm looking after.

Interviewer: Ok. So, the primary thing you were aiming for is your own health – Siti's health?

P6: Siti's health, yes.

Interviewer: And I realised, you maximised it. [Laughs]

P6: [laughs] Ya because I always feel that they... you have to look after yourself before you can look after the other people. And if you're looking after yourself, then you're doing the right things then therefore, the people you look after are also, being influenced by the way you cook, or by the way you're exercising.

4.2.6 Player's Response to Efficacy Age. We also asked the players if they noticed the *efficacy age*, and if it made any difference to their choices in the scenarios. Most players stated they only paid partial attention to the efficacy age, and it did not have much impact on their choice making. A small handful (P5, 10 and 11) were using it as a target, and making choices to see if they could prolong the number of years. P10 was another person who reported on having a regular exercise routine as part of their lifestyle. P10 had also earlier demonstrated a clear health literacy in his ability to explain the benefits of sleep and smaller portions of meals. For P10, the efficacy age took precedence as the key goal over other happiness goals. He explains:

Interviewer: Uh, alright. So as you were playing, what sort of things were you paying attention to, when making decision in general?

P10: [sighs, points at age screen and laughs].

Interviewer: Age ah. So once the age popped up, that was your main motivation, was it?

P10: Age, correct correct. I just want to be able to extend my age ah. Because I still want to play soccer at 77... At the end of the day, health is my health lah. Right? And I think, if I'm healthy, everybody will be happy. Uh, especially our loved ones ah.

These responses suggest that Efficacy Age may be a meaningful construct that can surface the long-term nature of health goals. However, the link between this construct and more immediate decision-making does not seem obvious to players who have not already experienced or contemplated the link themselves. Only P11, as seen in the quote earlier, seemed to be reflecting on how health choices might be affecting what to prioritize in her life.

5 DISCUSSION AND FUTURE WORK

Our research question was: **How can defamiliarization and poetic gameplay be used to design narrative-focused serious games, in order to promote contemplation about the players' personal reasons for health?** To answer this, we carried out a series of design explorations, followed by the implementation and evaluation of a serious game based on the insights gained from the design explorations. We evaluated our game to understand how players would experience the gameplay features of *no perfect choice*, *authentic complex considerations* and the *foregrounding of a long-term value*. We wanted to know if and how these gameplay devices could lead to the contemplation of personal values and linking of these values to health choices.

5.1 Limited Choices and Dialogic Reflection

Our results suggest that **the most productive poetic gameplay device was limitation of choice**. When there were no ideal choices available, the players responded by finding new answers that were not offered to them, reconsidering the options to see what they could truly give up, and using a satisficing strategy to resolve the competing requirements.

Since motivational interviewing requires that clients uncover their own reasons to undertake health behaviours, these responses show promise. When presented with authentic and complex scenarios, limiting choice seem to create opportunities for elaborating what is valuable to them. It helped players to surface the principles they are using to make such a choice. Using Fleck and Fitzpatrick's typology of reflective behaviour [12], we find that this behaviour matches the description for *dialogic reflection*, which is a productive, valuable level of reflection where people are "looking for relationships between pieces of experience" or "considering different explanations." In terms of the processes of change in the TTM, these behaviours bear similarities to the processes of change such as *self re-evaluation* and to a lesser extent, *consciousness raising*. Furthermore, having limited choices was productive of the exploration of pros and cons needed to shift *decisional balance*.

However the potential of limited choice is tempered by the finding that the players were using a satisficing strategy. The satisficing strategy "entails searching through the available alternatives until an acceptability threshold is met." [50] In our sample, this strategy sometimes meant that players were picking the option that made the most people happy, which usually led to short-term, less healthy outcomes. Alternatively, if they made decisions with longer-term priorities as the key outcome, it helped to counter the urge to satisfice in the short term.

5.2 Longer Term Values and Transformative Reflection

The previous point suggests that **helping the player foreground longer-term values could lead to players picking healthier choices**. This is because health is an enabler of the pursuit of life goals. However, the devices we used to surface longer term values (picking priorities and efficacy age) resulted in mixed outcomes. There was evidence that some players were initially using habitual choices (e.g. family first) but later reconsidering their current life circumstances (e.g. the need to be socially active) more thoughtfully.

This is a desirable outcome inasmuch as they were contemplating their priorities.

In contrast, some players were resistant to picking priorities because they did not identify with them. They thought the values were imposed on them, the values did not resonate with them, and they may have wanted to make their own. This may have been in conflict with the players' need to draw on their life experiences to make decisions for Siti, as is common in serious games where avatar identification is a key mechanism, e.g. [53].

Thus, in keeping with earlier work on including open-ended questions, we also arrive at the conclusion that open-ended questions should be used to increase the meaningfulness in a task, which potentially can lead to a greater sense of autonomy in a health promotion program. In this case, there is evidence that it would be useful for inviting players to input what they believe is a relevant personal priority. However, when used too often there is a risk of input burden, as has been surfaced by earlier work [15]. From our results, we suggest that future work on priority setting may merge these two approaches by offering some values as starting points, but also enable further modification of these statements.

Unfortunately, the device to connect longer term values with health, *efficacy age*, was mostly ignored by players. The interview data suggests that as a concept, *efficacy age* may not be real or believable enough to have any impact on the current outcomes of the various players. On the one hand, this attempt at expressing priorities was not helping players to make the key epiphany that "a focus on longer-term values can change the health choices we make." Players were clearly not reflecting to the point where they had experienced a change in the way they would approach a health choice. On the other hand, players who were already motivated enough to have high health literacy or have routine exercise, were expressing their personal motivations in terms of longer, efficacious life spans.

Hence, the artifact did not seem to help players to achieve *transformative reflection* [12]. In Fleck and Fitzgerald's framework, transformative reflection is a step beyond *dialogic reflection*, and has the added criterium of "leading to a change in practice or understanding". In the TTM, this achievement is linked to processes of change such as *self-liberation*, where the player has chosen to commit to change the problem behavior. It could also be the closure to the outcomes of *self re-evaluation* and *environmental re-evaluation*.

Therefore, we recommend that future work should continue to explore new ways to help the player make connections between longer-term values and current health choices. Additionally, designers may consider the creation of a summarizing feature, (e.g. "So where does that leave you?") where the player can reflect upon their in-game actions in a more transformative manner. The goal is to offer a space for players to gather their insights and articulate summarizing thoughts from the entire exercise.

6 LIMITATIONS

The study of reflective behaviour is particularly difficult because the very act of probing of such internal thoughts may influence the outcomes. We attempted to moderate such effects by using the retrospective think aloud method during playback of recordings of the players' behaviour, which helped minimize recall bias and

document actual behaviour while at the same time not interfering with the experience of the game.

We also did not use a control intervention. This was because our approach was novel and we were therefore engaged in a formative evaluation. Our results suggest that more work is needed to help players to reach conclusions about their current understanding of their personal values. We will conduct a comparison with a comparable MI intervention, once we have improved upon the current limitations of the system.

While the usability ratings of our game were relatively high, some participants still indicated that they were not paying attention to certain important screen elements, such as the efficacy age. This suggests that more could be done to enhance the visibility of the screen elements that are vital to the defamiliarization process. Without those elements being fully-prominent and taken into consideration by every player, it may be difficult to argue for a consistent pattern in the results being due to player choices rather than perception issues. Players also reported frustration at limited choices and exhibited satisficing behaviour rather than focusing on long-term goals. This is a problem given that the goal of the game is to prompt contemplation into health choices, and is something that should be investigated further.

In *Family Priorities*, the scenarios that we developed primarily focused on the experiences and health choices faced by working adults with families to raise. That does mean that there could have been lesser relevance to players who fall into our target audience (40+ years old) but who did not have families. While a couple of our participants were in that situation, what we discovered was that they were also caregivers of aged parents who lived with them, and thus related the game's characters and choices to those faced by their parents. They were still able to empathise with the characters, because they had gone through similar decision-making processes in collaboration with their parents. However, it must be acknowledged that there is a sizable group of people who fall into the appropriate age bracket but who live alone without families. Another project or more relevant scenarios would need to be designed to address that subgroup as their choices of life priorities may be significantly different without family considerations.

Finally, an assumption that we made in the design of the game is that focusing on health goals would enable a better pursuit of other life goals. However, it could be argued that a narrow focus on health goals may impede the pursuit of other life goals. And in fact, some of the frustrations expressed by the participants focused on the fact that there were artificial trade-offs imposed which did not enable win-win situations in which multiple life goals could be fulfilled simultaneously. Instead, health was often placed in opposition to other life goals in our designed scenarios. While this is done deliberately for defamiliarization purposes, there could be a problem in which the situations become less true-to-life and therefore impede the transformative potential of any reflective insights gained through the game. Alternate ways of creating defamiliarization without impacting believably should be explored.

7 CONCLUSION

We explored how to promote contemplative thinking about personal reasons for change. In order to create interactions that encourage

such contemplation, we turned to poetic gameplay devices to gain design insights. Consequently, we developed *Family Priorities*, a serious game that uses the devices of limited choice, authentic and complex considerations, and long-term values. Then we evaluated the game with 15 participants who have had some experience of chronic disease. Our results indicate that offering imperfect choices within health scenarios is a productive approach because the players demonstrated evidence of *self-reevaluation*, *environmental reevaluation*, *improving decisional balance*, and to a lesser extent, *consciousness raising*. This knowledge can be applied to the design of online systems to promote contemplation of health choices. Nevertheless, more work is needed to determine how to connect these processes of change to longer-term values, in order to help the player harness their reflections towards transformation.

ACKNOWLEDGMENTS

This research is supported by the Singapore Ministry of Health's National Medical Research Council under the Center Grant Program – Singapore Population Health Improvement Centre (MNRC/CG/C026/2017_NUHS) and (NMRC/CG/M009/2017_NUH/NUHS – Telehealth Core). We also thank our participants for their valuable time.

REFERENCES

- [1] William R. Miller and Nick Heather (Eds.). 1986. *Treating Addictive Behaviors* (Boston, MA, 1986). Springer US. <https://doi.org/10.1007/978-1-4613-2191-0>
- [2] Aaron Bangor, Philip T. Kortum, and James T. Miller. 2008. An Empirical Evaluation of the System Usability Scale. *International Journal of Human-Computer Interaction* 24, 6 (2008), 574–594. <https://doi.org/10.1080/10447310802205776>
- [3] Johnna Blair, Yuhua Luo, Ning F. Ma, Sooyeon Lee, and Eun Kyoung Choe. 2018. OneNote Meal: A Photo-Based Diary Study for Reflective Meal Tracking. *AMIA Annual Symposium Proceedings* 2018 (2018), 252–261. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6371351/>
- [4] John Brooke. 1996. SUS-A quick and dirty usability scale. *Usability evaluation in industry* 189, 194 (1996), 4–7.
- [5] Johannes Brug, Mark Conner, Niki Harre, Stef Kremers, Susan McKellar, and Sandy Whitelaw. 2005. The Transtheoretical Model and stages of change: a critique: observations by five commentators on the paper by Adams, J. and White, M.(2004) why don't stage-based activity promotion interventions work? *Health education research* 20, 2 (2005), 244–258.
- [6] Eleonora Ceccaldi, Rossana Damiano, Cristina Battaglini, Valentina Galetto, and Marina Zettin. 2020. An Emotional Agent for Moral Impairment Rehabilitation in TBI Patients. *Frontiers in Psychology* 11 (2020). <https://doi.org/10.3389/fpsyg.2020.01102> Publisher: Frontiers.
- [7] Lucie A. Chauveau, Nicolas Szilas, Anna Laura Luii, and Frédéric Ehrler. 2018. Dimensions of personalization in a narrative pedagogical simulation for Alzheimer's caregivers. In *2018 IEEE 6th International Conference on Serious Games and Applications for Health (SeGAH)* (2018-05). 1–8. <https://doi.org/10.1109/SeGAH.2018.8401354> ISSN: 2573-3060.
- [8] Evelyn Chew and Alex Mitchell. 2016. "As Only a Game Can": Re-creating Subjective Lived Experiences through Interactivity in Non-Fictional Video Games. In *Subjectivity across Media: Interdisciplinary and Transmedial Perspectives*, Maïke Sarah Reinert and Jan Noël Thon (Eds.). Routledge, 18–18. <https://doi.org/10.4324/9781315643625>
- [9] Evelyn C. Chew and Alex Mitchell. 2020. Bringing art to life: Examining poetic gameplay devices in interactive life stories. *Games and Culture* 15, 8 (2020), 874–901. <https://doi.org/10.1177/1555412019853372> Publisher: SAGE Publications Sage CA: Los Angeles, CA.
- [10] Leigh Clark, Nadia Pantidi, Orla Cooney, Philip Doyle, Diego Garaialde, Justin Edwards, Brendan Spillane, Christine Murad, Cosmin Munteanu, Vincent Wade, and Benjamin R. Cowan. 2019. What Makes a Good Conversation? Challenges in Designing Truly Conversational Agents. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems - CHI '19* (2019), 1–12. <https://doi.org/10.1145/3290605.3300705> arXiv:1901.06525
- [11] K. Anders Ericsson and Herbert A. Simon. 1984. *Protocol analysis: Verbal reports as data*. The MIT Press. Pages: 426.
- [12] Rowanne Fleck and Geraldine Fitzpatrick. 2010. Reflecting on Reflection: Framing a Design Landscape. In *Proceedings of the 22Nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction* (New York, NY, USA) (OZCHI '10). ACM, 216–223. <https://doi.org/10.1145/1952222.1952269> event-place: Brisbane, Australia.
- [13] Pin Sym Foong, Chang Siang Lim, Gerald C. H. Koh, Debjyoti Ghosh, Pan Wang, and Angela Yeo. 2020. Exploring the Role of Chatbots in Patient Engagement. <http://casforhealth.org/position-papers/>
- [14] Stijn Friederichs, Catherine Bolman, Anke Oenema, Janneke Guyaux, and Lilian Lechner. 2014. Motivational interviewing in a Web-based physical activity intervention with an avatar: randomized controlled trial. *Journal of Medical Internet Research* 16, 2 (2014), e48. <https://doi.org/10.2196/jmir.2974>
- [15] Stijn A.H. Friederichs, Anke Oenema, Catherine Bolman, Janneke Guyaux, Hilde M. Van Keulen, and Lilian Lechner. 2013. Motivational interviewing in a web-based physical activity intervention: questions and reflections. *Health Promotion International* 30, 3 (2013), 803–815. <https://doi.org/10.1093/heapro/dat069>
- [16] William Gaver. 2012. What should we expect from research through design?. In *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems - CHI '12* (Austin, Texas, USA, 2012). ACM Press, 937. <https://doi.org/10.1145/2207676.2208538>
- [17] Jasmine Hentschel, Samyukta Manjajya Sherugar, Rui Zhou, Vaishnav Kameswaran, Rajesh Chandwani, and Neha Kumar. 2017. Rice Today, Roti Tomorrow: Diets and Diabetes in Urban Indian Households. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems - CHI '17* (Denver, Colorado, USA, 2017). ACM Press, 4069–4081. <https://doi.org/10.1145/3025453.3025656>
- [18] Georg Kaufman and Mary Flanagan. 2015. A psychologically "embedded" approach to designing games for prosocial causes. *Cyberpsychology* 9, 3 (2015), 1–18. <https://doi.org/10.5817/CP2015-3-5>
- [19] Georg Kaufman, Mary Flanagan, and Max Seidman. 2021. Creating Stealth Game Interventions for Attitude and Behavior Change: An 'Embedded' Design Model. In *Persuasive Gaming in Context*, Teresa de la Hera, Jeroen Jansz, Joost Raessens, and Ben Schouten (Eds.). Amsterdam University Press. <https://doi.org/10.5117/9789463728805>
- [20] Rilla Khaled. 2018. Questions over answers: Reflective game design. In *Playful disruption of digital media*. Springer, 3–27.
- [21] Rafal Kocielnik and Gary Hsieh. 2017. New Opportunities for Dialogue-based Interaction in Behavior Change Domain. (2017), 7.
- [22] Rafal Kocielnik, Lillian Xiao, Daniel Avrahami, and Gary Hsieh. 2018. Reflection Companion: A Conversational System for Engaging Users in Reflection on Physical Activity. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 2, 2 (2018), 1–26. <https://doi.org/10.1145/3214273>
- [23] Timothy Koschmann, Kari Kuutti, and Larry Hickman. 1998. The Concept of Breakdown in Heidegger, Leont'ev, and Dewey and Its Implications for Education. *Mind, Culture, and Activity* 5, 1 (1998), 25–41. https://doi.org/10.1207/s15327884mca0501_3 Publisher: Routledge.
- [24] Ian Li, Anind Dey, and Jodi Forlizzi. 2010. A stage-based model of personal informatics systems. In *Proceedings of the 28th international conference on Human factors in computing systems - CHI '10* (Atlanta, Georgia, USA, 2010). ACM Press, 557. <https://doi.org/10.1145/1753326.1753409>
- [25] Catherine Y. Lim, Andrew B.L. Berry, Andrea L. Hartzler, Tad Hirsch, David S. Carrell, Zoë A. Bermet, and James D. Ralston. 2019. Facilitating Self-reflection about Values and Self-care Among Individuals with Chronic Conditions. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems - CHI '19* (Glasgow, Scotland UK, 2019). ACM Press, 1–12. <https://doi.org/10.1145/3290605.3300885>
- [26] Christine Lisetti, Reza Amini, Ugan Yasavur, and Naphtali Rishé. 2013. I Can Help You Change! An Empathic Virtual Agent Delivers Behavior Change Health Interventions. *ACM Transactions on Management Information Systems* 4, 4 (2013), 1–28. <https://doi.org/10.1145/2544103>
- [27] Ziwei Liu, Jim Warren, and Grant Christie. 2018. Design of a technology-delivered motivational interviewing intervention for youth empowerment. In *Proceedings of the Australasian Computer Science Week Multiconference on - ACSW '18* (Brisband, Queensland, Australia, 2018). ACM Press, 1–10. <https://doi.org/10.1145/3167918.3167934>
- [28] Brad W. Lundahl, Chelsea Kunz, Cynthia Brownell, Derrik Tollefson, and Brian L. Burke. 2010. A Meta-Analysis of Motivational Interviewing: Twenty-Five Years of Empirical Studies. *Research on Social Work Practice* 20, 2 (2010), 137–160. <https://doi.org/10.1177/1049731509347850>
- [29] Julie Maitland. 2011. Towards negotiation as a framework for health promoting technology. *ACM SIGCHI Record* 1, 1 (2011), 10–19. <https://doi.org/10.1145/1971706.1971710>
- [30] Lena Manykina, Elizabeth M. Heitkemper, Arlene M. Smaldone, Rita Kukafka, Heather J. Cole-Lewis, Patricia G. Davidson, Elizabeth D. Mynatt, Andrea Cassells, Jonathan N. Tobin, and George Hripscak. 2017. Personal discovery in diabetes self-management: Discovering cause and effect using self-monitoring data. *Journal of biomedical informatics* 76 (2017), 1–8. <https://doi.org/10.1016/j.jbi.2017.09.013>
- [31] Stacy Marsella, W. Lewis Johnson, and Catherine LaBore. 2003. Interactive pedagogical drama for health interventions. In *11th International Conference on Artificial Intelligence in Education, Sydney, Australia*. 341–348.

- [32] Tim Marsh. 2016. Slow serious games, interactions and play: Designing for positive and serious experience and reflection. *Entertainment Computing* 14 (2016), 45–53. <https://doi.org/10.1016/j.entcom.2015.10.001>
- [33] William R. Miller and Stephen Rollnick. 2009. Ten Things that Motivational Interviewing Is Not. *Behavioural and Cognitive Psychotherapy* 37, 2 (2009), 129–140. <https://doi.org/10.1017/S1352465809005128>
- [34] William R. Miller and Stephen Rollnick. 2012. *Motivational Interviewing: Helping People Change*. Guilford Press.
- [35] Alex Mitchell. 2016. Making the Familiar Unfamiliar: Techniques for Creating Poetic Gameplay. In *Proceedings of DiGRA/FDG 2016* (2016). Digital Games Research Association, 16.
- [36] Alex Mitchell, Sim Yui Theng, and Liting Kway. 2017. Making it Unfamiliar in the “Right” Way: An Empirical Study of Poetic Gameplay. In *Proceedings of the 2017 DiGRA International Conference* (Melbourne, Australia). Digital Games Research Association. http://www.digra.org/wp-content/uploads/digital-library/100_DiGRA2017_FP_Mitchell_Poetic_Gameplay.pdf
- [37] K. Mitgutsch. 2009. Passionate digital play-based learning.(Re) learning in computer games like Shadow of the Colossus. *Eludamos Journal for Computer Game Culture* 3, 1 (2009), 9–22.
- [38] Konstantin Mitgutsch. 2011. Playful learning experiences: meaningful learning patterns in players’ biographies. *International Journal of Gaming and Computer-Mediated Simulations (IJGCMs)* 3, 3 (2011), 54–68. Publisher: IGI Global.
- [39] Konstantin Mitgutsch and Matthew Weise. 2011. Subversive Game Design for Recursive Learning. In *Proceedings of DiGRA 2011*.
- [40] Robert P Nolan, Sam Liu, Ross Feldman, Martin Dawes, Susan Barr, Hazel Lynn, Femida Gwardy-Sridhar, Scott G Thomas, Jack Goodman, Paul Oh, Janusz Kaczorowski, Caroline Chessex, Vladimir Hachinski, and Kevin Shoemaker. 2013. Reducing risk with e-based support for adherence to lifestyle change in hypertension (REACH): protocol for a multicentred randomised controlled trial. *BMJ Open* 3, 8 (2013). <https://doi.org/10.1136/bmjopen-2013-003547>
- [41] Robert P Nolan, Ada YM Payne, Heather Ross, Michel White, Bianca D’Antono, Sammy Chan, Susan I Barr, Femida Gwardy-Sridhar, Anil Nigam, Sylvie Perreault, Michael Farkouh, Michael McDonald, Jack Goodman, Scott Thomas, Shelley Zieroth, Debra Isaac, Paul Oh, Miroslaw Rajda, Maggie Chen, Gunther Eysenbach, Sam Liu, and Ahmad Zbib. 2014. An Internet-Based Counseling Intervention With Email Reminders that Promotes Self-Care in Adults With Chronic Heart Failure: Randomized Controlled Trial Protocol. *JMIR Research Protocols* 3, 1 (2014). <https://doi.org/10.2196/resprot.2957>
- [42] Nolan Robert P., Ross Heather J., Farkouh Michael E., Huszti Ella, Chan Sammy, Toma Mustafa, D’Antono Bianca, White Michel, Thomas Scott, Barr Susan I., Perreault Sylvie, McDonald Michael, Zieroth Shelley, Isaac Debra, Wielgosz Andreas, and Mielniczuk Lisa Marie. 2021. Automated E-Counseling for Chronic Heart Failure. *Circulation: Heart Failure* 14, 1 (Jan. 2021), e007073. <https://doi.org/10.1161/CIRCHEARTFAILURE.120.007073> Publisher: American Heart Association.
- [43] Francisco Nunes, Nervo Verdezoto, Geraldine Fitzpatrick, Morten Kyng, Erik Grönvall, and Cristiano Storni. 2015. Self-Care Technologies in HCI: Trends, Tensions, and Opportunities. *ACM Transactions on Computer-Human Interaction* 22, 6 (2015), 1–45. <https://doi.org/10.1145/2803173>
- [44] Stefan Olafsson, Teresa O’Leary, and Timothy Bickmore. 2019. Coerced Change-talk with Conversational Agents Promotes Confidence in Behavior Change. In *Proceedings of the 13th EAI International Conference on Pervasive Computing Technologies for Healthcare* (Trento, Italy, 2019-05-20) (*PervasiveHealth’19*). Association for Computing Machinery, 31–40. <https://doi.org/10.1145/3329189.3329202>
- [45] Stefan Olafsson, Byron Wallace, and Timothy W. Bickmore. 2020. Towards a Computational Framework for Automating Substance Use Counseling with Virtual Agents.. In *AAMAS*. 966–974.
- [46] Meysam Pirbaglou, Joel Katz, Mehras Motamed, Sarah Pludwinski, Krista Walker, and Paul Ritvo. 2018. Personal Health Coaching as a Type 2 Diabetes Mellitus Self-Management Strategy: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *American Journal of Health Promotion* 32, 7 (2018), 1613–1626. <https://doi.org/10.1177/0890117118758234>
- [47] James O Prochaska and Carlo C DiClemente. 2005. The transtheoretical approach. In *Handbook of psychotherapy integration* (2nd ed ed.), John C. Norcross and Marvin R. Goldfried (Eds.). Oxford University Press.
- [48] Richard Shepherd. 1999. Social determinants of food choice. *Proceedings of the Nutrition Society* 58, 4 (1999), 807–812. <https://doi.org/10.1017/S0029665199001093>
- [49] Barry G. Silverman, John Holmes, Stephen Kimmel, Charles Branas, Doug Ivins, Ransom Weaver, and Yi Chen. 2001. Modeling Emotion and Behavior in Animated Personas to Facilitate Human Behavior Change: The Case of the HEART-SENSE Game. *Health Care Management Science* 4, 3 (2001), 213–228. <https://doi.org/10.1023/A:1011448916375>
- [50] H. A. Simon. 1956. Rational choice and the structure of the environment. *Psychological Review* 63, 2 (1956), 129–138. <https://doi.org/10.1037/h0042769>
- [51] Nada Terzimehić, Renate Häußelschmid, Heinrich Hussmann, and m.c. schraefel. 2019. A Review & Analysis of Mindfulness Research in HCI: Framing Current Lines of Research and Future Opportunities. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (New York, NY, USA, 2019-05-02) (*CHI ’19*). Association for Computing Machinery, 1–13. <https://doi.org/10.1145/3290605.3300687>
- [52] Reuven Tsur. 1992. *Towards a Theory of Cognitive Poetics*. North Holland Publishing Co.
- [53] Liyuan Wang, John L. Christensen, David C. Jeong, and Lynn C. Miller. 2019. Virtual prognostication: When virtual alcohol choices predict change in alcohol consumption over 6-months. *Computers in Human Behavior* 90 (2019), 388–396. <https://doi.org/10.1016/j.chb.2018.08.025>
- [54] WHO. [n.d.]. *Cardiovascular diseases*. <https://www.who.int/westernpacific/health-topics/cardiovascular-diseases> Accessed: 2020-09-10.
- [55] WHO. [n.d.]. *The global burden of chronic disease*. https://www.who.int/nutrition/topics/2_background/en/ Publisher: World Health Organization, Accessed: 2020-09-09.
- [56] John Zimmerman, Jodi Forlizzi, and Shelley Evenson. 2007. Research Through Design As a Method for Interaction Design Research in HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (New York, NY, USA) (*CHI ’07*). ACM, 493–502. <https://doi.org/10.1145/1240624.1240704>