

University of Nevada, Reno

**Mood Maestro:
Therapeutic Software for Helping Alleviate Depression**

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in
Computer Science

by

Corwin Fleming

Dr. Sergiu Dascalu/Thesis Advisor

December, 2010

Copyright © 2010 by Corwin Fleming

All rights reserved.



THE GRADUATE SCHOOL

We recommend that the thesis
prepared under our supervision by

CORWIN FLEMING

entitled

Mood Maestro: Therapeutic Software For Helping Alleviate Depression

be accepted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE

Sergiu Dascalu, Ph.D., Advisor

Dr. Frederick C. Harris, Jr., Ph.D., Committee Member

Dr. Eelke Folmer, Ph.D., Committee Member

Dr. Janet Usinger, Ph.D., Graduate School Representative

Marsha H. Read, Ph. D., Associate Dean, Graduate School

December, 2010

Abstract

Depression is a serious problem for many people in the United States and around the world. Cognitive Behavioral Therapy, or CBT, is a non-pharmacologic form of therapy that targets depression through teaching strategies that focus on an individual's depressive thoughts and behavior. CBT has been found to be quite effective in treating depression, administered both through traditional therapy sessions with a psychologist, and with self-help products like books or CDs. CBT software offers the same benefits of traditional self-help, such as anonymity and low costs, but can potentially be more effective by providing a superior, more interactive, user experience. Despite these advantages, very few examples of CBT software have been implemented.

This thesis explores traditional CBT methods and current software implementations and provides details on the specification, design, and implementation of a new CBT application called the Mood Maestro. In addition, this thesis describes product testing with the Mood Maestro, a comparative analysis with a leading CBT product available to the public, and finally suggests areas for future work.

Acknowledgements

First and foremost, I would like to wholeheartedly thank Dr. Stephen Mayville for the immense amount of time and effort he has contributed to this project. The concept of the Mood Maestro was conceived by him, and I can't thank him enough for his guidance and patience as his vision has slowly but surely become a reality.

I would like to express my sincere gratitude to Dr. Sergiu Dascalu not only for serving as my thesis advisor, but also for his continual guidance during my undergraduate and graduate studies.

Thank you to Dr. Eelke Folmer, Dr. Frederick Harris, and Dr. Janet Usinger for serving on my thesis committee and for providing feedback on this work.

I would like to thank my team members on the original undergraduate senior project SMILE prototype, Richard Delk, John Underwood, and Kyle Matossian for helping to build the foundation for this thesis.

Great thanks are extended to the MoodGYM team at the Australian National University for the use of their product, and for permission to include the MoodGYM in this thesis.

Finally, I would like to thank my family: my parents, Al and Nancy, my brother, Max, and my girlfriend, Inga for their never failing love and support. You are the most important people in my life.

Table of Contents

1	INTRODUCTION.....	1
2	BACKGROUND ON COGNITIVE BEHAVIORAL THERAPY.....	5
2.1	Depression.....	5
2.2	What is CBT?.....	6
2.3	History of CBT.....	7
2.4	Benefits of CBT.....	8
2.5	CBT Methods.....	9
2.6	Distribution of CBT.....	9
3	BACKGROUND ON CBT SOFTWARE.....	11
3.1	The MoodGYM Training Program.....	12
3.2	NICE Guidelines.....	14
3.2.1	Beating the Blues.....	15
3.2.2	FearFighter.....	17
3.3	Other Related Work.....	18
3.4	Conclusion.....	19
4	SPECIFICATION AND REQUIREMENTS OF THE MOOD MAESTRO TOOL.....	20
4.1	CBT Approach.....	21
4.2	Functional Requirements.....	22
4.3	Non-Functional Requirements.....	23
4.4	Use Case Modeling.....	24
4.4.1	Use Case Diagram.....	24
4.4.2	Detailed Use Cases.....	26
4.5	Requirement Traceability Matrix.....	31
5	DESIGN AND IMPLEMENTATION OF THE MOOD MAESTRO TOOL.....	32
5.1	System Architecture.....	32
5.2	Class Diagram.....	34
5.3	Class Descriptions.....	36
5.4	Activity Chart of Mood Maestro Workflow.....	39
5.5	Auto Save (Completing a Module) Activity Chart.....	41
5.6	Implementation of the Mood Maestro Tool.....	42
5.6.1	Login.....	44
5.6.2	Create New User.....	45
5.6.3	Main Menu.....	46
5.6.4	Modules.....	47
5.6.5	Examples.....	52
5.6.6	Quiz.....	53
5.6.7	Journal.....	54
5.6.8	Videos.....	55

5.6.9	Calendar.....	56
5.6.10	Graphs.....	57
6	MOOD MAESTRO TESTS AND SOFTWARE PROFESSIONAL FEEDBACK ..	59
6.1	Test Plan and Materials.....	60
6.2	ASQ Results	64
6.3	SUS Results.....	65
6.4	Reported Issues.....	66
6.4.1	Test Plan 1 Tasks	66
6.4.2	Test Plan 2 Tasks	67
6.4.3	Test Plan 3 Tasks	68
6.4.4	Common Tasks	69
7	COMPARATIVE ANALYSIS OF CBT SOFTWARE TOOLS.....	72
7.1	Comparative Analysis of Mood Maestro versus MoodGYM	72
7.1.1	Criteria of Evaluation.....	73
7.1.2	Evaluation Results.....	76
7.1.3	Conclusion	79
8	CONCLUSIONS AND FUTURE WORK	80
8.1	Future Work.....	80
8.1.1	Tool Improvement.....	80
8.1.2	Testing.....	81
8.1.3	Marketing.....	82
8.2	Conclusions and Contributions.....	82
	References.....	85

List of Tables

Table IV.1: Mood Maestro module descriptions	22
Table IV.2: Mood Maestro use case mapping	26
Table V.1: MoodMaestro class description	36
Table V.2: DatabaseManager class description	36
Table V.3: User class description.....	37
Table V.4: Journal class description.....	37
Table V.5: Quiz class description.....	37
Table V.6: Activity class description.....	38
Table V.7: Calendar class description	38
Table V.8: Video class description.....	38
Table V.9: Module class description	39
Table VI.1: ASQ results	65
Table VI.2: SUS results	66
Table VII.1: Criteria groups	73
Table VII.2: Comparison matrix.....	74

List of Figures

Figure 3.1:	A screenshot of the Feelings module in the MoodGYM training program	14
Figure 3.2:	A screenshot of the Introduction Session in Beating the Blues	16
Figure 4.1:	Functional requirements of the Mood Maestro program	23
Figure 4.2:	Non-functional requirements of the Mood Maestro program	24
Figure 4.3:	Use case diagram	25
Figure 4.4:	login	27
Figure 4.5:	quiz	28
Figure 4.6:	journal	28
Figure 4.7:	graphProgress	29
Figure 4.8:	scheduleActivities	29
Figure 4.9:	viewCalendar	30
Figure 4.10:	watchVideo	31
Figure 4.11:	Requirement traceability matrix	31
Figure 5.1:	Mood Maestro system architecture	33
Figure 5.2:	Core class diagram of the Mood Maestro software	35
Figure 5.3:	Activity chart of Mood Maestro workflow	40
Figure 5.4:	Activity chart depicting the actions taken when a module is completed	41
Figure 5.5:	The Mood Maestro login window	44
Figure 5.6:	The Create New User Window	45
Figure 5.7:	The Mood Maestro main menu	46
Figure 5.8:	Page 1 of the Thought Restructuring module	47
Figure 5.9:	Page 2 of the Thought Restructuring module	48
Figure 5.10:	Page 3 of the Thought Restructuring module	49
Figure 5.11:	Page 4 of the Thought Restructuring module	50
Figure 5.12:	The Life Plan module	51
Figure 5.13:	An example to help the user understand a CBT concept	52
Figure 5.14:	A Mood-Evaluating quiz	53
Figure 5.15:	The user's personal journal	54
Figure 5.16:	An example video	55
Figure 5.17:	The calendar feature of the Mood Maestro	56
Figure 5.18:	A sample bar graph	57
Figure 5.19:	A sample line graph	58
Figure 6.1:	After Scenario Questionnaire	61
Figure 6.2:	SUS Questionnaire for Mood Maestro Interface Evaluation	63

1 INTRODUCTION

The work presented in this thesis began in the fall of 2006 in the CS 425 Software Engineering course. Dr. Stephen Mayville, a Reno-based psychologist, addressed the class with a request for a new software project. Dr. Mayville impressed upon us the seriousness of depression as a malady, and the lack of research that has been done to approach its treatment from a computerized stance. It was his vision to create a standalone software tool that could be used to treat depression. This tool would employ Cognitive Behavioral Therapy, or CBT, to guide users through a number of exercises aimed at changing the way they think and feel.

Depression is a pervasive and costly problem. Studies conducted on the prevalence of depression indicate that between 5 and 12% of the population of the United States suffers from depression at any point in time [1]. Lifetime prevalence rates are substantially higher. CBT for depression [2] is a form of therapy that relies on a host of techniques to modify problematic behavior and the way an individual experiences thought. It is one of the most effective, if not the most effective, non-pharmacologic therapeutic modality used to treat depression [3]. However, current self-help strategies are done primarily on paper, and through books. Little research has been done to develop and test software that could be used for this same purpose [4].

As said by Dr. Mayville:

“I believe this project is representative of an area that has been largely neglected in the application of self-help approaches in psychology. I strongly believe such a project has the potential to be a valuable contribution to the research body of knowledge for both computer science and psychology, while also enhancing the application of cost-effective cognitive behavioral therapy...”

Through discussions with Dr. Mayville, the advantages of CBT software have become apparent. For instance, CBT software would allow the user, a patient of depression, to receive different CBT strategies in the same intervention (i.e., cognitive restructuring and acceptance based strategies). It would allow the user to maintain a certain measure of anonymity. Computerized treatment permits for easy collection of data for research. Moreover, an interactive form of self-help therapy would not only be advantageous to current self-help CBT, but also cost-effective, saving money by eliminating the need for prescription drugs and paper materials. Finally, while use of the program would ideally be completed in conjunction with regular therapy sessions with a psychologist, it could be used as a purely standalone tool.

With the advantages listed above serving as a foundation, a student team comprised of Richard Delk, John Underwood, and myself designed and implemented a software prototype called SMILE (Software Making Individual Lives Enjoyable). This work was completed over the period of the Software Engineering course and the Senior Projects capstone that followed. SMILE was created in an attempt to improve the state-of-the-art of therapy software design in general and computer supported CBT in particular. Harnessing the potency of current CBT methods, SMILE was a standalone software

application capable of offering a full complement of therapeutic strategies. However, while the completed prototype was considered to be a success, it was far from the polished product envisioned. In Fall 2007, the decision was made to rebuild SMILE, improving upon the structure of its source code, along with an update to its look and feel. With the support of Dr. Mayville and my advisor Sergiu Dascalu, it was decided that I would make it the topic of my thesis work to continue on this noteworthy project, carrying it to its greater potential. I began the work of rewriting SMILE from the ground up, and the project was renamed as the Mood Maestro.

The Mood Maestro allows users to receive CBT treatment in a friendly and pleasant environment. Users work through a series of eight lesson modules that utilize different aspects of CBT. In addition to these lessons, users are prompted to complete quizzes, enter thoughts into a personal journal, schedule activities, periodically check progress, and watch informative videos, all the while working toward a more healthy state of mind. To aid in the task of tracking the user's progress in the program, a MySQL database was implemented and integrated into the Mood Maestro, allowing for easy collection and better organization of user input.

The intended users of the Mood Maestro are patients of depression who want to take an active role in improving their condition. Through consistent use of the program, they will learn a host of techniques to achieve positive change in their life. For users who are already involved in professional therapy, the Mood Maestro can easily be used as an additional tool, assisting in their progress. While the focus of this software is primarily on

depression therapy, its results could be broadened to include patients of other afflictions (i.e., those recovering from serious injuries, accidents, and/or those suffering from anxiety disorders).

The work completed for this thesis began with initial research of traditional cognitive behavioral therapy in its current forms. This research was followed by an exploration of existing CBT software tools. After identifying the key facets of CBT and the strengths and weaknesses of computerized therapy (including the original SMILE prototype), specification and requirements of the new software prototype were formed. Implementation of the Mood Maestro was then put into action. Finally, a series of software tests were completed for assessment and validation of the tool, resulting in further software changes. This thesis aims to demonstrate that CBT software can be used as a fundamental outlet for treating depression, and further, that the Mood Maestro tool can help to lead the way in this cause.

The remaining chapters of this thesis are organized as follows: Chapter 2 provides background on CBT and traditional methods in which it is engaged; Chapter 3 contains an exploration of existing CBT software tools; Chapter 4 details the specification and requirements of the Mood Maestro tool; Chapter 5 focuses on the Mood Maestro's development and implementation; Chapter 6 discusses the completion of software tests conducted using the Mood Maestro; Chapter 7 offers a comparison and discussion of existing CBT software tools, including the Mood Maestro; finally, Chapter 8 contains details on future work to be completed and the conclusions of the presented thesis.

2 BACKGROUND ON COGNITIVE BEHAVIORAL THERAPY

2.1 Depression

Many people feel sadness, loneliness, and other symptoms of depression in their life. However, someone is only considered to be clinically depressed when these symptoms manifest themselves nearly all of the time for at least two weeks, causing significant disturbance to their life. This excludes those who feel depressed due to the effects of drugs or medication, and those with other medical conditions that result in the depressive symptoms [5]. Not everyone who is depressed experiences the same symptoms, but some of the more common symptoms include lack of energy, feelings of worthlessness, lack of concentration and remembering details, reduced pleasure in activities, insomnia, changes in eating habits, even thoughts of death or suicide [1]. Depression is a serious problem in the United States and around the world [6]. The percentage of those who suffer from depression varies from country to country, but generally ranges from 8% to 12% [7].

2.2 What is CBT?

Cognitive Behavioral Therapy is a psychotherapy that targets depression through teaching strategies that focus on an individual's depressive thoughts and behaviors. According to the National Association of Cognitive-Behavioral Therapists, CBT is rooted in the idea that “our *thoughts* cause our feelings and behaviors, not external things, like people, situations, and events. The benefit of this fact is that we can change the way we think to feel / act better even if the situation does not change.” [8]. Other CBT researchers and therapists have implemented CBT strategies that focus more on the patient's environment and learning history as primary antecedents to depression [9][10]. Individuals from these backgrounds have emphasized behavior change and thought acceptance rather than a more “traditional” CBT belief that negative thoughts are causal, and need to be direct targets for change.

Across theoretical variants of CBT, researchers have found that CBT skill development forms the foundation for some of the most successful treatments for depression. In fact, studies have shown that CBT can be just as, or more effective than medication used for the same purpose [11]. CBT is currently applied not only to depression, but also to a large number of clinical disorders. It has been successfully used to treat anxiety and mood disorders [3], insomnia [12], and even schizophrenia (in combination with medication) [13].

2.3 History of CBT

Cognitive Behavioral Therapy is a fusion between behavioral and cognitive therapies. Behavioral modification involves reinforcement and punishment in an attempt to change a person's behavior. Individuals who espoused the behavioral principles delineated by Pavlov, Watson, and Skinner began to apply their use to the early treatment of psychotic behavior and autism [14]. Peter Lewinsohn, performing work in beginning forms of behavioral activation, argued that by increasing reinforcement of avoided behaviors in depressed individuals (and therefore increasing participation in the behavior itself), one could start to eliminate depression [15].

Some of the more recognized major psychotherapy successes in treating depression were found in the works of Albert Ellis and Aaron Beck. Ellis developed Rational Emotive Therapy (later renamed to Rational Emotive Behavior Therapy), which is considered to be one of the original forms of CBT. REBT champions the idea that people are emotionally affected not by events in the world, but by the way they perceive these events [8]. Progressing along this same line, Beck widely became considered one of the founders of cognitive therapy, holding that an individual's mood and behaviors are based upon perceptions of previous events and experiences [16].

In the 1980s and 1990s, cognitive and behavior therapies were merged into the more modern forms of CBT [14]. While still including adaptations of the Thought

Restructuring and Behavioral Activation techniques discussed above, modern CBT has focused on the incorporation of acceptance-based skills such as Mindfulness [9].

2.4 Benefits of CBT

There are many benefits to CBT treatment that differentiate it from other forms of therapy. For instance, CBT users are able to see results in treatment relatively quickly. On average, users receive 16 sessions, much less than psychoanalysis, which can be carried on for years. This rapid turnaround can be attributed to the learning aspect of CBT; clients are often given “homework” to complete on their own, practicing and becoming self sufficient in different therapeutic techniques. The therapist and client are constantly working toward a point when formal therapy can end and the client can take independent, rational control of his or her feelings. CBT places focus on questions. The therapist asks the client questions, but more importantly prompts them to ask questions directed toward themselves. Clients learn to question negative thoughts, testing their validity as facts. For example, one might ask, “When my friend didn’t wave at me, did it really mean they were mad at me? Is it possible that they just didn’t see me?” CBT treatments are goal oriented. Therapists help clients to achieve the kind of life changes they desire by teaching them how to change their relationship with thoughts and engage in behavior that runs counter to the behavioral avoidance commonly seen among individuals suffering from depression. New methods are learned with each session [5][8].

2.5 CBT Methods

CBT treatment includes a number of exercises for alleviating depression. Some of these exercises are listed here. *Behavioral Activation* is a process in which patients attempt to participate in the kinds of activities that they used to find enjoyable, but have lost interest in or avoid as a result of their condition. Goal setting and listing values often accompany behavioral activation, helping patients guide their activity planning. *Thought Restructuring* includes an analysis of daily situations that cause negative feelings, supporting the idea that negative feelings are caused by inaccurate interpretations of events in our lives. By looking closer at these events it is hoped that they can make the realization that their negative thoughts are not based on facts, helping individuals to feel better. Users of CBT are often instructed to keep a diary or journal of their mood throughout the day. This can also aid in Thought Restructuring. Finally, *Mindfulness* is a practice in which patients attempt to live in the moment, identifying their thoughts and feelings, but not judging them one way or another [17].

2.6 Distribution of CBT

CBT is commonly delivered through regular sessions with a therapist, but also lends itself admirably to self-help methods like books and audio CDs. While the client is unable to receive the same level of feedback, he or she can still easily learn effective CBT techniques and complete the same kinds of practice assignments as those in face-to-face

therapy sessions. A quick look at the on-line shop for the NACBT yields a large number of products for purchase. For instance, Dr. Aldo Pucci has published a book called *Feel the Way You Want to Feel ... No Matter What!* This self-help book contains chapters focusing on many of the CBT methods previously discussed, and claims to teach people how to rationally deal with their daily troubles [18]. Pucci has also released a CD containing an audio seminar on these same topics called *Conquer Depression*. [19]. Both the book and CD can be obtained at an affordable price (\$25 each). More recently, CBT has begun to find its way into computerized forms in programs like *Beating the Blues* and *Fear Fighter*. We explore existing CBT software programs in the next chapter.

3 BACKGROUND ON CBT SOFTWARE

In recent years, the arena of self-help CBT has grown to include computerized tools. Like traditional self-help, CBT software provides an outlet for those who cannot see a therapist face-to-face, or those who wish to supplement their existing treatment. Therapy sessions with a professional can be time consuming and expensive. CBT software, on the other hand, can be completed at leisure, anonymously, and for much less money. CBT software incorporates many of the same techniques as traditional self-help CBT, but is superior in a number of respects. Software programs are interactive, engaging the patient to a much greater degree. Therapy conducted via a computer allows for easy collection of data and instant feedback. Computer programs are configurable and can be suited to fit a particular patient. Software eliminates the need for paper products. With the number of computer users growing throughout the world, computerized CBT seems to be the next logical step in self-help. In this chapter we review three examples of successfully implemented CBT software: *the MoodGYM training program*, *FearFighter*, and *Beating the Blues*, followed by a listing of other related CBT programs.

3.1 The MoodGYM Training Program

The MoodGYM training program was developed by the Centre for Mental Health Research at the Australian National University in 2001. This web program is designed to fight depression and anxiety in young people, and is free to the general public. Studies have shown use of the MoodGYM training program reduces depression and anxiety levels in users who complete at least two of the five modules contained in the program, persisting even a year after completed use of the tool [20][21][22]. The MoodGYM currently has more than 200,000 registered users. New users can register for an account by visiting the MoodGYM website (<http://moodgym.anu.edu.au>) [23].

The MoodGYM is well organized, consisting of five main modules: Feelings, Thoughts, Unwarping, De-Stressing, and Relationships. Each module focuses on a specific aspect of CBT, with a central focus on identifying and changing negative thoughts. In addition to these modules, users are prompted to complete Mood-Evaluating quizzes throughout their time with the program, hopefully showing steady improvement over time. Progress made in the modules is easily determined by viewing the progress bars that inhabit each page. At any time the user can access a personal workbook that records all progress and lists the completed contents of the program. Users can easily see what they have completed, and what they still have left to do [23].

Users of the MoodGYM are subjected to a pleasant and welcoming experience. The graphical interface is very colorful, and quickly grabs the attention of the user. Figure 3.1 displays a screenshot of a typical MoodGYM module. Most of the graphics used in the program are static, but there are also a number of simple animations. The backbone of the MoodGYM is the use of characters for the user to relate to. Characters such as *Noproblemos* and *Moody* are used in different scenarios to help describe healthy and unhealthy responses. Two characters, one happy and one unhappy, will react to a situation, a text description displaying their feelings about the event. Further explanation will then be given as to why one character's way of thinking is more healthy and preferable. The characters and scenarios add a fair amount of humor to the program, removing any idea that therapy has to be a sterile experience. As an option however, the user can choose to remove the characters, leaving only the text descriptions. The MoodGYM allows users to invest themselves as much as they desire. Interspersed throughout the text are links allowing the user to gain more information about a particular topic, or explanations of key terms and concepts [23].

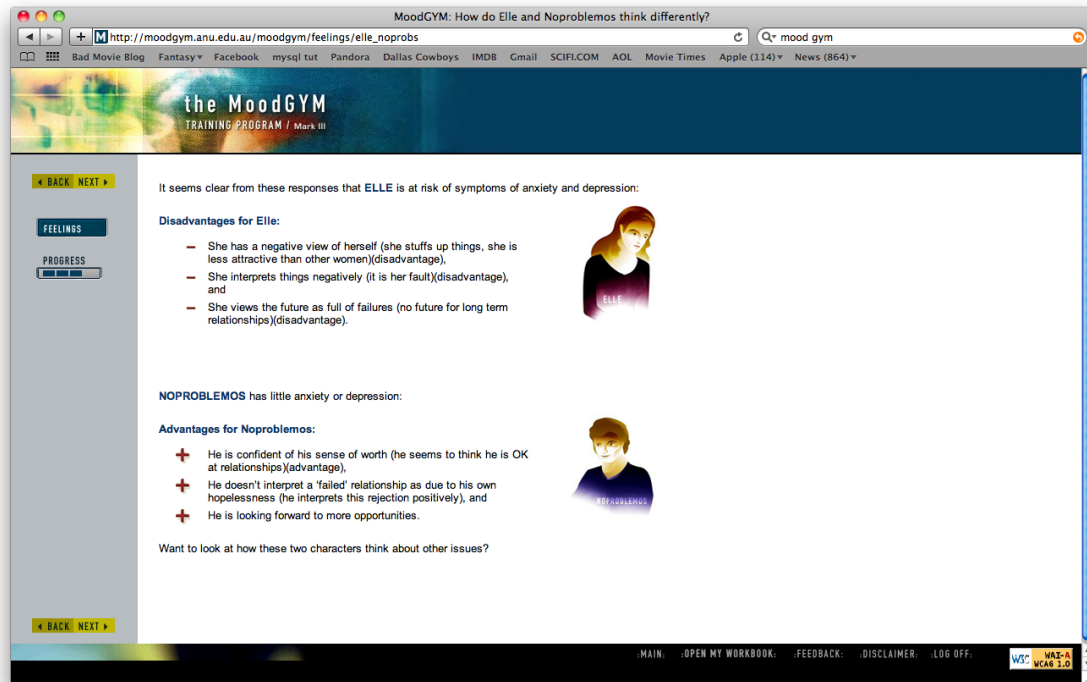


Figure 3.1: A screenshot of the “Feelings” module in the MoodGYM training program [23]. Two characters react to a situation, one with a positive outlook, and one negative.

3.2 NICE Guidelines

In 2006, the National Institute for Health and Clinical Excellence, or NICE (UK), conducted a study to update their official recommendations regarding computerized cognitive behavioral therapy (CCBT). The NICE reviewed five CCBT software tools, performing searches of published literature, electronic databases, and unpublished data. For depression, *Beating the Blues*, *COPE*, and *Overcoming Depression* were reviewed. *FearFighter* was tested for the treatment of panic and phobias. For obsessive-compulsive disorder, *OCFighter* was tested. In these reviews, the major outcomes considered were:

- Clinical effectiveness in terms of improvement in psychological symptoms

- Effectiveness in terms of interpersonal and social functioning
- Effectiveness in terms of preference, satisfaction, and acceptability of treatment
- Cost-effectiveness

After completing the study, the NICE recommended Beating the Blues for the treatment of depression, and FearFighter for panic and phobia. The other CCBT packages were not recommended for use [24].

3.2.1 Beating the Blues

Beating the Blues is a web program created by Ultrasis Group Plc for the treatment of depression and anxiety. After successfully completing randomized controlled trials [25], Ultrasis was able to negotiate with the UK's largest independent private healthcare provider to distribute Beating the Blues in the private healthcare market. Since 2006, BTB has been the program predominantly used by the National Health Service [26]. BTB is accessed over the internet, along with supplementary telephone support. A user account can be obtained through a general physician, or purchased over the internet for the cost 295 pounds (\$435) [27].

Introductions

Beating the Blues
session 1
1.500.060

ANDREW ELAINE JEAN BOB HEATHER

Click on a photo to see that person's story. Look at one or more before continuing.

Filmed during therapy

ANDREW is a teacher in his mid-twenties who is feeling overwhelmed and depressed.

ELAINE is a single parent with two children and serious money problems. She feels depressed.

JEAN, a widow in her seventies, has become tearful and depressed following the death of a close friend.

Filmed after therapy

BOB is worried about being made redundant, and has started to get pains in his chest and down his arm.

HEATHER is married with one child. She is a landscape gardener and is suffering from panic attacks.

BACK

Figure 3.2: A screenshot of the Introduction Session in *Beating the Blues* [27]. In this session users are introduced to five case study videos that are used throughout the other sessions.

The therapy program of *Beating the Blues* contains eight modules that each run for approximately 50 minutes. One module is to be completed per week, each with a homework project to be finished before the next session. In the first session, the user is introduced to five video case studies that are explored throughout the remaining treatment periods. A screenshot of the BTB Introduction session is shown in Figure 3.2. In the following sessions, users learn a wide variety of CBT concepts and techniques. Users learn to understand anxiety and depression, and to identify the link between thoughts, feelings, and behaviors. They are exposed to the practice of activity scheduling,

exploring beliefs, and problem solving to subvert negative thoughts. Also of great importance, users learn to set goals both within the program and for the future [27].

Beating the Blues contains interactive screens with voice narration, pictures, and videos. The user interface is quite simple, offering itself to users with even the most basic of computer skills. Like the MoodGYM, BTB is designed for users to relate to the feelings of the characters found in the case study videos. According to patient questionnaires, 89% found Beating the Blues to be helpful, and 7 out of 10 people who use the program report that they would recommend it to a friend [27].

3.2.2 FearFighter

The other NICE approved CBT program, FearFighter, was created by CCBT Limited. FearFighter is a web-based program that is reportedly just as effective as face-to-face therapy in helping anxious and phobic individuals. The team at CCBT (who also created COPE and OCFighter) emphasizes both the cost and time efficiency of their tool. Users of the program, who need not have any computer skills, are given a secure user account which they can access anywhere with an internet connection. Completion of the therapy program takes roughly three months. FearFighter allows users to circumvent the long waits and high costs of receiving treatment from a clinician. Users can work with FearFighter as often as they like, but are urged to complete at least one session every

week. Users also receive a small number of helpline phone calls to support their efforts [28].

The major therapeutic approach of FearFighter is the use of *exposure therapy*, habitually coming in contact with the things that one fears over time, relieving that fear in the process. This program contains nine modules, one to be completed each week. The techniques incorporated into the FearFighter include observing CBT case examples, maintaining a personal journal, identifying fear triggers, goal setting, and learning coping strategies and troubleshooting tips for continued success. Each time users return to the program, they are asked to report on their mood, allowing FearFighter to use its built in Patient Progress Monitoring System to chart the user's advancement. FearFighter has been purchased by a number of mental health organizations for use with patients [28].

3.3 Other Related Work

In this section a listing of other related CBT programs is given. *The Depression Center* is an internet-based CBT program that places a strong emphasis on the online community of members and health educators [29]. *Good Days Ahead* is a standalone software tool that makes use of instructional videos, but focuses more on cognitive therapy [30]. *CBTpal* is an online tool meant to be used in conjunction with regular therapy [31]. Another program from the Australian National University, the team that also created the MoodGYM is *e-couch*, an online self-help program that is more general, focusing not

only on depression, but also on generalized anxiety and worry, social anxiety, relationship problems, and loss and grief. As with the earlier MoodGYM it makes use of workbooks and characters, but this time adds animated videos [32].

3.4 Conclusion

By reviewing these examples of CBT software, it has become apparent that CCBT is a tested and viable means for self-help treatment of mental disorders like depression and anxiety. Although each program offers different techniques in helping patients, the core values of CBT treatment remain consistent. In every program, users were asked to record their activities and moods in a journal, identify the connection between thoughts and feelings, complete homework assignments, and engage in periodic evaluations to measure current mood levels. In all of the reviewed programs users were given feedback concerning their progress with the software. In all cases, maintaining the security and privacy of the user was a top priority. Finally, these programs were most definitely geared toward those with very basic computer skills. These qualities most certainly must be included in the foundation of any new CBT software product. In the next chapter, specification and requirements of our own CBT tool, the *Mood Maestro*, are provided.

4 SPECIFICATION AND REQUIREMENTS OF THE MOOD MAESTRO TOOL

The problems that depression can pose has been discussed. Further, there is evidence that Cognitive Behavioral Therapy can be used with great success to treat depression. There are many ways that CBT can be distributed, but software is an advantageous method for those who prefer self-help, whether it is for the opportunity of anonymity or for the relatively low costs. Software can provide any of the CBT techniques found in traditional distributions like books or CDs, but is superior in data collection, feedback, interactivity, and breadth of treatment techniques available in one product. Programs like the MoodGYM, Beating the Blues, and FearFighter have been made available to the public, and have been a positive force in the lives of many people. With that said, CBT software is still a relatively new invention, with a large amount of untapped potential.

As mentioned in the introduction to this document, a software prototype called SMILE was created in an attempt to build on the success of current CBT software implementations. The program was commissioned by Dr. Stephen Mayville and included his provided content. In SMILE, as with other CBT software programs, users would complete a series of modules over a short course of time. Complementing the exercise modules was a personal journal, calendar planner, evaluating quizzes, and educational videos. SMILE was successfully implemented in the spring of 2007.

Although complete, this implementation of SMILE left room for improvement in its code structure, GUI design, and overall user experience. With the beginning of my graduate program, it was decided to rebuild the program from scratch, working toward a more professional product. In this chapter the specification and requirements of the new tool, now called the *Mood Maestro*, are given.

4.1 CBT Approach

The CBT content of the Mood Maestro is an original method developed by Dr. Stephen Mayville, and is presented in a series of eight lessons, or modules. The Mood Maestro encompasses acceptance strategies, such as mindfulness, as well as restructuring techniques for dealing with thoughts. It is more similar to Mindfulness Based Cognitive Therapy for Depression in that thought restructuring is described to help patients identify maladaptive thoughts, but the patients are encouraged to see their thoughts as just phenomena of the mind that need less attention, rather than phenomena that have to be changed. Even though there is a “change” element to actually doing thought restructuring, the underlying emphasis of the Mood Maestro exercises is seeing ones thoughts as thoughts and nothing more. The Mood Maestro also emphasizes behavior as a stronger causal agent of depression when compared to other self-help programs such as the MoodGYM. In addition, the Mood Maestro emphasizes the bi-directional nature of thoughts and behavior to a greater degree.

Table IV.1 describes the eight modules that comprise the core content of the Mood Maestro program.

Table IV.1: Mood Maestro module descriptions.

Module	Justification
Introduction	Learn about depression, the purpose of the Mood Maestro, and the structure of the program.
Your Story	Identify the things that are responsible for starting and maintaining depression.
Thought Restructuring	Learn to relate to thoughts differently.
Behavioral Activation	Attack depression through engaging in different activities.
Mindfulness	Learn to operate from an observational stance, acknowledging surroundings and thoughts without judging them.
Life Plan	Identify personal values and behavior that is consistent with these values.
Relapse Prevention	Learn techniques for avoiding relapse into depression.
Happiness	Learn techniques for drawing attention to positive aspects of life and creating life meaning.

4.2 Functional Requirements

In this section functional requirements are provided. Functional requirements help to define what the system should accomplish in operation. The specific features to be found in the Mood Maestro program were defined through a combination of interviews with Dr.

Mayville and review of current CBT software programs, such as those found in the previous chapter. The functional requirements are shown in Figure 4.1. Those listed with a label of ‘1’ were previously implemented in the CS 426 prototype, and were carried over into the new product. Requirements with a label of ‘2’ were to be added in the new product. A label of ‘3’ indicates features that have not yet been implemented, but would be useful in future work.

R01	[1]	The Mood Maestro shall display quiz questions on the Zung Scale.
R02	[1]	The Mood Maestro shall save user responses for later review.
R03	[1]	The Mood Maestro shall allow the user to compose a personal journal.
R04	[1]	The Mood Maestro shall graph the user’s progress.
R05	[1]	The Mood Maestro shall allow the user to view professional, instructional videos.
R06	[1]	The Mood Maestro shall contain a series of CBT modules/lessons.
R07	[1]	The Mood Maestro shall contain a calendar with a history of user progress and future events.
R08	[1]	The Mood Maestro shall resume from saved progress.
R09	[1]	The Mood Maestro shall validate users for login.
R10	[1]	The Mood Maestro shall allow the creation of new users.
R11	[2]	The Mood Maestro shall log user events to a MySQL database.
R12	[2]	The Mood Maestro shall contain a reminder feature with a <i>to do</i> list.
R13	[3]	The Mood Maestro shall allow users to submit results to a professional.
R14	[3]	The Mood Maestro shall allow the user to create charts during exercises.

Figure 4.1: Functional requirements of the Mood Maestro program.

4.3 Non-Functional Requirements

Non-functional requirements bestow restrictions and constraints on the system’s implementation. These requirements, which can be found in Figure 4.2 below, define performance, security, and other technical qualities of the system.

T01	The Mood Maestro shall be implemented with Java.
T02	The Mood Maestro shall contain an easy to understand user interface.
T03	The Mood Maestro shall contain save states in an easy to access database.
T04	The Mood Maestro shall be available to multiple users.
T05	The Mood Maestro shall use encryption to protect personal states in the database.
T06	The Mood Maestro shall not require an installer.
T07	The Mood Maestro shall be functional on multiple operating systems.

Figure 4.2: Non-functional requirements of the Mood Maestro program.

4.4 Use Case Modeling

Use cases describe the desired behavior of a system through interaction with a user. Use cases can be demonstrated both graphically and textually. This section includes a use case diagram, detailed use case scenarios, and a requirements traceability matrix.

4.4.1 Use Case Diagram

The use case diagram displayed in Figure 4.3 below depicts a single user and his or her interaction with the Mood Maestro system. The user has access to a number of use cases, each containing a different aspect of CBT learning and exercise.

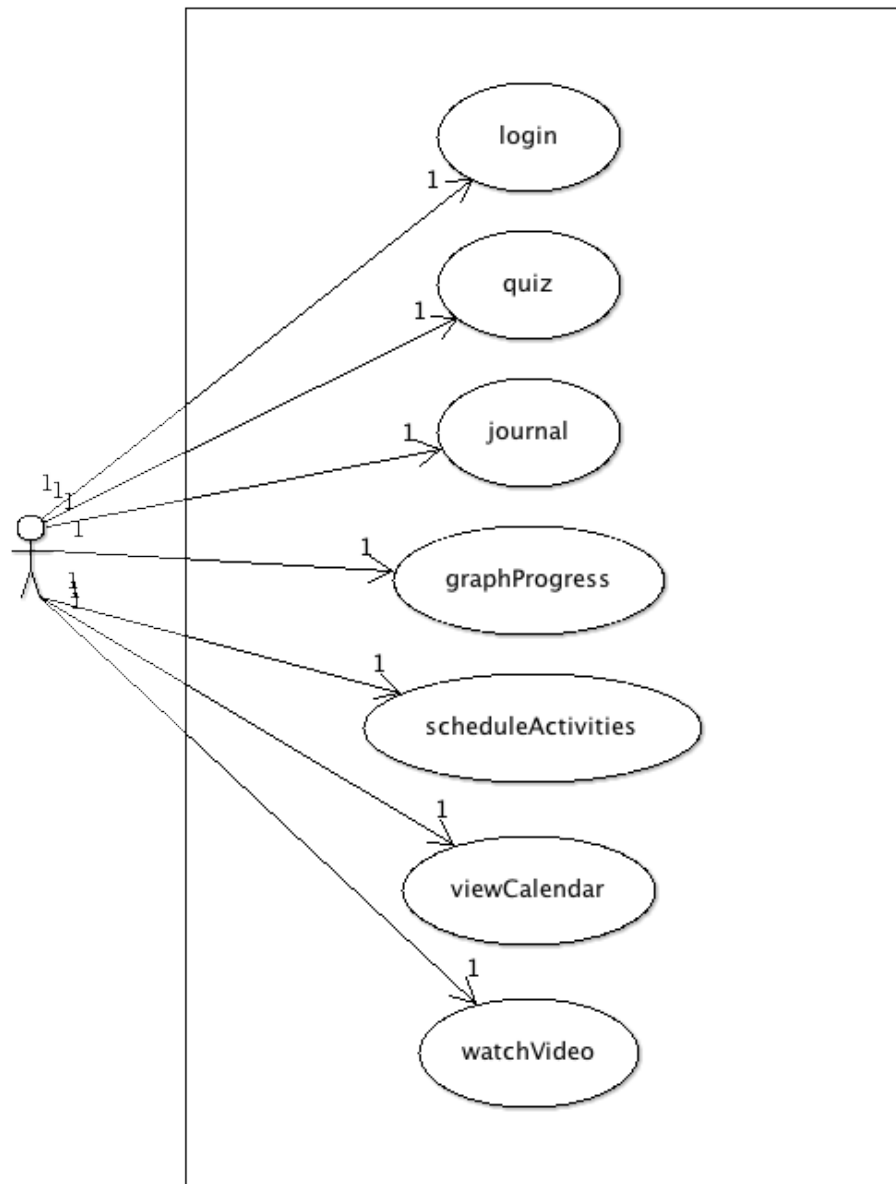


Figure 4.3: Use case diagram.

Table IV.2 indicates how the use cases correlate to the different modules found in the Mood Maestro. The login and quiz use cases are not included as they are performed outside the context of any specific module.

Table IV.2: Mood Maestro use case mapping.

Module	Applicable Use Cases
Introduction	watchVideo
Your Story	graphProgress, scheduleActivities, viewCalendar, watchVideo
Thought Restructuring	graphProgress, watchVideo
Behavioral Activation	graphProgress, scheduleActivities, viewCalendar, watchVideo
Mindfulness	graphProgress, scheduleActivities, viewCalendar, watchVideo
Life Plan	journal, graphProgress, watchVideo
Relapse Prevention	watchVideo
Happiness	journal, watchVideo

4.4.2 Detailed Use Cases

Use case scenarios express the flow of events as the user works with the system in different activities. Figures 4.4 – 4.10 each contain a primary scenario that details the

steps taken when the Mood Maestro UC01 to UC07 are used as intended, with no complications. Secondary scenarios portray the events that occur when an error is made, and accompany several of the use cases here.

Use Case: login	
Use Case ID	UC01
Actor	User
Precondition(s)	1. The program has started.
Primary Scenario	<ol style="list-style-type: none"> 1. The use case starts when the user starts the program. 2. The system prompts the user for a login name and password. 3. The user enters their login name and password. 4. The system verifies that the user exists and the password matches the user. 5. The system loads all saved progress of the user. 6. The system displays the Mood Maestro home page.
Secondary Scenarios	<ol style="list-style-type: none"> 1. The user is denied logon due to invalid login credentials. <ol style="list-style-type: none"> 1a. The system displays an error message and allows the user to try again.
Postcondition(s)	1. The user is able to begin using the program.

Figure 4.4: login. Work that the user completes in the Mood Maestro is private, and therefore must remain secure. Each time the user wishes to access the program, he or she must enter a user name and corresponding password.

Use Case: quiz	
Use Case ID	UC02
Actor	User
Precondition(s)	1. The user has logged in.
Flow of Events	<ol style="list-style-type: none"> 1. The use case starts when the user clicks the Take Quiz button. 2. The system displays the first question to the screen. 3. The user can select an answer. 4. The user clicks Next Question or Previous Question. 5. The system saves the answer and displays another question.
Postcondition(s)	1. The user has completed quiz questions.

Figure 4.5: *quiz.* As the user progresses through the program, he or she should begin to see an improvement in his or her mood. The user is prompted to take a daily quiz that can evaluate his or her mood progress over time.

Use Case: journal	
Use Case ID	UC03
Actor	User
Precondition(s)	1. The user has logged in.
Flow of Events	<ol style="list-style-type: none"> 1. The use case starts when the user clicks the My Journal button. 2. The system checks to see if the Journal file for the current user already exists. 3. The file is loaded into the Journal text area.
Secondary Scenarios	1. The file does not exist and new one is created for the user.
Postcondition(s)	1. The user is now able to make a journal entry.

Figure 4.6: *journal.* A key facet of CBT exercise is to maintain a journal of thoughts throughout the day, recording activities, events, and corresponding moods.

Use Case: graphProgress	
Use Case ID	UC04
Actor	User
Precondition(s)	1. The user has logged in.
Flow of Events	<ol style="list-style-type: none"> 1. The use case starts when the user clicks the My Progress button. 2. The user selects which CBT exercise he or she wishes to view progress for. 3. The system reads quiz results, activity ratings, etc. from files. 4. The system completes calculations on the data to graphically represent it.
Postcondition(s)	1. The user's progress is graphically displayed to the screen.

Figure 4.7: *graphProgress*. At any point during his or her treatment, the user can access the “My Progress” section to view different charts of his or her advancement in the Mood Maestro.

Use Case: scheduleActivities	
Use Case ID	UC05
Actor	User
Precondition(s)	1. The user has logged in.
Flow of Events	<ol style="list-style-type: none"> 1. The use case starts when the user clicks the Schedule Activities button. 2. The system displays text fields for entering activities, combo boxes for rating the activities, and a calendar with selectable dates. 3. The user can enter activities into the empty text fields and rate the activities using the combo boxes. 4. The user clicks Save. 5. The system saves the date, activity, and rating of all entered activities to a file.
Postcondition(s)	1. The user's activities are in the collection and can be viewed in the Calendar section.

Figure 4.8: *scheduleActivities*. One of the CBT exercises found in the Mood Maestro is Behavioral Activation. In this exercise, a patient learns to participate in activities that he or she used to find enjoyable, but now avoid or for which he or she has lost interest.

Use Case: viewCalendar	
Use Case ID	UC06
Actor	User
Precondition(s)	1. The user has logged in.
Flow of Events	<ol style="list-style-type: none"> 1. The use case starts when the user clicks the My Calendar button. 2. The system displays a calendar and a list of up to seven activities and ratings for the currently selected day. 3. The user clicks the More button. 4. Another page of scheduled activities are displayed. 5. The user clicks the Back button. 6. The previous page of scheduled activities is displayed. 7. The user selects a different date in the calendar. 8. Activities for the selected date are displayed. 9. The user clicks the Activities/Mindfulness button. 10. The activity type switches to either behavioral activation activities or mindfulness practice.
Secondary Scenarios	<ol style="list-style-type: none"> 1. The activity does not have an after rating. <ol style="list-style-type: none"> 1a. A combo box is displayed to enter one. 2. The activity does not have an after rating, but the day of the activity has not passed. <ol style="list-style-type: none"> 2a. A combo box is displayed, but disabled.
Postcondition(s)	1. The calendar and a set of activities are displayed to the screen for the user to review.

Figure 4.9: viewCalendar. In the “My Calendar” section of the Mood Maestro, the user can both schedule and view different activities, either for Behavioral Activation or Mindfulness practice.

Use Case: watchVideo	
Use Case ID	UC07
Actor	User
Precondition(s)	1. The user has logged in.
Flow of Events	1. The use case starts when the user enters one of the program modules. 2. The system loads the selected module. 3. The video begins playing after the user presses the Play button.
Postcondition(s)	1. The system begins playing a video.

Figure 4.10: watchVideo. A key feature of the Mood Maestro is its use of professional videos to lead the user through the CBT modules contained in the program. The videos serve as tutorials, examples, and short discussions.

4.5 Requirement Traceability Matrix

The requirement traceability matrix, shown below in Figure 4.11, maps the previously listed requirements to corresponding use cases that meet those requirements.

	UC01	UC02	UC03	UC04	UC05	UC06	UC07
R01		◆					
R02		◆	◆	◆	◆		◆
R03			◆				
R04				◆			
R05						◆	
R06						◆	
R07					◆		◆
R08	◆	◆	◆	◆	◆		◆
R09	◆						
R10	◆						
R11	◆	◆	◆	◆	◆		◆
R12		◆			◆		◆
R13						◆	
R14		◆	◆	◆	◆		◆

Figure 4.11: Requirement traceability matrix.

5 DESIGN AND IMPLEMENTATION OF THE MOOD

MAESTRO TOOL

With requirements elicited and specification documented, design work was undertaken. As with the other successful tools outlined in this document, the Mood Maestro would offer a graphical user interface to its clients. The interface would contain access to a series of modules, personal journal and calendar, and tools for completing quizzes and checking progress. In addition, each Mood Maestro component would be connected to a database management tool for recording user events and statistics. An object-oriented approach was selected as the most efficient means of creating this interface, a different module designed and implemented to represent each facet of the program. In this chapter the “blueprints” of the Mood Maestro tool are presented, followed by details of its implementation and screen shots of the resulting product.

5.1 System Architecture

The complete system architecture of the Mood Maestro, shown in Figure 5.1, highlights the different sections of the application. The front end GUI is dependent upon a number of interfaces (journal, module, calendar, quiz, progress) that make up the different areas of user interaction. Each subsystem within the domain makes use of the Database

Manager interface, which interacts with the database itself, saving and retrieving user data. A number of java packages are needed for realization of the interfaces as well.

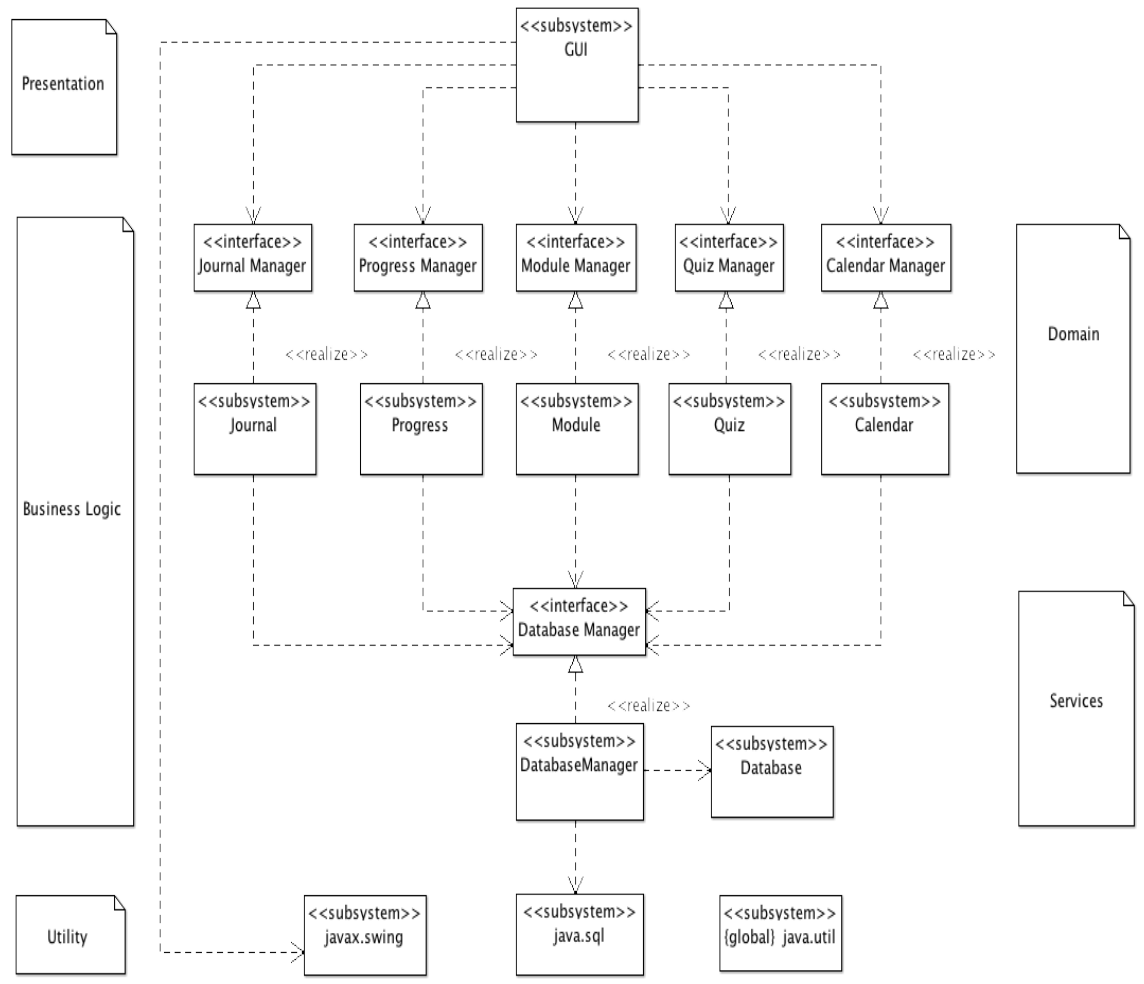


Figure 5.1: Mood Maestro system architecture.

5.2 Class Diagram

The implementation of the Mood Maestro system was completed in Java [33], and each program unit of the system is encapsulated in its own class. Figure 5.2 depicts the core classes in their relational arrangement. Additional utility classes are not shown. The **MoodMaestro** class drives the program and contains **users**, **modules**, and the **database manager**. Each of the eight modules in the program is populated with buttons, graphic examples, text fields for user input, and one or more QuickTime [34] movies for the user to view. Every user has access to his or her own journal for noting personal feelings and events related to mood. The calendar exists for scheduling activities associated with CBT treatment. Finally, the user is prompted to complete a daily quiz for mood assessment.

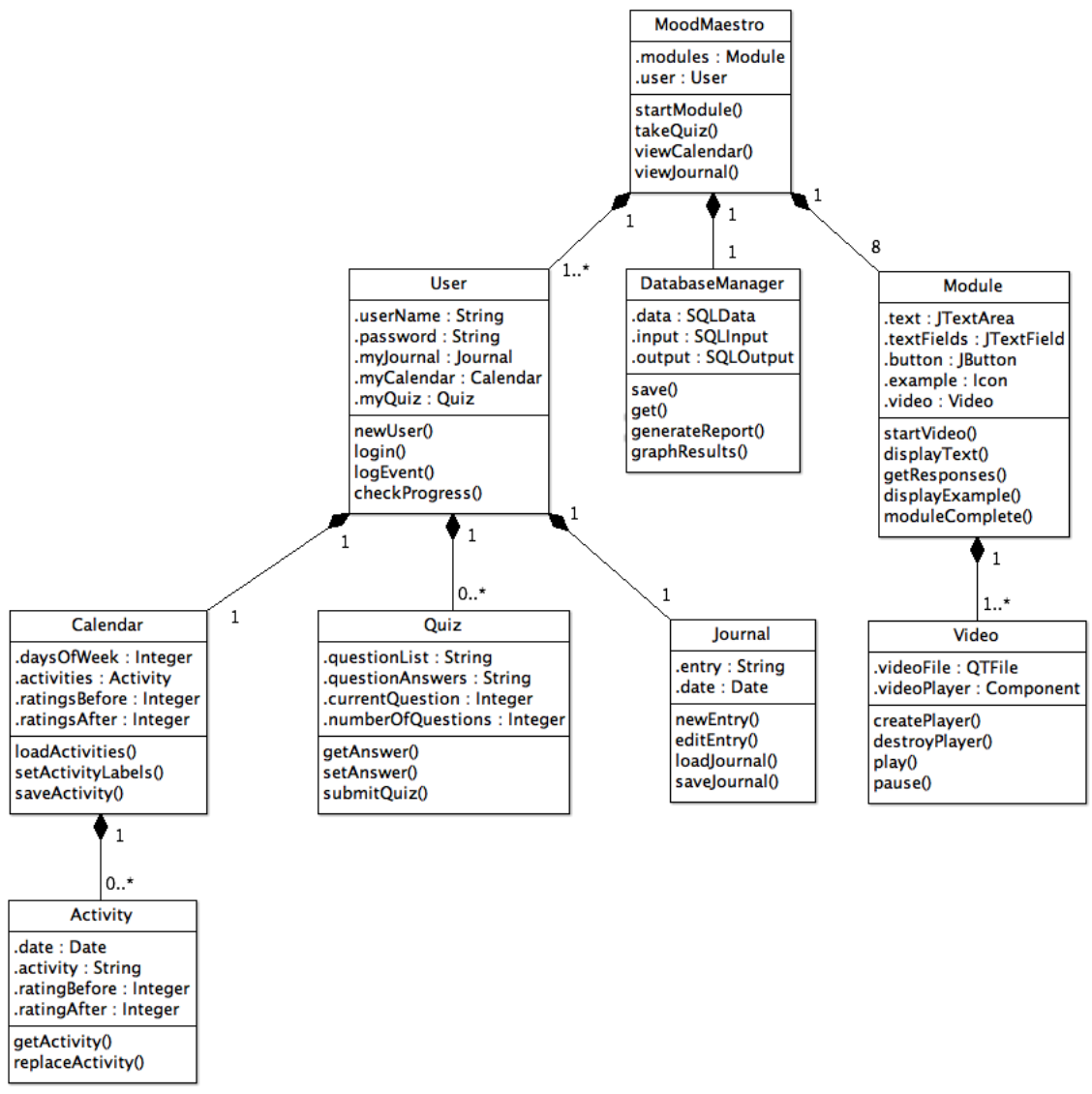


Figure 5.2: Core class diagram of the Mood Maestro software.

5.3 Class Descriptions

In this section each of the core classes in the Mood Maestro application is clarified. Tables V.1 – V.9 contain the purpose for each class, as well as an explanation of the major functions contained therein.

Table V.1: MoodMaestro class description.

Class: MoodMaestro	The role of the MoodMaestro class is to serve as the driver of the main functions of the application.
startModule()	This function loads the selected module.
assessmentCenter()	This function loads the assessment center and displays the quizzes available to take.
viewCalendar()	This function loads the user's calendar and its associated activities.
viewJournal()	This function loads the user's journal with all entries made previously.

Table V.2: DatabaseManager class description.

Class: DatabaseManager	The role of the DatabaseManager class is to serve as the interface between the main MoodMaestro system and the MySQL user database.
save()	This function sends a data packet to the database to be saved. The data packet will include the User ID for lookup in the database.
get()	This function retrieves data from the database for the main system to use. Specific information is requested by the system, the database is queried, and the information is returned if it exists.
generateReport()	This function gathers key data from the database pertaining to the specified user and creates an ASCII file containing user statistics. Possible future actions for the user are calculated and reported as well.
graphResults()	This function gathers key data from the database pertaining to the specified user and translates the information to graph form.

Table V.3: User class description.

Class: User	The role of the User class is to hold information about the current user.
newUser()	This function starts the Create New User... helper. It allows a person to create a new user account.
login()	This function processes the supplied login credentials and attempts to log the user in.
logEvent()	This function writes a description of what the user is currently doing to a log file for later use.
checkProgress()	This function displays all user progress in a formulated graph form.

Table V.4: Journal class description.

Class: Journal	The role of the Journal class is to provide an outlet for the user to record personal feelings and log events that affect their mood.
newEntry()	This function creates a new entry in the journal by inserting the current date and time and allowing the user to edit the journal.
editEntry()	This function allows the user to edit an existing entry. It sets the journal to editable without inserting the date and time.
loadJournal()	This function loads the user's journal from a file so that it can be read and edited.
saveJournal()	This function saves the journal to a file in encrypted form. The number of journal entries is incremented in the user database.

Table V.5: Quiz class description.

Class: Quiz	The role of the Quiz class is to present questions for the user to answer, which can then be interpreted to diagnose their level of depression.
getAnswer()	This function adds the answer of the current question to the array of question answers.
setAnswer()	This function finds the answer of the current question and selects the appropriate radio button.
submitQuiz()	This function calculates the average of the question answers and displays a graph of the user's progress on this quiz. All quiz statistics are saved to the user database.

Table V.6: Activity class description.

Class: Activity	The role of the Activity class is to keep a record of a single user activity, along with ratings of the activity before and after participation.
getActivity()	This function gets the date, time, activity, and first rating the user has just entered, and creates a new activity object.
replaceActivity()	This function replaces the activity at the set date and time if one already exists.

Table V.7: Calendar class description.

Class: Calendar	The role of the Calendar class is to allow the user to select dates, and to maintain a collection of all activities and ratings.
loadActivities()	This function reads the activities file and sets up a linked list containing the activities, dates, and ratings.
setActivityLabels()	This function displays all activities and ratings that fall on the selected date.
saveActivities()	This function runs through the activities list and writes all relevant information to a file. The number of activities is incremented in the user database.

Table V.8: Video class description.

Class: Video	The role of the Video class is to control the videos throughout the program.
createPlayer()	This function creates a new video session by loading a specified movie file.
destroyPlayer()	This function destroys the player.
play()	This function begins playback of the loaded movie.
pause()	This function pauses playback of the playing movie.

Table V.9: Module class description.

Class: Module	The role of the Module class is to present the user with information about their depression along with exercises to help them overcome it.
startVideo()	This function starts a new video specific to the module.
displayText()	This function displays information about depression, about the module's exercise, etc.
getResponses()	This function retrieves information that the user has entered as part of an exercise.
displayExample()	This function displays videos or diagrams to aid the user in completing an exercise.
moduleComplete()	This function sends all user data from the module such as start time, end time, and user responses to the database manager for saving to the database.

5.4 Activity Chart of Mood Maestro Workflow

When users first start the Mood Maestro program, they must login before accessing other functionality. Once they reach the main menu, they can work on module exercises, write in the journal, take the daily quiz, or access calendar functions. After completing any part of the program, the database manager is called to save user data to the database.

Figure 5.3 shows the workflow of the Mood Maestro.

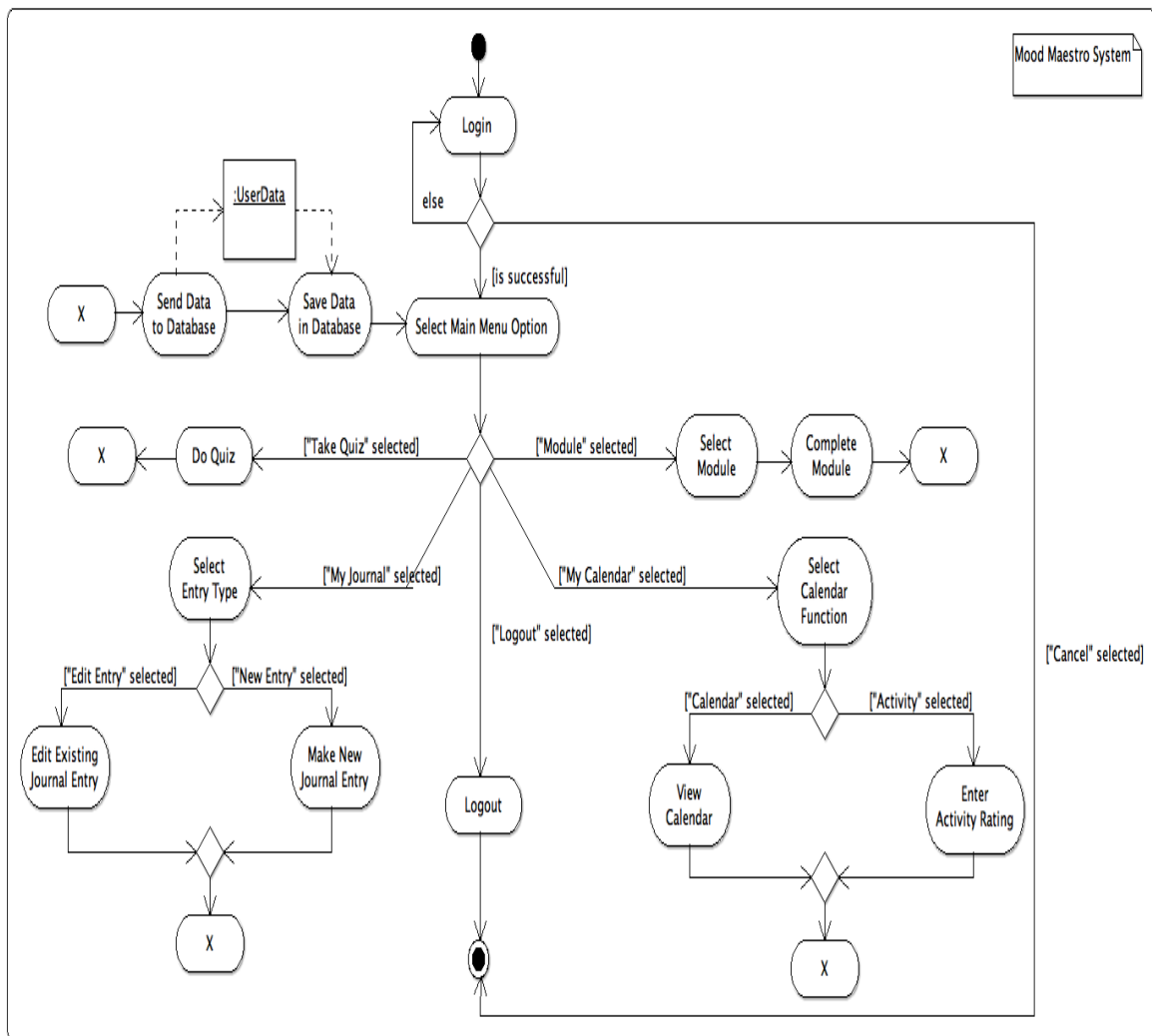


Figure 5.3: Activity chart of Mood Maestro workflow.

5.5 Auto Save (Completing a Module) Activity Chart

When the user completes a module, all data generated during the exercise is saved to the user database. Figure 5.4 shows that user statistics (such as module start and end time, and the User ID) are collected before being sent to the database manager. The database manager sends the statistics to the database itself for saving.

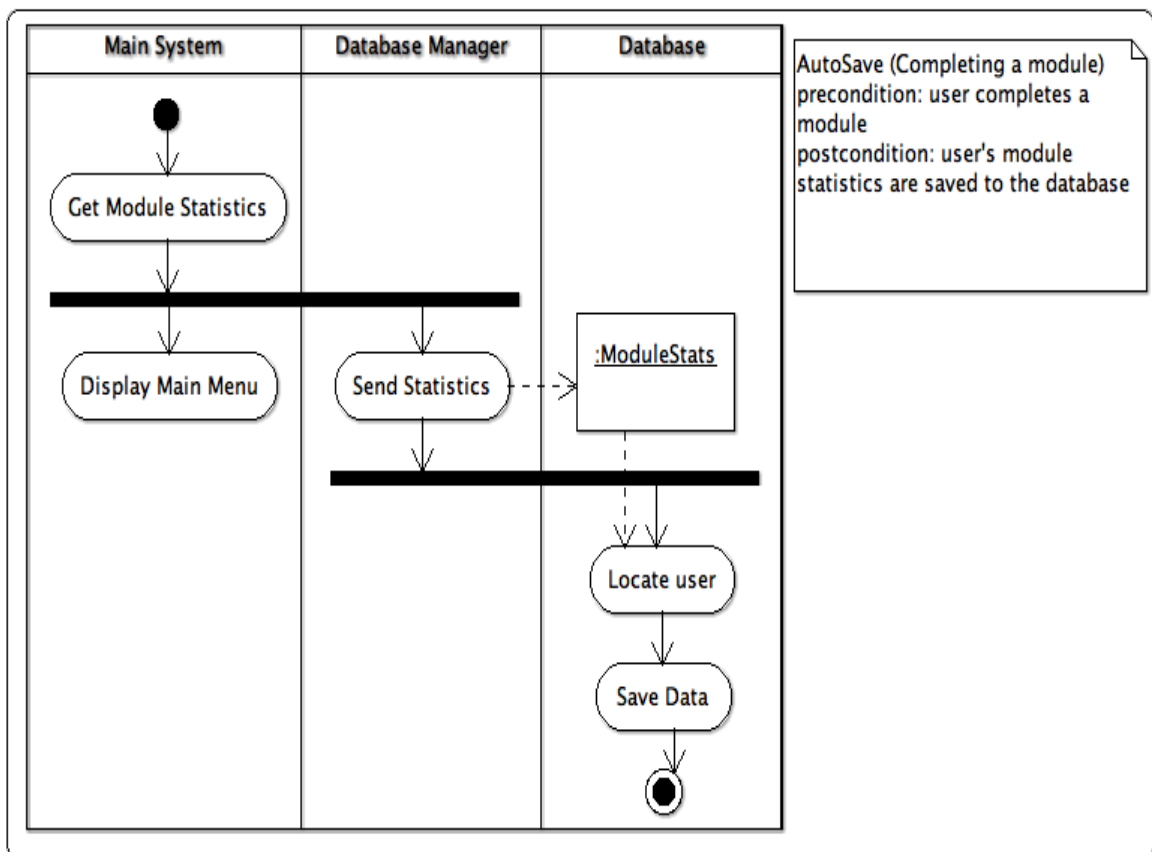


Figure 5.4: Activity chart depicting the actions taken when a module is completed.

5.6 Implementation of the Mood Maestro Tool

After completing design work, the process of implementation was begun. The Mood Maestro was constructed using Sun's Java Programming Language [33]. Java was advantageous in this project for a number of reasons. Using Java allows the Mood Maestro to be a cross-platform application and maintain portability. Java has a large and well-documented standard class library. Java can be obtained for free. Finally, using Java allowed for selected reuse of code from the original prototype.

The NetBeans IDE, an Oracle product, was employed to aid in GUI design [35]. NetBeans allows its users to select simple widgets such as buttons, text fields, and labels, and place them on screen. NetBeans can generate code for these widgets, and layout managers remove the tedious work of manually placing them in the user interface. NetBeans was also used as the text editor for back-end code implementation.

The structure of the Mood Maestro has purposefully been kept fairly simple. Each "page" of the program (modules, quiz, calendar, etc.) exists as a series of JPanel objects. All components are loaded at runtime and either shown or hidden, depending on where the user is located in the program. When navigating to the next page, the current panel is simply set as hidden and the next shown in its place.

Data collection and management is one area of the project that has evolved considerably from the first prototype to this incarnation. User input was originally stored in flat text

files, data read into memory at the beginning of the program and written out again as the user exited. For the sake of privacy, encryption was later added so personal information could not be easily accessed. It was quickly discovered however, that as user input accumulates over time, text files become unwieldy and inefficient. A MySQL database was then added to better organize and maintain user statistics and input. It was hoped that this database would also aid in future user tests.

The majority of the classes used in the Mood Maestro are completely original. However, certain components have been borrowed, and are listed here. The JCalendar class was written by Antonio Frexias, and provides the drop down date picker used in the Calendar section of the Mood Maestro [36]. The Graph classes were written by Maria Winslow as a JavaWorld.com example [37]. Finally, the Quicktime movie player was included in the Apple's Quicktime for Java package [34].

In the remainder of this chapter we review the major components of the Mood Maestro program, including certain details of implementation and screen shots of the GUI design.

5.6.1 Login

A Mood Maestro session starts with users typing in their login credentials to gain access to the system. If this is the first time the program has started, and therefore no users exist, the **Create New User** helper is automatically started. Otherwise, new users can be created by clicking the **Create New User...** button. The login window is shown in Figure 5.5.

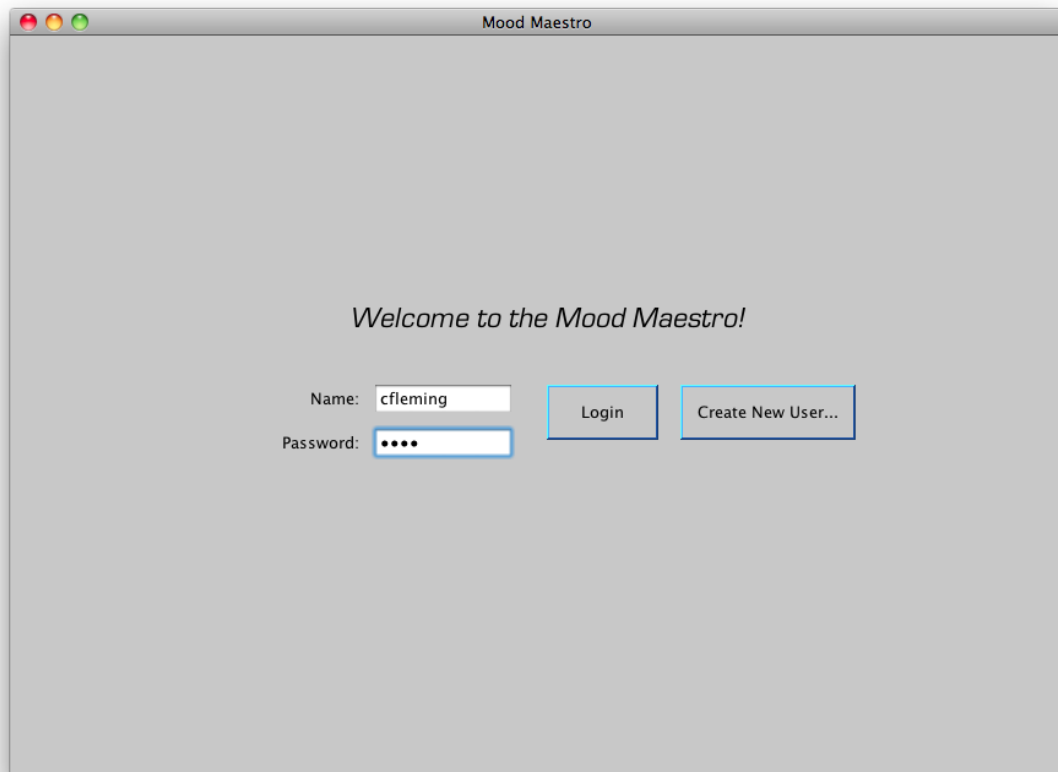
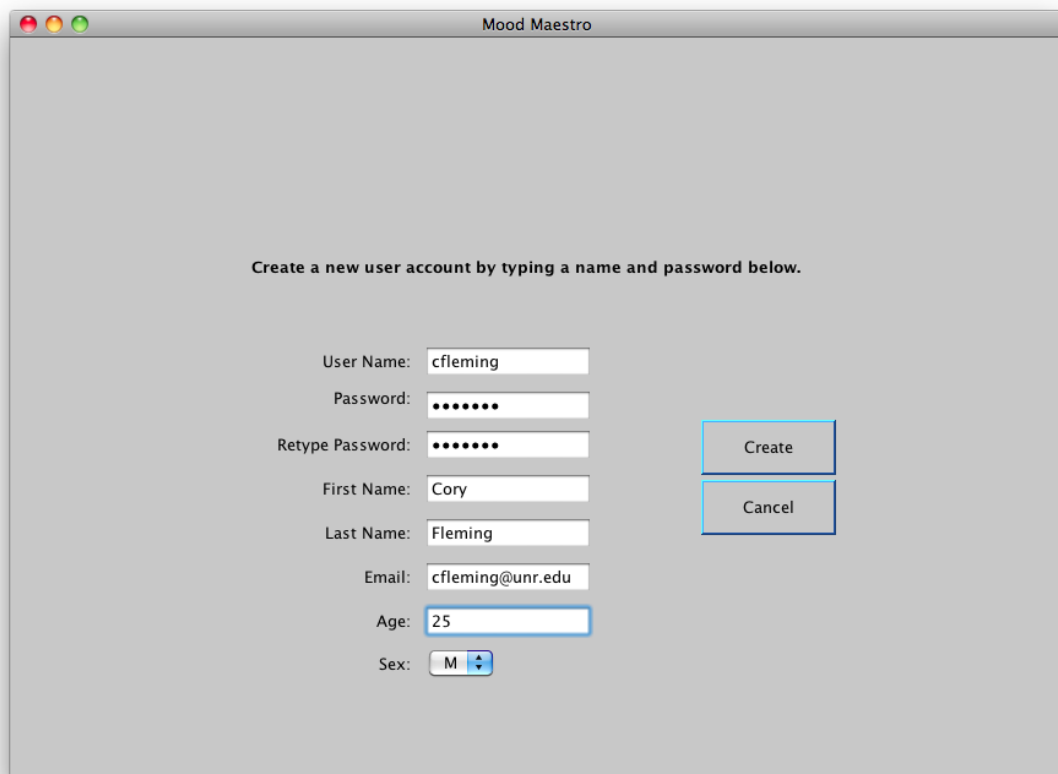


Figure 5.5: The Mood Maestro login window.

5.6.2 Create New User

New users to the Mood Maestro are required to create a new user account before they can access the rest of the program. In addition to creating a user name and password, the new user is prompted to enter his or her full name, email, age, and sex. The Create New User window is shown in Figure 5.6.



The screenshot shows a window titled "Mood Maestro" with a light gray background. At the top center, it says "Create a new user account by typing a name and password below." Below this, there are several input fields and two buttons. The fields are: "User Name:" with the text "cflaming"; "Password:" with a masked password of seven dots; "Retype Password:" with a masked password of seven dots; "First Name:" with the text "Cory"; "Last Name:" with the text "Fleming"; "Email:" with the text "cflaming@unr.edu"; "Age:" with the text "25"; and "Sex:" with a dropdown menu showing "M". To the right of the fields are two buttons: "Create" and "Cancel".

Figure 5.6: The Create New User Window.

5.6.3 Main Menu

From the main menu users can navigate to any part of the Mood Maestro. On the left, the module exercises are accessible. The top panel contains buttons for using the journal, calendar, or viewing progress. The bottom panel contains buttons for scheduling activities, taking the daily quiz, and viewing user values. There are a number of reminder messages listed in the main menu for the user to consider. The main menu of the Mood Maestro is shown in Figure 5.7.

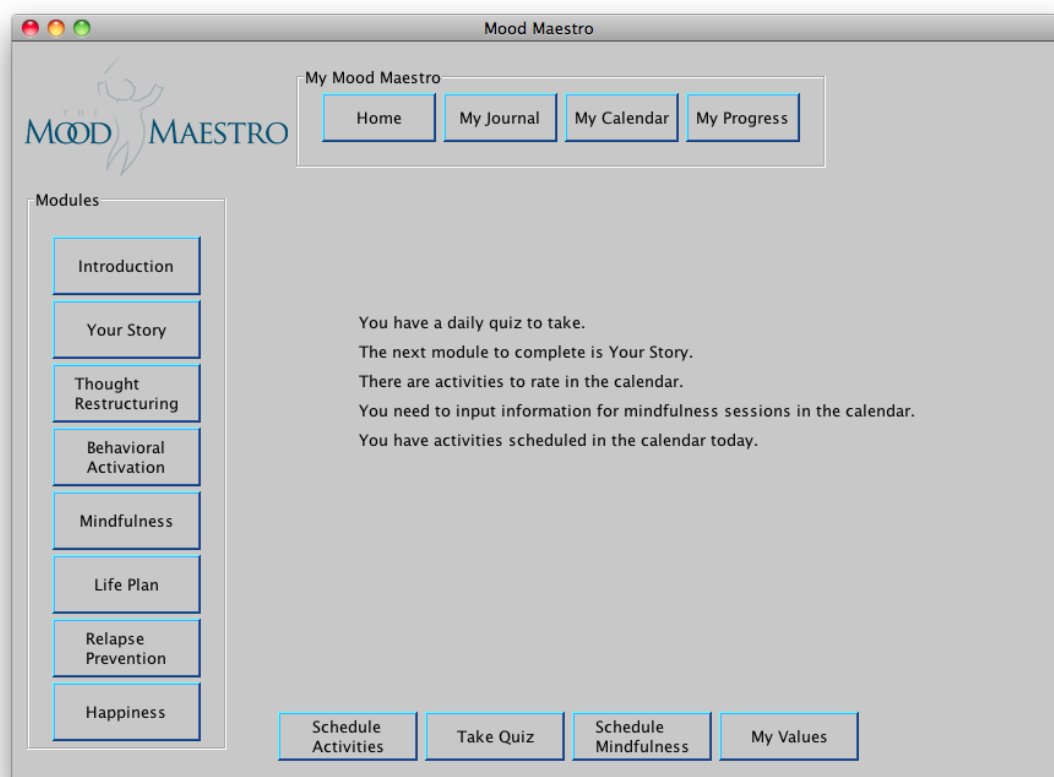


Figure 5.7: The Mood Maestro main menu.

5.6.4 Modules

There are eight modules that comprise the bulk of the Mood Maestro application. In each module users learn different CBT techniques and exercises. For example, in Thought Restructuring, users learn to analyze their negative thoughts, explore the connection with associated feelings, and think critically to determine if the negative thoughts are indeed factual. Figures 5.8 – 5.11 depict the progression of the Thought Restructuring module. In the first page of the module (shown in Figure 5.8), users are prompted to fill in the blanks, describing an upsetting event, the resulting thought, and a further consequence.

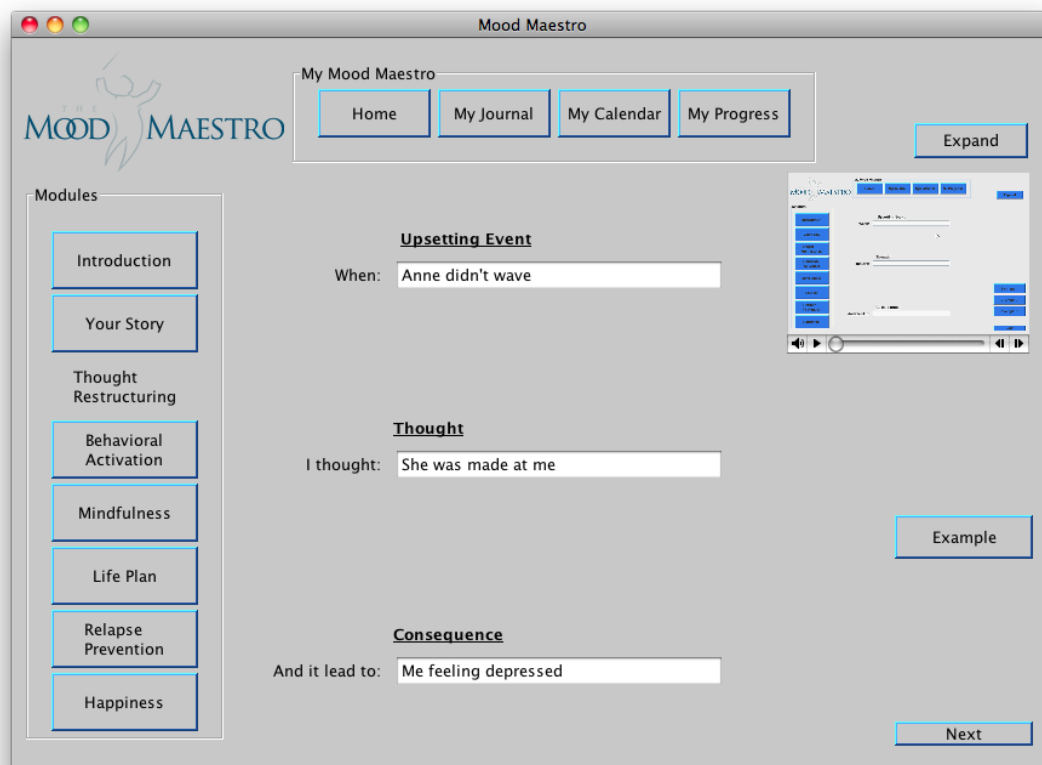


Figure 5.8: Page 1 of the Thought Restructuring module.

In the second page of the Thought Restructuring module, depicted in Figure 5.9, the user is asked to analyze their entries from the previous page. The provided list of questions helps to frame this analysis.

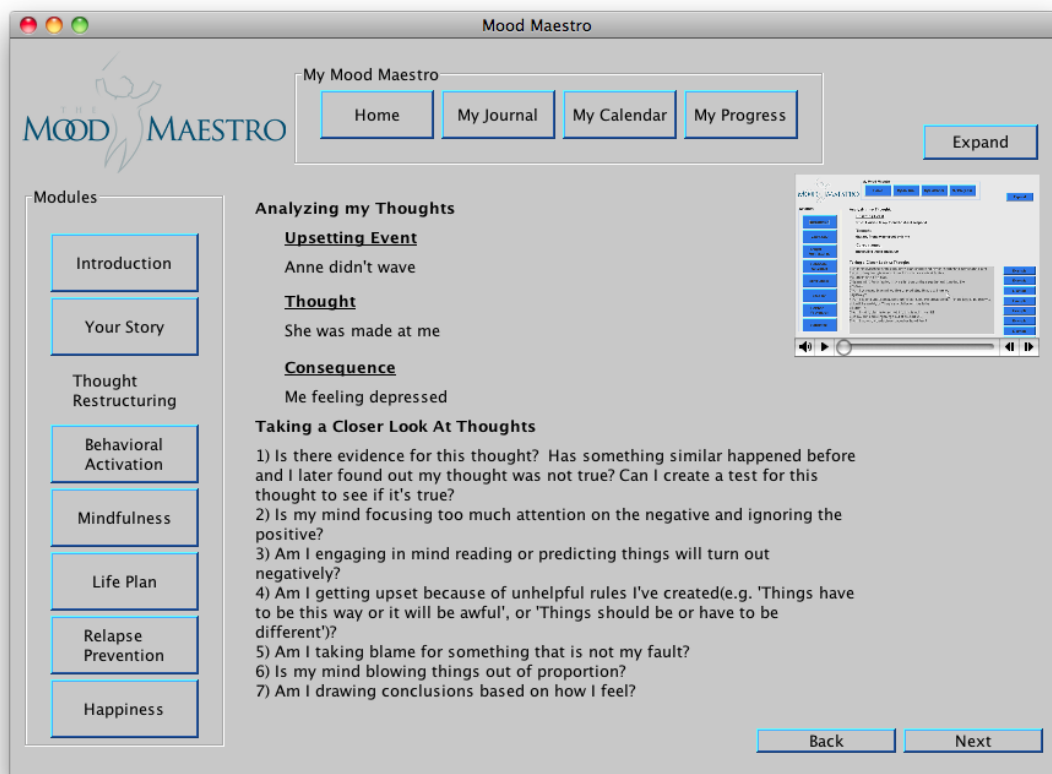


Figure 5.9: Page 2 of the Thought Restructuring module.

As shown in Figure 5.10, the third page of the Thought Restructuring module asks the user to extend their analysis of negative thoughts. For this task the user is directed to enter a more positive or rational thought that could explain the original event.



Figure 5.10: Page 3 of the Thought Restructuring module.

In the last page of the Thought Restructuring module, presented in Figure 5.11, the user enters a new consequence for his or her more positive or rational thought. Finally, the user is asked to confirm whether he or she believe their negative thoughts are truly facts or not.

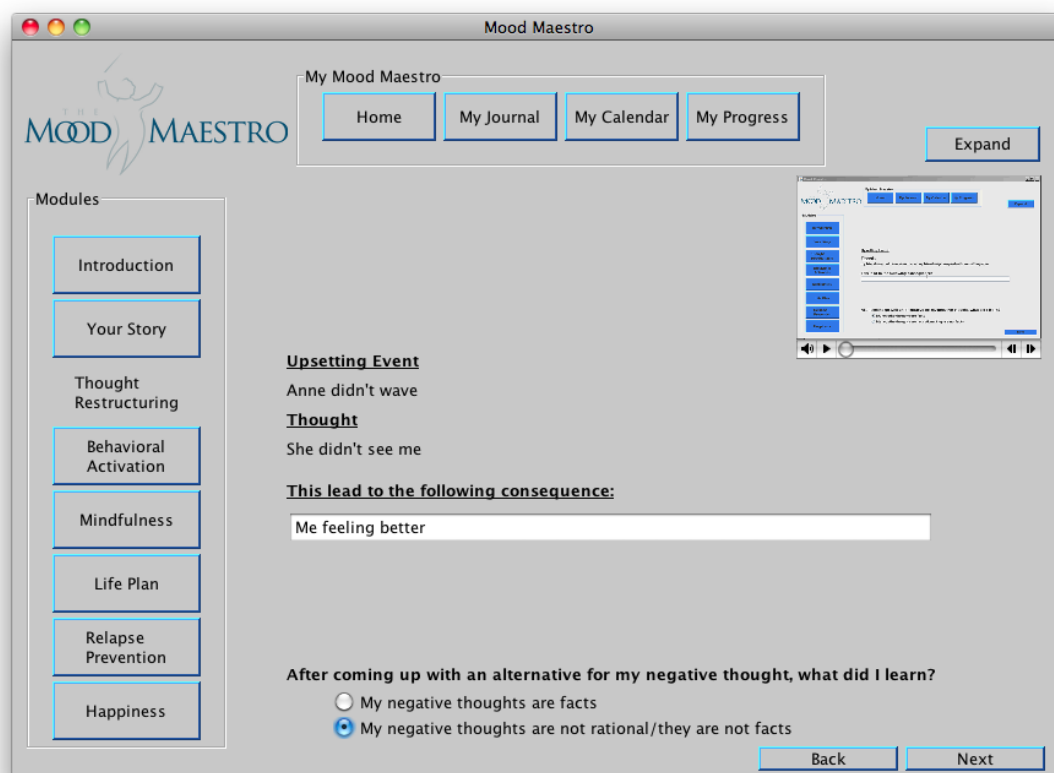


Figure 5.11: Page 4 of the Thought Restructuring module.

Another illustration of the type of modules found in the Mood Maestro is Life Plan. In this module users learn to identify the things in their life that are important to them, and rate how consistent their behavior corresponds to these values. A screenshot of the Life Plan module can be found in Figure 5.12.

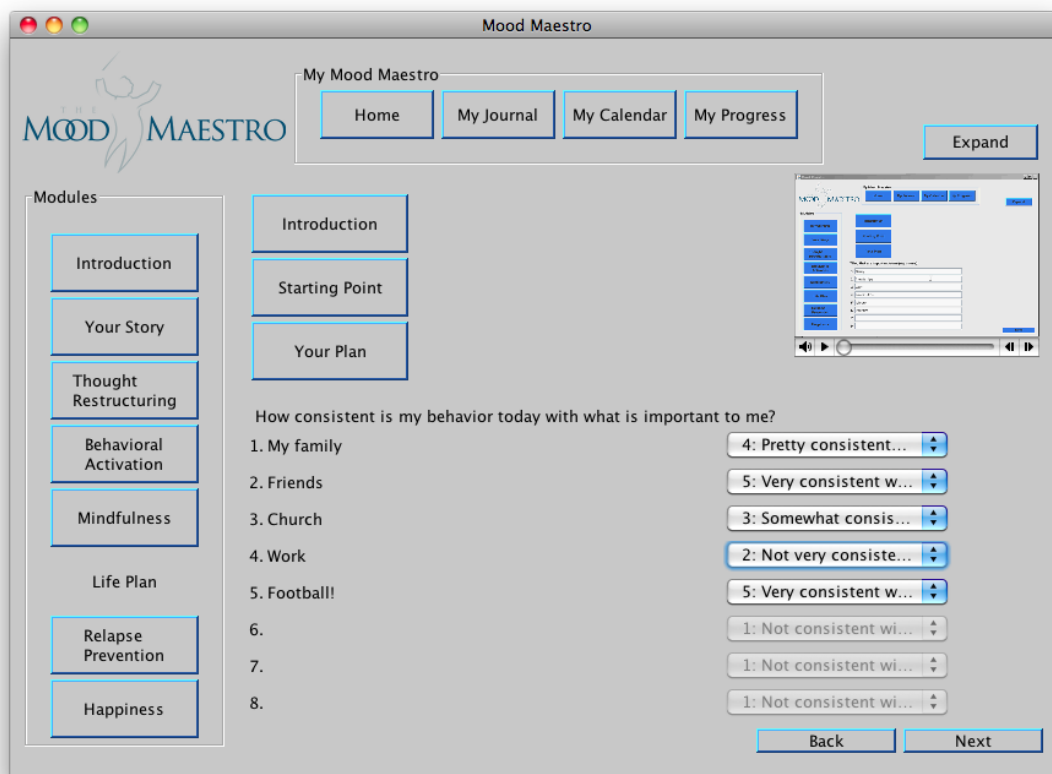


Figure 5.12: The Life Plan module.

5.6.5 Examples

Throughout the different modules, users are able to access examples to help them understand different CBT concepts or complete exercises. Figure 5.13 is an example found in the Your Story module.

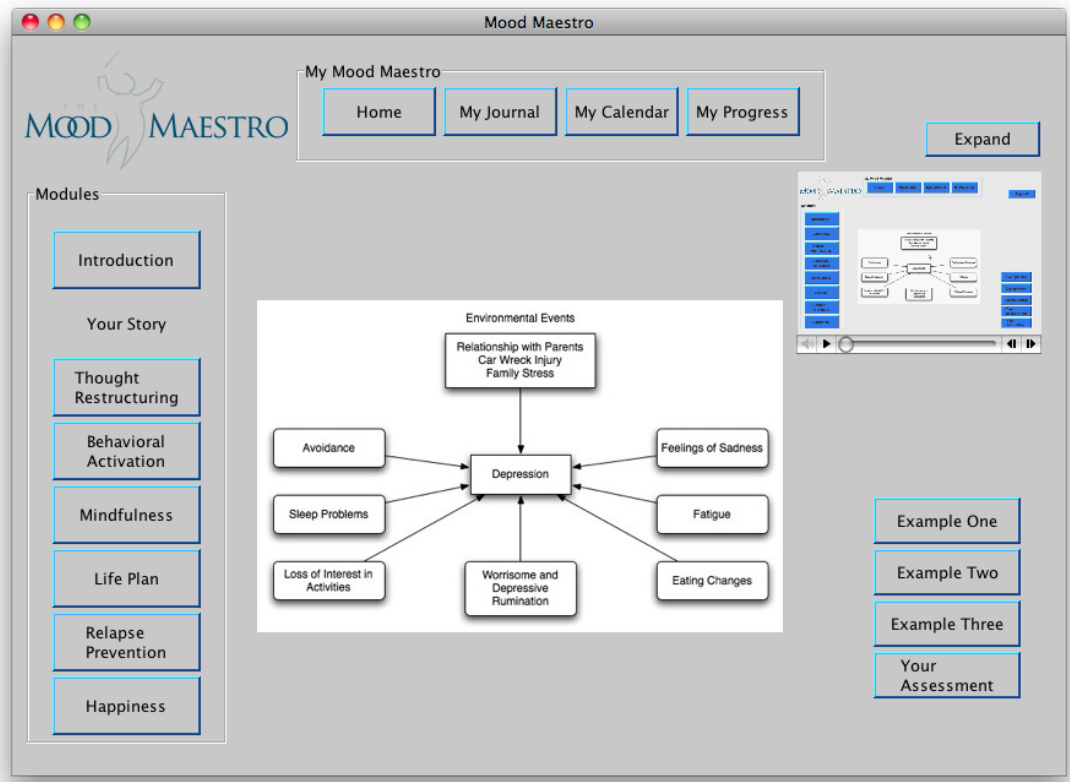
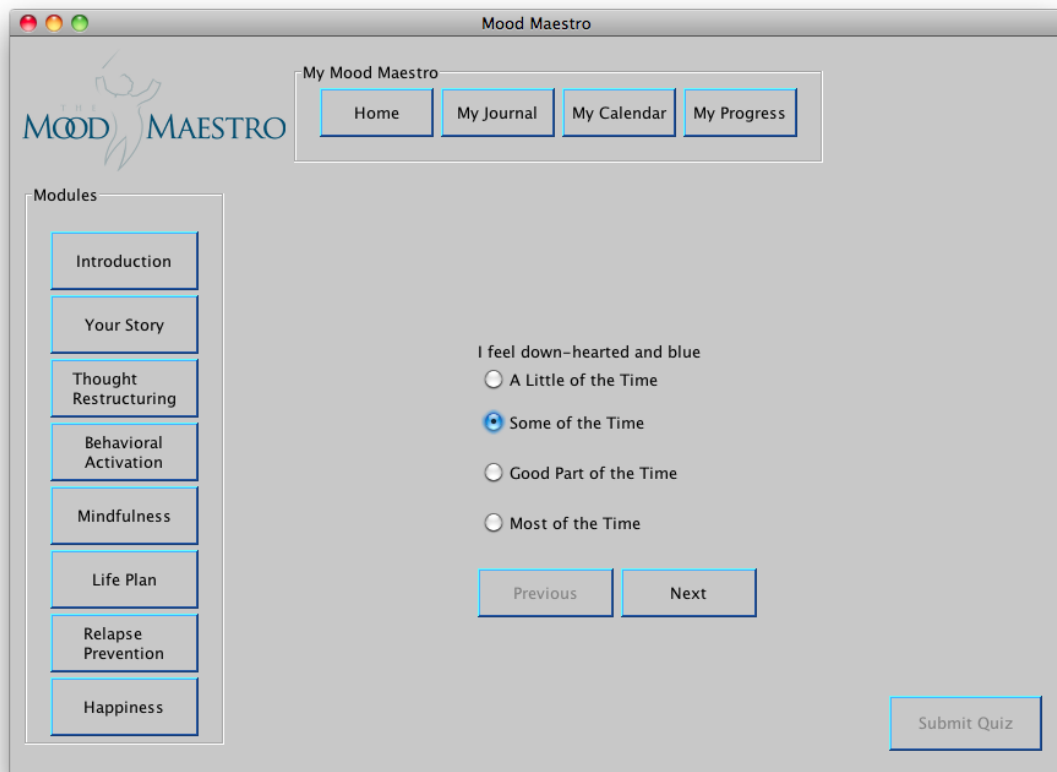


Figure 5.13: An example to help the user understand a CBT concept.

5.6.6 Quiz

Each time users log into the Mood Maestro, they are prompted to complete a Mood-Evaluating quiz. The user is asked a series of 20 multiple-choice questions using the Zung Self-Rating Depression Scale. For each question the user selects an answer by clicking a radio button, and then pressing the **Next** button to proceed. After all questions are completed, the user clicks the **Submit Quiz** button. Their answers are averaged and plotted in a graph with all other quizzes the user has completed, hopefully showing a positive mood trend over time. Figure 5.14 depicts one question from the quiz.



The screenshot shows the Mood Maestro application window. At the top left is the logo "MOOD MAESTRO" with a stylized figure. Below the logo is a "Modules" sidebar with buttons for Introduction, Your Story, Thought Restructuring, Behavioral Activation, Mindfulness, Life Plan, Relapse Prevention, and Happiness. At the top right, under "My Mood Maestro", are buttons for Home, My Journal, My Calendar, and My Progress. The main content area displays a quiz question: "I feel down-hearted and blue". Below the question are four radio button options: "A Little of the Time", "Some of the Time" (which is selected), "Good Part of the Time", and "Most of the Time". At the bottom of the question area are "Previous" and "Next" buttons. A "Submit Quiz" button is located at the bottom right of the window.

Figure 5.14: A Mood-Evaluating quiz.

5.6.7 Journal

Maintaining a journal is a common task in CBT treatment, and there are a number of modules within the Mood Maestro that make use of this tool. When the user selects to create a new journal entry, a time and date stamp is entered in the enabled text field. When the user clicks the save button, the work is encrypted and written to file for later retrieval. In Figure 5.15 a journal with several entries is shown.

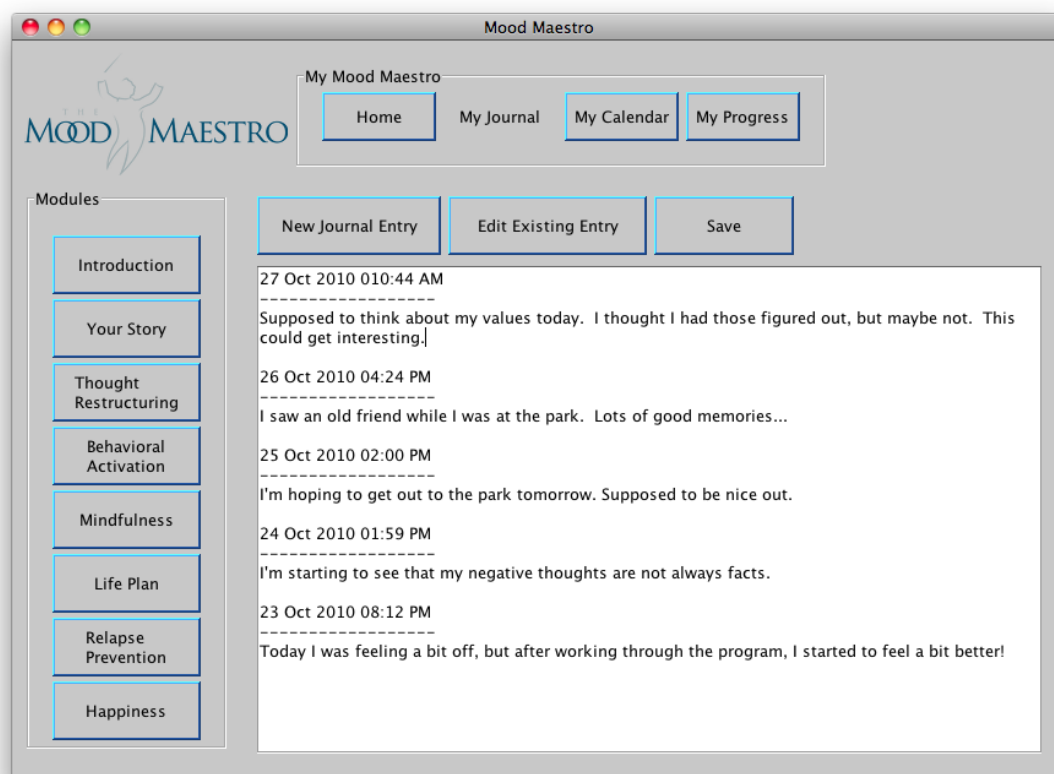


Figure 5.15: The user's personal journal.

5.6.8 Videos

Videos hold a prominent place in the Mood Maestro application. Most screens throughout the program contain at least one video for the user to view. The videos serve as examples to aid the user in completing exercises, and as a place for discussion of CBT techniques. Dr. Mayville, adding a more interactive feel and a human element to the program, narrates each video. The user has the ability to expand or minimize the video as necessary. The Quicktime video player object was supported in the QT for Java package, and all videos used in the program are stored in the .mov format [34]. Figure 5.16 shows one of the videos found in the program.



Figure 5.16: An example video.

5.6.9 Calendar

The calendar is used for scheduling the different CBT exercises taught throughout the program, specifically Behavioral Activation, Mindfulness practice, and Mood Progression in the Your Story module. Users select a date in the drop-down calendar widget before entering any number of activities for that date. Depending on the type of exercise, the user may be prompted to enter additional follow-up information such as activity ratings or minutes spent completing the exercise. Figure 5.17 displays the calendar for scheduling Behavioral Activation events.

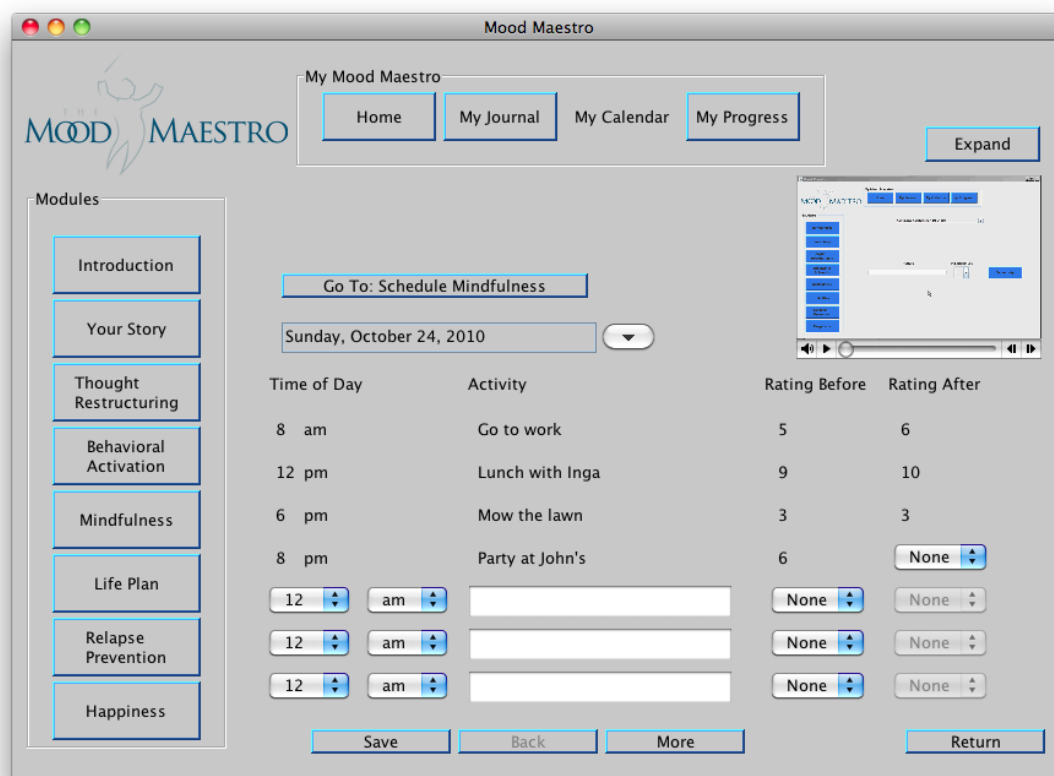


Figure 5.17: The calendar feature of the Mood Maestro.

5.6.10 Graphs

It is important that users see that they are actually making progress in lowering their depression levels over time. Graphs are an excellent way to present this information. The information used to create the graph is requested by the database manager, located by the database, and returned to the main system. The Mood Maestro plots simple bar graphs and line charts for these purposes. Figure 5.18 shows a bar graph that corresponds to the Thought Restructuring module.

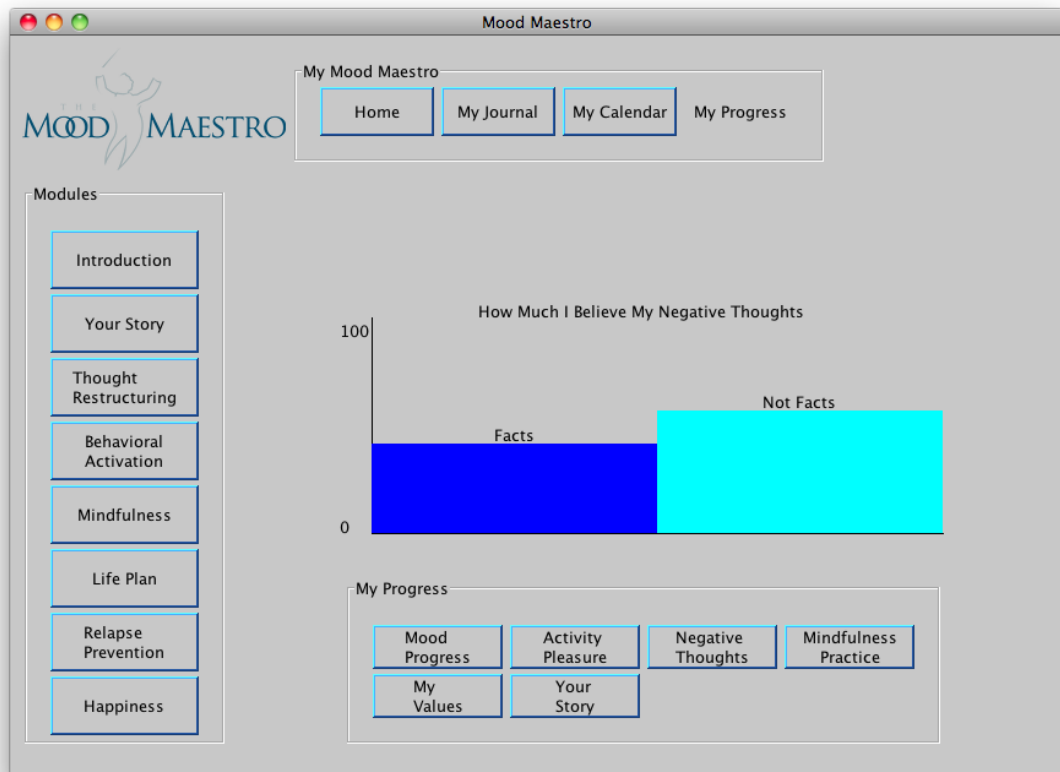


Figure 5.18: A sample bar graph.

As stated previously, every time the user logs into the Mood Maestro the user is asked to complete a Mood-Evaluating quiz. The scores of each quiz are saved and can be plotted to a line graph for the user to view. Figure 5.19 shows the mood progress of a user who has completed five quizzes.

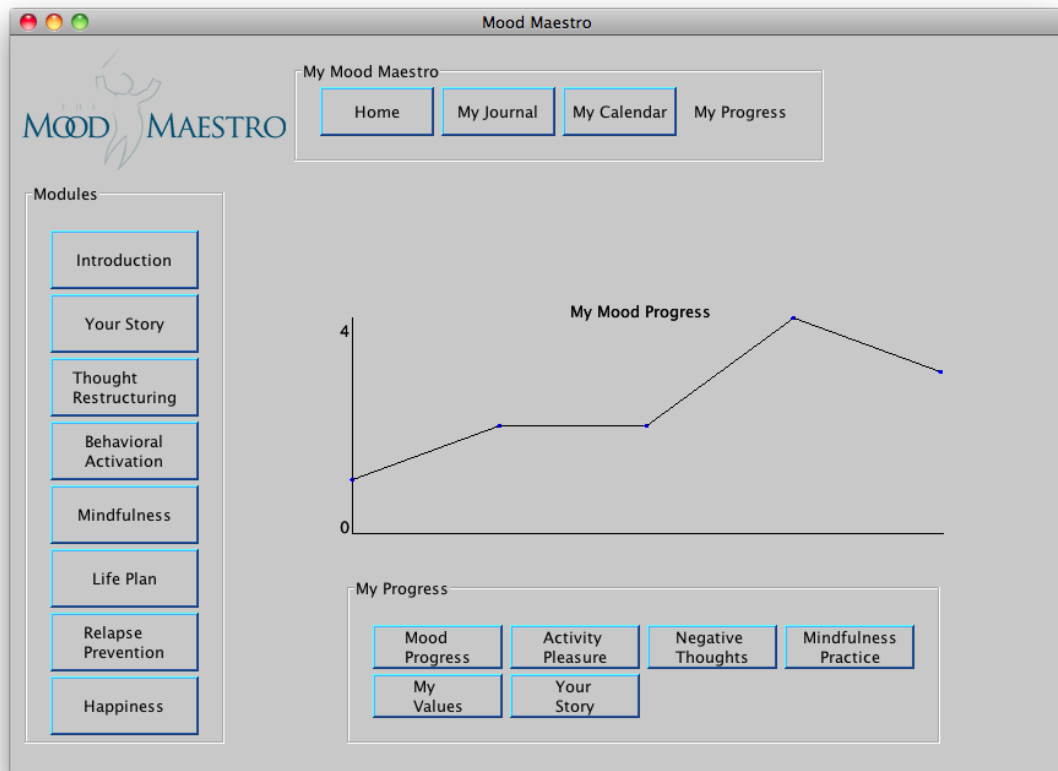


Figure 5.19: A sample line graph.

6 MOOD MAESTRO TESTS AND SOFTWARE PROFESSIONAL FEEDBACK

The next step after completing the implementation of the Mood Maestro prototype was to test the software. Software testing is useful for a variety of reasons. It allows for exploration of new concepts in design, assessment of current implementation, or verification of product goals in a finished product. It was initially considered to conduct proper usability tests with representative end users, in this case those with a history of depression. Unfortunately, this turned out to be extremely difficult. Not only do usability tests involve a high amount of liability, but the process of gaining approval would be complex, needing to involve UNR as well as other independent boards. Because of these facts, the decision was made to focus on product testing with feedback from peer software developers and professionals. This is equivalent to feedback received from the development community in open source projects. For the purpose of proper data collection, a test plan and test materials, including questionnaires, were prepared. Some addressed usability, but in the context of software development. The tests focused on product interface characteristics rather than assessing the experience of targeted end users or the program's effectiveness in treating depression. The remainder of this chapter contains details of the completed software product tests and their results.

6.1 Test Plan and Materials

To be successful, software products should be useful, efficient, effective, satisfying, learnable, and accessible [38]. The purpose in testing the Mood Maestro was first and foremost to investigate the ease of use of the product, specifically in efficiency and learnability. The program should be accessible to users with any level of computer experience, so it is imperative that the program be easy to learn and contain as little complexity as possible. Testing would concentrate on finding the areas of the program that proved confusing or more difficult for testers. The secondary purpose of testing was to discover any “bugs” in the program for correction.

The tests were completed in roughly one-hour time slots during which the participant worked through a series of tasks in the Mood Maestro while being observed by the investigator. Due to time constraints, the full set of tasks was broken up into three test plans, with each participant being given only a subset of the possible tasks to complete in the program. The tests were broken up into these tasks:

- All Test Plans: Create New User, Introduction, Quiz
- Test 1: Thought Restructuring, Behavioral Activation, Journal
- Test 2: Mindfulness, Happiness, Journal
- Test 3: Your Story, Life Plan, Relapse Prevention

Three testers completed each test plan, for a total of nine participants. The testers included software developers and engineers from the investigator’s professional network. The tests were conducted on the investigator’s personal laptop.

After each task was completed, the tester was asked to rate his or her experience by completing the After Scenario Questionnaire, or ASQ, which was developed by Jim Lewis in 1991 [39]. The ASQ is used to judge the tester's perception of effectiveness, efficiency, and satisfaction in completing the task. Ratings are completed on a seven-point scale from *Strongly Agree* to *Strongly Disagree*. The ASQ can be found in Figure 6.1. During work with the program, participants were encouraged to “think aloud,” verbalizing any confusion or difficulty. Time was also devoted for any additional comments the participant wished to write down.

After Scenario Questionnaire - Please check the box that reflects your immediate response to each statement. Don't think too long about each statement. Make sure you respond to every statement. If you don't know how to respond, simply check box “4”.

		1	2	3	4	5	6	7	
1. Overall , I am satisfied with the ease of completing the tasks in this scenario	Strongly Disagree								Strongly Agree
2. Overall, I am satisfied with the amount of time it took to complete the tasks in this scenario	Strongly Disagree								Strongly Agree
3. Overall, I am satisfied with the support information (text, videos)	Strongly Disagree								Strongly Agree
		1	2	3	4	5	6	7	

Additional Comments:

Figure 6.1: *After Scenario Questionnaire* [39].

At the conclusion of all tasks, testers were asked to complete a post-test questionnaire, the System Usability Scale, or SUS [40]. The SUS focuses on the program as a whole, as opposed to any specific aspect. The SUS was developed by John Brooke in 1986 and can be found in Figure 6.2. Both the ASQ and SUS metrics have been shown to be highly dependable when rating software products. In the final portion of the test, the participants were debriefed, verbally giving their opinions on the application and elaborating on problems found in the various tasks previously completed.

Post Session Questionnaire

Please check the box that reflects your immediate response to each statement. Don't think too long about each statement. Make sure you respond to every statement. If you don't know how to respond, simply check box "3".

		1	2	3	4	5	
1. I think that I would like to use this product frequently.	Strongly Disagree						Strongly Agree
2. I found the product unnecessarily complex.	Strongly Disagree						Strongly Agree
3. I thought the product was easy to use.	Strongly Disagree						Strongly Agree
4. I think that I would need the support of a technical person to be able to use this product.	Strongly Disagree						Strongly Agree
5. I found the various functions in the product were well integrated.	Strongly Disagree						Strongly Agree
6. I thought there was too much inconsistency in this product.	Strongly Disagree						Strongly Agree
7. I imagine that most people would learn to use this product very quickly.	Strongly Disagree						Strongly Agree
8. I found the product very awkward to use.	Strongly Disagree						Strongly Agree
9. I felt very confident using the product.	Strongly Disagree						Strongly Agree
10. I needed to learn a lot of things before I could get going with this product.	Strongly Disagree						Strongly Agree
		1	2	3	4	5	

Additional Comments (Use backside if necessary):

Figure 6.2: SUS Questionnaire for Mood Maestro Interface Evaluation [40].

6.2 ASQ Results

The ASQ asks participants to rate their experience on a seven-point scale ranging from *Strongly Disagree*, which is worth one point, to *Strongly Agree*, which is worth seven points. In summary, the ASQs revealed that task completion in the Mood Maestro was mostly effective, efficient, and satisfying. The average score for any particular task ranged from a low of 5.37 to a high of 6.89 (on a scale of 7). The **Create New User** and **Mindfulness** tasks received the lowest scores, and will require the most attention for improvement. While the average of the ASQ scores can be considered adequate, the questionnaire points to a slight deficiency in support information (videos, text, feedback) for completing tasks, with the scores for that particular question being slightly low. The core results of the ASQ, including averages and Standard Deviation (STD) values, can be found in Table VI.1. Note that the ratings for each question were averaged over all testers taking part in the particular task.

Table VI.1: ASQ results.

Activity	Q1 (Effectiveness)	STD Q1	Q2 (Efficiency)	STD Q2	Q3 (Support Info)	STD Q3	Average
Create New User	5.11	1.90	5.44	2.07	5.56	1.59	5.37
Introduction	6.11	1.05	6.11	0.93	6.00	1.41	6.07
Your Story	6.33	0.58	6.33	0.58	5.67	1.53	6.11
Thought Restructuring	6.33	1.15	6.67	0.58	6.00	1.00	6.33
Behavioral Activation	6.33	0.58	6.67	0.58	5.33	1.53	6.11
Mindfulness	5.67	1.53	5.67	1.53	5.33	1.15	5.56
Life Plan	7.00	0.00	7.00	0.00	6.67	0.58	6.89
Relapse Prevention	7.00	0.00	7.00	0.00	5.67	1.53	6.56
Happiness	6.33	0.58	6.33	0.58	6.00	1.00	6.22
Quiz	6.22	0.71	6.44	0.33	5.89	0.71	6.19
Journal	6.83	0.41	6.67	0.52	5.83	1.60	6.44

6.3 SUS Results

The SUS also indicated an above average system in terms of product interface characteristics. The average SUS score was 78.89 (out of 100). Scores between 70 and 79 are considered “good”, while scores above 80 are considered “excellent”. The range of scores went from a low of 65 to a high of 97.5, with a median score of 80. The complete results of the SUS tests can be found in Table VI.2. Note that scores are divided by test group.

Table VI.2: SUS results.

Participant	P1	P2	P3	Average
Score	77.5	82.5	65.0	75.00
Participant	P4	P5	P6	Average
Score	97.5	62.5	77.5	79.17
Participant	P7	P8	P9	Average
Score	80.0	82.5	85.0	82.50
Average	78.89			
Median	80.00			

6.4 Reported Issues

Through the course of all completed tests, there were 130 reported bugs, with 60 being unique issues. While not every reported issue must necessarily be changed, as personal preference plays a part in any user experience, those issues reported by many or most testers must certainly be focused on for improvement. In this section we review some of the more commonly reported issues.

6.4.1 Test Plan 1 Tasks

The Thought Restructuring module is one of the more involved in the Mood Maestro application. The exercise contained in the module involves identifying events that cause negative feelings and trying to classify them as facts or fabrications. Users are prompted to fill in the blanks and navigate through a series of pages as they complete the exercise.

This task proved difficult for several reasons. First, some testers did not access the video that explained the module before work began. Second, the labels prompting the tester's input were considered by some to be ambiguous and did not always elicit the proper type of response. Finally, the provided example, which is accessed through a button push, was not obvious to all participants.

In the **Behavioral Activation** module, users are encouraged to participate in activities that they used to find enjoyable, or may be avoiding. Users are asked to schedule these activities using the calendar tool, providing the name of the activity, the date and time, and a rating of how enjoyable they believe the activity will be (on a scale of 10). The user can enter as many activities for the selected day as he or she wishes. Scheduling proved fairly intuitive for our testers, but activity rating was not. The labels indicating where to provide ratings were not clear as to their meaning. The other reported issue involved saving activities. When the tester would press the **Save** button, the display of activities remained on the current page, rather than that of the new entry. Also, while not a bug, it was suggested that activities be color highlighted in the calendar for clarity.

6.4.2 Test Plan 2 Tasks

In the **Mindfulness** module, users learn to become more aware of their feelings while withholding judgment of them. Like in **Behavioral Activation**, users are asked to schedule activities, in this case sessions where they can complete mindfulness exercises.

After completing the exercise, the user is also asked to enter the number of minutes spent completing the task. However, it was found in testing that when participants pressed the **Save** button, the newly entered value in minutes was erased, a serious error. Testers also reported that the combo boxes used for scheduling the time of mindfulness exercises failed to reset after saving activities. Last, as with **Behavioral Activation**, the labels marking spaces for user input were somewhat ambiguous.

The **Happiness** module is fairly straightforward. The user completes a number of journal entries regarding different aspects of his or her life. The only reported error in this module was the suggestion that the example videos present in the exercise begin automatically after the user presses the various example buttons. All other issues were associated with the journal and can be found in the corresponding section.

6.4.3 Test Plan 3 Tasks

In the **Your Story** module users begin to map out how depression affects them in their life. After viewing example videos, the user is instructed to create a chart depicting the things in life that cause depression. Yet after viewing the examples, testers were unsure how to proceed. Certain participants commented that another video prompting them to create their own chart could be warranted.

Relapse Prevention involves learning techniques to help stay out of depression. One exercise of the module involves the user drawing charts that show the progression of their depression from events to feeling to actions. Videos are available to help the user learn what to do. Again, certain testers felt that more prompting was needed to point the user toward making a unique chart.

6.4.4 Common Tasks

A relatively large number of issues were reported with the **Create New User** feature. The most common reported issue, although not serious, was incorrect tab order as the tester entered information. It was unclear to a small number of testers that they must press the **Create New User** button before entering their information. It was a source of frustration to one participant when an identical user name was already in use, forcing her to re-enter all of her data. The most serious error discovered was the inability of the system to save certain password types to the database, preventing some participants from creating a new user account.

There were only minor cosmetic issues reported in the **Introduction** module, but several testers suggested that the module contain a comprehensive tutorial of the application, helping to clear up confusion and errors in later modules.

The Mood-Evaluating quiz found in the program will require some attention. The multiple-choice quiz asks a number of personal questions with the user able to select from these answers:

- A little of the time
- Some of the time
- A good deal of the time
- Most of the time

What it does not provide is an option for *None of the time* which many testers thought to be more appropriate. Some of the questions themselves were awkwardly worded and lead to confusion.

The Journal proved to be fairly intuitive for most testers, but there were a small number of issues reported by participants that could improve its efficiency. The most glaring inefficiency is the journal organization. At present, the journal is presented as a long text file with a collection of all entries. The newest entry is added to the top of the file. Several test participants voiced a desire for the entries to be organized by date, making searches for old entries easier. While the date and time is automatically stamped with each new entry, it was also suggested that the journal add automatic titles for those entries that are associated with a module exercise.

The most common complaint involved navigation, with all but one participant reporting confusion as to their current location in the application. For high-level navigation to main areas such as modules, button borders were removed to indicate the current program

location. However, within the modules themselves, the buttons did not present this behavior. As a result, testers could not be sure which section of the exercise they were currently completing, or where to go next. Better feedback is needed for completing modules and other activities, as many were confused as where to proceed.

Another area that caused frustration among participants was the use of videos. The videos in the Mood Maestro are meant to serve as guides in which key lessons are delivered, examples displayed, and modules explained. However, many testers had trouble using this tool. First, it was not obvious to all that the videos were in fact videos. Because the videos do not start automatically, some believed the videos to be static pictures, and did not push the play button. Others who did see the play button did not start the videos, not realizing that the videos were there for their aid, and leading to confusion in module exercises. Videos in the Mood Maestro can be expanded or minimized by the user, but this was not clear to everyone. The **Expand** button was not meaningful to all participants, and since videos are minimized by default, it made viewing difficult for certain videos. The general consensus was that videos needed to take on a higher priority to be effective.

7 COMPARATIVE ANALYSIS OF CBT SOFTWARE

TOOLS

The completed user tests were immensely useful in casting light on the state of the Mood Maestro tool. As expected, the tool performed very well in certain areas and needs improvement in others. In this chapter I compare and contrast the Mood Maestro with another software tool for depression. I discuss both the positive and negative aspects of the Mood Maestro as a basis for future work, and as a marketable tool.

7.1 Comparative Analysis of Mood Maestro versus MoodGYM

As discussed in the chapter on CBT Software tools, the Mood Maestro is not the first application of its kind. Several tools are available to the public for the purpose of treating depression. If the work of developing the Mood Maestro is taken to full realization, and eventually marketed, it is imperative that it can compete with similar tools. In this section a comparative analysis of the Mood Maestro application is conducted head to head against one of the more successful tools available, the MoodGYM training program. The MoodGYM is completely free and open to the public, allowing easy access for this kind of detailed comparison.

7.1.1 Criteria of Evaluation

The criteria used for evaluation is a mixture of qualities determined through experience of the investigator, and others taken from existing methods for evaluating software tools. There are six criteria groups that comprise the evaluation. The sections devoted to *Quality* and *Documentation* sample directly from work published by Dr. Barbara Kitchenham [41]. The *Usability* section borrows from both Preece [42] and Norman [43]. A section on *Effectiveness*, the degree to which the tool can help to alleviate depression, was withheld due to a lack of testing of the Mood Maestro with representative end users (actual patients). The complete listing of criteria groups can be found in Table VII.1.

Table VII.1: Criteria groups

No.	Criteria Group	Justification
1	CBT Content	This criterion evaluates the degree to which traditional Cognitive Behavioral Therapy has been integrated into the tool.
2	Features	This criterion evaluates the capabilities of the tool.
3	Quality	This criterion evaluates the strength of the tool, including efficiency, simplicity, robustness, etc.
4	Usability	This criterion evaluates the quality of interaction between users and the tool.
5	Documentation	This criterion evaluates the supporting documentation of the tool, including examples, tutorials, etc.
6	Appearance	This criterion evaluates the look and feel of the tool.

Many of the listed criteria groups are further divided into smaller criteria points. The complete comparison matrix used for evaluation, featuring these specific sub-criteria, is displayed in Table VII.2.

Table VII.2: Comparison matrix (continued on the next page)

Criteria Group	No.	Feature	Justification
CBT Content	1.1	Integration	This criterion evaluates the degree to which CBT theory and exercises have been infused into the tool.
Features	2.1	Organization	This criterion evaluates the ease in which the user can locate and access the available features of the tool.
	2.2	Completeness	This criterion evaluates to which extent the features of the tool cover the breadth of tasks the user would like to complete.
	2.3	Quality	This criterion evaluates the degree to which the features of the tool aid the user in completing tasks.
Quality	3.1	Efficiency	This criterion evaluates the overall efficiency of using the tool.
	3.2	Simplicity	This criterion evaluates the tool's simplicity in terms of the amount of steps needed to complete a task.
	3.3	Robustness	This criterion evaluates the degree to which the tool can compensate for user or system errors.
	3.4	Understandability	This criterion evaluates to which extent the tool is clear and understandable to the user.
Usability	4.1	Learnability	This criterion evaluates how easy it is to learn how to use the tool.
	4.2	Visibility	This criterion evaluates the degree to which the tool's features and available options are visible to the user.
	4.3	Feedback	This criterion evaluates the extent to which the tool keeps users informed of their actions, results of actions taken, current tool status, and errors encountered.

Table VII.2: Comparison matrix (continued from the previous page)

	4.4	Constraints	This criterion evaluates to which extent the tool limits user interaction when it is not appropriate for the task, in order to prevent the user from making a mistake.
	4.5	Mapping	This criterion evaluates to which extent the tool realizes a mapping between controls and their effects.
	4.6	Consistency	This criterion evaluates to which extent the tool performs similar operations and uses similar elements for accomplishing similar tasks.
	4.7	Affordance	This criterion evaluates to which extent the affordances of the interface objects such as button, icons, links, and menu options are perceptually obvious and to which extent it is easy to know how to use these objects.
Documentation	5.1	Organization	This criterion evaluates the organization of the documentation in terms of its logical and physical structure and ease of navigation through the documentation.
	5.2	Examples	This criterion evaluates to which extent provided examples help the user to practice concepts presented in the documentation.
	5.3	Completeness	This criterion evaluates to which extent the documentation covers all the aspects of the tool and the tool's usage.
	5.4	Quality	This criterion evaluates to which extent the documentation helps the user to learn the functions and capabilities of the tool.
Appearance	6.1	Accessibility	This criterion evaluates the degree to which the appearance of the tool is inviting and enjoyable for the user.
	6.2	Quality	This criterion evaluates the degree to which the appearance of the tool displays professionalism.

7.1.2 Evaluation Results

Using the comparison matrix, the evaluation was completed on the Mood Maestro and MoodGYM applications by both Dr. Mayville and myself. In completing the evaluation, Dr. Mayville and I attempted to remain objective and without bias, taking into account the results of the completed users tests whenever possible. However, the evaluation is opinion only, and therefore by nature, subjective. In the remainder of this section, a summary of the evaluation is given, each criteria group being addressed separately.

CBT Content – CBT content can be found throughout the Mood Maestro application. Each module contains text and videos that explain the CBT theory behind the upcoming exercises. Examples throughout the program also aid in displaying proven CBT techniques that users can learn to help aid in their fight against depression. Although the Mood Maestro and MoodGYM emphasize different CBT approaches, both are successful in seamlessly integrating CBT content.

Features – The features of the Mood Maestro tool are very easy to locate. The buttons used to access modules and many of the features, such as the journal and calendar, are always present on screen. Some features, such as the quiz, require two steps to reach, the user being forced to return to the main menu before navigating to the desired location. The amount of features seems adequate, and there were very few requests for additional features during product testing. However, the quality of the features included in the

Mood Maestro still require polishing. The quality of the Mood-Evaluating quiz would be improved with better wording and more answer options. The quality of the journal would be improved with better organization. There are other small corrections that can be made, like improving labels, automatically adding journal headers, and correcting bugs in the **Create New User** tool that would improve the quality of the features and the application in general. In contrast, while there are fewer unique features found in the MoodGYM, each feature has been presented with such simplicity that little confusion or error can occur during use.

Quality – The user tests showed that participants found completing tasks in the Mood Maestro to be efficient and easy. The structure of the program is purposefully simplistic, aiding users with even low amounts of computer experience in working with the program. The Mood Maestro is generally robust in compensating for user or system errors, but as was described previously, features like the **Create New User** tool do not always function gracefully when faced with certain user input. Understandability would be greatly improved by making it more clear what tasks the user is expected to complete, and in which order. The reminder feature helps in this process, but more could be done, either in the videos or by adding more text labels. The MoodGYM removes any issues with understandability by consistently using a **Next** button to guide the user to the next expected step.

Usability – The skills required to use the Mood Maestro are very easy to learn, with only a minimal amount of examples or tutorials required. The interface is very simple, and the affordances available to the user for interaction, buttons and text entry fields, are straightforward and mostly obvious as to their function. The layout of buttons and other controls are quite consistent, and once users learn how to navigate through one module, they should be able to easily complete those following. One of the biggest areas of participant frustration in the user tests was with feedback. Participants often complained that they knew which module they were in, but did not know where they were within the module itself. Participants were also unsure when they had actually completed the module. Better feedback, like the progress bar found in the MoodGYM, would certainly help to address these complaints. Neither the Mood Maestro nor the MoodGYM place many constraints on user activity. According to instructions given in the Mood Maestro, it is in the user’s best interest that they complete the lessons in order, but there are no measures taken by the system to ensure this is done.

Documentation – The organization and quality of documentation in the Mood Maestro is one of the strongest advantages of the program. The instructional videos present on most pages provide the information necessary to complete user tasks. Rather than documenting instructions in a single manual location, this method allows the user to access pertinent information as it is needed. The videos include both explanations of the exercises and screen captures of user interaction with the program, making it very clear what the user must do to complete their tasks. The videos, which were produced by Dr. Mayville himself, also add a more “human” element to the program, almost as if a

therapist is present while completing the program. The MoodGYM offers very little documentation as far as instruction in completing modules, but contains excellent examples of how to apply CBT techniques through use of the animated characters found in the program. While the quality of the videos in the Mood Maestro are very good, there were suggestions that more examples be added in certain areas of the program, such as a tutorial in the introduction. Certain videos also left the user unsure of what to do next.

Appearance – The appearance of the Mood Maestro is relatively simplistic. This is favorable for ease of use, but does not necessarily aid in attracting or generating positive feelings in the user. Better use of color and a more professional design configuration could aid in the quality of the appearance. The MoodGYM is also simplistic in appearance, but greater care seems to have been taken in terms of color schemes and screen layout.

7.1.3 Conclusion

This evaluation indicates that the MoodGYM is, at least at the present time, a superior tool to the Mood Maestro. In nearly every criteria group the MoodGYM showed superiority. There are many sub-criteria points in which the Mood Maestro is equal or competitive, but also a large number in which the application will need improvement before it can be marketed.

8 CONCLUSIONS AND FUTURE WORK

8.1 Future Work

The work presented in this thesis can and will be furthered beyond its current state, with a goal of developing the Mood Maestro into a marketable product. This section contains an outline of possible areas of future work on the Mood Maestro. Many of the points listed below involve correcting known issues and are classified under *Tool Improvement*. Work for further validation of the tool is listed under *Testing*. Finally, the remaining areas pertain to work to be completed after the tool is perfected and are listed under *Marketing*. Some improvements will be implemented by the time of the thesis defense, while others will need more time.

8.1.1 Tool Improvement

Planned improvements for the Mood Maestro include:

- Create comprehensive tutorial explaining the functions of the Mood Maestro.
- Place greater emphasis on videos by auto-starting playback and maximizing video size when necessary.
- Replace ambiguous labels.

- Use color and other visual cues to highlight expected user action.
- Improve videos to include better prompting for user exercises.
- Address issues with the **Create New User** feature.
- Improve wording of multiple-choice answers and add additional *None of the time* option to the Mood-Evaluating quiz.
- Add *sort by date* organization to the journal.
- Add automatic entry headings to the journal when appropriate.
- Use color and other visual cues to highlight the user's location within the application and improve navigation.
- Improve feedback for task completion.

Possible extensions to the Mood Maestro include:

- Implementing a mobile version of the Mood Maestro application (to be used on smartphones, etc.)
- Implementing a web version of the Mood Maestro application

8.1.2 Testing

Future testing of the Mood Maestro should include:

- Complete a Verification Test to ensure all needed improvements and corrections have been dealt with properly.
- Repeat a Comparative Analysis to reevaluate the strengths of the product against the similar CCBT MoodGYM tool.

- Conduct proper usability studies with representative end users to verify efficiency of product in helping to alleviate depression.

8.1.3 Marketing

The envisioned goal for the Mood Maestro is to eventually market the product.

Marketing could take place in these forms:

- Market product to psychologists as therapy aid.
- Release product to the general public as standalone self-help tool.

8.2 Conclusions and Contributions

Cognitive Behavioral Therapy (CBT) has for some time been used with great effect in the effort to aid people suffering from depression. Despite the fact that computers have permeated into many aspects of our everyday lives, relatively little work has been done to integrate traditional CBT methods into software. In the work of this thesis I attempted to remedy the situation by first researching traditional CBT methods and existing software implementations, and later by creating a new, original CBT application. The application was meant to further the state-of-the-art in therapeutic software, improving on the successes of current CBT software products, while avoiding their weaknesses and addressing needs of users that had not yet been addressed.

In many ways this work can be considered a success. The Mood Maestro tool was successfully created, incorporating CBT content provided by psychologist Dr. Stephen Mayville, most notably in the videos that populate the application. The results of product testing showed great promise, with participants overall reporting the Mood Maestro to be easy to learn, efficient, and satisfying. The tool is not without limitations however, as the same product tests revealed a number of defects in the application, and elicited suggestions for improvement. A comparative analysis of the Mood Maestro completed against the MoodGYM training program, a CBT software program currently available to the public, made it clear that these issues must be corrected before the Mood Maestro can be considered a truly marketable product. The tasks outlined for future work include the correction of the reported issues, integration of features for improvement, and further testing and validation of the tool. If followed, this work should help bring the Mood Maestro to its full potential.

Finally, the main contributions of this thesis are:

- Exploration of Cognitive Behavioral Therapy and current implementations of CBT software.
- Design and implementation of the Mood Maestro application for the purpose of helping to alleviate depression.
- Completed product testing of the Mood Maestro.
- Comparison of the Mood Maestro with another CCBT product, the MoodGYM training program.

- Discussion of the strengths and weaknesses of the Mood Maestro in its current state.
- Outline of future work for improving, testing, and eventually marketing of the Mood Maestro.

References

- [1] American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders-Text Revision*. Washington DC: American Psychiatric Press, 2000.
- [2] Segal, Z.V., Williams, J.M.G., and Teasdale, J.D. *Mindfulness-Based Cognitive Therapy for Depression; A New Approach to Preventing Relapse*. New York: Guilford Press, 2002.
- [3] Butler, A. C., Chapman, J. E., Forman, E. M., and Beck, A.T. “The Empirical Status of Cognitive Behavioral Therapy: A Review of Meta-Analyses.” *Clinical Psychology Review*, 26 (2006): 17-31.
- [4] Klein, B., Richards, J.C., and Austin, D.W. “Efficacy of Internet Therapy for Panic Disorder.” *Journal of Behavior Therapy and Experimental Psychiatry*, 37 (2006): 213-238.
- [5] “Depression Center: Symptoms, Causes, Medications, and Therapies.” WebMD. Accessed 12 June 2010. <<http://www.webmd.com/depression>>.
- [6] World Health Organization. *The World Health Report 2001 - Mental Health: New Understanding, New Hope*. 2001.
- [7] Andrade L., et al. “The Epidemiology of Major Depressive Episodes.” *Int J Methods Psychiatr Res.*, 12 (2003): 3–21.
- [8] “Homepage.” The National Association of Cognitive-Behavioral Therapists. Accessed 25 May 2010. <<http://www.nacbt.org>>.
- [9] Hayes, S.C., Strossahl, K.D., and Wilson, K.G.. *Acceptance and Commitment Therapy*. New York: Guilford, 1999.
- [10] Martell, C.R., Addis, M.E., and Jacobson, N.S. *Depression in Context: Strategies for Guided Action*. New York: W.W. Norton & Company, Inc., 2001.
- [11] Dimidjiam, S., et al. “Randomized Trial of Behavioral Activation, Cognitive Therapy, and Antidepressant Medication in the Acute Treatment of Adults with Major Depression.” *Journal of Consulting and Clinical Psychology*, 74 (2006): 658-670.
- [12] Chesson, A.L. Jr., et al. “Practice Parameters for the Nonpharmacologic Treatment of Chronic Insomnia.” *SLEEP*, 22 (1999): 1128-1133.

- [13] Rector, N. A. and Beck, A. T. "Cognitive-Behavioral Therapy for Schizophrenia: An empirical review." *Journal of Nervous and Mental Disease*, 189 (2001): 278-287.
- [14] Rachman, S. "The Evolution of Cognitive Behaviour Therapy". *Science and Practice of Cognitive Behaviour Therapy*. Clark, D., Fairburn, CG and Gelder. MG.Oxford: Oxford University Press, 1997: 1-26.
- [15] Spett, M. "Behavior Therapy vs. Cognitive Therapy For Depression: Here We Go Again." *NJ-Act.org*. The New Jersey Association of Cognitive Behavioral Therapists. 2004. Accessed 24 June 2010. <<http://www.nj-act.org/article13.html>>.
- [16] Beck, Aaron T. *Cognitive Therapy and the Emotional Disorders*. International Universities Press Inc., 1975.
- [17] Wright, J. "Cognitive Behavior Therapy: Basic Principles and Recent Advances." *Focus*, 4 (Spring 2006): 173-178.
- [18] Pucci, A. *Feel the Way You Want to Feel...No Matter What!* Bloomington: iUniverse, 2009.
- [19] Pucci, A. "Conquer Depression." Audio CD. 2010.
- [20] Calear, A. L., et al. "The YouthMood Project: A Cluster Randomized Controlled Trial of an Online Cognitive-Behavioral Program with Adolescents." *Journal of Consulting and Clinical Psychology*, 74 (2009): 1021-1032.
- [21] Christensen, H., Griffiths, K., Mackinnon, A. J., and Brittliffe, K. "Online Randomized Controlled Trial of Brief and Full Cognitive Behaviour Therapy for Depression." *Psychological Medicine*, 36 (2006): 1737-1746.
- [22] Mackinnon, A., Griffiths, K., and Christensen, H. "Comparative Randomised Trial of Online Cognitive-Behavioural Therapy and an Information Website for Depression: 12-Month Outcomes." *British Journal of Psychiatry*. 192 (2008): 130-134.
- [23] "The MoodGYM Training Program / Mark III." The Australian National University. 2010. Accessed 17 June 2010. <<http://moodgym.anu.edu.au>>.
- [24] National Institute for Health and Clinical Excellence. *Computerised Cognitive Behaviour Therapy for Depression and Anxiety*. London (UK): National Institute for Health and Clinical Excellence, 2006.

- [25] Cavanagh, K., et al. "The Effectiveness of Computerised Cognitive-Behavioural Therapy in Routine Primary Care." *British Journal of Clinical Psychology*, 45.4 (2006): 499-514.
- [26] "Beating the Blues Breaks New Ground with Major UK Health Provider." Ultrasis. 26 Apr. 2010. Accessed 10 June 2010. <http://www.ultrasis.com/news/article.html?article_id=248>.
- [27] "Beating the Blues." Ultrasis. 2010. Accessed 25 May 2010. <<http://www.beatingtheblues.co.uk>>.
- [28] "FearFighter Panic and Phobia Treatment Online." CCBT Limited. Accessed 17 June 2010. <<http://www.fearfighter.com>>.
- [29] "Depression Center Beta 3.0." Evolution Health Systems Inc. 2010. Accessed 28 Oct. 2010. <<http://www.depressioncenter.net/>>.
- [30] "Good Days Ahead: The Interactive Program for Depression and Anxiety." MindStreet. 2003. Accessed 28 Oct. 2010. <<http://www.mindstreet.com/>>.
- [31] "CBT Software/Web Application for Cognitive Behavioral Therapy – CBTpal." CBTpal. 2009. Accessed 28 Oct. 2010. <<http://www.cbtpal.com/Home/index.aspx>>.
- [32] "E-couch: Free Help for Anxiety and Depression." The Australian National University. 2005. Accessed 28 Oct. 2010. <<http://ecouch.anu.edu.au/welcome>>.
- [33] "Java Development Kit 6." Oracle. 2010. Accessed 29 July 2010. <<http://www.oracle.com/technetwork/java/javase/downloads/index.html>>.
- [34] "QuickTime for Java." Apple Computer, Inc. 2008. Accessed 29 July 2010. <<http://developer.apple.com/quicktime/qtjava/installation.html>>.
- [35] "NetBeans IDE 6.9." Oracle. 2010. Accessed 29 July 2010. <<http://netbeans.org/>>.
- [36] Freixas, A. "JCalendar FLib Component." 2004-2005. Accessed 29 July 2010. <<http://flib.sourceforge.net/JCalendar/doc/index.html>>.
- [37] Winslow, M. "Chart Your Way to Custom Graph Components." *JavaWorld.com*. 1 July 1997. Accessed 29 July 2010. <<http://www.javaworld.com/javaworld/jw-07-1997/jw-07-step.html>>.
- [38] Rubin, J. and Chisnell, D. *Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests*. Indianapolis: Wiley Publishing, Inc., 2008.

- [39] Lewis, J. “Psychometric Evaluation of an After-Scenario Questionnaire for Computer Usability Studies: the ASQ”. *ACM SIGCHI Bulletin*, 23.1 (1991): 78-81.
- [40] Brooke, J. “SUS: a ‘Quick and Dirty’ Usability Scale” in P.W. Jordan, et. al. *Usability Evaluation in Industry*. London: Taylor and Francis, 1996.
- [41] Kitchenham, B. “DESMET: A Method for Evaluating Software Engineering Methods and Tools”. *Technical Report TR96-09*. University of Keele. Staffordshire, UK, 1996.
- [42] Preece, J., Rogers, Y., and Sharp, H. *Interaction Design*. Indianapolis: Wiley Publishing Inc., 2002.
- [43] Norman, D. *The Design of Everyday Things*. New York: Basic Books, 2002.