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Executive Summary

The WP6 Evaluation reports are delivered in three parts. Part 1\(^1\) and Part 2\(^2\) (D20-6.3.2 delivered in month 24) consisted of a preliminary series of evaluation reports on each of the application areas and associated trials. Part 3 (this document, D20-6.3.3, delivered at the end of the project) presents an analysis of the final findings from the evaluations.

D20-6.3.3 begins with an overview of the xDelia Learning Pathway. This Learning Pathway is a key output from the project, and one that is being implemented as part of the overall strategy of the xDelia commercial partner Saxo Bank. The Learning Pathway consists of a series of Learning Elements that are grounded in pedagogies of self-directed, informal learning underpinned by dialogic interaction with peers and reflective self development.

The evaluation activities of the xDelia project have been guided by the macro level Design and Evaluation (D&E) Framework, which forms another project output. In conjunction with the D&E Framework, the micro-level evaluation of the user experience of the xDelia Learning Pathway has been structured using the M3 Evaluation Framework (Vavoula and Sharples, 2009).

Throughout, the stakeholder perspective has been sought through interviews, surveys and ultimately, the Stakeholder Workshop (milestone M6.5) at which investors from the S-M8\(^3\) study at Camden had the opportunity to give their feedback having taken part in the study and been given a detailed description of the project and the opportunity to ask questions. This has provided strong support for the xDelia approach by answering RQ4. What are the stakeholders’ perceptions of what xDelia is trying to achieve, and how well does this map onto the partners’ perceptions and to what the project actually achieves?\(^4\)

The evaluation findings at the level of the learner experience, described in this deliverable, show that investors feel that emotions are at the heart of trading decisions, and they believe that the xDelia Learning Pathway has potential to improve emotion regulation and thereby improve their financial decision making under pressure. Some change in behaviour has also been shown at the level of effects, and this is documented fully in D9-2.3.3. Findings include:

- Positive user feedback that our learning approach of game-based trainings on disposition effect and emotion regulation is engaging, enjoyable and a good basis for learning.
- Good evidence for the effects of the learning interventions in achieving proximal goals of improving emotion regulation, mindfulness and interoception.
- Evidence that games can be used effectively to diagnose various elements in decision-making. More specifically, sensor based games were effective at diagnosing emotion regulation capabilities and the Two Index Game was an effective instrument in diagnosing a propensity to the disposition effect.
- That game-based training on the disposition effect is associated with changes in real world trading behaviour.

These findings suggests that when the full xDelia Learning Pathway is implemented, it is likely to be successful in achieving the Learning Objectives and Learning Outcomes set out in sections 4.1.1 and 4.1.2.

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\(^1\) D20-6.3.1, delivered in month 12
\(^2\) D20-6.3.2, delivered in month 24
\(^3\) See appendix 6 for an overview of the studies and for study short labels
\(^4\) See section 1.3 below for more details about the research questions
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1 Introduction

This deliverable is the last in a series of WP6 evaluation reports spanning the three years of the xDelia project. The first report, D20-6.3.1, documents the design and development activities undertaken in the first 12 months of the project. The second report, D20-6.3.2, gives an account of the formative evaluations of the design and development activities, and of the studies. This last report discusses the outcomes from the final evaluation of the main output, the xDelia Learning Pathway.

The evaluation report is structured as follows:

- **Section 1** The Introduction describes the structure and scope of this document, classifying the project activities and placing the year 3 activities in the context of the studies conducted in year 1 & year 2.
- **Section 2** The xDelia Learning Pathway Overview details the final Learning Pathway, identifying the different Learning Elements and showing how they work together to achieve the Learning Objectives and Outcomes.
- **Section 3** Conceptual Design for xDelia Learning Pathway presents a set of high-level conceptual design views of the Pathway that provide a visual representation of the connection between the Learning Elements and the Learning Objectives and Outcomes.
- **Section 4** Evaluation Methodology and Methods briefly recaps the Design and Evaluation (D&E) Framework that has guided research, design and evaluation activities throughout the project. It then introduces the micro-level M3 framework that we have used to structure the evaluation of the xDelia Learning Pathway, describing how combinations of Learning Elements have been rolled out and evaluated with private investors, our target stakeholder group.
- **Section 5** Evaluating the User Experience uses the M3 framework as the basis of assessing how well the project has performed collecting data from the target learners, private investors.
- **Section 6** Conclusion draws together the findings from the previous chapters into a critical summary.
- **Appendix A** Year 3 Study Summary summarises the studies conducted in year 3 to further the traders and investors research, detailing how the findings feed into and from each other, and ultimately inform the design and implementation of the xDelia Learning Pathway.
- **Appendix B** User Experience Interview Questions
- **Appendix C** Evaluation Web Survey Questions completed by the S-M1 & S-M2 study participants.
- **Appendix D** Evaluation Post-Survey Questions completed by S-M8 study participants at the end of the 2-week study, after attending the focus group.
- **Appendix E** Games Survey completed by participants in S-M8 after day 1.
- **Appendix F** Prototype xDelia diary including mindfulness sheets used in S-M8.
- **Appendix G** xDelia Peer Forum Model provides a wireframe outline for implementing the forum and a brief overview of the evaluation plans.
1.1 List of Acronyms

AUC Auction Game  
D&E Design and Evaluation  
DE Disposition Effect  
DIAG Diagnostic mode (for games)  
DIDAC Didactic mode (for games)  
DoW Description of Work  
EC European Commission  
ER Emotion Regulation  
ERQ Emotion Regulation Questionnaire  
EU European Union  
EV Evaluation study – label  
F2F Face to Face  
FZI IPE Forschungszentrum Informatik  
HRV Heart Rate Variability  
IET Institute of Education Technology  
IS Intervention Study  
LE Learning Element  
LI Learning Intervention  
LO Learning Outcome  
M1 to M39 Month 1 to Month 39 of the xDelia project  
MF Mindfulness  
NIC National Investors’ Conference  
SI Space Investors Game  
TEL Technology Enhanced Learning  
TIG Two Index Game  
URL Universal Resource Locator  
WP Work Package

1.2 Research Context

During year 1 comprehensive literature reviews established the current state-of-the-art, and a series of research studies were undertaken to identify valid measures of arousal, and appropriate and practical methods for collecting data on these with a view to using them as input to the game play in serious games designed to improve emotion regulation. Previous research suggested that emotion plays an important part in financial decision-making. The impact of emotional arousal on the decision-making process of professional traders has been demonstrated in studies using bio-sensors to measure and record their physiological responses during trading (Lo and Repin, 2002, Fenton-O’Creevy et al., 2011). The year 1 work gathered evidence that highlighted the importance of
emotion regulation in financial decision making. During this period, the Disposition Effect (DE) was selected as a common emotional bias that could be measured and targeted by the xDelia Learning Intervention. The DE refers to a financial bias whereby investors tend to hold on to losing positions for longer than winning ones, thereby maximising investment losses whilst minimising gains.

Heart-rate-variability (HRV) was identified as a valid measure of arousal that could be readily measured and collected by way of physiological sensors. Methods for measuring and collecting physiological data were trialled in the lab and the results informed the design of the trader field studies conducted during year 2.

In year 2, a series of field studies with professional traders working for two different investment banks were run. These studies demonstrated that less experienced traders had lower ability to regulate their levels of emotional arousal during stressful trading than more experienced traders, and were liable to make less optimal financial decisions. The fact that more experienced traders had learned to regulate their emotions pointed to emotion regulation as a skill that could be learned. These studies also demonstrated that HRV provided a good measure of arousal that could be measured and recorded accurately in the field.

Concurrently during year 2, studies with student participants and physiological sensors identified mindfulness as a valid technique for managing emotional arousal. A set of Learning Elements were specified which could work both standalone and in combination to address the impact of emotions on trading decisions. Learning Elements included serious games that would cause emotional arousal in players, and then feed this physiological information back into the game to affect the game play. These Learning Elements, which include games and small apps, were designed to help learners acquire and practice techniques to regulate their emotions. Complex algorithms were written to calculate the DE from real-world trading history as well as from performance in a financially realistic game, the Two Index Game (see section 5 below).

By the end of year 2, the xDelia Learning Pathway was taking shape. Building on the findings from the first two years, the year 3 focus shifted toward the development and testing of the Learning Elements that had been specified and prototyped during year 2. Thus the xDelia Learning Pathway was created, comprising a series of Learning Elements aimed at diagnosis, skill development and skill transfer.

1.2.1 The xDelia Learning Intervention

During year 3, the primary focus of research and design activities has been to formulate and implement a Learning Intervention that incorporated serious games and bio-feedback, to help private investors acquire better emotion regulation skills, and support the transfer of these skills to their real-world trading context. The ultimate goal is to improve their financial decision making and trading performance under pressure through better management of emotions. The Learning Intervention needed to provide support for informal, self-directed learning. This support therefore had to be both engaging and relevant to the learning needs of private investors, the target stakeholder group:

"The challenge for environments supporting self-directed learning is to allow learners to work on authentic problems and tasks of their own choosing, and yet still provide them with learning support contextualized to their chosen problem." (Fischer and Scharff, 1998)

The design of the Learning Intervention was guided by the analyses and findings from studies conducted during the first two years of the xDelia project. During year 3, these findings drove the development of a coherent Learning Intervention called the xDelia Learning Pathway.
The xDelia Learning Pathway is founded on informal learning principles (Burbules, 2006, Livingston, 1999) and consists of a flexible set of Learning Elements designed to work together to teach investors strategies to manage their emotions and thereby support them in making better financial decisions under stress. Each Learning Element – online game, questionnaire, diary tool, mobile app, peer forum, and so on – is standalone, so that learners can mix and engage with these elements in ways that best suits their learning needs. A journey along the xDelia Learning Pathway can last between 6 weeks and 6 months.

1.3 Document Structure

The WP6 evaluation efforts during year 3 were aimed at gathering user experience data from our target learners, investors, in order to answer the following research questions:

RQ1. What pedagogies are being used in the project, and how are they represented?

RQ2. How can Learning Design represent the Learning Objectives and Learning Outcomes of the xDelia Learning Pathway?

RQ3. How are the design principles associated with the games translated into tangible Learning Outcomes?

RQ4. What are the stakeholders’ perceptions of what xDelia is trying to achieve, and how well does this map onto the partner's perceptions and to what the project actually achieves?

This deliverable is structured around these research questions. Section 2 xDelia Learning Pathway Overview addresses the pedagogical questions in RQ1. Section 3 uses a set of Conceptual Design Views (Conole, 2012) to visualise the design principles underpinning the xDelia Learning Pathway in answer to RQ2. Section 4 describes the theoretical approach, methodology and methods used to evaluate how the design principles translate into Learning Outcomes for RQ3. Section 5 presents the evaluation of the user experience that we have collected from our target stakeholders, private investors, presenting their responses to the stages of the xDelia Learning Pathway that they have followed to answer RQ4 and Chapter 6 concludes the evaluation with key summaries, recommendations and directions for future research.
2  xDelia Learning Pathway Overview

The xDelia Learning Pathway is an informal Learning Pathway consisting of Learning Elements that learners can undertake at a time and location that suits them over a period of between 6 weeks and 6 months. It uses pedagogical principles of dialogic and reflective learning implemented through computer-delivered Learning Elements (questionnaires, games, online forum, online diary tool). This allows the learners to choose the learning context, manner and extent to which they engage with the Learning Elements. In answer to RQ1: What pedagogies are being used in the project, and how are they represented?, Figure 2.1 illustrates the pedagogical framework that underpins the xDelia Learning Pathway.

The Learning Pathway embodies a three-stage approach: the first stage incorporates Learning Elements that diagnose a learner’s habitual emotion regulation strategies and trading bias, feeding this information back to raise awareness. The second stage offers Learning Elements to develop emotion regulation skills that address the learning needs identified during Stage 1. The third stage supports the consolidation and transfer of these emotion regulation skills to the real world context through reflection and through discussion with a network of peers.

The different elements that comprise the Learning Pathway were trialled through the lab and field studies conducted during year 3. These studies, their findings, and how they informed the final design of the xDelia Learning Pathway are described in detail in D9-2.3.3.

Once the individual elements had been tested with students, sections of the xDelia Learning Pathway were put together to be trialled with real investors in the field at Investor Conferences. The methodology and methods used are described in Section 4. In addition to the single-day field studies conducted at conferences, longitudinal studies were run to test combinations of Learning Elements.
that make up Stage 1: Diagnosis and Feedback and Stage 2: Skill Development. An end-to-end evaluation of the full Learning Pathway was not planned within the timeframe of the project, however early results from pre and post trading data from S-M1/2 suggest that some degree of Stage 3: Transfer has taken place. These findings have been written up in D9-2.3.3.

The xDelia Learning Pathway is aimed at private investors, however during the interviews, it emerged that private investors who deal in fast-paced buying and selling of shares or currencies refer to themselves as traders, e.g.: You’re asking me about investments, and I’ll have to split investments and trading into two separate things (T28). However, for the purposes of the xDelia project, our target learners are referred to as private investors or investors.

The xDelia Learning Pathway is designed to be undertaken over a period of time. Once learners have completed the initial Diagnosis and Feedback stage, they can engage with the Skill Development elements in any order, and the Diary and Peer Forum are designed to support the learners’ journeys along the xDelia Learning Pathway and beyond.

The following three subsections describe each of the Stages in the xDelia Learning Pathway.

2.1 Stage 1: Diagnosis and Feedback

The xDelia Learning Pathway begins with a diagnosis stage in which investors complete an emotion regulation questionnaire (ERQ) to diagnose their habitual emotion regulation strategies. They can complete this questionnaire online from any location where they have access to the Internet. At the same time, their actual disposition effect (DE), as reflected in their real-life trading data, is calculated behind the scenes to give them a score (high, medium or low). After completing the ERQ, investors are presented with video, first explaining emotion regulation and giving them feedback on their ERQ score, and then explaining the DE, giving them their DE score and explaining how these scores might be affecting the success of their trading activities. This is the first step in raising their awareness of how emotions affect their day-to-day behaviour.

This feedback aims to help learners understand the extent to which their financial decision making can be affected by their emotion regulation strategies and by their susceptibility to the DE, which is an important emotional bias. Armed with an understanding of their habitual emotion regulation strategies and their DE score, they are in a position to learn techniques to regulate their emotional responses and then practice these techniques in the safe games-based environment. Emotional biases are not limited to the DE; we selected it since it is a bias that has a proven impact upon trading and that might be improved by effective emotion regulation.

At this point along the Learning Pathway, investors can play the Two Index Game online in diagnostic mode (TIG-DIAG). The xDelia games can be run in diagnostic mode, where they assess the extent to which the learner exhibits a particular emotional bias or physiological response, and in didactic mode where they feed this information back to the learner in a variety of ways to show whether their emotion regulation skills have improved. The TIG simulates a trading scenario in which players make fast buy/sell decisions based on a predictor index and a market index. In diagnostic mode the game calculates the extent to which the player is suffering from the DE in real-time. This score is then shared with the player after they finish playing the game, reinforcing their self-awareness of their susceptibility to the DE.

The evaluation plan for the Diagnosis and Feedback Stage is described in Table 5-1, where this stage is referred to as Learning Context #1.
2.2 Stage 2: Skill Development

The emotion regulation technique selected for the xDelia Learning Pathway is mindfulness. The MF2 study (summarised in Section 6.2.1 and described in detail in D9-2.3.3) provided the empirical foundation for the benefits of mindfulness-based interventions on financial decision-making in emotionally charged situations. In this stage, learners receive instructions on mindfulness techniques, which they can practice in their own time. Supporting this practice is the xDelia Mindfulness Application, which is accessible from a desktop or laptop computer and the xDelia Mindfulness App, which runs on a mobile phone and guides learners through paced breathing exercises. Learners can record their mindfulness practice in the xDelia online diary (described in Section 5.3.1).

After learning mindfulness techniques, it is important for individuals to practice these techniques in a stressful but non-critical situation, that is, where they are not risking real financial loss if the mindfulness techniques aren't mastered properly. Three games developed in xDelia provide such practice opportunities for mindfulness.

**Two Index Game in didactic mode (TIG-DIDAC):** In didactic mode, the Two Index game can be played on any computer with an Internet connection. The game shows the learner the extent to which she is exhibiting the DE by means of a meter on the screen. As the needle moves from the green towards the red sector, the player is demonstrating a stronger tendency to hold on to trading losses for longer than trading gains. Using the mindfulness techniques they have learned, individuals should be able to use this feedback to reverse the tendency to higher levels of DE. If they are successful, this should result in an improved real-time reading of the DE on the screen. At the same time, a reduced DE will also result in better performance in the game in terms of monetary gains.

**Space Investors in didactic mode (SI-DIDAC):** The SI game is a first person shooter game in which the player has to destroy grey asteroids but avoid shooting down the green ones. The game is made more difficult by feeding back arousal levels into game play. This results in increased blurring of targets, adding distractive sound, and a shaky screen. Each time the player gets hit by one of the asteroids, an arousal bar displays the player's real-time level of arousal and thereby provides her with a visual indicator of how successfully they are in applying the mindfulness techniques they have learned. The better the player manages his or her arousal levels, the easier it becomes to shoot the targets – they shake less and are not blurred, and there are less distracting sounds.

**Auction Game in didactic mode (AUC-DIDAC):** The Auction game is a fast-paced game, which displays a high and a low price in clouds in random locations on the screen. After a while, these clouds disappear and a new cloud appears with an auction price that is somewhere between the first two prices. The player needs to calculate whether or not to ‘buy’ at this auction price. The aim is to buy only if the auction price is below half way between the low and the high price previously displayed and thus make a profit, which increases your score. If the player miscalculates and buys at a price that is above half-way between the high/low prices, they lose money. The speed of the mental calculations needed can increase arousal levels, and these levels are displayed on the screen as an arousal bar. As the player gets more aroused, the first two prices displayed in the clouds get further apart which makes it much harder to calculate whether or not it is worth buying at the third price displayed.

The AUC didactic game has 10 levels with 5 decisions in each level. The player has to accumulate enough money before they can progress to the next level. Therefore the number levels that players play will differ and the number of decisions each player will make and the time that they will play each level will vary.

In the skill development stage of the xDelia Learning Pathway, learners can play the games repeatedly to develop their mindfulness skills and see if this enables them to perform better in the games.
The evaluation plan for the Skill Development Stage is described in Table 5-2, where this stage is referred to as Learning Context #2.

2.3 Stage 3: Transfer

The diagnostic and skill-based elements of the Learning Pathway described in Section 2.1 and Section 2.2 are underpinned by an online diary and peer forum to support personal reflection, informal learning and skill transfer. The specification for both the diary and the peer forum has been informed by input from the stakeholders and by the findings from the diary study S-M9 and the diary evaluation, EV-6, both described in Section 5.3.1.

As the xDelia learners explore using mindfulness techniques to regulate their emotions, they can share their thoughts and experiences through the xDelia Peer forum and record data about their emotional state and trading activities in their online diary. When ready, they can try out their mindfulness techniques during their actual trading. At this point, skill transfer from the safe practice environment of the xDelia games to the real-world trading situation begins to take place.

The evaluation plan for the Diagnosis and Feedback Stage is described in Table 5-3, where this stage is referred to as Learning Context #3.

The following section, Section 3 provides a visualisation of the xDelia Learning Pathway, making explicit the links between Learning Elements, the activities they support and the intended Learning Outcomes.
3 Conceptual Design for xDelia Learning Pathway

The design process for the xDelia Learning Pathway has been made explicit and shareable through a set of Conceptual Design views (Conole, 2012). The Learning Pathway can last for up to 6 months, so different learners will engage with different aspects for varying lengths of time according to their personal preference. Therefore the following conceptual design views represent an indicative average amount of time that a learner would spend on different aspects of the learning intervention; in reality different learners will spend a different amount of time working on this.

Figure 3.1 shows the course view map. Guidance & Support consists of a self-directed learning pathway (up to six months). Content & Activities are made up of a series of games, relevant didactic material and some real-world practice. There are no collaborative activities, but learners have the possibility to communicate with peers in a discussion forum. There are no formal assessment activities, but the Reflection & Demonstration provides opportunities for diagnostic feedback and critical reflection.

![Course map](image)

**Figure 3.1 – The xDelia Learning Pathway Map**
3.1 Pedagogy Profile

The pedagogy profile is shown in Figure 3.2, and the learner activities break down as follows:

- **Assimilative:** didactic content (10 mins to 1 hr depending on choices made by the individuals).
- **Information handling:** the index game (for each iteration 30 mins – 1 hr) and aiming game (for each iteration 30 mins to 1 hr).
- **Communication:** peer discussion (zero to several times a week 1 hr).
- **Productive:** none.
- **Experiential:** trading practice (1 hr per week to review the feedback).
- **Adaptive:** none.
- **Assessment:** diagnostic feedback (1 hr), critical reflection (10 mins at the end of every trading session).

![Pedagogy Profile Tool](image)

*Figure 3.2 – The xDelia Learning Pathway Pedagogy Profile*
3.2 Course Dimensions

The course dimensions view for the intervention is shown in Figure 3.3. It indicates that the learning intervention is very activity-based, with little in the way of tutor support. Reflection and demonstration of learning is mainly through self-reflection.

Figure 3.3 – The xDelia Learning Pathway Course Dimensions View
3.3 Learning Outcomes

There are four Learning Outcomes associated with the Learning Pathway:

1. Understand the disposition effect and emotional regulation.
2. Improve awareness of one’s personal profile in relation to the disposition effect and emotional regulation.
3. Develop skills in relation to the disposition effect and emotional regulation in a learning environment.
4. Transfer skills into practice.

Figure 3.4 shows how these map to the learning activities. Please note that the term Student is used in place of Learner since the Conceptual Learning Design tool was created with formal learning scenarios in mind.
3.4 Task Swimlane

The following Learning Elements guide and support the journey along the xDelia Learning Pathway (Figure 3.5):

- Diagnostic feedback through an e-assessment tool, a questionnaire and calculations based on their existing trading history if they have one and the TIG-DIAG.
- Delivery of propositional knowledge through a series of videos, whereby different video segments are delivered based on the learners’ response to the survey and calculations. Feedback becomes a vehicle for individualised didactic delivery of content.
- Engagement with three games iteratively: i) the TIG-DIDAC (disposition effect) in which the learner gets feedback each time on the extent to which they are displaying a dispositional effect and ii) access to a play environment where they can manage their emotional arousal in the SI-DIDAC and the AUC-DIDAC game. These games have a number of levels of difficulty.
- Learning Elements for developing mindfulness, which may be delivered online or via a mobile app and includes a tool on paced breathing meditation.
- Using sensors to review their emotional status in a trading context in a day trading centre (optional).
- Access to a peer discussion space so that the learners can come together in peer learning groups in discussion forums.
- Writing down and reviewing real world trading practices, and engaging in critical reflection. This includes recording and reviewing emotional state (for example rating themselves on the extent to which they have experience particular emotional states). Also make notes on what causes the emotions and what impact they think that has had on how they behave.
These conceptual design views provide a visualisation of the pedagogical approaches underpinning the xDelia Learning Pathway and illustrate how activities undertaken by the learner contribute to the xDelia Learning Outcomes. Section 4 describes the evaluation methodology and methods used to assess the effectiveness of the xDelia Learning Pathway.
4 Evaluation Methodology & Methods

At a macro level, the collaborative research, design and evaluation methodology has been guided by the project’s Design and Evaluation (D&E) Framework (Clough et al., 2009, Clough et al., 2010). The D&E Framework predicates an iterative development, evaluation and feedback cycle underpinned by the principle of utilization-focused evaluation (Patton, 2008) designed to inform ongoing activities throughout the project.

The D&E framework is designed to facilitate the evaluation of project interventions and collaborations. It fulfils a dual function. On the one hand, it acts as a model for the design of effective project interventions, clarifying the interdependent relationship between the research questions, research interventions, the evaluation, and the mechanisms by which the findings from the evaluation are fed back into the project to inform future interventions. On the other, it acts as a lens through which to reflect on what happened during the intervention, supporting collaboration by involving the stakeholders as reflective evaluators (Schuler and Namioka, 1993, Cousins and Whitmore, 1998, Poth and Shulha, 2008), feeding the findings back into the project on an on-going basis. Figure 4.1 illustrates the D&E framework as used throughout the project.

The D&E Framework embeds formative evaluation and feedback in all project activities such that on-going evaluation findings inform future research and design activities (Schuler and Namioka, 1993). It assisted in considering how the project activities described in earlier sections (research studies, workshops and meetings) produced useful outputs which drove forward the design and implementation of the xDelia Learning Pathway. At the level of local evaluation, WP6 have received and collated summary reports on all studies done on behalf of the project. This approach is described...
in detail in the previous evaluation reports, D20-6.3.1 and D20-6.3.2 and Appendix A summarises the local evaluation reports.

The D&E Framework is one of the xDelia outputs developed to guide its work and to specify formative evaluation studies. It formalised and captured the relationship between the research activities and the project outcomes such that the research findings were fed into subsequent studies and ultimately informed the overall design of the Learning Intervention. The final version of the Learning Intervention, the xDelia Learning Pathway, was constructed from a set of the constituent features arising from all the research, design and evaluation work conducted over the life of the project.

As described in Section 2 the xDelia Learning Pathway Learning Objectives are framed at three levels: Diagnosis and Feedback, Skill Development, and Transfer. Each Learning Objective is broken down into discrete Learning Outcomes, which are achieved by completing one or more of the Learning Elements. For example, to achieve Learning Outcome 1: an understanding of the disposition effect (DE) and emotional regulation (ER), the learner needs to engage with the diagnostic Learning Elements to assess their habitual ER strategies, and the didactic Learning Elements that explain their ER and DE scores and the implications their scores have for their trading behaviour.

This complex interrelationship between the Learning Objectives, the Learning Elements and their associated Learning Outcomes required a detailed evaluation plan to ensure that all aspects of the impact of the Pathway were captured. For this micro level evaluation, the M3 Evaluation Framework (Vavoula and Sharples, 2009) was deployed to formulate the detailed evaluation plans necessary to assess the success of the xDelia Learning Pathway against its Learning Objectives and Learning Outcomes. While the overall D&E framework emphasised the need to explore these aspects, using the M3 framework as a constraint enabled us to evaluate the Learning Pathway at the level of its constituent elements.

### 4.1 Framework for Evaluation

The M3 framework structures the detailed evaluation of the xDelia Learning Pathway at the level of Learning Outcomes. Often, several Learning Elements work together to contribute to a single Learning Outcome. In the same way multiple Learning Outcomes can feed into each overall Learning Objective. The M3 framework is instantiated in the form of a table which explicates these complex relationships, clarifying how the Learning Elements are linked to the learning objectives and learning outcomes that need to be evaluated. Based on this detailed analysis of the evaluation requirements, the appropriate evaluation instruments are designed. The columns in the M3 Framework table are:

- **Activity description** - The learning activity that contributes to the Learning Outcome. For the xDelia project, the term Learning Element has been substituted for Activity description.
- **Actor(s):role(s)** - The actor (learner, computer, bank) and its role in the Learning Element, i.e. what it does.
- **Tool(s)** - Artefacts that contribute to the Learning Element (software, technology)
- **Topic** - The topic that is to be learned, or skill that is to be developed.
- **Contributes to objective** - The overall learning objective that this Learning Element addresses.
- **Generates outcome** - The specific Learning Outcome targeted by this Learning Element.
- **Approach / method** - The pedagogic approach underpinning the Learning Element.
- **Led by** - Who is driving the learning activity? Because the xDelia Learning Pathway is informal learning, most of the Learning Elements are learner-led.
• **Related activity** - Other learning activities related to the one under discussion. As all the xDelia Learning Elements relate to each other, this column was omitted and instead the column **Evaluation Study** was used.

The M3 framework has been adapted in order to better match the characteristics of the informal xDelia Learning Pathway; the title of M3 framework first column was changed from Activity description to **Learning Element description**, and the final column, Related Activity, was replaced with **Evaluation study(s)** indicating which studies contributed to the evaluation. Evaluation studies are marked with the prefix ‘EV’ and a list of the studies can be found in Appendix A

### 4.1.1 xDelia Learning Objectives

The Learning Objectives of the xDelia Learning Pathway described in Section 2 are framed at three levels:

1. **Level 1: Diagnosis and Feedback**  
   - Learning objective: Understanding the DE and emotion regulation strategies and how they relate to investor trading, and improved awareness of personal profile in relation to the DE and habitual emotion regulation strategies.

2. **Level 2: Skill Development**  
   - Learning objective: Development of skills in recognising and avoiding the DE and in effective emotion regulation in a learning environment.

3. **Level 3: Transfer**  
   - Learning objective: The transfer of skills from the learning environment into the real-world trading context.

### 4.1.2 xDelia Learning Elements & Learning Outcomes

The xDelia Learning Pathway addresses each of the Learning Objectives described above through a series of Learning Elements. The xDelia Learning Elements include:

**Learning Element #1: Emotion Regulation Questionnaire**  
- to diagnose habitual emotion regulation strategies

**Learning Element #2: Behind-the-scenes algorithms to calculate the disposition effect**  
- to calculate DE based on real trading data

**Learning Element #3: Feedback on emotion regulation score**  
- to teach awareness of personal emotion regulation strategies

**Learning Element #4: Feedback on DE score**  
- to teach awareness of personal tendency to DE

**Learning Element #5: Two Index game in diagnostic mode (TIG-DIAG)**  
- to teach awareness of personal tendency to DE

**Learning Element #6: Mobile Mindfulness app**  
- to practice mindfulness techniques for emotion regulation

**Learning Element #7: Mindfulness game**  
- to practice mindfulness techniques for emotion regulation

**Learning Element #8: Auction game (biosensors) in didactic mode (AUC-DIDAC)**  
- to practice emotion regulation under stress

**Learning Element #9: Space Investors game (biosensors) in didactic mode (SI-DIDAC)**  
- to practice emotion regulation under stress

**Learning Element #10: Two Index game in didactic mode (TIG-DIDAC)**
• to practice emotion regulation during financially realistic task with real-time visual
display of DE.

**Learning Element #13: Peer forum**
• to provide interaction with other learners and more able peers, sharing experiences,
reflections, ideas and skill transfer

**Learning Element #14: Online diary**
• to record trading and emotional state together with state-of-the-market data for
reflection and to support skill transfer

Each Learning Element aims to achieve one of 4 Learning Outcomes:

**Learning Outcome 1:** Understand the disposition effect (DE) and emotional regulation
(ER).

**Learning Outcome 2:** Improve awareness of personal profile in relation to DE & ER.

**Learning Outcome 3:** Develop skills in relation to DE & ER in a learning environment.

**Learning Outcome 4:** Transfer skills into practice.

Section 5 describes the evaluation of the xDelia Learning Pathway, both at the level of the three
Learning Objectives: Diagnosis and Feedback, Skill Development and Transfer, and at the level of
the individual Learning Elements, using the M3 framework to identify the connection between the
Learning Objectives, the Learning Elements and the Learning Outcomes.

As noted in the Description of Work and in year 2 deliverable, D9-2.3.2, evaluating user engagement
in an end-to-end journey along the Learning Pathway was not anticipated within the scope of the
project.

Given that the ideal Learning Pathway through this learning design is around 6 months in duration, it is not
practical within the scope of the project to follow a large cohort of learners through the entire learning design
(See D23 – Pedagogic Framework). Rather we primarily examine each element of the
learning design through a series of studies to establish whether each element performs as expected. Where
we see important synergies between different elements of the design, we test their joint effects. (D9-2.3.2, p.32)

Individual Learning Elements were evaluated with investors through the studies conducted at the
year 3 conferences. In these conference-based studies, investors completed the ERQ, played the
games and took an interoception measure before and after playing to assess their awareness of
internal physiological state and had the opportunity to play the games. This was followed by the user
experience survey and an interview.

These conference-based studies were used as an opportunity to gather detailed feedback on the
insights gained by investors into emotion regulation from completing the ERQ, on their experience
of playing the games, and their views on the usefulness of what the xDelia project was aiming to
achieve. The longitudinal studies S-M1/S-M2 and S-M8 provided the opportunity to evaluate the joint
effects of combinations of Learning Elements.

### 4.2 Evaluation Data Collection Events

The evaluation studies (EV-1 to EV-5) collected stakeholder feedback as the Learning Elements of
the xDelia Learning Pathway were trialled with private investors at conference events and field
studies. Final focus-group feedback was collected during the M6.5 Stakeholder workshop in May
2012.
Figure 4.2 illustrates the data collection method (email, focus group, surveys, interviews) used at each data collection event, and the number of investors who participated:

The data collection events were:

**November 2010 - National Investment Club Conference**
16 private investors were interviewed as they left the games study room in which they had played either the Columbian Card Task game or the Space Invaders game.

**April 2011 - Traders Expo Conference**
31 investors were interviewed as they left the games study room in which they had played the Two Index Game.

**February 2012 - Forex Conference**
21 private investors completed the user experience pre-survey before they were interviewed. 20 private investors were interviewed as they left the games study room in which they had completed the ERQ, interoception measure, played either Space Investors (with sensor) or Auction game (with sensor), interoception measure followed by the TIG.

**March 2012 - Traders Expo Conference**
18 private investors completed the user experience pre-survey before they were interviewed. 18 private investors were interviewed as they left the games study room in which they had completed the ERQ, interoception measure, either Space Investors (with sensor) or Auction game (with sensor), interoception measure followed by the TIG. 1 private investor sent email feedback.

April 2012 - S-M8 Camden UKLNG Field Study

61 private investors completed the user experience pre-survey before they were interviewed. 61 private investors were interviewed at the end of day 1 of the Camden Longitudinal study after completing the ERQ, interoception measure, either Space Investors (with sensor) or Auction game (with sensor), interoception measure followed by the TIG. 1 private investor sent email feedback.

May 2012 - S-M1/2 Saxo Bank Client Field Study

51 Saxo Bank clients (private investors) completed the user experience pre-survey as they exited the study. 3 Saxo Bank clients (private investors) took part in telephone interviews after having participated in S-M1/S-M2, doing an online ERQ, receiving video feedback on their DE score as calculated from their past trading data and on their habitual emotion regulation strategies, then playing the TIG online. 3 Saxo Bank clients (private investors) sent email feedback

May 2012 - M6.5 Stakeholder Feedback Workshop and Focus Group

34 private investors who had participated in the S-M8 study attended the Stakeholder Feedback workshop and took part in the focus group discussions.

4.2.1.1 April 2012 - S-M8 Camden UKLNG Field Study

The study S-M8 sought to determine whether emotion regulation training through serious games with bio-feedback and mindfulness training can reduce private investors and traders' susceptibility to the DE. This study lasted 2 weeks and incorporated a paper pilot of the xDelia diary together with a mindfulness exercise. Cohorts of private investors, who trade on their own account, were recruited to the studies via 2012 trade shows (The World Money Show, Trader Expo, and FOREX) and via an online trading forum. Participants were randomly assigned into one of two groups. The control group played the Space Investor and Auction sensor games without the biofeedback feeding into gameplay or being displayed on the screen. They also waited to receive their mindfulness training until after the study 'proper' had finished. The treatment group played the games with biofeedback and received mindfulness training over two weeks following the laboratory session.

Participants completed the user experience pre-survey after playing the games. They were interviewed at the end of the session. They were invited to complete the post-user experience survey online after they had attended the M6.5 Stakeholder workshop and received feedback on their performance, either at the workshop or via email if they had been unable to attend the stakeholder workshop.

4.2.1.2 May 2012 - S-M1/2 Saxo Bank Client Investor Feedback Trial

This study evaluated the first stage of our learning journey design (Diagnosis and Feedback) using a sample of study participants drawn from our primary target audience (investors trading their own portfolio on a regular basis).

For the investor feedback studies S-M1/2, Saxo Bank clients were invited to take part by email and clicked on a personalised link to enter the study. Participants completed an online questionnaire on
their habitual emotion regulation approaches. The questions drew on the Emotion Regulation Questionnaire (Gross, 2002) to diagnose propensity to intentional cognitive approaches to emotion regulation versus expressive suppression and the Mainz Coping Inventory (Krohne et al., 2000, Krohne et al., 2002) to diagnose defensive approaches to emotion regulation (high on avoidance, low on vigilance). Behind the scenes, the online system at Saxo Bank calculated the disposition effect score\(^5\) for each participant using their real trading history records.

The diagnostic Learning Element was followed by two videos, one explaining emotion regulation and giving feedback on their ER score, and one explaining the DE, and tell them the extent to which they suffered from the DE as calculated from their previous trading history. S-M1/2 is described in detail in D9-2.3.3.

They received structured personalised feedback on their emotion regulation approaches, their disposition effect and the likely meaning of these for their trading behaviour and performance. The automated online feedback (which follows completion of the questionnaire) was delivered via a combination of text and video.

Following this feedback investors were offered an opportunity to get further feedback by playing the TIG-DIDAC online. The didactic version of the TIG displays a real-time visualisation of the DE based on the player’s performance in the game while the player is playing the game.

270 Saxo clients took part in the S-M1/2 study, and of these, 64 went on to play the TIG online.

### 4.2.1.3 May 2012 - M6.5 Stakeholder Feedback Workshop and Focus Group

The M6.5 Stakeholder workshop was held in month 39 at Saxo Bank in London. The 61 Camden S-M8 investors were invited, and 34 were able to attend. The xDelia project was described in detail, with full background, and the Saxo implementation and plans were also presented. Participants were asked questions around their experiences on the study, and their thoughts on elements of the Learning Pathway that had not been implemented, but which had been trialled with their cohort, specifically the online diary tool, the mindfulness exercises and the peer forum. This formal part of the workshop was followed by an informal focus group in which the investors provided their feedback and reflections on the S-M8 study experience and on the overall aims and plans of xDelia.

### 4.3 Methods

WP6 used the following methods to collect evaluation data from stakeholders:

- Interviews
- User Experience Pre-Surveys administered immediately after playing the games
- User Experience Post-Surveys administered after having engaged with xDelia Learning Elements over longer period (2 weeks).
- Focus group
- Email feedback

Figure 4.3 illustrates the number and nature of stakeholder feedback data collected, visualised according to data collection method.
Sections 4.3.1, 4.3.2 and 4.3.3 below describe the methods used in more detail.

4.3.1 Interviews

A total of 149 interviews were conducted with investors after they had taken part in xDelia studies over a period from November 2010 through to May 2012. Guided by the D&E framework, the aim of the interviews was to gather stakeholder feedback on the xDelia games so that we could inform future development work. The interviews were also used to gather feedback on the stakeholder perspective on the xDelia approach:

- Q1: Could you summarise which games and activities you have just taken part in?
- Q2: What did you think of the game experiences?
- Q3: Have you any suggestions for improvement?
- Q4: Do you think this approach of using games with bio-feedback could help you improve your day-to-day trading decisions?
- Q5: Approximately how long have you been trading and how did you initially get started?
  - Q5a: How did you start learning about investing?
- Q6: How do you currently go about improving your trading skills (peer network, online forums, contact with banks, conferences such as these, online resources, financial papers, books, coaching)?
- Q7: Do you keep a trading diary?
The interviews were transcribed and the investor feedback on the games passed on to those partners and game designers involved in the study on which each evaluation was built. The feedback helped inform and guide the iterative development cycle. The transcripts were loaded into Nvivo qualitative analysis software and coded to identify emergent themes and the findings elaborated in Section 5.4 which explores the stakeholder perspective. Table 4-1 lists the participant IDs used in the different studies. These IDs are included with the interview quotes used in this deliverable to ensure that the quotes can be attributed to the appropriate study context.

Table 4-1 – Map of Participant IDs to Studies

<table>
<thead>
<tr>
<th>xDelia Study</th>
<th>Interviewee IDs used in Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yr 2 &amp; 3 Interviews at Investment Conferences</td>
<td>T01 to T45</td>
</tr>
<tr>
<td>February 2012 - S-M8(a) Forex Conference</td>
<td>FA01 to FA21</td>
</tr>
<tr>
<td>March 2012 - S-M8(b) Traders Expo Conference</td>
<td>TE_01 to TE_18</td>
</tr>
<tr>
<td>April 2012 - S-M8 Camden UKLNG Field Study</td>
<td>UKLNG_01 to UKLNG_67</td>
</tr>
<tr>
<td>May 2012 - S-M1/2 Saxo Bank Client Field Study</td>
<td>SX01 to SX51</td>
</tr>
</tbody>
</table>

4.3.2 Evaluation Surveys

User experience evaluation surveys were administered both at the single-day conference data collection events S-M8(a) & S-M8(b), at the end of study S-M1/2 and both at the start and end of the study S-M8. The surveys were administered after investors had completed the 2-week study in Camden (S-M8 asked questions about Learning Elements such as the diary and the mindfulness activity that participants in the single-day studies did not experience). A total of 174 surveys were collected. All participants in S-M8(a), S-M8(b) and S-M8 completed a survey. The Saxo investors who took part in the online study S-M1/2 could elect whether or not to do the survey online; 61 S-M1/2 participants completed the survey.

- February 2012 - S-M8(a) Forex Conference
  21 private investors completed the user experience pre-survey before they were interviewed.

- March 2012 - S-M8(b) Traders Expo Conference
  18 private investors completed the user experience pre-survey before they were interviewed.

- April 2012 - S-M8 Camden UKLNG Field Study
  61 private investors completed the user experience pre-survey before they were interviewed.
  20 private investors complete the post-survey after completing the study and attending the M-6.5 Stakeholder workshop.

- May 2012 - S-M1/2 Saxo Bank Client Field Study
  51 Saxo Bank clients (private investors) completed the user experience pre-survey as they exited the study.
  Of the 270 investors who took part in S-M1/2, 51 (19%) responded to the invitation to complete the user experience survey online. This is a good response rate for an online survey which is typically 11% lower than that of a paper questionnaire (Keusch, 2012). The user experience survey was presented when the participant exited the study. Therefore, those who exited the study before playing the TIG online would complete only the first sections of the survey. 64 went on to play the TIG online and of these, 21 completed the TIG section of the user experience web survey. This represents a response from 33% of those investors who had gone through the entire diagnosis and feedback stage including playing the TIG. Following-on from the study, investors were invited by email to take part in a short semi-structured interview. Three investors were interviewed. In the light
of the low take-up of the telephone interviews, all investors were then invited to email their feedback. They were asked to structure their feedback around the following:

- Three positives that they took with them from their participation in the xDelia Learning Pathway.
- Any suggestions they had for improvement.

One S-M1/2 investor emailed feedback.

All 64 participants in the Camden study S-M8 completed the user experience pre-study survey (after completing the ERQ, playing the SI, AUC and TIG once). 61 took part in the user experience interviews. After completing the two-week study activities and receiving their personalised feedback either in person at the M6.5 Stakeholder Workshop, or by email, 20 investors went on to complete the user experience post-study survey and 3 emailed feedback.

The low response-rate to invitations to provide email feedback is likely to be related to the fact that it takes much more effort and thought to type an email than it does to through a set of radio-button responses in a web survey.

### 4.3.3 Focus Group

The focus group was held during the M6.5 Stakeholder Workshop held at Saxo Bank for participants of the longitudinal Camden study S-M8. All 61 participants in the S-M8 Camden Study were invited to attend. 39 participants accepted the invitation and 34 turned up.

The event began with two presentations to explain the rationale and context for the S-M8 study the participants had taken part in. Professor Mark Fenton-O’Creevy presented on the aims of xDelia project and summarised some of the emergent findings from the research which had led to the design of the xDelia Learning Pathway. Jeffrey Todd Lin, Head of Research at Saxo Bank, presented details about how Saxo were implementing the xDelia Learning Pathway.

At the end of the presentations, participants were invited to ask questions, and these were recorded in electronic note form. The presenters then asked participants for their input regarding the Learning Elements of the xDelia Learning Pathway that had not yet been implemented, specifically the online diary and the peer forum.

Afterwards, delegates were encouraged to give informal feedback about their experiences of the Camden study to members of the xDelia team. This feedback was written up after the event and collated.
5 Evaluating the User Experience

As described in Section 2 and visualised in Section 3 the xDelia Learning Pathway consists of a series of diagnostic, didactic and reflective Learning Elements designed to be undertaken over a period of 6 weeks up to 6 months.

Section 5 presents the collected evaluation findings with the aim of answering RQ3:

How are the design principles associated with the games translated into tangible Learning Outcomes?

Learning Elements may be combined in different ways and in different modes according to when in the Learning Pathway they occur. Learning Elements range from diagnostic tasks to identify the personalised learning needs of each learner, through training activities to teach emotion regulation techniques, to serious-games activities to practice and improve the techniques learned in a simulated financial context. Underpinning the performative Learning Elements are an online diary and peer forum to support reflective learning throughout an individual’s journey along the Learning Pathway. Each Learning Element addresses a Learning Objective and may be undertaken alone or in combination with other Learning Elements. A Learning Element may address different Learning Objectives according to when in the Learning Pathway the trader takes it.

The location and timing of the Learning Elements that comprise the xDelia Learning Pathway is under the control of the learner. They can take part in a Learning Element once only, or repeatedly, practicing for instance games to improve their emotion regulation skill level or re-taking a diagnostic test after practice to see whether the skills they have learned are making a difference. This places the xDelia Learning Pathway firmly at the informal learning end of the learning spectrum with the order, pace and frequency of use of the learning process very much under the control of the learner. The user experience must be engaging and perceived as valuable by the learners in order for them to undertake it, and thus the WP6 evaluation studies in Year 3 have concentrated on gathering user experience data from investors, the main stakeholders in the Learning Pathway, as they experience different Learning Elements and combinations of those elements.

The following sub-sections describe the evaluation at the level of the three objectives presented in Section 2. Section 5.1 describes the evaluation at Level 1: Diagnosis and Feedback. Section 5.2 describes the evaluation at Level 2: Skill Development, and Section 5.3 presents the findings and evaluation studies that contribute to assessment at Level 3: Transfer.

5.1 Level 1 Evaluation: Diagnosis & Feedback

The evaluation of the Level 1 Diagnosis and Feedback stage uses data collected during the S-M1/2 Saxo Investor Feedback studies, and at the S-M8 Camden Longitudinal study on the following Learning Elements:

Learning Element LE #1: Emotion Regulation Questionnaire
- to diagnose habitual emotion regulation strategies
Learning Element LE #2: Behind-the-scenes DE calculation algorithms
- to calculate DE based on real trading data
Learning Element LE #3: Feedback (video or written) on emotion regulation score
- to teach awareness of personal emotion regulation strategies
Learning Element LE #4: Feedback (video or written) on DE score
to teach awareness of personal tendency to DE

Learning Element LE #5: Two Index game in diagnostic mode

to teach awareness of personal tendency to DE

These Learning Elements address the following Learning Outcomes:

1. Understand the disposition effect (DE) and emotional regulation (ER).
2. Improve awareness of personal profile in relation to the disposition effect and emotional regulation.

Table 5-1, below, uses the M3 Framework to highlight how each Learning Element (LE) is linked to the Learning Outcomes described in Section 3.3 and Section 4.1.2. It identifies the actor(s), roles, and tools, and how they contribute to the Diagnosis and Feedback stage of the xDelia Learning Pathway. It also lists the EV studies (see Appendix A for a list of these studies) that contribute data to the evaluation of each Learning Element.
Table 5-1 – M3 Framework for Evaluating Level 1 Learning objectives: Diagnosis and Feedback

<table>
<thead>
<tr>
<th>#</th>
<th>Learning Element description</th>
<th>Actor(s):role(s)</th>
<th>Tool(s)</th>
<th>Topic</th>
<th>Contributes to objective</th>
<th>Generates outcome</th>
<th>Approach / method</th>
<th>Led by</th>
<th>Evaluation Study(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emotion Regulation Questionnaire (ERQ)</td>
<td>Learner: completes web-based ERQ. Bank software: Immediate, behind the scenes analysis of responses to give ERQ score.</td>
<td>Computer Bank analysis software</td>
<td>Emotion regulation (ER)</td>
<td>Level 1 Diagnosis and Feedback</td>
<td>1. Understand the DE and ER. 2. Improve awareness of personal profile in relation to DE and ER.</td>
<td>Diagnostic &amp; didactic</td>
<td>learner</td>
<td>EV-1 EV-4 EV-5 EV-7</td>
</tr>
<tr>
<td>2</td>
<td>Analysis of past trading data to give DE score</td>
<td>Bank software: Behind the scenes analysis of trading data to determine the extent to which trader suffers from the DE.</td>
<td>Bank analysis software</td>
<td>Disposition effect (DE)</td>
<td>Level 1 Diagnosis and Feedback</td>
<td>2. Improve awareness of personal profile in relation to DE and ER.</td>
<td>Diagnostic</td>
<td>bank</td>
<td>EV-1 EV-4 EV-5 EV-7</td>
</tr>
<tr>
<td>3</td>
<td>Personalised text and video feedback on emotion regulation</td>
<td>Short video explaining emotion regulation followed by personalised feedback giving ERQ score and describing habitual emotion regulation strategies.</td>
<td>Computer plays video and audio</td>
<td>Emotion regulation</td>
<td>Level 1 Diagnosis and Feedback</td>
<td>1. Understand the DE and ER. 2. Improve awareness of personal profile in relation to DE and ER.</td>
<td>Diagnostic &amp; didactic</td>
<td>learner</td>
<td>EV-1 EV-4 EV-5 EV-7</td>
</tr>
<tr>
<td>4</td>
<td>Personalised text and video feedback on DE</td>
<td>Short video explaining the DE followed by personalised feedback on disposition score based on past year’s trading data.</td>
<td>Computer plays video and audio</td>
<td>DE</td>
<td>Level 1 Diagnosis and Feedback</td>
<td>1. Understand the DE and ER. 2. Improve awareness of personal profile in relation to DE and ER.</td>
<td>Diagnostic &amp; didactic</td>
<td>learner</td>
<td>EV-1 EV-4 EV-5 EV-7</td>
</tr>
<tr>
<td>5</td>
<td>Two Index game (TIG) in diagnostic mode</td>
<td>TIG in diagnostic mode simulates trading environment to elicit the DE to diagnose whether the learner suffers from it.</td>
<td>DE calculated real-time as learner plays TIG</td>
<td>DE</td>
<td>Level 1 Diagnosis and Feedback</td>
<td>1. Understand the DE and ER. 2. Improve awareness of personal profile in relation to DE and ER.</td>
<td>Diagnostic and game-based diagnostic</td>
<td>learner</td>
<td>EV-1 EV-4 EV-5 EV-7</td>
</tr>
</tbody>
</table>
5.1.1 Evaluation of LE #1 ERQ & LE #3 ER Feedback

This section presents the stakeholder view of the Emotion Regulation Questionnaire (ERQ) and the feedback they received on their habitual emotion regulation strategies based on their responses to the ERQ. Evaluation data were collected during the S-M1/2 Saxo Investor Feedback study, and the S-M8 Camden longitudinal study. Appendix C lists the questions in the web survey administered post-S-M1/2 and Appendix D lists those administered in the evaluation survey administered post-Camden S-M8 study.

The S-M1/2 Saxo Bank investors’ reaction to the ERQ and video feedback was positive, with a majority finding it informative (76% agree, 10% disagree) interesting and engaging (80% agree, 10% disagree) and provided a good basis for reflective learning (78% agree, 6% disagree). The S-M8 Camden investors completed a paper version of the questionnaire and received feedback by email after they had completed the study. They were equally positive about this Learning Element, finding it informative (75% agree, 0 disagree), and providing a good basis from which to reflect and work to improve their trading (80% agree, 5% disagree).

The reaction of the Saxo investors on S-M1/2 to their personalised results was also encouraging with 68% finding that they had learned something new about their personal emotion regulation strategies (68% agree, 12% disagree), 39% were surprised by their ER results but 66% agreed with the assessment.

Equally positive reactions were received by the Camden Study investors taking part in S-M8, with the majority feeling that they had learned something new about their personal emotion regulation strategies (65% agree, 15% disagree), half were surprised at their ER results (50% agree, 10% disagree) however the majority agreed with the assessment of their ER strategy (70% agree, 0% disagree).

A good level of support for the xDelia approach was shown by the response of 78% of the S-M1/2 investors who agreed/strongly agreed with the statement I believe that the personalised information on my emotion regulation strategy will provide me with a good basis from which to reflect on and work to improve my trading.

When asked the same question, 80% of S-M8 participants agreed/strongly agreed. The following quote is typical of the feedback we have received from investors as we have trialled the approach throughout the development of the xDelia Learning Pathway:

Well in general I am a strong believer in the fact that trading is a very emotional game and you really need to control your emotions well if you want to perform well in trading [...] in general I support the approach quite strongly. T26

5.1.2 Evaluation of LE #2 DE Diagnosis & LE #4 DE Feedback

During S-M1/2, the DE was calculated using past trading history. The reaction of the S-M1/2 investors to their DE diagnosis and feedback was positive, with most finding it informative and engaging (82% agree, 9% disagree) and they felt they had learned something new about the DE (76% agree, 12% disagree). They felt it provided a good basis for reflective learning (76% agree, 6% disagree) and gave them insight into the extent to which they suffered from DE in their own trading (85% agree, 3% disagree):
The test results showed, as I remember, that I'm not, that I am actually good at cutting my losses and I mean I expected that but it was good to hear it confirmed, so to speak (SX01)

The DE for the Camden Study investors in S-M8 was calculated using only the TIG and their score emailed to them after they had completed the study. Most 75% felt that the information they were given on the DE was informative (75% agree, 5% disagree), that they had learned something new about tendency to display the DE (65% agree, 15% disagree). Just under half were surprised by their DE score (45% agree, 15% disagree, 40% undecided). Their responses suggest that the DE is an emotional bias that people are largely unaware of (75% felt they had learned something new about the DE).

### 5.1.3 Evaluation of LE #5 TIG in diagnostic mode

The S-M1/2 investors were presented with a video explaining what the DE is, giving them their DE score calculated from their trading data and explaining what the implications of this score were. They were then given the opportunity to play the TIG-DIAG. Evaluating the TIG as a diagnostic Learning Element, half felt that it helped them understand how much they demonstrated the DE (50% agree, 15% disagree) and over half felt that playing the TIG in combination with other xDelia Learning Elements would help them reduce their tendency to show the DE when trading (58% agree, 8% disagree).

Overall, they found the TIG fun (69% agree, 12% disagree), and opinions were divided about whether or not the TIG felt realistic (50% agree, 35% disagree, 35% undecided).

Interview feedback on the TIG-DIAG from investors recruited from the Trade Shows demonstrated the subtleties of investors' reactions. Many felt it was realistic:

> I found the 2 Index trading game, incredibly realistic. It moves how the market moves, there was also an element of irrationality about it. (UKLNG_32)

Although some felt that no matter how realistic, a game could never fully simulate the emotions of trading with real money:

> The live trading game I enjoyed that. To some extent it matches, it graphically matches the real life situations fairly well for short-term, very short-term, trading. Although I think the only thing it cannot simulate is the fact that you are playing with virtual money, so it will not be the same if you were playing real money of your own, You would be more careful. (TE_14)

Others found the gameplay unrealistic:

> Well the first thing you have to do with the two index game is ignore the predictor because that’s just a waste of time. I just concentrate on the price action, which is what I did. (F-A09)

Although some who played the TIG online in the S-M1/2 study found the gameplay too fast (50% agree, 23% disagree) slightly more found it difficult to take in all the information on the screen (62% agree, 15% disagree). This finding is confirmed by the interview responses:

> interesting but a little bit fast. And because I knew I was in a game environment I somehow was not relying on the forecast indicator because that could be misleading. (FA13)

Integrated into the S-M1/2 studies run at Saxo Bank were complex software algorithms to calculate the actual DE score of the investors invited to take part. These scores were calculated based on their previous real-world trading data. The score was then compared to their DE score as calculated, real-time, as they played the TIG in diagnostic mode during the study. The results showed a strong correlation between investors’ DE scores prior to the study and their scores when playing the TIG in
diagnostic mode. This validates the use of the TIG as an instrument for diagnosing the DE, as (D9-2.3.3, Section 4.1.3.2 contains a detailed description of the findings). The study also revealed a relationship between higher DE, as shown in the TIG, and lower profits in the game, which supports the suggestion that the DE has a negative impact on trading performance.

Although the Camden S-M8 participants played the TIG in diagnostic mode at the start of the study, they were not told about the DE until they received their email feedback at the end of the study as this knowledge might have affected the study outcomes, therefore their post-survey did not ask their opinion of the TIG as a diagnostic tool.

5.1.4 Evaluation at the level of Learning Outcomes 1 & 2

Referring back to the Table 5-1 framework for the evaluation of the Learning Elements contributing to the Diagnosis and Feedback stage, the Learning Objectives was broken down into two Learning Outcomes:

Learning Outcome 1: Understand the DE and ER.
Learning Outcome 2: Improve awareness of personal profile in relation to the DE and ER.

Feedback from S-M1/2 and S-M8 investors was consistent across the two studies in that the majority (65% and 68%) felt that they had developed an increased awareness of their personal ER strategies as a result of completing the ERQ and receiving feedback:

I’m probably taking back more in some ways from the survey because that just drives home the idea of staying ... just be non-committal with emotions, just keep them calm and try to work them to your favour as you say. (UKLNG_01)

Having become more aware of emotion regulation tendencies after completing the ERQ, some investors tried to maintain this awareness when playing the games:

I think while filling in the surveys I, it asked me whether I was conscious of my heartbeat and my emotions and my body and all that. I think it was only Space Investors where I was conscious of how I was feeling, perhaps because there was a bar there, showing you know, that activity. So I was trying to calm myself on purpose in my head. But Auction game was too fast, I just got too carried away and I didn’t think about my body or my emotions or anything like that. (UKLNG_28)

The above interview response was from an S-M8 Camden study participant who had completed the ERQ and then immediately played the SI and the AUC games. This supports the use of the AUC game as a financially realistic stress inducing game, however in a real-world learning context of the xDelia Learning Pathway, a learner would have the opportunity to learn and practice mindfulness techniques, which would better equip him/her to manage emotions when playing the AUC game.

Investors participating in both S-M1/2 Saxo and S-M8 Camden studies reported increased awareness of their own DE. However a larger percentage of Saxo participants felt that this was higher (85%) than the proportion of Camden participants (65%). The Camden study incorporated a control group and a treatment group, therefore to avoid biasing the results, neither group were informed about the DE until after they had completed the study. Participants in both studies found the information on the DE to be informative and engaging (82% and 75%), so the difference in awareness may be due to the fact that the Camden participants had no information on the DE until after they had completed the study.

In the S-M1/2 study run at Saxo Bank, investors’ actual DE was calculated behind the scenes from their past trading data. The video feedback explaining the DE and giving them their real-world DE score was presented immediately after they had completed the ERQ and before they went on to play
the TIG-DIAG. Therefore, they played the TIG-DIAG with full awareness of what the DE was and what its implications were. In addition, the fact that they had been told their real-world DE score as calculated from their trading data may have carried with it more credibility and caused higher levels of self-reflection as they played the TIG online. As described in Section 5.1.3, the results showed a strong correlation between investors' DE scores prior to the study derived from their real-world trading data and their scores when playing the TIG in diagnostic mode. This correlation was noted by some participants:

Yeah, well it's because I have worked deliberately on this, these issues [disposition effect] myself. I mean I have been trading and I have experienced this tendency not to cut losses short and to this sort of selection bias if you want to. You know I can talk about this disposition effect and then I have been working with that for myself. The test results showed, as I remember [...] that I am actually good at cutting my losses and I mean I expected that but it was good to hear it confirmed, so to speak. (SX-03)

The majority (82% agree, 3% disagree) felt that the personalised information they received on the DE provided them with insights into their own trading behaviour.

The evaluation feedback received from investors taking part in the Diagnosis and Feedback stage was overwhelmingly positive. Investors reported that the Stage 1 Learning Elements achieved the Learning Objective of increasing their understanding of DE and ER strategies and improving their awareness of their personal profile in relation to these strategies. Most investors learned something new about emotion regulation (68% agree, 20% disagree) and DE (76% agree, 12% disagree) and some revealed during the interviews that receiving this didactic feedback made them more aware of their emotional responses as they were playing the diagnostic games. Thus the diagnostic and feedback stage prepares the learner for the skill development stage that follows.

5.2 Level 2 Evaluation: Skill Development

During the Diagnosis and Feedback stage, investors receive feedback on their own habitual emotion regulation traits and of how this might affect their decision-making under stress. They are also told the extent to which they suffer from the DE, during their actual trading and/or when playing the TIG-DIAG. Having completed the Diagnosis and Feedback stage, investors then continue, in an idealised learning path, on to the Skill Development stage.

During Skill Development, xDelia Learning Elements are designed to help investors learn and practice emotion regulation skills in a financially safe environment. They receive mindfulness training, access to a mindfulness game, playable on a computer, and a mobile app with which to practice mindfulness techniques such as paced breathing. They can practise these techniques in an artificially stressful context by playing the xDelia games. These games are designed to induce raised levels of emotional arousal, which players have to regulate in order to improve their game performance.

To evaluate Level 2: Skill Development, user experience data was collected at the level of the individual Learning Elements from investors during the studies S-M8(a) Forex 2012, S-M8(b) Traders Expo 2012. The joint effects of combinations of Learning Elements was assessed through evaluation studies run alongside the longitudinal study S-M8 Camden ULKNG. The Learning Elements that comprise the Skill Development stage are:

Learning Element LE #6: Mobile Mindfulness app
- to practice mindfulness techniques for emotion regulation

Learning Element LE #7: Mindfulness game
- to practice mindfulness techniques for emotion regulation

Learning Element LE #8: Auction game (with biosensors) in didactic mode
• to practice emotion regulation under stress
Learning Element LE #9: Space Investors game (with biosensors) in didactic mode
• to practice emotion regulation under stress
Learning Element LE #10: Two Index game in didactic mode (not trialled in the year 3 studies)
• to practice emotion regulation during financially realistic task with real-time visual display of DE (feeding physiological data back into the game, if sensors attached).

These Learning Elements address Learning Outcome 3: Develop skills in relation to the disposition effect and emotional regulation in a learning environment.

Table 5-2 uses the M3 Framework to illustrate how each Learning Element is linked to the learning Outcome described in Section 3.3 and Section 4.1.2. It identifies the actor(s), roles and tools and how they contribute to the Skill Development stage of the xDelia Learning Pathway. It lists the evaluation studies that contributed data to the evaluation of each Learning Element.
### Table 5-2 – M3 Framework for Evaluating Level 2 Learning Objective: Skill Development

<table>
<thead>
<tr>
<th>#</th>
<th>Learning Element description</th>
<th>Actor(s):role(s)</th>
<th>Tool(s)</th>
<th>Topic</th>
<th>Contributes to objective</th>
<th>Generates outcome</th>
<th>Approach / method</th>
<th>Led by</th>
<th>Evaluation Study(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Mindfulness app</td>
<td>Learners learn and practise mindfulness techniques designed to aid their emotion regulation</td>
<td>Mobile phone (android or iPhone)</td>
<td>Learn and practise mindfulness techniques</td>
<td>Level 2 Skill Development</td>
<td>3: Develop skills in relation to the DE and ER in a learning environment.</td>
<td>Reflective, Performative</td>
<td>Learner</td>
<td>Local evaluation study S-HP(2)</td>
</tr>
<tr>
<td>7</td>
<td>Mindfulness game</td>
<td>Learners learn and practise mindfulness techniques designed to aid their emotion regulation</td>
<td>Computer</td>
<td>Learn and practise mindfulness techniques</td>
<td>Level 2 Skill Development</td>
<td>3: Develop skills in relation to the DE and ER in a learning environment.</td>
<td>Reflective, Performative</td>
<td>Learner</td>
<td>Local evaluation study S-HP(1)</td>
</tr>
<tr>
<td>8</td>
<td>Space Investors game</td>
<td>Learners apply mindfulness techniques in order to succeed at an aiming game where game play gets harder if player unable to regulate emotion.</td>
<td>Computer</td>
<td>Practise mindfulness techniques to regulate emotion in game</td>
<td>Level 2 Skill Development &amp; Level 3 Transfer</td>
<td>3: Develop skills in relation to the DE and ER in a learning environment.</td>
<td>Game-based, Performative</td>
<td>Learner</td>
<td>EV-1 EV-3 EV-7</td>
</tr>
<tr>
<td>9</td>
<td>Auction Game</td>
<td>Learners apply mindfulness techniques in order to succeed at an aiming game where game-play gets harder if player unable to regulate emotion.</td>
<td>Computer connected to bio-sensors.</td>
<td>Practise mindfulness techniques in a financially authentic game</td>
<td>Level 2 Skill Development &amp; Level 3 Transfer</td>
<td>3: Develop skills in relation to the DE and ER in a learning environment.</td>
<td>Game-based, Performative</td>
<td>Learner</td>
<td>EV-1 EV-3 EV-7</td>
</tr>
<tr>
<td>10</td>
<td>Two-Index Game in didactic mode</td>
<td>TIG in didactic mode simulates trading environment to elicit the DE. Moving bar indicates levels of DE as game is played. and provides immediate feedback</td>
<td>Computer (optionally connected to bio-sensors)</td>
<td>Practise ER and reduce DE in a financially authentic game.</td>
<td>Level 2 Skill Development &amp; Level 3 Transfer</td>
<td>3: Develop skills in relation to the DE and ER in a learning environment.</td>
<td>Game-based, Performative</td>
<td>Learner</td>
<td>EV-1 EV-3 EV-7</td>
</tr>
</tbody>
</table>
5.2.1 Evaluating Sensor Comfort

After seeing prototypes of the games, which use sensors to relay physiological data back into the game, the reviewers at the previous review posed the question of how comfortable the sensors were to wear. Therefore, during the local evaluation of SM-3 (calibrating the SI, summarised in Appendix A), the 32 student participants were asked how comfortable the sensors were. Over half (51%) said they were comfortable or very comfortable (39% neither uncomfortable nor comfortable, 10% uncomfortable).

When this question was repeated with the investors taking part in the year 3 studies, 70% found the sensors comfortable to wear, with 14% aware of the sensors but finding them neither comfortable nor uncomfortable and 16% aware of them and finding them uncomfortable.

Wearing the sensors under clothes does not seem to cause any appreciable discomfort.

5.2.2 Evaluation of LE #6 & LE #7 Mindfulness App & Program

The mindfulness app and program aim to support the development of emotion regulation skills and were evaluated by the local studies described in Appendix A. The software development and study timeframes meant that it was not possible to integrate these two Learning Elements into the longitudinal studies S-M1/2 and S-M8. Therefore, to evaluate the impact of mindfulness training on emotion regulation during trading, study S-M8 integrated mindfulness instructions on Day 1 of the study, in which participants attended in person, followed by mindfulness record support in the prototype xDelia trading diary. D9-2.3.3 contains a detailed description of the research design for S-M8. The mindfulness app and program were not evaluated within that study.

Investors were aware that playing games alone would not be sufficient to improve their ability to manage their emotions: Yes but I guess you need more training rather than one time game. (FA13). During interviews with investors earlier in the project, mindfulness has emerged as a technique they used to improve their emotional control when trading:

A bit like the mindfulness stuff I try and be very aware of my emotions at different times and how that will affect how I perceive the market and what's happening there and then mainly I try and structure my trading investment in such a way that I'm less prone to, obviously I always say I always think that I'm the biggest problem in my investment. (T35)

More for me what helps is my personal practice of meditation, I'm a bit of a meditator, into meditation so I would say that aspect of it definitely helps with managing your emotions (T39)

I'm doing meditation myself, so I have quote a good awareness of what I fall like and what it is caused by. (TE_02)

When the S-M8 participants were asked if they had practiced mindfulness prior to taking part in the study, 30% said that they had. These responses suggest that mindfulness would be seen by the target learners as a valid approach to managing their emotions.

We therefore built an evaluation of the practice of mindfulness around the S-M8 study. Participants in the S-M8 treatment group were given a paper trading diary in which to record not only their emotions before and after their trading sessions, but also to record details of their mindfulness practice.
During the Camden study, participants in the treatment group (those who were given mindfulness instructions) practiced mindfulness techniques (33% every 1-2 days, 66% every 3-4 days) for an average of 13 minutes per session. They agreed that the mindfulness exercises increased their levels of attention (55% agree, 0% disagree) and their awareness of their emotions (56% agree, 1% disagree). The majority felt that the mindfulness exercises helped them manage their emotions (67% agree 0% disagree) and made it easier to cope with stress (67% agree 0% disagree). Opinions on whether the mindfulness exercises improved their ability to make good trading decisions was mixed (33% agree, 67% undecided), however a strong majority planned to continue practising mindfulness after the end of the study (78% agree, 0% disagree).

The majority said that they would use a mindfulness app on a phone (75%) or an iPad (60%) that guided them through practicing mindfulness techniques.

This response suggests that mindfulness is perceived by investors as a valid technique for regulating emotion when trading, and that a structured approach to practicing mindfulness helps increase levels of attention and manage emotions. To evaluate the effectiveness of mindfulness on emotional control when trading needs a longer study at the level both of self-report and of effects.

5.2.3 Evaluation of LE #9 SI-DIDAC Game

Two games with biosensors were trialled with private investor: the Space Investor game (SI-DIDAC) and the Auction game (AUC-DIDAC). The trials took place across three events: the Forex Conference in February 2012, the Traders Expo in March 2012 and the Camden ULKNG study that started in April 2012. Feedback on investors’ experiences with the games was collected through the user experience survey (the survey questions are presented in Appendix E: and interviews.

61 participants at the Camden ULKNG study S-M8 played the SI game with biosensors. The majority found it engaging to play (84%), easy to understand (89%) and fun (82%). These responses align with those from the Forex Conference (21 participants) and Traders Expo (17 participants) where 79% found the game engaging to play, 67% easy to understand and 71% thought it fun.

I thought the space investors was probably the most interesting of all of [...]So the idea of it feeding back and then that feeding back onto the screen I think is a fantastic idea. And I can see how that would work and just get, you know, get you in tune with what’s going on. (UKLNG21)

the space investor game was amazing. It’s really very good to see how your emotions work (UKLNG_20)

Investors found that the act of playing the game raised their awareness of their emotion state: Very exciting. And I was much more aware of my heart rate and breathing during the first game. (FA21) Some used this awareness to try to improve their performance in the game by controlling their emotional arousal:

well because the screen became blurry and the mouse became erratic and I, to make it behave if you like, I had to just calm down and I did that, I did try to think of myself as an RAF pilot, and I had to shoot these planes and it was professional thing I was doing but I also realised that I could race around like an idiot trying to get all of them, but very often if I just remained calm and waited for them to come to me with minimal movements then I could do pretty well (T33)

I could see it on the bar although I didn’t really feel it until I started to maybe realise it that yes ok maybe my heart rate is a little bit higher than it should be. Then I just took deep breaths to calm myself down and it worked actually quite well I thought just some deep breathing. (TE-09)
Although the overall response to the SI-DIDAC was positive, investors were not un-critical. The games are still early prototypes, and investors provided helpful feedback on the level of instruction and player in-game feedback:

...I think a little bit about the instructions with the different weapons, I didn't understand that. At the beginning the instructor had to tell me you had to sort of score a certain amount of points before you could get access to the other weapons. (FA12)

For example, the fact that you were supposed to aim at some asteroids in preference to others was unclear:

The space game I think the instructions could have been more clear. I didn't realise I was shooting everything. I didn't realise you weren't supposed to shot the green or resources. (TE_09)

In addition, the choice of red/green to distinguish between asteroids that you should aim and those that you should avoid could cause problems:

What I found slightly difficult for me was, the last level where they introduced the asteroids which were covered in red and green. (UKLNG_23)

However this detailed level of end-user usability feedback can be incorporated into future iterations of the games to improve their visual appeal and playability.

During the interviews, some investors found it difficult to engage with the games because they were not game players:

Yeah. I can imagine my grandchildren playing them have no trouble at all, you know, whereas ... I've never sat down ... I've heard about these games they play but I've never done them before. (TE_01)

Asteroid one, computer games, I don't actually play so that harassed me a little bit, or got me stressed out. (UKLNG_19)

Although even some non-game players enjoyed playing the SI game:

As a non-game player, it was fun. I'm at the age where I don't play games, but it was fun. (UKLNG_64)

It would be unrealistic to expect a games-based approach to work for everyone, and as the xDelia Learning Pathway is an informal learning solution, investors will engage with different Learning Elements to a greater or lesser extent. The overall response to the SI-DIDAC was positive; with 54% agreeing that they would recommend it both to a fellow trader (54%) and to a friend who does not trade (61%). This suggests that the SI can help learners practice simple ER skills in a straightforward gaming environment to progress along the pathway to achieve Learning Outcome 3: Develop skills in relation to the DE and ER in a learning environment.

5.2.4 Evaluation of LE #8 AUC-DIDAC Game

The Auction (AUC-DIDAC) game was trialled across the same events as the SI-DIDAC; the Forex Conference in February 2012, the Traders Expo in March 2012 and the Camden ULKNG study that started in April 2012. Feedback on their experiences with the games was collected through the User Experience survey (the survey questions are presented in Appendix E: and interviews.

61 participants at the Camden ULKNG study S-M8 played the AUC game with biosensors. The majority found it easy to understand (77% agree, 12% disagree), although when asked if the AUC was fun, most investors disagreed (7% agree, 83% disagree), their interview responses revealed that despite this lack of fun element they found the AUC game engaging to play (84% agree, 5% disagree).

I liked the ... especially the cloud one that was more like get my brain working. That was my favourite one. (UKLNG_05)
The auction game was again very good and I think it was a good practice to apply in the real time. (UKLNG_20)

I thought the most engaging one was the auction one, because you really had to think about the average in most of them, and that was quite tough, in time pressure. (UKLNG_26)

The AUC game got more difficult the more stressed the player became, and this made it less enjoyable. Some felt that the AUC game was too fast (60% agree, 20% disagree). However most felt that the AUC game was realistic (58% agree, 13% disagree)

The auction game [...] you know quickly which is right or roughly which way you should go but if you miss one thing and you get frustrated you just do it wrong and then it sort of compounds on top of the next and it’s very hard to get yourself back into your rhythm and do it properly. That is ... that’s very important to stay calm. Once you lose your cool you just make all kinds of mistakes while trading, especially if you do short-term trading like what I do (UKLNG_01)

I think the one I enjoyed the most was the auction game. It required sort of quick mental agility just doing the calculations. It’s where it felt like, you know, the similar skills when you sort of, you know, reading level 2 and you’re seeing prices, you know, coming in and out. (UKLNG_03)

Regarding the Auction game, I found that quite fascinating, I started off really well, and then I got progressively worse. And then right near the end, it got better again. Why I liked the Auctioning game, was that I believe it sort of, it has the integral components of trading. (UKLNG_32)

Most investors found the information on the screen easy to follow (83% agree, 13% disagree), with 62% prepared to recommend the AUC game to a friend or colleague who does not trade and 78% prepared to recommend it to a fellow trader.

This feedback is a positive endorsement from our primary stakeholders, private investors, to the AUC game. They view it as a realistic financial task that simulates the type of stress they experience when trading for real.

It was interesting. I think the auction game out of the three stood out the most for me. I did find it interesting the ... where it noted your arousal levels and on the final screen where I felt like when it speeded up and I was concentrating more that was my lowest arousal level. So from a trading point of view with respect to concentrating and having to make instant intuitive decisions is probably, from personally speaking, is when you’re going to make the best decisions. (UKLNG_04)

The overall response from investors was that the AUC-DIDAC provided them with a good game-based environment in which to practice emotion regulation techniques.

5.2.5 Evaluation of LE #10 TIG-DIDAC Game

The TIG-DIDAC was not trialled during the studies, however it was demonstrated to investors who had taken part in the Camden (S-M8) study and attended the M6.5 Stakeholder Workshop. Their reaction was very positive (please refer to Section 5.5 where the Stakeholder Workshop findings are detailed).
5.2.6 Evaluation at the Level of Learning Outcomes

At the Skill Development stage, we are evaluating against Learning Outcome 3: Develop skills in relation to the disposition effect and emotional regulation in a learning environment.

In the feedback trial study (S-M1/2), the DE was measured in actual trading data for each participant at three time periods; before the training and in two periods after. No significant differences were observed between the training group and a comparison group prior to the training but significantly lower DE in the training group (and relative to the comparison group) was found following the training. This represents some evidence for the impact of the Skill Development stage of the xDelia Learning Pathway on the DE. However further studies over longer time periods and incorporating more Learning Elements are needed to confirm these findings.

Investors who took part in the Skills Development stage were enthusiastic about the games and their potential to help them develop emotion regulation skills that would help their trading performance. The improvements in DE demonstrated through S-M1/2 are evidence that this potential was realised during trials. For details, please see D9-2.3.3.

5.3 Level 3 Evaluation: Transfer

The Level 3 Learning Objective, Transfer, occurs progressively as the learner engages more deeply with the different Learning Elements. Underpinning the learning transfer are the following Learning Elements:

Learning Element LE #13: Peer forum
- to provide interaction with other learners and more able peers, sharing experiences, reflections, ideas and skill transfer

Learning Element LE #14: Online diary
- to record trading and emotional state together with state-of-the-market data for reflection and to support skill transfer

Table 5-3 – M3 Framework for Evaluating Level 3 Learning Objective: Transfer includes the evaluation plan for the online diary and Peer forum and how they support the development and transfer of the emotion regulation skills to the real trading field. Neither the online diary nor peer forum were scheduled for implementation within the timeframe of the project, however a prototype diary was evaluated during the Camden study S-M8 and the methodology and plans for evaluating the peer forum have been drawn up.
### Table 5-3 – M3 Framework for Evaluating Level 3 Learning Objective: Transfer

<table>
<thead>
<tr>
<th>#</th>
<th>Learning Element description</th>
<th>Actor(s):role(s)</th>
<th>Tool(s)</th>
<th>Topic</th>
<th>Contributes to objective</th>
<th>Generates outcome</th>
<th>Approach / method</th>
<th>Led by</th>
<th>Evaluation Study(s)</th>
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<td><strong>Learning Context #3</strong></td>
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<td><strong>Physical:</strong> Sitting at a computer, or on a connected mobile device; <strong>Social:</strong> In learner’s own home or other learner-chosen setting, fixed or mobile; <strong>Technical:</strong> Computer or device connected to the internet, interaction via web browser; <strong>Temporal:</strong> Whenever the learner chooses – these activities run continuously throughout the Learning Pathway.</td>
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<td>11</td>
<td>Diary</td>
<td>Learners reflect on their learning and on their actual trading. Widgets allow them to capture snapshots of market state, trades and their actions as they apply what they have learned to their trading.</td>
<td>Online diary tool accessed via computer or mobile device</td>
<td>Reflect on experiences of Learning Pathway in conjunction with reflections on own trading practices</td>
<td>Contributes to objectives at all levels.</td>
<td>4. Transfer skills into practice.</td>
<td>Reflective</td>
<td>Learner</td>
<td>EV-6, EV-7</td>
</tr>
<tr>
<td>12</td>
<td>Peer Forum</td>
<td>Learners reflect on experience of Learning Pathway, discussions with other learners, forum moderators seed forum discussions and moderate content</td>
<td>Peer forum accessed via computer or mobile device.</td>
<td>The learner experience of the xDelia Learning Pathway. Peer support</td>
<td>Contributes objectives at all levels</td>
<td>4. Transfer skills into practice.</td>
<td>Collaborative</td>
<td>Modera tors and learner</td>
<td>EV-6.2, EV-7</td>
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</table>
5.3.1 EV-6 Diary evaluation: S-M9 Diary Study

In S-M9 a prototype xDelia diary was trialled in paper form with a cohort of 61 investors as part of the 2-week longitudinal study S-M8. At the end of the initial stage of S-M8 in which private investors completed an ERQ, played the games with sensors, the interoception measure and finally the Two Index game, they were given the diary and asked to record their emotional state as they traded. Following the design of the study, half were asked to fill in a Trading Diary, recording their emotional state before and after trading and its effect on their performance, while the remainder were asked to additionally fill in a Mindfulness Diary recording whether they carried out mindfulness training, and if they applied this to their trading practice. Two versions of the diary were tested, one with mindfulness instructions and a control version without. In the Mindfulness version, pre-formatted pages were provided with check boxes in which investors could record their emotions. At the end of the two weeks, participants were asked to return their completed diaries if they were happy to share this information with us.

5.3.2 Sample and methods

A sample of 68 investors were recruited to take part in S-M8 and S-M9; of these 61 completed both studies. These participants all have experience of real world trading using an online platform and placing their own money at risk. Participants ranged in age from 18 to 77 and varied in trading experience from zero to 15 years, with the majority having traded for between 1 and 7 years.

Participants were invited to attend the final stakeholder workshop, milestone M-6.3, held at Saxo Bank on 15th of May 2012. At this workshop, 34 participants took part in a focus group to gather their views on the diary experience and to give their input on what an online diary should look like.

After the stakeholder workshop, and after all participants had received feedback on their results, a follow up web-survey was administered, with a set of questions relating specifically to their experiences with the diary.

5.3.3 Findings

User Experience Interviews: Prior to the S-M9 study, 90 investors who took part in the day studies at the conferences and those who attended day 1 of S-M8 were asked if they kept a trading diary. The consensus was that a trading diary was important, both for keeping a record of trades in order to track money made and lost, but also for recording a form of snapshot of the state of the market at the time of the trade. Some investors also described using the diary to record how they were feeling:

So I will start with a bad day, or a good day, or felt good today, or some sort of expression on how the experience went just naturally seems to come mind first when I fill in my log. And I guess learning points are probably the next thing I’d write down and just obviously the accounting side, profit or loss, I’ll write that sort of thing down as well. (TE_06)

A number of investors replied that they believed that a trading diary was a valuable tool, however they didn't currently keep one although they felt they ought to,

6 The interoception measure assesses awareness of internal bodily state which is an important prerequisite for emotion regulation.
I have occasionally. I know I should do but I don’t. (UKLNG_08)

Several made the point that they found a trading diary to be a most useful tool when they were losing money and so tended to lose the routine when their trades were doing well:

I used to when I was losing. Since I’m winning I’m not keeping it. I don’t know why. I should keep I think. (UKLNG_20)

it’s whether you keep the routine and then when things start going ... if you’re going through a period where things are going well and you tend to kind of let it slip a bit. (UKLNG_04)

Post-S-M8 User Experience Web Survey: In the web survey administered after the S-M8 study, most participants already kept a trading diary (35% for every trade, and 35% for 4 out of every 5 trades). 15% responded that they believed a diary was important but didn’t keep one at present and 15% said that they didn’t feel the need to keep a trading diary. When asked whether they felt that keeping a trading diary was good practice, 90% responded yes, 10% unsure.

When asked if they had used the xDelia Trading Diary, with its check boxes for recording emotional state before and after trading, 68% had done so, (16% for every trade, 5% for 4 in 5 trades, 16% for approx 2 in 5 trades and 16% intermittently).

The majority of participants were positive about the value of recording emotions in the xDelia Trading Diary, with 67% agreeing that keeping the diary helped them manage their emotions effectively during trading (22% undecided, 11% disagree, 0% strongly disagree). 67% felt that recording their emotional state before and after trading made them aware of their emotions (22% undecided, 11% disagree, 0% strongly disagree) and 50% felt that this emotion awareness during trading helped them make better trading decisions (44% unsure, 6% disagree). Part of the role of the xDelia Trading Diary is as a reflective mechanism, and 67% of participants reviewed their previous diary entries and felt that reviewing their previous diary entries provided insights into the role of their emotions in their trading decisions.

5.3.4 Implications for the design of the Online Diary

The pre-S-M8 interviews and the S-M9 survey responses provided evidence that our diary-based approach to supporting reflection on emotional state during trading was seen as valid by our target stakeholders, and that the support for recording emotions provided in the pilot xDelia diary promoted emotion awareness leading to better trading decisions. The S-M9 focus group, held during the Stakeholder workshop in month 39, allowed us to give our participants the bigger picture of the xDelia research on which these studies were based, and to gather their input on the design of the online diary tool.

All 61 participants in S-M8 were invited to the Saxo Bank final stakeholder workshop (Project milestone M-6.5), and 34 attended. All had used the prototype xDelia diary for 2 weeks during the S-M8 study and their feedback was collected after they had seen the presentations explaining the full context of the xDelia study and the xDelia Learning Pathway. Thus this focus group data gives us a realistic view of our target stakeholders’ perspective.

During the focus group, it emerged that slightly over 50% of the investors in the room kept a trading prior to taking part in the study. They agreed that recording their emotions or feelings at the point they occurred was important as it was easy to forget these later and fail to take them into account
when analysing wins or losses. The example was given of waking up with a hangover and assessing the impact that had had on trading during that day. Approximately one third of those present used their journals to capture emotional aspects of their trading day and felt that it would be useful to use an online trading diary to capture details of their emotional state.

Carrying out a weekly review of their diaries was considered important, and diaries were seen as particularly useful for reflecting on bad trades. This is consistent with the interview responses, which highlighted the fact that a trading diary was often neglected when trading results were good, but used regularly when trading was not going well.

When asked about the design of the online xDelia diary, the majority felt that the previous day’s entries should not be editable, however they felt that it would useful to be able to annotate entries after the event. They also felt that the ability to track transactions against other events (with timestamps) over a long period would be very useful. Some online diaries exist, but the ability to track the state of the market over a period is limited (to a few days).

All participants had played the games with biosensors, and the overwhelming majority (almost 100%) were positive about the idea of integrating the sensor-based physiological feedback into the diary.

Figure 5.1 shows a mock-up of the online diary interface for making entries. Figure 5.2 shows a mock-up of the diary settings page to allow the investor to customise the appearance and widgets displayed in the diary.
It was not possible to evaluate transfer through participation in the online diary and peer forum because these were not implemented at the point the studies took place. However initial findings from the Stakeholder Perspective presented in Section 5.4 suggests that both the forum and the online diary they are seen by investors as valid tools and worthwhile Learning Elements on the xDelia Learning Pathway.

5.4 The Stakeholder Perspective

The preceding sections evaluate the User Experience at the level of the Learning Objectives, Learning Elements and Learning Outcomes. However it is important to listen to the stakeholder voice in order to assess the extent to which the Learning Objectives and Learning Outcomes are relevant to them, and whether the Learning Elements are seen as appropriate mechanisms to achieve these goals. The stakeholder perspective is addressed by the following research question:

RQ4: What are the stakeholders’ perceptions of what xDelia is trying to achieve, and how well does this map onto the partner’s perceptions and to what the project actually achieves?

The early stakeholder interviews were conducted in 2010 and early 2011 as prototypes of the games and methods of collecting emotion arousal data were trialled with private investors. These studies and interviews took place at conferences aimed at both long term investors and private traders, and revealed that not only were investors aware of the impact of emotions on their trading, some also took steps to mitigate that effect:

"I'm a long term trader because I know that I don't let my emotions get tangled up and I would be concerned if I were to do any short term trading that would be a real risk. (T33)"
This comment is typical of many we received in the early interviews which highlighted the difference in perspective between investors who invested money over a longer term, and those who traded in fast-paced markets highlighted through the responses of investors who invested in the longer term. They felt that the xDelia Learning Pathway might be of less relevance to them:

> If you’re taking a medium to long term strategic view of your investments, and you’re investing in a company because you think it’s got a good medium to long term prospect then frankly your attitude over controlling your emotions over a short term don’t really matter quite so much (T43)

However, even at this early prototyping stage, the relevance of the xDelia approach to emotion regulation and the appropriateness of the xDelia Learning Objectives was apparent in the interview responses:

> I am a strong believer in the fact that trading is a very emotional game and you really need to control your emotions well if you want to perform well in trading (T26).

> ...trading today is 10 percent theory, 90 percent is emotional, and any of the successful traders, anyone whose made it big will tell you the same thing. It’s all emotion. (T20)

> This was really, really good, and very well worth coming, almost worth coming today just for the experience I’ve had with this game. (T5)

> I think successful trading is probably about 75% down to emotions rather than strategies, so yes. (F-A_06)

As the project progressed into year 3, and the study participants were recruited from private investors who engaged in fast-paced trading, our approach of diagnosing and addressing the impact of emotion regulation on financial decision-making under stress continued to be seen as relevant by our target stakeholders. The majority felt that their emotions had an impact on their financial decisions (91% agree, 1% disagree)

> I do believe that behaviour is a big, you know, your personal behaviour has a big impact on your trading decisions, right. So it would help control the impulses I think when you have. (TE_09).

> That’s why my focus is more towards emotions and improving performance. (UKLNG_66).

### 5.4.1 Managing Emotions

As we moved into the longitudinal year 3 studies (S-M1/2 & S-M8) with investors who specialised in trading rather than long term investing, we administered surveys to participants who took part in each study. The survey response showed a high level of support for our approach; most expected that playing the xDelia games could help them learn to manage their emotions (94% agree, 1% disagree). However opinion was more evenly divided as to whether managing emotions would lead to making better trading decisions (43% agree, 36% disagree).

The response to the question I believe that I will make better trading decisions if I can manage my emotions varied according to the study the investor had taken part in. Those who had taken part in the Camden study, S-M8 believed overwhelmingly that they would make better trading decisions if they could manage their emotions (98% agree, 0% disagree). However opinion was more evenly divided as to whether managing emotions would lead to making better trading decisions (43% agree, 36% disagree).

> It’s simply because I believe that managing my emotions and my emotional decisions, not necessarily action, but my decision and thought processes will lead me to make better decisions in trading. (UKLNG_64)

Subsequently, keeping the emotion diary before and each trade encouraged awareness of the affect their emotions might having and provided a record which they could later review and reflect upon.
Their response contrasted with that of the Saxo investors to the statement *I believe that I will make better trading decisions if I can manage my emotions* (15% agree, 55% disagree).

A plausible reason for this is the fact that the Saxo Study participants were not exposed to the games that incorporated physiological feedback, and thus did not experience the impact of their arousal on their performance in the game. In the Camden study, the day 1 session involved the investors playing the sensor-based games (AUC-DIAG and SI-DIAG) and the TIG-DIAG. The Camden investors therefore saw on day 1 how their emotional arousal affected their game play:

> At one time when I tried to keep up, every time I tried to keep up with it, I think I wasn’t controlling my emotions, it became very difficult to control. So I think it’s a good game, to, you know, if you were to practice how to control emotions, that one is a brilliant game. (UKLNG_60)

This immediate physiological feedback as they played the games demonstrated the effect of their emotional arousal on their performance and helped convince the Camden Study investors that they could improve their trading performance if they could better manage their emotional responses.

By contrast, although the Saxo investors experienced the diagnostic Learning Elements (ERQ, analysis of actual DE and then TIG-DIAG), they did not have access to the sensor-based games which would give them real-time feedback on the way their emotional state was affecting their performance. The Saxo investors, although aware of the impact of emotions, had not had the same level of personal experience of this through the sensor-based games, and were therefore more sceptical about whether managing their emotions would have an effect on their trading decisions.

This difference in the response to the statement *I believe that I will make better trading decisions if I can manage my emotions*, suggests that the physiological feedback built into the games was both a realistic and effective demonstration of the impact of emotions on decision making.

We found that the reactions of investors to the games we trialled with them was generally positive:

> I think it was amazing experience. Not only for learning purposes but to see how emotions work while playing those games.

Several investors returned on multiple occasions to take part in the studies at conferences because they wanted to remain involved with the developing approach. Trader UKLNG_31 in the Camden S-M8 study had already taken part in two previous games trials at conferences:

> for whatever reason I enjoyed the auction game the most probably because I’ve done the previous two before at some of your Forex events, but I just enjoyed that, and also it kind of relates to some knowledge I have of, you know there’s certain options traders at some kind of companies and they’re sort of renowned for being able to these very fast mental calculations, and then making split second, micro second decisions on those. (UKLNG_31)

This reaction was not untypical as even investors who merely paused by the trade stand were interested and engaged. As the project progressed through year 3, and as more interviews were conducted with investors, it emerged that although they felt that specific emotional biases, such as the Disposition Effect, were worthwhile targets for our learning intervention, an area of key importance to investors was to be able to develop techniques that would help them stick to their chosen trading strategy even when under stress.

> I would probably improve my system by a trading journal and recording why I’ve taken trades so I’d have a specific plan in place and made sure I’ve stuck to the plan. And if I haven’t stuck to the plan, why I haven’t stuck to the plan [...] and then things like this for the emotion side of things, as well. (UKLNG_66)

This points to a productive area for future development of the xDelia Learning Pathway, as investors frequently mentioned problems, not in formulating a trading strategy, but in sticking to that strategy when things began to go wrong.
5.4.2 The xDelia approach

Among our target stakeholder group of private investors, the xDelia approach to helping them understand and manage the impact that their emotional reactions have on their trading decisions was seen as both valid and useful and the following quotes are typical of the positive feedback we received after the S-M8 longitudinal study in Camden:

I get twenty or more emails each week offering trading systems or training. Yours just stood out as something completely different and I am so glad that I took up the opportunity.

I just want to say thank you so much for including me in this study. It has really been quite inspirational. I have so much to reflect on about how I manage my emotions whilst trading, I am sure it will improve my ability to stay focused on my strategy.

However no approach works equally well for all learners.

5.4.3 Limitations to a Game-Based Approach

Reactions to the xDelia Learning Pathway from our target learners, private investors, has been overwhelmingly positive. However there are limitations to a games-based approach to Skill Development. There was a noticeable difference in how well investors engaged with and performed at the games, particularly the SI game which has no financial authenticity. Although most found the SI game easy to understand (89% agree, 5% disagree) those who disagreed found it confusing:

Well the whole thing was a bit of a mystery to me. I’d never played it before so it was completely new to me. I wasn’t quite sure what to expect. What I found was when they said about choosing your weapons that I couldn’t choose any weapons, it kept on telling me, you know, I didn’t have enough points or something. So I didn’t really understand what that was all about [...] the instructions weren’t very clear at all. (TE_01)

Some others found it frustrating: Asteroid one, computer games, I don’t actually play so that harassed me a little bit, or got me stressed out. and a number of the investors felt that lack of experience with games was a barrier to engagement:

Yeah. I can imagine my grandchildren playing them have no trouble at all, you know, whereas ... I’ve never sat down ... I’ve heard about these games they play but I’ve never done them before. (UKLNG_19)

5.5 M6.5 Stakeholder Workshop

An important mechanism for obtaining the stakeholder perspective on the year 3 achievements of the xDelia project has been M6.5 Stakeholder Workshop held in M39. At this workshop, investors who had taken part in the longitudinal S-M8 study, where they engaged with the Level 1: Diagnosis and Feedback stage and also with elements of the Level 2: Skill Development stage, were given the opportunity to share their views on the project. However in contrast to the interviews conducted as part of EV-1, in which stakeholders completed the ERQ, played the games and were then interviewed immediately afterwards, stakeholders at the workshop were given two presentations and invited to voice their opinions both during the presentations and afterwards.

In the first presentation, Professor Mark Fenton-O’Creevy explained the background, aims, research and findings from WP2 studies to give a context for the project. In the second presentation by Jeffrey Todd-Lins, Head of Research at Saxo Bank, he outlined the Saxo bank implementation of the xDelia Learning Pathway some early indications from the Bank’s research, and an overview of their plans for future implementation of the xDelia Learning Pathway.
These workshop attendees therefore had a much more complete overview on the xDelia project than the interviewees. Data were collected through electronic notes taken during the presentations, followed by participant observations during the focus group discussions.

5.5.1 Mindfulness as an Emotion Regulation Technique

Attendees reported a learning curve involved in practising mindfulness. When they started the Camden study, S-M8, they found that practicing the 15 min mindfulness each day made them more aware of the role emotions played in their trading decisions. However, this initial awareness had a negative effect on their trading. Those that persisted with the training said that it eventually helped them to stay on track; to stick to their trading strategy, but that this skill took time to develop. One attendee said that mindfulness had made him aware how angry he was when he was trading and by becoming aware of this he was able to stop this anger from having a negative effect on his trading decisions. Another attendee said that he made it a practice to carry out the 15 minutes of mindfulness before each trading day and planned to continue with the exercises because of the positive impact it was having on his ability to stick to his strategy. This suggests that Mindfulness was useful in helping investors sticking to their planned trading strategy, a difficulty that had been reported earlier in Section 5.4.2

One investor said that he had not practiced mindfulness before, but felt that having done so during the Camden study he was utterly convinced by its usefulness; that it had helped him to be in the moment whilst trading, and that it had made his trading more enjoyable experience. He therefore planned to continue the practice.

Another focus group attendee reported that the 15 minutes of mindfulness exercises definitely made him more aware of his emotions, so much so that it began to interfere with his trading. In response, he stopped carrying out the exercises but started to seek out peaceful locations where he could trade. Apparently this significantly helped his trading and made it a lot easier to stick to his trading strategy.

Another investor was very enthusiastic about the experience of having passed through the 15 minutes per day mindfulness exercises. He too reported experiencing initial negative effects that becoming more aware of his emotions interfered with his trading, however he found that by persisting with the exercises he soon saw the benefits. He also said that he had been able to incorporate the practice into his trading. He explained that when he became more aware that his emotions were getting the better of him he would pass his hand in front of his face as he would tell himself to manage his emotions. He said that this had really helped him to stick to his strategy.

One investor reported:

I have been doing mindfulness for a while and at first it was making it harder to focus on my trading. Then I realised that when I am trading it is not about bringing my attention back to my breath but bringing it back to the trade and my planned strategy.

The focus group consensus was that practising mindfulness and sticking with it despite the initial negative effects brought benefits, which translated into better trading decisions and a strengthened ability to stick to their chosen trading strategy.
5.5.2 Online Diary

The mindfulness diary was reported to be very useful, particularly the emoticons to indicate emotional state. One investor said that he took a copy of the diary he was provided with and intends to continue to use it.

One attendee already kept a diary assiduously, and pointed out that this could take up to an hour per day to do properly but was really worthwhile. Any diary support that would automate the process of keeping comprehensive records of both the state of the market at the time of trade and details of your emotions would be a real time saver.

A second attendee said that he didn’t keep a diary because he had no time being too busy, either trading at his workplace (trading is not his job) or at home where the children were a distraction. Another said that he hadn’t been keeping a diary but after this presentation and seeing the evidence of its benefit to other attendees in the focus group, he was convinced by the value of keeping one. This suggests that the influence of peers going through the same Learning Pathway may be supportive, and such peer support is planned through the Peer Forum.

One attendee noted that they looked over previous diary entries and reflected upon them to help better understand their practice. More than one attendee admitted that they were not very good at keeping diaries but felt they should as they saw the value in reflecting on prior practice to help improve. This corresponded to the post-Camden survey responses to the question "Did you keep a trading diary before joining the study", in which 35% kept a regular diary for every trade, 35% for most (4 out of 5) trades, 15% believed that a diary was important but didn't keep one at present and 15% didn't keep a diary. However in response to the question "Do you think keeping a trading diary is important", 90% felt that it was important.

Some attendees gave a mixed response to the usefulness of the prototype xDelia diary because many of the investors said they had not been actively trading. One said that he had always tried to keep a diary in the past but was never disciplined enough to do so. However, having taken part in the two week study he could now see the benefits of writing down his thoughts and planned to incorporate the diary into his future trading.

When asked their views on the planned xDelia online diary, many of the attendees said that they knew of existing online diaries that offered the ability to record thoughts, emotions etc on the go and then to see what the market was doing (or what they were trading) at the time that they made the diary entry. It seemed like the biggest barrier to the diary was the time that it would take from their trading. Most people liked the idea of having a drop down menu of emotions but often questioned the value of having too many categories.

Keeping a diary on this study has been really interesting and I am sure keeping track of emotions has value. However, I have used a diary for periods before. Each time I have given up as the effort of keeping a detailed log of each trade and what is going on has become too much. I know I will only succeed with keeping a trading diary if logging information is really quick and simple.

When the xDelia plans for developing the online diary tool further at Saxo Bank were outlined to the above attendee, he added:

Yes that is exactly it. If capturing my positions and market action around that time is automated and I just have to click a button to mark a point I want to reflect on or click an emotional state button then I am much more likely to stick with it. It is also really important that when I want to go back and reflect that drilling down to what went on is really easy.
5.5.3 Sensor-based games

Reactions to the sensor-based games at the stakeholder meeting varied according to whether the trader was an experienced games player or not. Investors who were frequent game players noted it was not challenging compared to the normal games they played. One said that the sensor-based games did not affect his arousal because he was an experienced game-player and accustomed to much more arousing games.

Older investors tended to be less frequent game players. Those who were not game-players reported that they found it difficult to get to grips with the Space Investor (SI) (1st person shooter) game and the Auction game. The researchers when running the studies noted that younger participants were generally more at ease with the concept of playing Space Investor as a game. It was clear that some older investors were not as comfortable with the concept and found the twitch reaction that the SI game requires harder to master.

Many of the investors reported that the SI interface needs to be developed and is not sufficiently functional. For example, the neon blue lettering used to indicate ‘action’ text that participants can click on to move the game on, is also used for ‘non-action’ static text. This resulted in many players repeatedly clicking on text that would not perform any action, and the researcher had to intervene to help them move the game forwards.

Several investors were enthusiastic about the games and asked if the SI and AUC games could be made available to download so they could continue to practice at home. At this stage in the development of the xDelia Learning Pathway, the need for the sensor input made this impossible, although more affordable sensors might make this a possibility in the future. Attendees were very interested in this possibility.

5.5.4 Two Index game

Varied responses were noted during the studies. Because the TIG was closer to an authentic financial tool, investors seemed to respond to it more critically, in particular in their judgement as to whether it matched their experience of trading. For example, a couple of investors noted that it was nothing like the kind of trading they did so they couldn't really understand it. In some ways a number of participants were more accepting of the SI and AUC games as they bore less resemblance to a real trading task, although this may be a reflection on how the experimenters introduced the tool.

The majority of focus group attendees said they had really enjoyed playing the TIG and were looking forward to continuing to play it after the Canary Wharf event (Final Stakeholder Workshop). The didactic version with the live feedback (red-green dial with arrow) was demonstrated during the presentations. One investor at the focus group was invited up to play it and the screen displayed to the entire room with the live DE effect dial visible. The attendees were enthusiastic and noted their wish to have the option to play this version asking if and when it would be made available.

5.5.5 Peer Forum

The focus group attendees could see value in an xDelia Peer Forum. One investor elaborated at length about a closed forum that he had joined. He said he could not overestimate the importance this closed forum had for him. He described how trading was an essentially solitary activity so some
form of social space was nice. He found that totally open forums were often used for bragging and felt that he could not really rely on the information people wrote because he lacked any confidence in the reliability or credibility of the poster. However in the private forum, he had developed a sense of community with the other members. He felt he could discuss his reactions to the market conditions openly, without fear of flaming or harsh responses. He cited an instance where the members of the forum were discussing particularly volatile market conditions that day, and some were considering trading whereas others were reluctant. There were some very experienced investors on the forum whose opinions the other members respected. One of these posted that in his experience it was too dangerous to enter the market in these conditions and it was better to sit on your hands. The less experienced forum members, including the focus group attendee, found this advice very helpful and indeed it proved to be useful and good advice.

Thus, some investors feel that a closed peer forum can provide a safe and supportive environment in which to discuss the markets as well as an important social aspect that is otherwise missing.

Evaluation plans and a wireframe design for a peer forum were put in place, but not implemented within the timescales of the project. Appendix 12 describes this work.

5.6 Conclusion

D20-6.3.3 has focused on collecting data from our target stakeholders, private investors, to evaluate the successfullness of the xDelia Learning Pathway and the validity of the xDelia approach by answering four Research Questions:

RQ1. What pedagogies are being used in the project, and how are they represented?

RQ2. How can Learning Design represent the Learning Objectives and Learning Outcomes of the xDelia Learning Pathway?

RQ3. How are the design principles associated with the games translated into tangible Learning Outcomes?

RQ4. What are the stakeholders perceptions of what xDelia is trying to achieve, and how well does this map onto the partner’s perceptions and to what the project actually achieves?

Section 2 xDelia Learning Pathway Overview, addressed RQ1. What pedagogies are being used in the project, and how are they represented? expressing the pedagogical approach of dialogic, reflective learning constructed from a series of Learning Elements that guide each investor along his or her optimum Learning Pathway. Learning Elements include questionnaires, games, computer program, mobile app, online diary and peer forum which investors can engage with whenever and as often as they like, motivating them to develop and practise ER skills.

This pedagogic approach is visualised in Section 3 through a set of Conceptual Design Views which articulate the pedagogy underpinning the xDelia Learning Pathway in an explicit and shareable visualisation in answer to RQ2. How can Learning Design represent the Learning Objectives and Learning Outcomes of the xDelia Learning Pathway? The views illustrate the mapping between the Learning Objective, Learning Elements and Learning Outcomes as investors take part in as they travel along the xDelia Learning Pathway.

In Section 5 the user experience of the xDelia Learning Pathway is evaluated at the level of the Learning Elements both individually and in combination as they were trialled during the studies, and at the level of the Learning Outcomes to answer RQ3: How are the design principles associated with the games translated into tangible Learning Outcomes?
Four Learning Outcomes are targeted by the xDelia Learning Pathway:

**Learning Outcome 1:** Understand the disposition effect (DE) and emotional regulation (ER).
**Learning Outcome 2:** Improve awareness of personal profile in relation to DE & ER.
**Learning Outcome 3:** Develop skills in relation to DE & ER in a learning environment.
**Learning Outcome 4:** Transfer skills into practice.

The evaluation of Learning Outcome 1 and Learning Outcome 2 was built around studies S-M1/2 and S-M8. The findings were positive in that investors found that completing the ERQ and receiving personalized video feedback on their ER and DE gave them an increased awareness of their own emotion regulation strategies. This information was not only informative, but the act of completing the ERQ triggered reflection on how they responded to stressful situations and this, in turn, affected the way they approached the game play. Investors were more conscious of their emotional responses to the game. However, the effect of this increased awareness of their ER tended to slip away as the game-play became more challenging, i.e. simply making investors aware of their ER approach or DE score is not sufficient to improve reactions under stress. Some form of skill development is needed.

The Learning Elements designed to help investors develop emotion regulation skills are the **Mindfulness App** and the **Mindfulness Game**. Mindfulness emerged as a valid technique for ER, both as a result of the MF research studies conducted in year 2 and year 3 of the project, and from comments made by investors during the interviews. Many shared the fact that they already did regular meditation in order to improve their emotional control during trading, and they were receptive to the suggestion of providing tools (mindfulness app and computer game) to support their practice.

The Mindfulness App and Mindfulness Game were not evaluated with investors as they were not available at the time of the study. However, in order to test the effect of mindfulness training and practice, we built a **prototype paper diary** into study S-M8. This diary included mindfulness instructions and sheets for recording mindfulness practice. The diary proved popular and effective, with the majority of participants planning to continue with the mindfulness practice post-study because they found it useful. There was some uncertainty about whether or not mindfulness led to better trading decisions, but this may reflect the short duration of the S-M8 study (2 weeks) which did not really give enough time for investors to notice improvements.

The Learning Elements designed to foster skill development (Learning Outcome 3) in relation to ER and DE include the SI, AUC and TIG.

In S-M1/2, which trialled the Diagnosis and Feedback stage of the xDelia Learning pathway alongside the TIG with participants drawn from clients of Saxo Bank, we were able to measure disposition effect using actual trading data. Evidence of a reduction in DE after training was found in those who took part in the study compared to a comparison group who did not take part in the study. Further research over longer timeframes and incorporating more of the xDelia Learning Elements is needed to confirm these findings, but the initial results are encouraging.

Initial findings from S-M8 which trialled the AUC and the SI suggest that these games were effective as mechanisms for developing and practising skills in ER. They were not equally suited to all investors, with those at both ends of the games experience scale (very little experience, or a lot of games experience) reporting that the games were either too difficult to play or not difficult enough. The majority of investors who played the games enjoyed them and felt that they were a valid tool for improving their ER skills. They also gave us a great deal of helpful feedback and suggestions for improvement which can be incorporated in future iterations of the games.

Although the online version of the xDelia diary was not implemented, we were able to explore the concept through the paper prototype diary trialled in S-M8. The investors taking part in the study...
used the diary and agreed that it provided a good tool for reflection, particularly with regard to recording their emotional state before and after trades. Once the rationale behind the online diary was explained, investors responded to the plans for the online implementation with many helpful suggestions including:

- Snapshots of state-of-market associated with posts
- Automation of elements of diary entry making to speed the process of diary keeping
- Ability to track transactions against other events (with timestamps) over a long period

A wire-frame model for the online diary has been produced (shown in Section 5.3.4 which demonstrates how these elements might be incorporated into the final implementation of the xDelia Online Diary).

Throughout, the stakeholder perspective has been sought through interviews, surveys and ultimately, the M6.5 Stakeholder Workshop at which investors from the S-M8 study at Camden had the opportunity to give their feedback after having taken part in the study and listened to a detailed description of the project with the opportunity to ask questions. This has provided strong support for the xDelia approach by answering RQ4. What are the stakeholders’ perceptions of what xDelia is trying to achieve, and how well does this map onto the partner’s perceptions and to what the project actually achieves?

The overall response from investors is that emotions are at the heart of trading decisions, and they believe that the xDelia Learning Pathway has the potential to improve emotion regulation and thereby improve their financial decision making under pressure. This alignment between stakeholder perceptions and xDelia project goals is illustrated by the following interview quote:

> How one can use one’s mind psychological control one’s emotions which is very important when doing anything really. Because it’s having the wrong sort of emotional resource state and things like that that can make one trade or perform badly in something of a negative resource state then obviously one can perform worse if one has a positive resource state obviously one performs better (TE_15)

This stakeholder perspective provides compelling support for the xDelia approach to emotion regulation through the xDelia Learning Pathway. This support is exemplified by an email from a trader who had taken part in two xDelia Game trials at the Traders Expo conference in 2011 and at the Forex conference in 2012, and was disappointed to be unable to participate in the Camden S-M8 study:

> I am a big supporter of your research project. Through this type simulation and gaming is where my true colors as trader come up. The feedback you give is very valuable because are things we can’t measure ourselves (e.g. stress levels). When I am trading I have tunnel vision, I am unable to notice my body “indicators” heartbeat and breathing. Please keep me in your database for the next round of studies. (T24 in Traders Expo 2011, FA_13 in Forex Conference 2012)

### 5.7 Future Work

It was never anticipated that the full xDelia Learning Pathway be completed within the lifespan of the project. Those elements that have been implemented and tested have provided encouraging results. Future work, and effort which is planned at Saxo Bank, involves implementation and evaluation of the remaining Learning Elements of the Pathway.

These include the TIG-DIDAC, the xDelia Peer Forum and the Online Diary. The xDelia peer forum was not planned to be fully implemented in the 3-year duration of the project. However evaluation plans have been put in place for evaluating the peer forum once it is running, outlined in Appendix G.
The design for the online diary has been put together with input from our target stakeholder (outlined in Section 5.5.4 The overall response from investors both during the interviews and during the final M6.5 Stakeholder workshop was that an online diary tool would be a useful Learning Element to support reflection as they journey along the xDelia Learning Pathway. Further evaluation of the impact of the online version of the diary needs to be carried out in order to assess its effectiveness and improve its functionality.

Once the full xDelia Learning Pathway has been put in place, a detailed evaluation at the level of the joint effects of the Learning Elements should be conducted to collect data at the level of actual effects, i.e. improvements in trading behaviour, as a result of the learning journey. In addition, the effectiveness of the Mindfulness Learning Elements and evidence of transfer from the learning environment to the trading environment needs to be evaluated over a longer period both at the level of self-report and of effects.
# 6 Appendix A: Studies Overview

Appendix A contains brief summaries of the studies conducted during year 3. Please refer to D9-2.3.3 for more detail on the WP2 studies.

## 6.1 Overview of Evaluation Studies

This data has been collected as part of the WP6 evaluation studies which are listed below:

<table>
<thead>
<tr>
<th>EVALUATION STUDIES (INVESTOR EXPERIENCE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EV-1</strong> Investor interviews</td>
</tr>
<tr>
<td>A series of interviews conducted between November 2010 and May 2012 with investors who took part in our studies. Guided by the design and evaluation (D&amp;E) framework, the aim of the interviews was to obtain stakeholder feedback on the xDelia games, and channel it into future development work. The interviews were also used to gather feedback on the stakeholder perspective of the xDelia approach.</td>
</tr>
<tr>
<td><strong>EV-3</strong> User experience evaluation surveys</td>
</tr>
<tr>
<td>These studies evaluated investor experience of learning elements for <strong>skill development</strong>. Evaluation surveys were administered to investors both at the single-day conference data collection events S-M8(a) &amp; S-M8(b), at the end of study S-M1/2 and both at the start and end of the longitudinal study S-M8. These surveys were typically followed by an interview.</td>
</tr>
<tr>
<td><strong>EV-4</strong> Evaluation of feedback trials</td>
</tr>
<tr>
<td>These studies evaluated investor experience of learning elements for <strong>diagnosis and feedback</strong>. These include the diagnostic emotion regulation questionnaire and the personalised feedback on their habitual emotion regulation strategies; the automated calculation of their disposition effect based on past trading history and the personalised feedback on this; and the two index game as a diagnostic tool for the disposition effect. These evaluations were conducted during the S-M1/2 and the S-M8 studies. In addition, we conducted follow on telephone and email interviews.</td>
</tr>
<tr>
<td><strong>EV-6</strong> Diary evaluation</td>
</tr>
<tr>
<td>These studies evaluated investor experience of learning elements for <strong>learning transfer</strong>. Several diary evaluation studies were conducted during S-M8 and S-M9. During S-M8 Camden Longitudinal study with private investors, a prototype mindfulness diary was trialled (S-M9). Feedback was collected on the usefulness through interviews, Final Stakeholder Workshop and the post-study user experience survey.</td>
</tr>
<tr>
<td><strong>EV-7</strong> Evaluation of the overall learning intervention</td>
</tr>
</tbody>
</table>
| Stakeholder perceptions of the usefulness of the approach have been collected as part of the evaluations of the separate elements. The early stakeholder interviews were conducted in 2010 and early 2011 as prototypes of the games and methods of collecting emotion arousal data were trialled with private investors. These studies and interviews took place at conferences aimed at both long term investors and private traders. As we moved into the longitudinal year 3 studies (S-M1/2 & S-M8) with investors who specialised in trading rather than long term investing, we administered surveys to participants who took part in each study. An important mechanism for obtaining the
stakeholder perspective on the year 3 achievements of the xDelia project has been the Final Stakeholder Workshop held in month 39.

- **EV-1 Investor interviews**
  - A series of interviews conducted with investors who have taken part in our studies.

- **EV-3 Games evaluation conducted during S-M8(a), S-M8(b) & S-M8. Learning context #2 in Table 5-2 – M3 Framework for Evaluating Level 2 Learning Objective: Skill Development**
  - Local evaluations of the games with student populations have been supplemented by the WP6 evaluations conducted with investors.

- **EV-4 & EV-5 Evaluation of S-M1 and S-M2 Investor Feedback trials conducted at Saxo Bank. Learning Context #1 in Table 5-1 – M3 Framework for Evaluating Level 1 Learning objectives: Diagnosis and Feedback**
  - A specific survey instrument was designed to gather feedback on the user experience from S-M1 and S-M2 studies with private trader clients of Saxo Bank.
  - In addition, follow on telephone and email interviews were conducted.

- **EV-6 Diary evaluation conducted during S-M8 & S-M9 Evaluation Learning context #3 in Table 5-3 – M3 Framework for Evaluating Level 3 Learning Objective: Transfer**
  - During S-M8 Camden Longitudinal study with private investors, a prototype mindfulness diary was trialled (S-M9). Feedback was collected on the usefulness through interviews, Stakeholder workshop M-6.3 and the post-study user experience survey.

- **EV-7 Evaluation of the overall Learning Intervention.**
  - Full implementation of the entire xDelia Learning Pathway was not planned within the 3-year timescale, therefore stakeholder perceptions of the usefulness of the approach have been collected as part of the evaluations of the separate elements.
6.2 Summary of Year 3 Studies

This section summarises the local studies conducted by the xDelia Partners. Table 6-1 – Year 3 Studies and Workshop Timeline shows how the studies link together across the final year of the project.

Table 6-1 – Year 3 Studies and Workshop Timeline

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Workshops Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Lab-based study</td>
<td>i) Prototype development workshop</td>
</tr>
<tr>
<td>2) Field study</td>
<td></td>
</tr>
<tr>
<td>3) Evaluation study</td>
<td></td>
</tr>
</tbody>
</table>

The following sub-sections summarise these studies.
6.2.1 MF-2 Second Mindfulness study

<table>
<thead>
<tr>
<th>Evaluation Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
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<tr>
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<tr>
<td>Institution Name</td>
</tr>
<tr>
<td>Work Package(s)</td>
</tr>
<tr>
<td>Contact</td>
</tr>
<tr>
<td>Planned start &amp; end date</td>
</tr>
<tr>
<td>Actual start &amp; end date</td>
</tr>
<tr>
<td>Aims</td>
</tr>
<tr>
<td>Link to past studies</td>
</tr>
<tr>
<td>Link to future studies or anticipated outcomes</td>
</tr>
<tr>
<td>Methods</td>
</tr>
<tr>
<td>Number of subjects</td>
</tr>
<tr>
<td>Background of subjects</td>
</tr>
<tr>
<td>Duration of intervention</td>
</tr>
<tr>
<td>Type of intervention</td>
</tr>
<tr>
<td>Reports available</td>
</tr>
<tr>
<td>Status of analysis</td>
</tr>
<tr>
<td>Summary of findings</td>
</tr>
</tbody>
</table>
6.2.2 Traders Expo EUR Study

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<thead>
<tr>
<th>ID</th>
<th>Trader Expo (no ID)</th>
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<tbody>
<tr>
<td>Title</td>
<td>Testing the Two Index Game (TIG) and effects of a mindfulness instruction in a cohort of day traders.</td>
</tr>
<tr>
<td>Institution Name</td>
<td>EUR</td>
</tr>
<tr>
<td>Work Package(s)</td>
<td>WP2</td>
</tr>
<tr>
<td>Contact</td>
<td>M. van Overveld</td>
</tr>
<tr>
<td>Planned start &amp; end date</td>
<td>April 2011</td>
</tr>
<tr>
<td>Actual start &amp; end date</td>
<td>April 2011</td>
</tr>
<tr>
<td>Aims</td>
<td>The main goal was to test the TIG in a sample of investors. The second goal was to test a mindfulness instruction on performance in the TIG</td>
</tr>
<tr>
<td>Link to past studies</td>
<td>MF1, MF2, Calibration TIG</td>
</tr>
<tr>
<td>Link to future studies or anticipated outcomes</td>
<td>S-M3, S-M7</td>
</tr>
<tr>
<td>Methods</td>
<td>Participants received an instruction (mindful/control) that they should perform when playing the game. Then, they played the TIG, followed by a set of surveys.</td>
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<tr>
<td>Number of subjects</td>
<td>47</td>
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<tr>
<td>Background of subjects</td>
<td>Day traders</td>
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<tr>
<td>Duration of intervention</td>
<td>Approx one hour</td>
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<tr>
<td>Type of intervention</td>
<td>Mindfulness instruction / control instruction</td>
</tr>
<tr>
<td>Reports available</td>
<td>A summary on the main findings is circulated internally at EUR. The main results are likely to be combined with the other mindfulness studies in one high impact paper.</td>
</tr>
<tr>
<td>Status of analysis</td>
<td>Complete</td>
</tr>
<tr>
<td>Summary of findings</td>
<td>Mindfulness manipulation was unrelated to DE coefficient, suggesting that mindfulness influences other beneficial aspects of decision-making besides the DE. More decision-making parameters should be extracted from the Index Game.</td>
</tr>
</tbody>
</table>
### 6.2.3 Mindfulness Workshop

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<tr>
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<td>Contact</td>
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<td>Actual start &amp; end date</td>
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<tr>
<td>Aims</td>
</tr>
<tr>
<td>Link to past studies</td>
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<tr>
<td>Link to future studies or anticipated outcomes</td>
</tr>
<tr>
<td>Methods</td>
</tr>
<tr>
<td>Number of subjects</td>
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<tr>
<td>Background of subjects</td>
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<tr>
<td>Duration of intervention</td>
</tr>
<tr>
<td>Type of intervention</td>
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<tr>
<td>Reports available</td>
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<tr>
<td>Status of analysis</td>
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<tr>
<td>Summary of findings</td>
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## 6.2.4 Calibrating the Two Index Game

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<td><strong>Actual start &amp; end date</strong></td>
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<td><strong>Aims</strong></td>
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<tr>
<td><strong>Link to future studies or anticipated outcomes</strong></td>
</tr>
<tr>
<td><strong>Methods</strong></td>
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<td><strong>Background of subjects</strong></td>
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<tr>
<td><strong>Duration of intervention</strong></td>
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<td><strong>Type of intervention</strong></td>
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<tr>
<td><strong>Reports available</strong></td>
</tr>
<tr>
<td><strong>Status of analysis</strong></td>
</tr>
<tr>
<td><strong>Summary of findings</strong></td>
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</table>
6.2.5 S-M1 - Investor Feedback Trial A

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<td>Link to past studies</td>
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<tr>
<td>Link to future studies or anticipated outcomes</td>
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<tr>
<td>Methods</td>
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<td>Number of subjects</td>
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<td>Duration of intervention</td>
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<td>Type of intervention</td>
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<tr>
<td>Reports available</td>
</tr>
<tr>
<td>Status of analysis</td>
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</tbody>
</table>
| Summary of findings | Significantly, a disposition effect score in the Two Index Game shows a significant association with a disposition effect score in real world trading. This finding is especially notable since we know from prior work that disposition effect can be highly influenced by context. Particular implications include:-  
  - Strong support for the view that the disposition effect is underpinned by individual characteristics as well as trading context.  
  - Support for the value of the TIG as a diagnostic tool and training environment for addressing the disposition effect.  
We also found a relationship in the Two Index Game gameplay between disposition effect and lower game profits, consistent with our expectation that when trading on the basis of some level of information a disposition effect reduces average trading performance. |

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### 6.2.6 S-M2 - Investor Feedback Trial B

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<th>Evaluation Data</th>
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<tr>
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<td><strong>Actual start &amp; end date</strong></td>
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<td><strong>Aims</strong></td>
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<td><strong>Number of subjects</strong></td>
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<td><strong>Background of subjects</strong></td>
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<td><strong>Reports available</strong></td>
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<tr>
<td><strong>Status of analysis</strong></td>
</tr>
<tr>
<td>Summary of findings</td>
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<tr>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>A key finding is that a DE score in the Two Index Game shows a significant association with a DE score in real world trading. DE scores in actual trading and in the Two Index game show a significant correlation (0.28, p&lt;.05). When we use the TIG DE score to predict whether or not participants show a DE in their real world trading (based on binary logistic regression), the TIG score correctly classifies 67% of participants.</td>
</tr>
</tbody>
</table>

This finding is especially notable since we know from prior work that DE can be highly influenced by context. Participants were, in their real world trading, trading a wide range of different assets and facing dissimilar and changing market conditions. That we find a relationship between a game based measure (where the only incentive is a desire to get a high score) and a real world trading context with significant sums of money at stake is highly notable. Particular implications include:

- Strong support for the view that the DE is underpinned by individual characteristics as well as trading context.
- Support for the value of the TIG as a diagnostic tool and training environment for addressing the DE.

We also found a relationship in the Two Index Game gameplay between DE and lower game profits, consistent with our expectation that when trading on the basis of some level of information a DE reduces average trading performance.

The group who went on to complete the Two Index game were also mostly positive about the experience. They felt it was fun (69% agree, 12% disagree); very few felt it was boring (4%) and most thought that the Two Index game was likely, in combination with other Learning Elements, to help them learn to reduce their DE when trading in the real world (58% agree, 8% disagree).
6.2.7 S-M3 Emotion regulation training by means of an arousal-based aiming game

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<tbody>
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<td>ID</td>
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<td>Aims</td>
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<td>Link to future studies or anticipated outcomes</td>
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<td>Methods</td>
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<td>Number of subjects</td>
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<td>Summary of findings</td>
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6.2.8 S-M4 Improvement of Emotion Regulation by playing the Auction Game V2

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<tr>
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<td>Calibration of Auction Game (Emotion Regulation)</td>
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<td>FZI-IPE</td>
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<tr>
<td>Work Package(s)</td>
<td>WP 2</td>
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<tr>
<td>Contact</td>
<td>Philipp Astor</td>
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<tr>
<td>Planned start &amp; end date</td>
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<tr>
<td>Aims</td>
<td>Calibration of the Auction Game (ER) and test whether the Auction Game is valid to help arousal-regulation. Give feedback to BTH in case last modifications need to be done. Check whether arousal increases game difficulty. Control group will receive no feedback information on the emotional state.</td>
</tr>
<tr>
<td>Link to past studies</td>
<td>IS1 and IS2</td>
</tr>
<tr>
<td>Link to future studies or anticipated outcomes</td>
<td>S-M5, S-M6</td>
</tr>
<tr>
<td>Methods</td>
<td>Participants play the AUC-DIAG. One group receives constant feedback on their emotional state. Subjects state from level to level their state of arousal. Afterwards subjects receive a questionnaire to state which strategies they used to regulate their emotions.</td>
</tr>
<tr>
<td>Number of subjects</td>
<td>36 participants in part 1, 68 participants in part 2</td>
</tr>
<tr>
<td>Background of subjects</td>
<td>Mostly business students.</td>
</tr>
<tr>
<td>Duration of intervention</td>
<td>The game is the complete intervention</td>
</tr>
<tr>
<td>Type of intervention</td>
<td>Playing the game in order to 1.) become aware of own level of arousal and 2.) controlling own level of arousal.</td>
</tr>
<tr>
<td>Reports available</td>
<td>Reported in more detail in Deliverable D9-2.3.3</td>
</tr>
<tr>
<td>Status of analysis</td>
<td>Complete</td>
</tr>
<tr>
<td>Summary of findings</td>
<td>The Auction Game ER rewards active down-regulation of high levels of arousal and provides a learning environment in which emotion regulation can be practiced and rewarded. Moreover, the results show that the players' average arousal levels during the game are correlated with the average money earned in the game. Subjects that apply the emotion regulation strategies ‘emotion reappraisal’ and ‘emotion suppression’ performed better in the game than those subjects who did not apply these strategies.</td>
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6.2.9 S-M5 Auction game as feedback tool on phasic physiological responses

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<tr>
<td>Title</td>
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<tr>
<td>Auction game as feedback tool on phasic physiological responses</td>
</tr>
<tr>
<td>Institution Name</td>
</tr>
<tr>
<td>FZI-IPE</td>
</tr>
<tr>
<td>Work Package(s)</td>
</tr>
<tr>
<td>WP 2</td>
</tr>
<tr>
<td>Contact</td>
</tr>
<tr>
<td>Philipp Astor</td>
</tr>
<tr>
<td>Planned start &amp; end date</td>
</tr>
<tr>
<td>September 2011 - October 2011</td>
</tr>
<tr>
<td>Actual start &amp; end date</td>
</tr>
<tr>
<td>November 2011 - January 2012</td>
</tr>
<tr>
<td>Aims</td>
</tr>
<tr>
<td>The goal of this study is to evaluate the Auction Game as a learning tool in relation to emotional overweighting of losses.</td>
</tr>
<tr>
<td>Research Questions:</td>
</tr>
<tr>
<td>• Can people learn to deal with their emotional phasic responses?</td>
</tr>
<tr>
<td>• Does this group perform better in a subsequent task relating to the disposition effect (measured by the Two Index Game) compared to a control group?</td>
</tr>
<tr>
<td>One part of the study was to calibrate the Auction Game Diagnostic (DIAG) and the Two Index Game (TIG). The second part of the study was conducted to examine the influence of a learning Intervention (Auction Game ER and Space Investors) on phasic emotional responses in the Auction DIAG and effects on the Disposition Effect (DE) as measured by the Two Index Game (TIG).</td>
</tr>
<tr>
<td>Link to past studies</td>
</tr>
<tr>
<td>IS1 and IS2, S-M4</td>
</tr>
<tr>
<td>Link to future studies or anticipated outcomes</td>
</tr>
<tr>
<td>S-M6</td>
</tr>
<tr>
<td>Methods</td>
</tr>
<tr>
<td>Participants play the AUC-DIAG and subsequently the TIG.</td>
</tr>
<tr>
<td>Number of subjects</td>
</tr>
<tr>
<td>36 subjects</td>
</tr>
<tr>
<td>Background of subjects</td>
</tr>
<tr>
<td>Mostly business students.</td>
</tr>
<tr>
<td>Duration of intervention</td>
</tr>
<tr>
<td>n/a</td>
</tr>
<tr>
<td>Type of intervention</td>
</tr>
<tr>
<td>Two-part study: Part I of the study consisted of 36 subjects. Subjects’ performance in a preliminary version of the TIG was measured, however, due to technical problems data collected for only 22 subjects. Part II of the study was carried out in combination with S-M6. HR was assessed for 81 subjects to test how ER training affected subjects’ performance in the Auction Game DIAG, economically and physiologically, and in the TIG. Finally, subjects were then asked to complete a questionnaire. Participants were compensated in cash according to how well they performed. Participants were told in advance of taking part in the study that they would be paid this money to assure that subjects performed to the best of their ability.</td>
</tr>
<tr>
<td>Reports available</td>
</tr>
<tr>
<td>Reported in more detail in Deliverable D9-2.3.3</td>
</tr>
<tr>
<td>Status of analysis</td>
</tr>
<tr>
<td>Complete</td>
</tr>
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</table>
### Summary of findings

| | The physiological response to winning and losing varies significantly and provides more evidence that the game is highly arousing. The results provide evidence that a single one shot intervention is not fruitful in improving subjects’ skills on effective emotion regulation. However, the results provide an indication that subjects’ emotional constitution, even between unrelated tasks, is a driver of the DE and that the Auction Game DIAG elicits emotions that are relevant for decision making. |
## 6.2.10 S-M6 Biofeedback on Performance

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Title</td>
<td>Transfer of learned emotion regulation skills from Aiming Game to Auction Game V2 and Index game</td>
</tr>
<tr>
<td>Institution Name</td>
<td>FZI-IPE</td>
</tr>
<tr>
<td>Work Package(s)</td>
<td>WP 2</td>
</tr>
<tr>
<td>Contact</td>
<td>Philipp Astor</td>
</tr>
<tr>
<td>Planned start &amp; end date</td>
<td>November 2011 – December 2011</td>
</tr>
<tr>
<td>Actual start &amp; end date</td>
<td>January 2012 – February 2012</td>
</tr>
<tr>
<td>Aims</td>
<td>The goal is to examine the learning effects over a three weeks period of several emotion regulation training interventions (e.g., biofeedback game Auction Game, Space Investors, Auction Game x Space Investors) on decision performance in several financial tasks.</td>
</tr>
<tr>
<td>Link to past studies</td>
<td>S-M4, S-M5</td>
</tr>
<tr>
<td>Link to future studies or anticipated outcomes</td>
<td>This study is the counterpart to S-M7</td>
</tr>
<tr>
<td>Methods</td>
<td>After an emotion regulation manipulation, participants completed a survey, played Two Index Game, Weber task, emotional STROOP and Auction game diagnostic.</td>
</tr>
<tr>
<td>Number of subjects</td>
<td>108</td>
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<tr>
<td>Background of subjects</td>
<td>Mostly business students</td>
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<tr>
<td>Duration of intervention</td>
<td>Between 10 min up to 1 hour.</td>
</tr>
<tr>
<td>Type of intervention</td>
<td>Dependent on condition. All games 1.) boost emotional awareness of participants and 2.) train ability to regulate down levels of high arousal.</td>
</tr>
<tr>
<td>Reports available</td>
<td>Reported in more detail in Deliverable D9-2.3.3</td>
</tr>
<tr>
<td>Status of analysis</td>
<td>Complete</td>
</tr>
<tr>
<td>Summary of findings</td>
<td>The findings from this study show that the Learning Interventions tested are both successful in increasing subjects emotion regulation tendencies measured by the emotion regulation questionnaire as well as by the psycho-physiological mean of heart rate. However, the differences between the treatment conditions (Auction Game (ER), vs. Auction (ER) + Space Investors vs. Space Investors + Auction Game (ER)) are small. Making it hard to judge the incremental contribution of the different interventions.</td>
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## 6.2.11 S-M7 (Preliminary work)

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<td>Contact</td>
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<td>Actual start &amp; end date</td>
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<td>Aims</td>
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<td>Link to past studies</td>
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<tr>
<td>Link to future studies or anticipated outcomes</td>
</tr>
<tr>
<td>Methods</td>
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<tr>
<td>Number of subjects</td>
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<tr>
<td>Background of subjects</td>
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<td>Duration of intervention</td>
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<td>Type of intervention</td>
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<td>Web link to resources</td>
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<tr>
<td>Status of analysis</td>
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<tr>
<td>Summary of findings</td>
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6.2.12 S-M7 Mindfulness and aiming game with index game. Influencing the disposition effect: how effective are xDelia’s learning intervention tools?

<table>
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<td>Work Package(s)</td>
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<tr>
<td>Contact</td>
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<td>Planned start &amp; end date</td>
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<td>Actual start &amp; end date</td>
</tr>
<tr>
<td>Aims</td>
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<tr>
<td>Link to past studies</td>
</tr>
<tr>
<td>Link to future studies or anticipated outcomes</td>
</tr>
<tr>
<td>Methods</td>
</tr>
<tr>
<td>Number of subjects</td>
</tr>
<tr>
<td>Background of subjects</td>
</tr>
<tr>
<td>Duration of intervention</td>
</tr>
<tr>
<td>Type of intervention</td>
</tr>
<tr>
<td>Reports available</td>
</tr>
<tr>
<td>Status of analysis</td>
</tr>
</tbody>
</table>
### Summary of findings

The students showed changes in trait and state emotion regulation and in state (but not trait) mindfulness over the different emotion regulation training sessions compared to the control group. Body vigilance increased in all treatment groups compared to the control group as result of the emotion regulation training sessions, and the use of maladaptive emotion regulation strategies (suppression) declined across all participants. This indicates that the emotion regulation exercises were effective.

More importantly, this study on the repeated practise of the emotion regulation exercises indicated that a longitudinal training (e.g., a training of several weeks) is a valid approach as this weekly training session with simple exercises was already associated with an increase in trait emotion regulation (RA), interoception (body vigilance) and state mindfulness before and after the study. This implies that, for example, the xDelia Mindful Trading Training where people log in daily to find a new exercise could be a helpful training programme to teach skills on emotion regulation and mindfulness. Such a daily exercising approach could also be implemented for SI.

The data indicated that a longitudinal approach could facilitate more robust changes on trait indices for long-term effects on emotion regulation, whereas in S-M7, only short-term effects on state variables were to be expected. The present data suggest that it is feasible and recommendable to use a longitudinal approach for teaching emotion regulation skills (albeit a mindfulness training, or a training designed around biofeedback games).
### 6.3 S-M8

<table>
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<th>ID</th>
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<tbody>
<tr>
<td>Title</td>
<td>UK Longitudinal Study with Private Traders (Camden)</td>
</tr>
<tr>
<td>Institution Name</td>
<td>OUBS, OU-IET</td>
</tr>
<tr>
<td>Work Package(s)</td>
<td>WP2</td>
</tr>
<tr>
<td>Contact</td>
<td>Dr Ben Hardy</td>
</tr>
<tr>
<td>Planned start &amp; end date</td>
<td>Start of March – End of April</td>
</tr>
<tr>
<td>Actual start &amp; end date</td>
<td>22-March-2012 to 18-May-2012</td>
</tr>
<tr>
<td>Aims</td>
<td>To determine whether emotion regulation training (through serious games with bio-feedback and mindfulness training) can reduce private investors and traders' susceptibility to the DE.</td>
</tr>
<tr>
<td>Link to past studies</td>
<td>S-M8(a) S-M8(b)</td>
</tr>
<tr>
<td>Link to future studies or anticipated outcomes</td>
<td>xDelia Learning Pathway</td>
</tr>
<tr>
<td>Methods</td>
<td>The study was carried out in two parts. First participants were invited to take part in a 2.5 hour session at the Open University Camden office. Here, participants completed a survey, played the TIG, provided a measure of interoception before playing the SI and AUC, provided another measure of interoception, played the TIG, completed another survey, were interviewed and given their diary. If participants were in the treatment arm of the experiment then they played the didactic version of the SI and AUC and were given a trading diary and a mindfulness diary. If participants were in the control arm they played the diagnostic version of SI and AUC and were only given the trading diary. The second part of the study required participants to rank the relevance of emotion-words. They were also instructed to add (and rank) any words they thought better characterised the emotions they experienced at the start and during the trading session. If participants were in the treatment arm, they were then instructed to undertake a 15min mindfulness exercise every day and to report each day on whether they carried out the exercise and whether they noticed that it was helping their trading. Participants were also told that they would receive an email one and two weeks after the date of the first session, which would contain a link to play the TIG online. They were also told that they would receive reminder emails with reminders and instructions on how to complete the course of the study. If participants were in the treatment arm of the experiment then they received the mindfulness instructions and email reminders/instructions after the two-week study.</td>
</tr>
<tr>
<td>Number of subjects</td>
<td>68</td>
</tr>
<tr>
<td>Background of subjects</td>
<td>Mix if private investors and traders. The distinction being that traders were entering and exiting the market usually on a daily basis whereas private investors were take positions in the market that lasted longer than 24hours.</td>
</tr>
</tbody>
</table>
### Duration of intervention
2 weeks

### Type of intervention

#### Treatment:
- TIG-1, INT-1, SI-Didactic, AUC-Didactic, INT-2, TIG-2,
- Interview, Mindfulness-exercise

#### Control:
- TIG-1, INT-1, SI-Diagnostic, AUC-Diagnostic, INT-2, TIG-2,
- Interview

NB: An interoception measure (INT), which required participants to tap-out the rhythm of their heart by clicking on a mouse-key 35 times x 3.

### Reports available
Reported in more detail in Deliverable D9-2.3.3

### Status of analysis
Complete

### Summary of findings
This study adds to evidence that the target audience find the xDelia learning games engaging and likely to promote useful learning relevant to their trading behaviour.

The results on interoception suggest that not only do the games and MF improve emotion regulation as found in previous studies but offer direct evidence that they may do so via improved attention to internal physiological states (interoception). The interoception tool developed as part of xAffect functionality and tested in this study may thus provide an important contribution to feedback and learning about emotion regulation.

The study provides further evidence that the TIG disposition effect measure has test retest validity given the moderately good agreement in DE scores across multiple plays.

Evidence on disposition effects is weak and mixed. However, there is some indication that DE rises immediately with engagement in sensor based games and falls subsequently over a period of mindfulness training, in contrast to a steady rise for those not engaged in mindfulness training.
6.3.1 S-M9 Diary and Reflection Learning Intervention

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<tr>
<td>Aims</td>
</tr>
<tr>
<td>Link to past studies</td>
</tr>
<tr>
<td>Link to future studies or anticipated outcomes</td>
</tr>
<tr>
<td>Methods</td>
</tr>
<tr>
<td>Number of subjects</td>
</tr>
<tr>
<td></td>
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<tr>
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</tr>
<tr>
<td>Duration of intervention</td>
</tr>
<tr>
<td>Type of intervention</td>
</tr>
<tr>
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</tr>
<tr>
<td>Status of analysis</td>
</tr>
<tr>
<td>Summary of findings</td>
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</tbody>
</table>
### 6.3.2 S-HP(1) Mindfulness Game

Heuristic evaluation and play testing studies – Mindfulness game, mindformer

<table>
<thead>
<tr>
<th>Evaluation Data</th>
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<tbody>
<tr>
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<td><strong>Actual start &amp; end date</strong></td>
</tr>
<tr>
<td><strong>Aims</strong></td>
</tr>
<tr>
<td><strong>Link to past studies</strong></td>
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</tr>
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<td><strong>Methods</strong></td>
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<td><strong>Type of intervention</strong></td>
</tr>
<tr>
<td><strong>Reports available</strong></td>
</tr>
<tr>
<td><strong>Status of analysis</strong></td>
</tr>
</tbody>
</table>
Summary of findings

Three out of four players said they would like to know more about mindfulness after they have played the game. The players only played the game once.

Two of the players were very inexperienced gamers, while two of the player plays computer games several hours a day. Only one of the players stated to be experienced in the platform genre, which was confirmed by the final score.

All of the users did find the game very easy to use and no one had questions about how to play. The only difficulty was the paced breathing exercise, it was hard to understand how to use the key to make the circle shrink and expand. The breathing exercise has been redone and tested separately, and is in the present version easier to understand. It is the improved version that is described in this document.

All of the players, also the experienced one, found the game hard. The experienced user managed to finish all levels. To count the platforms at the same time as you need to keep track ducks or moles was experienced as extremely difficult especially as the platforms are so many. It is easy to lose track. It might be better to tell the user to follow the breathing patterns visualized by the clouds and instead count the breaths. But it has to be tested to see what has the best effect. As it is now the breathing and mindfulness was experienced to get out of focus.

All of the users experienced level 3 and level 6 as very stressful and it was hard for all of them to keep up.

When it comes to how much fun the game is there was different opinions. Two of the users thought it was quite fun. The most inexperienced player and the most experienced player found the game fun. It seems like the reason was that the inexperienced user concentrated on jumping and getting coins and to succeed to do that was fun enough. The experienced user scored much better than the others and tried to take all of the coins, which appeared to motivate him. The two other players lost a little bit of interest when they lost all their points in almost every level.
# 6.3.3 S-HP(2) Mind Manager App

Mindfulness application xDelia Mind Manager

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<tr>
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<td>Actual start &amp; end date</td>
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<tr>
<td>Aims</td>
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<td>Methods</td>
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<td>Type of intervention</td>
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<tr>
<td>Reports available</td>
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<tr>
<td>Status of analysis</td>
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</table>
### Summary of findings

- One of the five users had practiced mindfulness before. Neither of the other users knew anything about mindfulness.
- All the users had problems to understand how to make the calibration work. The test leader had to help out.
- When the users got the breathing exercise to work they found it quite good, except for the experienced user that did not think it added anything to the mindfulness training. The experienced user experienced it as the visual pattern (expanding and shrinking circle) draw the attention from the breathing itself.
- All the users managed the meditation timer without trouble. As the users had performed the paced breathing just before this exercise they all practiced the breathing again. The experienced user closed the eyes while the other users stared at the progress bar.
- All the users found the timer ok.
- The user didn’t have any trouble to understand the charts except that they did not do the questionnaire, why they could not see anything on those charts, which was confusing.
- The users did not have any opinion of what to get statistics on. They found that what there was was ok. The experienced user was unsure if the training would benefit from the feature.
- All users manage fairly quickly to set the planner to alert three times a day.
- All users manage fairly quickly to set the time to alert twice a day. Lunch, after work 2h.
- The experienced user thought that the randomized time periods in the planner are something that would not be used. The experienced user preferred to use the fixed time options.
- All the users thought that the planner was fairly easy to use when you got the hang of it.
- None of the users had any comments on the design more than it was rather easy to use it.

From the user test it was revealed that the calibration of the breathing pace was hard to understand. It resulted in a re-make of the calibration and better instructions. The experienced user also questioned if the breathing exercise add something to the mindfulness experience or if it just drew attention from the intended activity. That is something that could be explored in the studies at EUR and Saxo Bank. Another issue that is important to look into is if the progress bar in the meditation timer influences the meditation positively or negatively. The outcome of the test also indicates that the usefulness of the statistics and planner must be investigated further.

The System Usability Scale was also applied. The questionnaire confirmed that the overall design was rather sufficient. The only issue was statement one “I think that I would like to use this program frequently.” As three of the participants didn’t plan to practice mindfulness and the fourth participant was not sure of the usefulness of the application it is hard to tell anything concerning this matter. How useful the application is and how frequent the users are motivated to use it will be explored in upcoming studies. The xDelia Mind Manager is planned to be used in a study involving day traders at Saxo Bank in April - May 2012.
Appendix B: Interview Questions

- Q1: Could you summarise which games and activities you have just taken part in?
- Q2: What did you think of the game experiences?
- Q3: Have you any suggestions for improvement?
- Q4: Do you think this approach of using games with bio-feedback could help you improve your day-to-day trading decisions?
- Q5: Approximately how long have you been trading and how did you initially get started?
  - Q5a: How did you start learning about investing?
- Q6: How do you currently go about improving your trading skills (peer network, online forums, contact with banks, conferences such as these, online resources, financial papers, books, coaching)?
- Q7: Do you keep a trading diary?
8 Appendix C: Web Survey Questions (Post S-M1 & S-M2)

Emotion regulation

1. Please rate the extent to which you agree or disagree with the following statements:
   
   Please choose the appropriate response for each item:
   
   strongly disagree
   disagree
   undecided
   agree
   strongly agree

   • The video on emotion regulation strategy was informative.
   • I was interested and engaged by the video on emotion regulation strategy.
   • I would have liked the option to read the information on emotion regulation as text on the screen.
   • I was surprised by my emotion regulation strategy results.
   • I believe that the personalised information on my emotion regulation strategy will provide me with a good basis from which to reflect on and work to improve my trading.

Emotion regulation (2)

2. Have you learned anything new about emotion regulation?
   
   Please choose only one of the following:
   
   yes
   no
   unsure

3. Have you learned anything new about your personal emotion regulation strategies?
   
   Please choose only one of the following:
   
   yes
   no
   unsure

4. Do you agree with the assessment of your personal emotion regulation strategies?
   
   Please choose only one of the following:
   
   yes
   no
   unsure
Disposition effect

5. Did you also receive feedback about your trading history and the disposition effect?

*Please choose only one of the following:*

- yes
- no

6. Please rate the extent to which you agree or disagree with the following statements:

*Only answer this question if the following conditions are met:*

- Answer was ‘yes’ at question ‘5’ (Did you also receive feedback about your trading history and the disposition effect?)

*Please choose the appropriate response for each item:*

- strongly disagree
- disagree
- undecided
- agree
- strongly agree

- The video on the disposition effect was informative.
- I was interested and engaged by the video on the disposition effect.
- I would have liked the option to read the information on the disposition effect as text on the screen.
- The text box comparing my disposition effect score to the mean disposition effect score gave me insights into my trading behaviour.
- I was surprised by my disposition effect score.
- I believe that the personalised information on my disposition effect score will provide me with a good basis from which to reflect on and work to improve my trading.

7. Have you learned anything new about the disposition effect?

*Only answer this question if the following conditions are met:*

- Answer was ‘yes’ at question ‘5’ (Did you also receive feedback about your trading history and the disposition effect?)

*Please choose only one of the following:*

- yes
- no
- unsure

8. Have you learned anything new about your tendency to display the disposition effect?

*Only answer this question if the following conditions are met:*

- unsure
o Answer was 'yes' at question '5' (Did you also receive feedback about your trading history and the disposition effect?)

Please choose only one of the following:

yes
no
unsure

Two Index Game

9. [7]Did you have an opportunity to play the Two Index Game?
   * Only answer this question if the following conditions are met:
     o Answer was 'yes' at question '5' (Did you also receive feedback about your trading history and the disposition effect?)

Please choose only one of the following:

yes
no

10. Please rate the extent to which you agree or disagree with the following statements:
   * Only answer this question if the following conditions are met:
     o Answer was 'yes' at question '9' (Did you have an opportunity to play the Two Index Game?)

Please choose the appropriate response for each item:

- strongly disagree
- disagree
- undecided
- agree
- strongly agree

- The Two Index Game was engaging.
- It was difficult to take in all the information presented on the screen.
- The Two Index Game was too fast.
- Playing the Two Index Game helped me understand how much I demonstrate the disposition effect.
- The Two Index Game was boring.
- The information on the screen was easy to follow.
- The Two Index Game was too slow.
- The Two Index Game felt realistic.
- The Two Index Game was fun.
- I think that playing the Two Index Game in combination with other xDelia learning activities, will help me reduce my tendency to the disposition effect when trading.
I would recommend the Two Index Game to a friend or colleague who does not invest or trade.

I would recommend the Two Index Game to a friend or colleague who does not trade

Follow up

11. Any comments or suggestions for improvement?
   Please write your answer here:

12. Would you be prepared to take part in a follow-up telephone interview?
   Please choose only one of the following:
   
   yes
   
   no

13. Please provide your email address or any other details so that we may contact you.
   * Only answer this question if the following conditions are met:
     o Answer was 'yes' at question '12' (Would you be prepared to take part in a follow-up telephone interview?)
   Please write your answer here:

Submit your survey.
Thank you for completing this survey.
9 Appendix D: Web Survey (Post S-M8)

xDelia User Experience Survey

Consent

Thank you for taking part in the Camden Study. Your feedback will give us an insight into how useful you find our approach and help us improve the design of the ultimate xDelia learning journey. Your responses will be stored securely, accessible only by the xDelia research team.

This survey should take no more than 5 minutes to complete. The data will be anonymised and may be used in written reports, presentations and published papers in ways which cannot identify any individual.

By clicking "Next" and continuing with the survey you confirm that you understand that the results of this research project will be kept secure and not released to any third party. All raw data that is personally identifiable will be destroyed after the project is complete.

You also give your permission for the data collected to be used in an anonymous aggregated format in any written reports, presentations and published papers relating to this study.

1. Name
xDelia User Experience Survey

Emotion Regulation

At the start of your session in Camden, you completed a survey to identify how you manage your emotions. We then emailed you feedback on your emotion regulation strategies. This section asks about your reaction to the emotion regulation feedback you received.

2. The feedback I received on emotion regulation strategy was informative.
   - strongly agree
   - agree
   - undecided
   - disagree
   - strongly disagree

3. I was surprised by my emotion regulation strategy results.
   - strongly agree
   - agree
   - undecided
   - disagree
   - strongly disagree

4. I believe that the personalised information on my emotion regulation strategy will provide me with a good basis from which to reflect on and work to improve my trading.
   - strongly agree
   - agree
   - undecided
   - disagree
   - strongly disagree

5. Have you learned anything new about emotion regulation?
   - yes
   - no
   - unsure

6. Have you learned anything new about your personal emotion regulation strategies?
   - yes
   - no
   - unsure

7. Do you agree with the assessment of your personal emotion regulation strategies?
   - yes
   - no
   - unsure
xDelia User Experience Survey

Disposition Effect

During your session in Camden, you played the Two Index game in diagnostic mode to assess your disposition effect. We then emailed you feedback on your disposition effect score. This section asks about your reaction to the feedback you received.

8. The information I was sent by email describing the disposition effect was informative.
   ○ strongly agree   ○ agree   ○ undecided   ○ disagree   ○ strongly disagree

9. I was surprised by my disposition effect score.
   ○ strongly agree   ○ agree   ○ undecided   ○ disagree   ○ strongly disagree

10. I believe that the personalised information on my disposition effect score will provide me with a good basis from which to reflect on and work to improve my trading.
    ○ strongly agree   ○ agree   ○ undecided   ○ disagree   ○ strongly disagree

11. Have you learned anything new about the disposition effect?
    ○ yes
    ○ no
    ○ unsure

12. Have you learned anything new about your tendency to display the disposition effect?
    ○ yes
    ○ no
    ○ unsure

xDelia User Experience Survey

Mindfulness Exercises

At the end of the session at the Camden Office, some participants were given an emotion regulation exercise called mindfulness and asked to practice this daily for two weeks. If you were part of this group, please answer “yes” to Q12 and select “Next”.

Other participants were given the mindfulness instructions later, after playing the Two Index game remotely. If you were not told about mindfulness at the Camden Office, please answer “no” to Q12 and select “Next”.

13. Were you given the Mindfulness instructions verbally at the Camden Office?
    ○ yes
    ○ no
    ○ unsure
14. How often did you practice the mindfulness techniques over the two weeks following your visit to the Camden Office? (enter the number of times as digits, eg 21 or 9)
- Daily
- Every two days
- Every three days
- About once a week
- Once only
- I didn't practice the mindfulness techniques

Any comments

15. Approximately how many minutes did you spend on each mindfulness exercise?

Minutes spent practicing mindfulness: [ ]
### xDelia User Experience Survey

16. Please rate the extent to which you agree or disagree with the following statements relating to the Mindfulness techniques you were asked to practice and apply.

<table>
<thead>
<tr>
<th>Statement</th>
<th>strongly agreed</th>
<th>agree</th>
<th>undecided</th>
<th>disagree</th>
<th>strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The mindfulness exercises increased my levels of attention</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The mindfulness exercises increased my awareness of my emotions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The mindfulness exercises made it easier to cope with stress</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The mindfulness exercises improved my ability to make good trading decisions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I plan to continue practicing mindfulness after the end of the study</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The mindfulness exercises helped me manage my emotions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Keeping the mindfulness diary helped me apply the mindfulness techniques during my trading</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Any comments on the TiG after having played it more often

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xDelia User Experience Survey

About your practices and preferences

This section asks about what you did before you took part in the xDelia study.

17. Did you practice mindfulness techniques before joining the xDelia study?
   - [ ] yes
   - [ ] no
   - [ ] unsure

Any comments:

18. Did you practice meditation before joining the xDelia study?
   - [ ] yes
   - [ ] no
   - [ ] unsure

Any comments:

19. Would you use a mindfulness app on a phone that guided you through practicing mindfulness techniques?
   - [ ] yes
   - [ ] no
   - [ ] unsure

20. Would you use a mindfulness app on a tablet device such as an iPad that guided you through practicing mindfulness techniques?
   - [ ] yes
   - [ ] no
   - [ ] unsure

21. Would you use a mindfulness application on your computer that guided you through practicing mindfulness techniques?
   - [ ] yes
   - [ ] no
   - [ ] unsure
22. Did you keep a trading diary before joining the xDelia study?
- yes / I keep a regular trading diary (every trade)
- yes / I keep a trading diary, but not regularly (approximately every four or five trades)
- I believe a trading diary is important, but I don’t keep one at present.
- No / I don’t keep a trading diary and don’t feel the need to.
- Unsure

23. Do you think that keeping a trading diary is good practice?
- yes
- no
- unsure

xDelia User Experience Survey

Keeping a Diary

At the Camden Office, you were given an xDelia diary and asked to use it to record details of emotions before and after each trade. This section asks questions about your xDelia Diary keeping.

24. During the two weeks after your visit to the Camden office, how often did you fill in the xDelia diary you were given?
- before and after each trade
- before and after most trades (approximately four out of every five trades)
- before and after some trades (approximately two out of every five trades)
- intermittently, before and/or after some trades
- regularly to start with, getting less frequently as time went on
- never
25. Please rate the extent to which you agree or disagree with the following statements relating to the xDelia Diary keeping activities.

<table>
<thead>
<tr>
<th>Statement</th>
<th>strongly agree</th>
<th>agree</th>
<th>undecided</th>
<th>disagree</th>
<th>strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeping the diary helped me manage my emotions effectively during trading</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Recording my emotional state before and after trading made me aware of my emotions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Being aware of my emotions during trading helped me make better trading decisions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I reviewed my previous diary entries</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Reviewing my previous diary entries provided insights into the role of my emotions in trading decisions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

**xDelia User Experience Survey**

**The Two Index Game**

You were reminded to play the Two Index game at weekly intervals. This last page of the survey asks for your impressions of this game now that you have got to play it more often.

26. Please rate the extent to which you agree or disagree with the following statements now that you have played the Two Index game (TIG) more than once.

<table>
<thead>
<tr>
<th>Statement</th>
<th>strongly agree</th>
<th>agree</th>
<th>undecided</th>
<th>disagree</th>
<th>strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The TIG provided an effective space in which to practice emotion management techniques</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The TIG was engaging</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The TIG was easy to understand</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The TIG was too fast</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The TIG was boring</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The information on screen was easy to follow</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The TIG was too slow</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The TIG felt unrealistic</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would recommend the TIG to someone who does not invest or trade</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would recommend the TIG to a fellow trader</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The TIG lasted for too long</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It was difficult to take in all the information presented on the screen</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
xDelia User Experience Survey

Your feedback

This section is for you to give us your feedback (writing as much or as little as you wish) on xDelia and your experiences during this study.

Thank-you very much for your participation.

27. Name

28. Study ID if you remember it, for example UKLN9gn

29. Please share with us any other feedback or comments that you have.
## 10 Appendix E: Games Survey

The following questions involve gameplay of the Space Investor game. Please rate to what extent you agree to the following statements.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Space Investor Game was engaging to play.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without the tutorial, I still could have played the Space Investor game well.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Space Investor Game is easy to understand.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Space Investor Game was too fast.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Space Investor Game was boring.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Space Investor Game was fun.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The information on the screen was easy to follow.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Space Investor game was too slow.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Space Investor game felt realistic.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would recommend the Space Investor game to a friend or colleague who does not invest or trade.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would recommend the Space Investor game to a fellow trader.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The following questions involve gameplay of the Auction game. Please rate to what extent you agree to the following statements.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Auction Game was engaging to play.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
<tr>
<td>Without the tutorial, I still could have played the Auction game well.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
<tr>
<td>The Auction Game is easy to understand.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
<tr>
<td>The Auction Game was too fast.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
<tr>
<td>The Auction Game was boring.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
<tr>
<td>The Auction Game was fun.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
<tr>
<td>The information on the screen was easy to follow.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
<tr>
<td>The Auction game was too slow.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
<tr>
<td>The Auction game felt realistic.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
<tr>
<td>I would recommend the Auction game to a friend or colleague who does not invest or trade.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
<tr>
<td>I would recommend the Auction game to a fellow trader.</td>
<td>1  2</td>
<td>3  4  5</td>
<td>6  7</td>
</tr>
</tbody>
</table>
To measure heart rate when playing the biofeedback games, we used a mobile heart rate sensor. How comfortable was it to wear the sensor?

<table>
<thead>
<tr>
<th>Not at all Uncomfortable</th>
<th>all</th>
<th>Neither uncomfortable</th>
<th>comfortable</th>
<th>nor</th>
<th>Extremely Uncomfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
The following questions involve gameplay of the Two-Index game. Please rate to what extent you agree to the following statements.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Two-Index Game was engaging to play.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Without the tutorial, I still could have played the Two-Index game well.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>The Two-Index Game is easy to understand.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>The Two-Index Game was too fast.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>The Two-Index Game was boring.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>The Two-Index Game was fun.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>The information on the screen was easy to follow.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>The Two-Index game was too slow.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>The Two-Index game felt realistic.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I would recommend the Two-Index game to a friend or colleague who does not invest or trade.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I would recommend the Two-Index game to a fellow trader.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
The Two-Index game lasted for too long.
The following questions relate to the xDelia Learning Pathway you are undertaking. Please rate to what extent you agree to the following statements:

I believe that my emotions have an impact on how well I make financial decisions.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 3 4</td>
<td>5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

I expect that playing the xDelia games could help me learn how to manage my emotions.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 3 4</td>
<td>5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

I believe that I will make better trading decisions if I can manage my emotions.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 3 4</td>
<td>5 6 7 8 9 10</td>
</tr>
</tbody>
</table>
11 Appendix F: Prototype xDelia Diary

During S-M8, two versions of the diary were used. The Treatment version, which contained additional sheets on which to record mindfulness practice and the Control version, which contained no mindfulness instructions. This appendix contains both the prototype diary, which was the same for both groups, and the mindfulness instructions and record page, which was supplied only to the treatment group.

xDelia Trading and Mindfulness diary
User ID

Contact us: xdelia@open.ac.uk
Introduction

Thank you for participating in the xDelia training programme. In this programme we aim to examine the impact of emotions on trading. A key component of this is the process of reflection both on trading and our emotions. This diary is a place where you can record information about your trading and emotions in a structured manner. We would like you to keep this diary throughout your training programme.

We are interested in hearing about your experience of using the Trading Diary as part of your trading practice, but are not asking you to give this back to us unless you wish to.

We would like to have a copy of your Mindfulness Diary at the end of the project.

Trading Diary

Please fill in this diary before and after each trading session. This might be more than once a day if you have several trading sessions in a day, or only once every few days if this is how often you trade.

We have given you enough diaries for 25 sessions, though you might not need to use them all. If you need more copies, please contact us at xdelia@open.ac.uk.

Mindfulness diary

Please fill in this diary each day of the training programme. Keep track of how well you've kept up with the learning journey, and how it's affected your trading practices. We have given you enough diaries for 14 days. If you need more copies, please contact us at xdelia@open.ac.uk.
TRADING DIARY
Please fill in this diary before and after each trading session. This might be more than once a day if you have several trading sessions in a day, or only once every few days if this is how often you trade.

Date of Session:
Start time of session:
End time of session:

Your emotions at the start of the trading session

Write in each blank space the number (from 1=not at all to 7=very) which best reflects your emotions at the start of your trading session. There is space to write in other emotions

____ Pressured
____ Irritated
____ Frustrated
____ Defeated
____ Happy
____ Guilty
____ ......

Circle below the box which best reflects your overall level of emotion at the start of your trading session.

Your emotions during the trading session

Please fill this section in after you have finished trading

Write in each blank space the number (from 1=not at all to 7=very) which best reflects the emotions you experienced during your trading session.

____ Pressured
____ Irritated
____ Frustrated
____ Defeated
____ Happy
____ Guilty
____ ......

(Please continue over the page)

Circle below the box which best reflects your overall level of emotion during your trading session.

How successful were you at managing your emotions effectively in this trading session? (Circle the appropriate box.)

Not at all successful | Not much success | A little unsuccessful | Some success | Successful | Very successful

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What did you notice about your emotions during your trading sessions?

How well did you manage your emotions during your trading sessions?

How many times during the course of trading today did you bring your attention back to the moment?
MINDFULNESS DIARY – Meditation Instructions

Meditations are a powerful tool in learning to train your attention and manage your emotions. For the next two weeks, we would like you to meditate each day for 15 minutes. It is important that you meditate each day to obtain the strongest effects on your performance in the computer tasks. Meditation may appear difficult, but it can be done quite easily using these principles:

1. Find a quiet place where you will not be disturbed. Sit down in a comfortable position or lie down. It may help to close your eyes.
2. Follow the movement of your breath with great precision. Focus on your belly moving up during inhalation, and down during exhalation.
3. If you find that your attention starts to drift, kindly guide it back to your breathing.

This exercise may prove very difficult at first. Many thoughts will pop up during the meditation and distract you from the task. That is fine, it is just how the brain works. Notice these distractions, and then kindly bring your attention back to your breathing. Mindfulness is losing our focus 100 times and returning to it 101 times. Mindfulness is a process where you do not reach a final and total state of mindfulness.

Try to perform this meditation daily. If you wish, you can try longer meditations. However, it is better to only do 15 minutes of meditation daily than one hour-long meditation with longer intermittent time intervals. So, spend at least 15 minutes daily meditating, but feel free to lengthen the meditations to enhance its effects.

Over the next two weeks we will email you with various exercises which will help this process.

Should you experience any difficulty meditating, or have any other questions, do not hesitate to contact us: xdelia@open.ac.uk
Mindfulness Diary

We would like you to keep a diary of how you found the mindfulness exercises we’ve asked you to carry out. This will help you reflect on how well you kept to the training programme, and to what extent it has helped you with your trading practice.

Date:

I carried out 15 minutes of the Mindfulness exercise today **YES /NO**

If this was a trading day, did you draw on the techniques from the Mindfulness training, for example, bringing your attention back to the moment, or focussing on your breathing?

**Notes:**
12 Appendix G: xDelia Peer Forum Model

Implementation of the Peer Forum was never planned within the timeframe of the project. However the following wireframe was produced, together with evaluation plans.

Initial plans to evaluate the Peer Forum include:

- Identify a set of key emotion terms used by private traders from open forums such as Linked-in Trader and Trading and Risk Psychology trading forums.
- Use these words to create a set of key emotion terms typically used by investors when talking about their experiences of investing.
- Extract additional themes from the qualitative analysis of the EV-1 investor interviews.

The raw text will be extracted and aggregated using a Perl script (already written by the xDelia team) to remove all personally identifiable data about the people who have made the posts. These terms will inform the analysis of what the xDelia traders say about their experiences.

The xDelia peer forum postings will then be extracted using the same Perl script and loaded into a qualitative analysis software package (Nvivo). The text will be coded against the key emotion terms, and the themes identified from the EV-1 investor interviews. It will also be open coded to identify emergent themes.
13 References


