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The work described in this document was performed as part of the xDELIA project ("Boosting Deliberate Practice and Handling Biases through Immersive Cognitive and Emotional Reinforcement Strategies & Tools") which is funded under contract No. 231830 of the European Community. The project is a collaboration between CIMNE (coordinating partner), Forschungszentrum Informatik, Open University, Blekinge Tekniska Högskola (Game and Media Arts Laboratory), Erasmus University Rotterdam (Erasmus Centre for Neuroeconomics), University of Bristol (Personal Finance Research Centre), and Saxo Bank A/S. The opinions, findings and conclusions expressed in this report are those of the authors alone and do not necessarily reflect those of the EC or any other organisation involved in the project.

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Executive Summary

The WP6 Evaluation reports are delivered in three parts. Part 1 (M12) and Part 2 (M24) consist of a preliminary series of evaluation reports on each of the application areas and associated trials. Part 3 (M36) will update the previous parts and present an analysis of the final findings from the evaluations. This document represents Part 2 of the evaluation.

This Part 2 report describes the studies that have been undertaken around the activities of WP2-5 during M13 to 24 of the project together with the WP6 studies that have taken place alongside these outward-facing project activities. It categorises the project activities and shows how they link together. It consolidates the findings from the individual studies, depicting the bigger picture of how they inform subsequent project activities and the design of the learning interventions planned for yr3. Using one example, the document uses a set of Conceptual Learning Design Views (Conole, 2010) to represent the complete learning intervention, making the contributions of each design element explicit.

It concludes by highlighting the impact of the refocusing of the xDelia project over the first two years, focusing in particular the debates and negotiations that have taken place in order to make the changes in scope and direction that arose out of the 1st review in M12 and the interim review in M24.
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1 Introduction

1.1 Document Purpose and Scope

This deliverable D20-6.3 takes the form of an evolving report on the xDelia studies, delivered in three parts. Part 1 documented the design and development activities undertaken in the first 12 months of the project. Part 2 contains formative evaluations of the design and development activities, and of the studies. The evaluations were undertaken in some instances by the evaluation team and in other cases by the other project partners, with support from the central evaluation team. The evaluation team also synthesised the overall narrative from across the studies to produce a coherent picture of the whole that ties together the activities conducted by the different partners. Part 3 will contain the final evaluation together with a critical review of the effectiveness of the evaluation framework for participatory design and evaluation alongside a summary of the lessons learned along the way. This document is Part 2 of the WP6 evaluation report.

At the October 2010 interim review, it was decided to suspend WP3, Financial Capability, and to amalgamate WP5, Sensors, into WP4, Games. Therefore the WP3 and WP5 activities conducted during yr1 are noted in this document, but not evaluated as they no longer form part of the project. Instead, the focus is directed toward the activities conducted to further the WP2 Investors case, as directed by the review report.

The document is divided into the following sections:

- **Section 1** “Introduction” describes the structure and scope of this document, describing how the project activities are classified and recapping the approach adopted by xDelia partners to the evaluation of the project, revising the D&E Framework in the light of the yr2 work. The yr2 trader and investor studies are visualised along a timeline to show how they relate to each other.
- **Section 2** “Interventions for Traders and Investors” discusses the activities conducted in yr2 to further the traders and investors research, showing how these activities feed into and from each other and ultimately inform the work planned for yr3.
- **Section 3** “Design for Learning Interventions” describes the application of a learning design methodology which helps to articulate the nature of learning interventions to make them more explicit. It shows the application of this methodology to one of the planned learning interventions which will be carried out in yr3.
- **Section 4** “Discontinued Year 2 Activities” briefly summarises the activities that were conducted for the financial capability and sensors work packages which has been stopped in response to the yr2 October interim review.
- **Section 5** “Other Evaluation Activities” describes the evaluation studies conducted alongside the studies described in the preceding sections as well as the WP6 specific studies that were run independently of the other project interventions.
- **Section 6** “Summary” summarises the activities conducted in yr2 and takes the project forward into yr3.
- **Appendix A** “Investor Interviews Consent form” contains the consent form used for the WP6 Investor Interviews at the NIC conference.
- **Appendix B** “Partner Consent form” contains the consent form used for the partner follow up interviews.
- **Appendix C** “Technology Web Survey” contains the text of the WP6 web survey to elicit data on collaborative technology use by project partners.
## 1.2 List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AG</td>
<td>Auction Game</td>
</tr>
<tr>
<td>AIE</td>
<td>Arousal Induction Experiment</td>
</tr>
<tr>
<td>BART</td>
<td>Balloon Analogue Risk Task</td>
</tr>
<tr>
<td>BIS</td>
<td>Behavioural Inhibition system</td>
</tr>
<tr>
<td>BTH</td>
<td>Blekinge Tekniska Högskola – Game and Media Arts Laboratory</td>
</tr>
<tr>
<td>CFEB</td>
<td>Consumer Financial Education Body</td>
</tr>
<tr>
<td>D&amp;E</td>
<td>Design and Evaluation</td>
</tr>
<tr>
<td>DHPS</td>
<td>Dutch Household Panel Survey</td>
</tr>
<tr>
<td>DoW</td>
<td>Description of Work</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>EEG</td>
<td>Electroencephalography</td>
</tr>
<tr>
<td>EMG</td>
<td>Electromyography</td>
</tr>
<tr>
<td>ER</td>
<td>Emotion Regulation</td>
</tr>
<tr>
<td>ERQ</td>
<td>Emotion Regulation Questionnaire</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>F2F</td>
<td>Face to Face</td>
</tr>
<tr>
<td>FSA</td>
<td>Financial Services Authority</td>
</tr>
<tr>
<td>FZI IPE</td>
<td>Forschungszentrum Informatik</td>
</tr>
<tr>
<td>HF</td>
<td>High Frequency</td>
</tr>
<tr>
<td>HRV</td>
<td>Heart Rate Variability</td>
</tr>
<tr>
<td>IAPS</td>
<td>International Affective Picture System</td>
</tr>
<tr>
<td>IET</td>
<td>Institute of Education Technology</td>
</tr>
<tr>
<td>IFS</td>
<td>Investor Field Study</td>
</tr>
<tr>
<td>IS</td>
<td>Intervention Study</td>
</tr>
<tr>
<td>LF</td>
<td>Low Frequency</td>
</tr>
<tr>
<td>LI</td>
<td>Learning Intervention</td>
</tr>
<tr>
<td>M1 to M36</td>
<td>Month 1 to Month 36 of the xDelia project</td>
</tr>
<tr>
<td>MF</td>
<td>Mindfulness</td>
</tr>
<tr>
<td>NIC</td>
<td>National Investors’ Conference</td>
</tr>
<tr>
<td>P-PE</td>
<td>Practical Participatory Evaluation</td>
</tr>
<tr>
<td>RS</td>
<td>Regret Study</td>
</tr>
<tr>
<td>SCL</td>
<td>Skin Conductance Level</td>
</tr>
<tr>
<td>SCR</td>
<td>Skin Conductance Response</td>
</tr>
<tr>
<td>T-PE</td>
<td>Transformative Participatory Evaluation</td>
</tr>
<tr>
<td>TFS</td>
<td>Trader Field Study</td>
</tr>
</tbody>
</table>
1.3 xDelia Design & Evaluation Framework

The rationale and theoretical underpinnings for the D&E framework have been set out in Deliverables D12-6.2 and D20-6.3 Part I. This section briefly revisits these discussions in order to give a context to the evaluations described in the following sections and shows the latest iteration of the D&E framework as it has developed over yr2.

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 (Namioka and Schuler, 1993, Cousins and Whitmore, 1998, Poth and Shulha, 2008), feeding the findings back into the project on an ongoing basis.

The D&E Framework has been developed progressively as it has been applied to the xDelia workshops, meetings and studies conducted in yr2. It may develop further in response to the evaluation requirements of the learning interventions in yr3. Over the course of yr2, it has been refined to reflect the project activities that have taken place.

The D&E framework consists of two layers – a Design layer and an Evaluation layer. The design layer represents the aims for the project activity under evaluation in the left-most box. The aims will depend on the type of project activity – for studies, these aims will be formulated in the form of research questions, for learning interventions, these aims will be in the form of learning goals. The middle box contains detail of the structure of the activity, for a study this will summarise the research activities undertaken by participants, for a learning intervention, this will consist of learning activities that the learners engage in. The right-most box contains the analysis, findings and outcomes. A design layer activity might be a workshop to brainstorm the titles and methods, timelines and partner responsibilities for preliminary research interventions, a study to test out whether induced stress leads to poorer financial decision making amongst a target group of investors or a learning intervention that aims to address a specific emotional bias identified as having an influence on financial decision making by the target population. The evaluation layer represents these same aspects from the evaluative perspective, and an evaluation layer intervention might include video of the workshop or study, interviews with the participations, pre and post questionnaires, debriefing sessions, online data mining or a post-interview with participants to collect their feedback. Both design and evaluation activities formulate their goals and RQs in the left most box, with the evaluation RQs guided, to some extent, by those of the design layer. Both design layer and evaluation layer activities are then implemented in the centre box. Data are collected and analysed and the analysis fed back into future project activities via the right-most box. Figure 1.1 illustrates the D&E framework, highlighting the interdependent relationship between the design and evaluation sides of the framework in which each builds upon and feeds into the other.
The D&E framework looks at project activities from a macro level – iteratively guiding the project activities. Evaluation is also necessary at the micro level and these will form the large part of the work of all work packages in Yr3.

As the xDelia project work has progressed, it has become evident that the project activities can be categorised into one of three types. Section 1.4 describes these intervention types.

### 1.4 Categorising xDelia Project Activities

The bulk of the work undertaken to further the xDelia project consists of activities that can be categorised as follows:

- **Workshops and Meetings**: Involving partners and sometimes external stakeholders, workshops and meetings may hosted at the different partner institutions, or at external stakeholder institutions. Each has a different goal although all share the overarching aim to further the development of a shared understanding between project partners and among external stakeholders and to inform the design of subsequent study and learning interventions.

- **Studies**: These are research activities that aim to provide data for the research that will feed into the design of follow on studies or learning interventions. For example, a pilot study that uses bio-sensors to identify which physical responses are linked to known emotional
responses, or interviews designed to obtain the external stakeholder perspective for input to the project.

- **Learning Interventions**: These are currently being scoped out and will be implemented in yr3, combining the findings from the earlier workshops and studies to address the learning needs of the target financial audience, investors.

Section 1.4.1 describes the different types of workshops and meetings undertaken during the project, and classifies the workshops undertaken in yr2 according to type.

Section 1.4.2 describes the different types of studies undertaken during the project and classifies those conducted in yr2 according to type.

The learning interventions are being outlined in D18-2.4.1 and will be designed and implemented during yr3. They will be evaluated in the final evaluation deliverable, D20-6.3.3.

### 1.4.1 Workshops and Meetings

During the first year of the project, much of the knowledge sharing activities and the collaborative decisions about how to drive the project forward arose out of workshops and meetings. During these activities, partners pooled their knowledge and expertise to design the studies that would fulfil the needs of the project as defined in the Description of Work (DoW). The workshops and meetings clarified the research goals of the project and provided a means by which the project partners could collaborate on the design of the study interventions and to work out how the different disciplines could work together most effectively.

On the xDelia project, workshops and meetings (referred to hereafter as workshops) have been one of three types:

1. **Prototype development workshops** – aimed at progressing toward a specific conceptual or design goal such as brainstorming games ideas or coming up with technical specifications for a game or learning intervention.
2. **Substantive, subject-orientated workshops** – aimed at sharing specific knowledge between the project partners to support effective collaboration. For example, the sensors workshop was run to enable partners from other disciplines to use the sensors in the field. The first games workshop was run to give the games designers an understanding of the games-requirements of the financial work packages and to give the partners from the other work packages an understanding of what they needed to provide to enable the games designers to design games that would be effective.
3. **Evaluation workshops** – conducted to collect evaluation data from project partners or from external stakeholders.

The workshops have enabled knowledge sharing across the different disciplinary domains that comprise the xDelia project. They have helped partners scope out the study interventions that would provide the empirical data to feed into the design of the learning interventions. The workshops held during Year 1 are described in D20-6.3 Part 1. Table 1-1 lists the workshops held in Year 2.

<table>
<thead>
<tr>
<th>Type i) Prototype Development Workshops</th>
<th>Type ii) Substantive Subject Orientated Workshops</th>
<th>Type iii) Evaluation Workshops</th>
<th>Section Reference</th>
</tr>
</thead>
</table>

**Table 1-1 – Workshops in Year 2**

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The WP2 sensor workshop was held in M14 to give the WP2 researchers conducting TFS1 and TFS2 practical hands-on experience in setting up the HRV sensors, in applying them to participants and in downloading and storing the data.

The WP2 game workshop was a prototype development workshop held in M18 at Saxo Bank in Copenhagen. Its aim was to deploy the expertises of the various disciplines in the project to come up with a set of viable games that would address the emotional biases identified by previous studies. This workshop is evaluated in Section 2.8.

The WP3 stakeholder meeting was held in M20 in order to further the development of a shared understanding between project partners and external stakeholders and to inform the direction of the WP3 work. WP3 was suspended in response to the interim review recommendations.

The WP2 Work Planning workshop was held in Barcelona in M24 to consolidate the findings from the previous years studies into a coherent set of plans and timelines for the design and implementation of the learning interventions in Yr3.

Year 2 has seen the emphasis shifting from workshops to studies. The following section lists the different studies undertaken in year 2 and classifies them according to type.

### 1.4.2 Studies

Studies conducted in the xDelia project can be classified into one of three types:

1. Lab-based studies – aimed at testing out a concept, theory or game in a controlled setting using participants who are not necessarily members of the target group (traders, investors or young people).
2. Field studies – designed to validate the findings from the lab-studies in the field using members of the target population.
3. Evaluation Studies – Studies built around other lab or field studies and conducted in parallel to them guided by the D&E framework. This type also includes Studies initiated independently on behalf of WP6 to collect data that can be reflected back into the project.

Table 1-2 Lists the studies conducted for the Trader and Investors, classifying them according the different study types listed above.

<table>
<thead>
<tr>
<th>Type 1) Lab-based Studies</th>
<th>Type 2) Field Studies</th>
<th>Type 3) Evaluation Studies</th>
<th>Section Reference</th>
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<tr>
<td>IS1: Validating Mindfulness Study</td>
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<td></td>
<td>Section 2.2</td>
</tr>
<tr>
<td>Study Type</td>
<td>Section Reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MF1: Mindfulness &amp; Finance</td>
<td>X</td>
<td>Section 2.3</td>
<td></td>
</tr>
<tr>
<td>MF-1/IS2.2 Mindfulness &amp; CCT</td>
<td>X</td>
<td>Section 2.4</td>
<td></td>
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<tr>
<td>TFS1: Trader Field Study 1</td>
<td>X</td>
<td>Section 2.6</td>
<td></td>
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<td>TFS2: Trader Field Study 2</td>
<td>X</td>
<td>Section 2.7</td>
<td></td>
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<td>IFS-3: Prelim Disposition study</td>
<td>X</td>
<td>Section 2.8</td>
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<tr>
<td>RS1: Regret Study 1</td>
<td>X</td>
<td>Section 2.10</td>
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</tr>
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<td>RS2: Regret Study 2</td>
<td>X</td>
<td>Section 2.11</td>
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</tr>
<tr>
<td>IS5: Emotion Induction</td>
<td>X</td>
<td>Section 2.12</td>
<td></td>
</tr>
<tr>
<td>IS3: Emotion Reg &amp; Aiming Game</td>
<td>X</td>
<td>Section 2.13</td>
<td></td>
</tr>
<tr>
<td>Emotion Regulation study</td>
<td>X</td>
<td>Section 2.14</td>
<td></td>
</tr>
<tr>
<td>WP6 NIC Investor Interviews</td>
<td>X</td>
<td>Section 2.15 and in detail in Section 5.1</td>
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</tbody>
</table>

Table 1-3 Lists the Financial Capability activities against the different types. The Financial Capability work was ended in response to the interim review report so they have been taken no further.

Table 1-3 – Financial Capability Studies in Year 2

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Section Reference</th>
</tr>
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<tbody>
<tr>
<td>Evaluating Physiological Correlates</td>
<td>X</td>
</tr>
<tr>
<td>DHPS</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 1-4 Lists other WP6 study activities against the different types. Throughout the project, WP6 have been conducting studies to evaluate interdisciplinarity alongside the role of technology in mediating interdisciplinary collaboration. This work is ongoing and discussed in more detail in Section 5.

Table 1-4 – Evaluation Studies in Year 2

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Section Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluating Physiological Correlates</td>
<td>X</td>
</tr>
<tr>
<td>DHPS</td>
<td>X</td>
</tr>
</tbody>
</table>
1.4.3 Learning Interventions

Yr3 of the project will focus on the design of learning interventions. These have been scoped out at the end of yr2, building on the findings from the yr2 work and these plans reported in D18-2.4.1. They will be evaluated in part 3 of the evaluation reports.
1.4.4 Yr2 Trader & Investor Interventions Timeline

This section shows the studies and workshop conducted in Year 2 on a timeline, using colour to identify the study type.

Table 1-5  –Year 2 Studies and Workshop Timeline

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF-2: stressed</td>
<td>April 2010</td>
</tr>
<tr>
<td>WP6 Investor Interviews</td>
<td>May 2010</td>
</tr>
<tr>
<td>IS3: AimGame Invstrs</td>
<td>June 2010</td>
</tr>
<tr>
<td>IS2.2: CCT Invstrs</td>
<td>July 2010</td>
</tr>
<tr>
<td>MF-1: MF financial decision making</td>
<td>August 2010</td>
</tr>
<tr>
<td>IS5: Emotion Induction Experiment (EMI)</td>
<td>Sep 10 2010</td>
</tr>
<tr>
<td>WP2gmewksh</td>
<td>Oct 2010</td>
</tr>
<tr>
<td>IFS-3: Preliminary Disposition Effect Study for Intervention Cohort</td>
<td>Nov 2010</td>
</tr>
<tr>
<td>RS2: Regret Study 2</td>
<td>Dec 2010</td>
</tr>
<tr>
<td>TFS2/TraderField Study 1</td>
<td>Jan 2011</td>
</tr>
<tr>
<td>TFS1/TraderFieldStudy 1</td>
<td>Feb 2011</td>
</tr>
<tr>
<td>Sensor Wkshp</td>
<td>Mar 2011</td>
</tr>
<tr>
<td>RS1: Regret Study 1</td>
<td>April 2010</td>
</tr>
<tr>
<td>IS1: Validating Mindfulness study with students</td>
<td>May 2010</td>
</tr>
</tbody>
</table>

Key:

- Study Type 1) Lab-based study
- Study Type 2) Field study
- Study Type 3) Evaluation study
- Workshop Type i) Prototype development workshop

The field studies were conducted in two locations. The trader field studies took place in two investment banks, one in Denmark and one in the UK. The Game field studies took place at the National Investment Club conference in London attended by private investors from around the country. Section 2 provides more detail on the studies and shows they inform the activities planned for yr3.
2 Interventions for Traders & Investors

This section describes the project activities that have been undertaken to progress the Traders and Investors case, linking into WP2, WP4 and WP5. Games (WP4) were connected to sensors (WP5) and deployed as part of the studies to answer research questions from WP2. Thus the studies described below contain contributions from several xDelia partners. This section identifies the connections between the studies and evaluates how they contribute to our goal of creating pedagogically sound learning interventions that will operate in the informal learning sphere to improve financial decision-making among investors.

Section 2.1 summarises the interventions conducted over yr2, identifying where they feed into each other and into yr3 work.

Sections 2.2 through 2.16 present more detail about each study in table form, listing the aims, research questions, methods and summarising the findings and implications for future studies.

2.1 Links across Trader & Investor Studies in yr2

During yr2 a series of studies were conducted. The studies contribute to the overall design of the learning interventions planned for yr3, however the studies also feed into each other. The study findings, and the connections between studies are summarised below:

1. IS1 Validating Mindfulness Study with Business students: April – August 2010 (Section 2.2)
   - This type 1) lab-based study aimed to validate the literature that showed that short-term mindfulness interventions could be an effective technique to help manage emotions and improve attention; 212 participants participated. The findings showed that mindfulness inductions could be effective when applied to student populations and suggest further study using a more sensitive risk taking task undertaken relatively close to the mindfulness induction. The findings from IS1 fed into MF-1.

2. MF-1 Mindfulness Study on Financial Decision Making: October – December 2010 (Section 2.3)
   - This type 1) lab-based study aimed to show that mindfulness training could be an effective technique to financial decision making; 50 participants participated. The findings from this study confirmed the findings from IS1 suggesting that mindfulness was a good candidate for learning interventions to improve financial decision making. The decision-making task needed to be more stressful in order for the mindfulness intervention to be effective. The findings from MF-1 fed into into IS2.2.

3. IS-2.2 Investor Mindfulness study (Columbian Card Task): October – December 2010 (Section 2.4)
   - IS1 showed that mindfulness inductions were effective when applied to students, MF-1 extended these findings to demonstrate that mindfulness inductions were effective when applied to financial decision making. This type 2) field study built on these findings by testing the effects of mindfulness interventions on performance on a stressful and authentic financial task using members the target audience, investors attending the NIC conference. The findings from this study showed an association between decision-making on the Columbia Card Task and real-world investment performance, with both
improved investment performance and hormone changes related to stronger performance in the CCT. The implications of this study are that the Columbia Card task proves an externally valid task for future xDelia lab studies and that mindfulness remains a valid choice for learning interventions aimed at improving financial decision making under stress. These findings feed into the yr3 mindfulness studies S-M6, S-M7 and S-M8 and ultimately into the design of a mindfulness course aimed at the target group, Investors. The mindfulness learning intervention plans are described in more detail in D18.

4. WP6 Investor Interviews: November 2010 (Section 2.15 and Section 5.1)
   - This type 3) evaluation study was conducted in association with IS2.2 and IS3. Its findings showed that investors felt such games had significant potential to help with investment performance by supporting more productive management of emotions. They expressed interest in learning from professional traders and saw great value in using expert professional traders as a benchmark for their own trading behaviour. These triangulated the findings from the IS2.2 and IS3 field studies.

5. WP2 Sensor Training Workshop (Section 2.5)
   - This workshop was a knowledge sharing activity to teach WP2 researchers to be able to manage and use the HRV sensors in the field during the Trader Field Studies to collect data. Traders are a limited resource, and it was therefore of critical importance to ensure that each data collection opportunity was used effectively and that data was stored securely. It is important to be able to set up the sensors and attach them properly to the chests of participants as mistakes in the setup may result in no data being recorded, and mistakes in application may result in artefacts or so much ‘noise’ that the data collected is unusable. It is also important to develop research protocols to download and backup the data in the field, and for all researchers present to be able to step in and do every aspect of the data collection. This workshop contributed to the successful execution of TFS1 and TFS2.

6. TFS1 Trader Field Study 1: May – June 2010 (Section 2.6)
   - The first trader field study (type 2) aimed to establish the viability of the planned measures in the field setting; to provide a working definition of performance episode for the next stage of research; to provide a rich description of the interplay of trader behaviour, emotion arousal and emotion regulation across a performance episode and to examine qualitative differences in emotion and emotion regulation responses between less experienced and expert traders during live trading. Combined with the exploratory interviews this study pointed both to the importance of domain specific approaches to emotion regulation whilst trading and the role of anticipatory arousal in preparing for scheduled market news events and informed the design of TFS2.

7. TFS2 Trader Field Study 2: June – July 2010 (Section 2.7)
   - The second trader field study (type 2) adapted the measures and protocol based on the findings from TFS1 and extended the scope to include a wider sample of subjects drawn from two investment banks. This study provides an empirical basis for understanding the relationship between trader expertise, susceptibility to biases and emotion regulation. Combined with the exploratory interviews this study pointed both to the importance of domain specific approaches to emotion regulation whilst trading and the role of anticipatory arousal in preparing for scheduled market news events. The findings from TFS1 and TFS2 feed into the design of learning interventions that use HRV as a proxy for emotion regulation described in D18.

8. WP2 wkshp: Yr2 Games Design Workshop for WP2: August 2010 (Section 2.9)
This workshop built on the studies conducted during the first half of yr2 to come up with design and implementation plans for games that could be trialled in yr2 and used as part of the learning interventions in yr3.

9. IFS3 Preliminary Disposition Effect Study for Intervention Cohort: July 2010 – Feb 2011 (Section 2.8)

This type 1) lab based study demonstrated, mathematically, the correlation between disposition effect and reduced investor performance in financial decisions. It also showed that professional traders suffered significantly less from the disposition effect than private investors. The findings confirmed that disposition effect is a good emotional response to target and that traders may be used as a benchmark for investors. This study fed into the design of the two-index game and the type 2) field studies conducted at the Trader Expo conference in March 2011, to be described in part 3 of D20. The disposition effect studies inform the design of the yr3 learning interventions aimed at addressing the disposition effect, including the online diagnostic tool and the two-index game.

10. RS1: Regret Study 1: Feb – July 2010 (Section 2.10)

The first Regret Study was a type 1) lab-based study to assess the effect of regret feedback information on a cohort of students engaged in auction tasks. It aimed to see whether feedback would induce regret, and if so, whether the induction of regret would influence decision-making in the auction task. This study informed the design of RS2.

11. RS2 Regret Study 2: July – December 2010 (Section 2.11)

Regret study 1 showed a strong influence of the emotion regret on decision making with induced values. The second regret study (type 1 lab-based study) aimed to verify that these findings would be repeated when participants were faced with financial decision making under conditions of uncertainty. It also gave a deeper understanding of the role of anticipated regret on financial decisions. The findings from the two regret studies have informed the design of the yr3 Intervention Study 4 (IS4) and will feed into the design of the yr3 learning interventions in which awareness of the role of regret in financial decision making is addressed.

12. IS5 Emotion Induction Experiment: October 2010 – February 2011 (Section 2.12)

This type 1) lab study use pictures from the International Affective Picture System (IAPS) and music to induce levels of high arousal, and instructed participants to use either reappraisal or suppression to regulate their levels of arousal whilst engaged in the auction game. This was to determine whether reappraisal or suppression had an impact on financial decision making and feeds into the yr3 auction game work.

13. IS3 Investor Emotion Regulation study (Aiming Game): October – December 2010 (Section 2.13)

This type 2) field study used an aiming game to investigate whether participants (investors at the NIC conference) who received explicit emotion regulation instructions are able to effectively manage their arousal levels and thereby perform better in the game. Feedback on emotional arousal during the game was provided by an EPOC headset which disturbed the targets as the subject became more aroused and therefore made it more difficult to hit them. If the subjects successfully managed their arousal levels, the targets became less blurred and easier to hit. (16 participants). This study feeds into the design of learning interventions that incorporate arousal regulation in their pedagogical approach and informed the Emotion Regulation and Performance Study.

Following on from the IS3, Investor Emotion Regulation study, this type 1) lab-based study assessed whether the aiming game could be effectively used to train up-regulation; 20 participants participated. This study feeds into the design of learning interventions in yr3 that incorporate arousal regulation in their pedagogical approach. The findings from this study will inform the design of the yr3 learning interventions that incorporate the aiming game as a way of training emotional regulation.

These studies, together with a summary of their findings, are described in the sub-sections following.
2.2 IS1: Mindfulness Study with Business Students

This study was a Type 1) Lab-based study aiming to validate the literature that showed that short-term mindfulness interventions could be an effective technique to help manage emotions and improve attention. (212 business student participants Apr – Aug 2010)

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<td>Study Title</td>
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<td>Start and End Date</td>
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<td>Research Questions</td>
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<td>Link to past studies</td>
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<td>Link to future studies</td>
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<td>Methods used</td>
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<td>Number of Subjects</td>
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<td>Background of subjects</td>
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<td>Length of intervention</td>
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<td>Type of intervention</td>
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<tr>
<td>Web link to resources</td>
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<tr>
<td>Status of analysis</td>
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<tr>
<td>Reports available</td>
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</table>
Summary of findings

As expected, the mindfulness groups demonstrated higher levels of state mindfulness, and awareness to bodily signals during the experiment. There were no differences between the three exercises in their effectiveness. Additionally, the groups did not differ with respect to trait mindfulness or dispositional emotion regulation, so the effects were short-lived as expected. Students were not skeptical or negative about the mindfulness inductions. No differences were observed between groups on the BART task. One explanation for this lack of effect on risk taking may be that the BART task was at the end of the study (which lasted about an hour), and effects of a short interventions may have worn off at that time, or that the BART task is not sensitive. We conclude that mindfulness inductions can be effectively applied in our student population. Another implication is that a more sensitive risk taking task is required in order to find effects of short mindfulness inductions, and that risk taking tasks should be scheduled relative close to the mindfulness induction.

The findings from this study demonstrated the effectiveness of short-term mindfulness inductions on a student population engaged in a non-financial task. The next step was to test the efficacity of mindfulness inductions with a financial decision making task. This study fed into the design of MF-1

2.3 MF-1: Mindfulness Study with Financial Decision Making

This study build on the findings from IS1 and aimed to show that mindfulness training could be an effective technique for improving financial decision making. (50 participants Oct – Dec 2010)

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<td>Study Title</td>
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<tr>
<td>Start and End Date</td>
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<tr>
<td>Research Questions</td>
</tr>
<tr>
<td>Link to past studies</td>
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<tr>
<td>Link to future studies</td>
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</tbody>
</table>
Methods used

Students were divided into two groups. All received one of the following audio fragments: meditation with breathing (experimental groups) or a chapter from Lord of the Rings (neutral condition). Following, they completed several questionnaires on mindfulness, body vigilance, a STROOP-task (attention) and a financial risk-taking task (Columbia Card Task).

Number of Subjects

50 (approx. 25 per group)

Background of subjects

Students Business Administration

Length of intervention

10 minutes

Type of intervention

Audioclip of a mindfulness exercise

Web link to resources

None available online, though all measures are readily available from the main researchers

Status of analysis

Completed

Reports available

A short internal report containing a brief summary of the findings was written. As with all the current mindfulness studies in xDelia, we will combine the output of the studies in one higher-impact article rather than seeking smaller publications.

Summary of findings

Replicating the findings from our earlier work, the mindfulness groups demonstrated higher levels of state mindfulness, and awareness to bodily signals during the experiment. In addition, this study showed borderline significant positive effects of mindfulness on performance in an attention task (STROOP task). Finally, on the Columbia Card Task, both groups performed equally well in terms of financial performance. However, the mindfulness group did process more information before making financial decisions. Mindfulness thus proves a likely intervention candidate for improving performance in financial decision making. One implication of the study is that the decision making task should be more stressful in order to become more sensitive to mindfulness inductions.

The findings from this study confirmed the findings from IS1, suggesting that mindfulness was a good candidate for learning interventions to improve financial decision making. The findings suggested that the decision-making task needed to be more stressful in order for the mindfulness intervention to be effective and fed into into the design of IS2.2.

2.4 IS2.2 Investor Mindfulness Study - Columbian Card Task

This study aimed to evaluate whether a short mindfulness induction affects financial risk-taking in a stressful version of the Columbian Card Task game and how performance in the Columbia Card Task game relates to real-world performance using investors attending the NIC conference. (22 participants Oct – Dec 2010)
<table>
<thead>
<tr>
<th>Study Title</th>
<th>IS2.2 Effects of mindfulness on financial decision-making in a sample of investors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start and End Date</td>
<td>October 2010 – December 2010</td>
</tr>
<tr>
<td>Research Questions</td>
<td>Does a short mindfulness induction effectively impact financial risk-taking on a stressful version of the Columbia Card Task? How does performance in the Columbia Card Task relate to self reported real-world performance?</td>
</tr>
<tr>
<td>Link to past studies</td>
<td>In earlier WP2 studies, we showed that mindfulness could be effectively applied within students samples. This is the first study to explore the effects of mindfulness in the target population (i.e. private investors). Moreover, the Columbia Card Task was revised based on earlier work to be more stressful, which is more representative of real-world financial decisions. We also measured salivary hormone levels (testosterone and cortisol) to explore neurobiological mechanisms for mindfulness effects on decision-making, and we examined links between real-world investment portfolio performance and Columbia Card Task performance to determine whether the Columbia Card Task taps into real-world financial decision-making skills.</td>
</tr>
<tr>
<td>Link to future studies</td>
<td>This study informs whether real-world financial decision-making can be influenced in investors via the mindfulness intervention.</td>
</tr>
<tr>
<td>Methods used</td>
<td>Upon arrival in a secluded room at the conference, participants were randomly assigned to the experimental group (mindfulness induction: 10 minutes meditation and breathing exercises) or the control group (listening to a Lord of the Rings audioclip). Next, they provided a saliva sample to measure hormonal levels. Finally, participants received a set of online questionnaires on mindfulness, investment history, and they completed the Columbia Card Task.</td>
</tr>
<tr>
<td>Number of Subjects</td>
<td>22</td>
</tr>
<tr>
<td>Background of subjects</td>
<td>Participants were private investors at the World Money Show in London (2010). Participation was voluntary, although they did receive a book as a reward.</td>
</tr>
<tr>
<td>Length of intervention</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Type of intervention</td>
<td>Mindfulness induction with a strong focus on breathing and becoming attentive to bodily signals</td>
</tr>
<tr>
<td>Web link to resources</td>
<td>All resources are readily available from the main researchers (M van Overveld &amp; P Mehta)</td>
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<tr>
<td>Status of analysis</td>
<td>Completed.</td>
</tr>
<tr>
<td>Reports available</td>
<td>Only a summary of the main findings was written. No paper or full article will be written as the sample size is too small for adequate publications in scientific journals. Yet, these data are still under consideration for inclusion in a combined article on the effects of mindfulness. The summary report is available from the main researchers (M van Overveld &amp; P Mehta) and main findings have been reported on the project wiki: <a href="http://xdelia.fzi.de/index.php/WP2_National_Investment_Club_Conference:_13Nov2010">http://xdelia.fzi.de/index.php/WP2_National_Investment_Club_Conference:_13Nov2010</a>.</td>
</tr>
</tbody>
</table>
Summary of findings

Decision-making on the Columbia Card Task was associated with real-world investment performance. The better the investment performance in the past 12 months, the more normative decision-making was demonstrated on the Columbia Card Task. Moreover, hormone changes were related to the stronger performance. No differences were observed between the mindful and non-mindful participants. There were several situational artifacts that may explain this latter finding. The implications of this study are that the Columbia Card task proves an externally valid task for future xDelia lab studies and that mindfulness seems a viable intervention in private investors.

The findings from this study showed an association between decision-making on the Columbia Card Task and real-world investment performance, with both improved investment performance and hormone changes related to stronger performance in the CCT. The implications of this study are that the Columbia Card task proves an externally valid task for future xDelia lab studies. During the post-interviews conducted by WP6, some investors reported that the 3-card CCT was not sufficiently challenging so a more complex 5 or 7 card CCT would be a useful format to try. Mindfulness remains a valid intervention based on its link to real-world investment. Together with MF-1, IS2.2 feeds into the MF-2 study on emotions and stress during decision-making initiated in M24 and currently ongoing, and into yr3 mindfulness studies S-M6, S-M7 and S-M8 and ultimately into the design of a mindfulness course aimed at the target group, Investors.

2.5 WP2 Sensor Training Workshop

This workshop was a knowledge sharing activity to teach WP2 researchers to be able to manage and use the HRV sensors in the field during the Trader Field Studies to collect data. Traders are a limited resource, and it was therefore of critical importance to ensure that each data collection opportunity was used effectively and that data was stored securely. It is important to be able to set up the sensors and attach them properly to the chests of participants as mistakes in the setup may result in no data being recorded, and mistakes in application may result in artefacts or so much ‘noise’ that the data collected is unusable. It is also important to develop research protocols to download and backup the data in the field, and for all researchers present to be able to step in and carry out every aspect of the data collection.

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<td><strong>Institution Name</strong></td>
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<tr>
<td><strong>Workshop Title</strong></td>
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<td><strong>Start and End Date</strong></td>
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<tr>
<td><strong>Aims</strong></td>
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<tr>
<td><strong>Link to future studies</strong></td>
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<tr>
<td><strong>Methods used</strong></td>
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</tbody>
</table>
The WP2 researchers then developed and practiced the research protocols and sensor handling skills during pilot studies with colleagues before taking them into the field during TFS1 and TFS2.

### 2.6 TFS1: Trader Field Study 1

This first field study was conducted with traders on the Saxo bank. It was a first opportunity to test out the methods of collecting physiological data in a real-world trading floor and to explore the relationship between planned news events and trader behaviour and emotional arousal and regulation as measured by HRV.

<table>
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<th>Evaluation Data</th>
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<tbody>
<tr>
<td>downloaded HRV data and viewed the resulting traces.</td>
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<table>
<thead>
<tr>
<th>Number of Subjects</th>
<th>8 – 4 sensor experts and 4 other partners</th>
</tr>
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<tbody>
<tr>
<td>Background of subjects</td>
<td>WP2, WP4, WP5, WP6</td>
</tr>
<tr>
<td>Length of intervention</td>
<td>1 day</td>
</tr>
<tr>
<td>Web link to resources</td>
<td>xDelia Wiki <a href="http://xdelia.fzi.de/index.php/Traders_Study_-_Sensor_Training">http://xdelia.fzi.de/index.php/Traders_Study_-_Sensor_Training</a></td>
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<tr>
<td>Status of analysis</td>
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<tr>
<td>Reports available</td>
<td>n/a</td>
</tr>
<tr>
<td>Summary of findings</td>
<td>n/a</td>
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</table>

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### 2.6 TFS1: Trader Field Study 1

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episodes to capture the nature of their thinking and decision processes.

Video and audio data were brought together with moment by moment data on market price, trading positions, heart rate and heart rate variability using the software ‘Observer XT’.

The period of data capture for each trader included at least one important scheduled news release, enabling us to pay particular attention to an event likely to move market prices.

The data was used to develop a rich picture of the physiological responses of traders to market events and provide an early test the value of physiological data in highlighting areas of concern in traders’ self-regulation.

### Number of Subjects
- expert/inexperienced pairs

### Background of subjects
- Professional traders

### Length of intervention
- data collection periods spread across 4 days

### Web link to resources
- xDelia Project Wiki
  - [http://xdelia.fzi.de/index.php/In_depth_Trader_Study_1](http://xdelia.fzi.de/index.php/In_depth_Trader_Study_1)

### Status of analysis
- Complete

### Reports available

### Summary of findings
1. Despite some problems with noisy data the sensor technology operated well in this setting and was clearly viable for measurement purposes and acceptable to study participants.
2. Think aloud data showed novices to be much preoccupied with the detail of trading and suffering significant cognitive overload while the expert trader was concerned mostly with a strategic overview of market conditions.
3. We found major differences between physiological reactions of the novices and more experienced traders to market events.
4. We established the importance of scheduled news releases as providing easily identifiable market events when physiological reactions to market events can be examined at a fixed point in time and over a predictable timescale. This is important both for further research but also for the design of feedback mechanisms.
5. We established expectations for later studies and development of feedback mechanisms about the timescales over which cardio-responses to market events unfold.
6. Combined with the exploratory interviews this study pointed both to the importance of domain specific approaches to emotion regulation whilst trading and the role of anticipatory arousal in preparing for scheduled market news events.

The findings from TFS1 were analysed and important differences in emotional regulation demonstrated between novice and experienced traders. Some of the data collection techniques
proved unscaleable, for example collecting video data, or unsuitable, for example getting traders to use the think-aloud protocol during rapid trading. The findings and insights fed into the design of the larger Trader Field Study 2.

2.7 TFS2: Trader Field Study 2

The second trader field study used the measures and research protocols used in TFS1, but adapted them based on the findings from TFS1, and extended the scope to include a wider sample of subjects drawn from two investment banks. It examined the relationship between emotion regulation and performance both at the individual level and at the level of performance episodes. The study consisted of two components, a between trader comparison in which the individual trader was the unit of analysis and a within trader comparison in which performance episodes clustered within traders.

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<td><strong>Study Title</strong></td>
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<td><strong>Start and End Date</strong></td>
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<td><strong>Link to past studies</strong></td>
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<td><strong>Link to future studies</strong></td>
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<tr>
<td><strong>Methods used</strong></td>
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Not all data was usable since over the course of a day sensor electrodes can be dislodged. In total we captured usable data on 153 trader-days of trading activity. The primary research question concerned the relationship between emotion regulation as measured by heart-rate variability and trader expertise.

<table>
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<tr>
<th>Number of Subjects</th>
<th>28</th>
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<tbody>
<tr>
<td>Background of subjects</td>
<td>professional traders</td>
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<tr>
<td>Length of intervention</td>
<td></td>
</tr>
<tr>
<td>Type of intervention</td>
<td>Field study conducted on the trading floor of a bank</td>
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<tr>
<td>Web link to resources</td>
<td>xDelia Project Wiki</td>
</tr>
<tr>
<td>Status of analysis</td>
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</tr>
<tr>
<td>Summary of findings</td>
<td>The primary research question concerned the relationship between emotion regulation as measured by heart-rate variability and trader expertise.</td>
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</table>

The fundamental premise that underpins the xDelia project is that emotions and emotional regulation play a key role in financial decision making. TFS2 provided quantitative evidence to validate this premise, and demonstrated the viability of heart rate variability as a physiological measure of emotional regulation. The findings from TFS1 and TFS2 findings will feed into the learning interventions being designed in yr3.

### 2.8 IFS-3 Preliminary Disposition Effect Study

This study was conducted in order to establish, quantitatively, whether the disposition effect had a negative impact on investor performance and to develop mathematical formulae that would measure it. It used a large sample of over 3000 investors and compared the evidence with data collected from professional traders to see whether there was any difference in the way the disposition effect was manifest in the two groups.

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<td>Work Package(s)</td>
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<td>Study Title</td>
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<td>Start and End Date</td>
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This study examined four questions:
1) Does the disposition effect reduce investor performance?
2) How might the disposition effect be effectively measured in trading data for large numbers of trades in ways which are meaningful at the level of the individual investor?
3) W.r.t., what can be said about the mathematical form of biases manifest in data which relate to the disposition effect?
3) Does the disposition effect manifest differently in professional traders than in the target cohort (investors)?

These questions were addressed through theoretical analysis, simulation and empirical test on the trading data of over 3000 investors.

This work is the basis for measurement of disposition effect in the two index game and for providing investors feedback on their trading behaviour.

Mathematical analysis, statistical simulation, statistical data analysis.

3000

Professional Traders

Complete

Results are reported in two working papers:

1. A novel algorithm and data processing approach was developed for measuring disposition effect in high frequency trading data and during gameplay, based on more precise computations of temporal effects in decision-making.

2. Disposition effect is associated with reduced investor financial performance both in simulation and in empirical tests, which bear out what may be already demonstrated in mathematical analysis.

3. Mathematical form (power law behaviour) of temporal bias in decision-making under disposition discovered

4. Professional traders show markedly lower disposition effect than private investors. Trading frequency was shown to be related to the level of disposition effect among private investors.

The findings from IFS-3 confirm that the disposition effect is a valid target for learning interventions aiming to improve investor performance and suggest that professional traders are a useful “expert case”. The mathematical formulae developed through this study can be used in the games that aim to detect and address disposition effect (the two-index game).
2.9 YR2 Games Design Workshop WP2

This workshop was conducted in M18, halfway through the project. Its aim was to combine the findings from the studies conducted by the xDelia partners to come up with a set of games that could realistically be developed and tested within a fixed timeframe.

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**Methods used**
1. Whole group discussions to come to a shared understanding of the types of games that could be designed, the sorts of sensor feedback and its role and the financial issues that needed to be addressed. This was followed by small group work.
2. Four groups of 4 were constituted, each consisting of at least one person with experience in trading/investing and one person from the games design side.
3. Two groups focused on games to train emotional regulation.
4. Each group came up with up to 2 games ideas to be elaborated into playable prototypes that could be technically specified.
5. The whole group then met again to share their games ideas and select specific games that could be shortlisted for prototyping.
6. The selected games would be specified in detail with tasks and dependencies defined.
7. Tasks were allocated between the xDelia partners to a detailed timescale to ensure that there was something available for the October interim review.

**Number of Subjects**
- Host - Saxo Bank (WP2): 4 participants
- OUBS (WP2): 2 participants
- BTH (WP4): 5 participants
- FZI (WP2 & WP5): 2 participants
- Erasmus (WP2): 1 participant
- OU-IET (WP6): 1 participant
- CIMNE (WP1): 1 participant

**Background of subjects**
- WP1, WP2, WP4, WP5, WP6

**Length of intervention**
- 2 days

**Web link to resources**
Records stored on the project wiki
http://xdelia.fzi.de/index.php/WP2_Games_Workshop_2010

**Status of analysis**
- Complete

**Reports available**
- Games implemented and used in subsequent studies
Summary of findings

Four main games were defined:
- 1st Person Shooter
- Brain ball game (may be linked with 1st person shooter)
- Two Index game (the only game on cognitive biases. It was deemed easy to implement and had a clear link to the application domain of financial decision making)
- Disposition Farm
- Auction Game
- Guitar hero arousal

Three games were developed into playable prototypes:
- 1st person shooter which became the Aiming Game used in IS3 study at the NIC conference
- Two-index game which will be used in the Traders Expo Conference in Yr 3
- Auction game which is being used as a feedback tool in yr3 in study S-M5

The Yr2 Game workshop at Saxo Bank, Denmark, built on the lessons learned in the yr1 Games workshop in Sweden. The yr1 workshop had leveraged the expertise of non-games partners to come up with game prototype ideas which they created as playable table-top prototypes. However because the non-games partners lacked the games design expertise, the prototypes did not incorporate many of the important elements that needed to be addressed because the greatest effort went into making the game. Thus it had proved difficult for the games designers to turn these ideas into games would address the financial biases that were the focus of the project.

The yr2 games workshop therefore focused on coming up with concrete designs for games that could be technically specified so that development effort from the different partners could be accurately scheduled. Partners took responsibility for specific areas of work and agreed to a delivery timetable that would give the project some tangible games by the October Review. The selected games have been prototyped, tested, built and incorporated into a range of WP2 studies. These games will form key components of the learning interventions being designed and delivered in yr3.

2.10 RS1: Regret Study 1

Regret Study 1 investigated the effect of giving positive and negative feedback to students engaged in an auction task. It aimed to see if negative feedback would induce the emotion of regret, and if so, whether this emotion would have an impact on subsequent decisions made in the auction task.

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### Research Questions

- Does negative feedback information induce the emotion regret?
- Does the induction of regret influence decision making in an auction task?
- Is there a difference in efficiency and outcomes between different emotion regulation strategies?

### Link to past studies

Emphasis is on regret because it is rated as being the most intense of all negative emotions (Zeelenberg and Pieters, 2007). Engelbrecht-Wiggans, R., Katok, E (2008) state that winner and loser regret, induced by simple feedback information, are main drivers for subjects’ behavior in Simple Financial Markets such as Auctions. Lee, Kräussel and Paas (2009) state that there is a strong effect between Anticipated and Experienced Regret and Pride on investors’ future selling decisions.

Gross (1998) has developed a process model of emotion regulation, which is widely known and acknowledged in the field of emotion regulation studies. The broadest distinction by Gross of these strategies is dividing them into antecedent- and response-focused emotion regulation strategies. Then the two emotion regulation strategies reappraisal and suppression will be analyzed in particular, as they are the most important strategies in economic situations. The intention here is to find efficient regulation strategies for emotion regulation. Both the Emotion Regulation Questionnaire (ERQ) and physiological measures (Skin Conduction Response and Heart Rate Variability) are used.

### Link to future studies

Newer studies already show that loser and winner regret also have a major impact in the financial decision bias: disposition effect

### Methods used

Participants receive in each of the 50 auction tasks one induced private value. Subsequently they can place a bid. In case they win the auction they gain value – bid. In case they lose the auction they receive 0.

Laboratory experiment with students, additionally to economic behavior measurement of physiological data such as heart rate (HR), heart rate variability (HRV) and skin conductance response (SCR). In all of the experiments real money was used as an incentive for good performance.

### Number of Subjects

76 (24 loser regret induction, 24 winner regret induction, 30 without regret induction)

### Background of subjects

Students in their undergraduate years. 48 out of 78 with background in economics.

### Length of intervention

Single feedback information after each auction task. Depending on treatment group participants learned after the auction outcome, in case they lost - the highest bid and “missed opportunity to win” (loser regret) or – in case they won -the second highest bid and the “money left on the table” (winner regret). Each treatment subject participated in 50 consecutive auctions.

### Type of intervention

Feedback information

### Web link to resources

Written up study analysis on the xDelia wiki. Paper can be found on the xDelia SVN.

### Status of analysis

Finished
Results have been published on European Conference on Information Systems (ECIS) 2011 in Helsinki. Acceptance rate of 31%.

Showing regret feedback information induces strong levels of regret into participants. This reveals participant self-perception as well as bidders high-physiological responses to the information. Moreover, regret has a significant influence towards participants’ behavior in the task. Regret from feedback after losing an auction task leads to significantly worse decisions compared to regret from winning an auction task to high. Physiological data reveals a strong asymmetry between regret from winning at an unfavorable price compared to losing when it might have been possible to win. This is a potential explanation for several biases in financial decision making such the disposition effect.

Of all 78 subjects, 28 could be identified using suppression strategies for emotion regulation. A simple regression reveals that these subjects come to significantly more aggressive bids and hence worse decisions compared to the rest of the population (p<.064). This is not the case for subject using reappraisal strategies (n=57). Reappraisers seem to be able to more quickly down-regulate negative high emotionality after negative feedback information. An overestimation of regret after losing leads to worse financial decision making compared to adequate processing of regret.

RS1 showed a strong correlation between feedback and the emotion of regret, and linked this emotion to poorer subsequent financial decisions. In particular, it showed that regret feedback from losing an auction task had a significantly worse effect of subsequent performance than regret feedback from winning an auction task with too high a bid.

### 2.11 RS2: Regret Study 2

RS2 was a type 1) lab-based follow-up economic experiment that incorporated psychophysiological measures to analyse the impact of regret on decision making. It used a questionnaire and HRV to categorise participants into emotion suppressors and emotion reappraisers to see how their decisions differed depending on whether they were given “winner” or “loser” feedback on their performance, and whether they would reflect on their decisions and learn from them.
### Research Questions

Does the strong influence of regret feedback mechanism also persist under more realistic assumptions with increasing levels of uncertainty? Does regret increase with level of uncertainty?

Are suppressors more exposed to uncertainty compared to reappraisers? Does the difference in financial performance between varying emotion regulation strategies persist in a more realistic setting?

### Link to past studies

Loewenstein and Weber (2001) state that emotions should result especially as instantaneous visceral reactions to levels of uncertainty. Regret Study 1 (RSI) could already show a strong influence of induced regret feedback information towards participants’ behavior. This study takes one step closer to reality, since financial markets always also incorporate high levels of uncertainty.

Since RSI already could show that suppression strategies lead to worse financial decision making compared to reappraisal strategies, it will be interesting whether this effect persists in this experimental study.

### Link to future studies

Intervention study 4 (IS4) will explore the effectiveness of varying regret feedback information in a real financial decision task, the disposition effect. The study will reveal the effectiveness of regret feedback information to help subjects learning to deal with the emotion of regret. A growing number of studies state a strong influence of regret towards financial tasks, especially the disposition effect (Lee et al., 2009, Fogel et al., 2006).

### Methods used

Laboratory experiment, additionally to economic behavior measurement of physiological data such as heart rate (HR), heart rate variability (HRV) and skin conductance response (SCR).

Participants receive in each of the 50 auction tasks one induced private and common value. The common value is not known previously and represents the uncertainty in the task. Subsequently they can place a bid. In case they win the auction they gain value – bid. In case they lose the auction they receive 0. Again there is a regret treatment group and a control group. Each subject in both treatment groups was exposed to three levels of uncertainty (0, 1, and 2).

### Number of Subjects

60 (30 with regret induction, 30 without regret induction)

### Background of subjects

Students in their undergraduate years. 32 with background in economics, 28 without background in economics.

### Status of analysis

Finished

### Reports available

Regret feedback information.

### Summary of findings

Higher levels of uncertainty increase risky behavior and hence increase subjects’ experienced regret. However, regret is only experienced when winning at a favorable price would have been possible.

In this study 42 subjects could be identified as reappraisers, 16 could be identified as suppressors. However, in this study there are no significant differences in financial performance between subjects using reappraisal and suppression strategies.
RS1 showed a strong influence of the emotion regret on decision making. RS2 aimed to verify that these findings would be repeated when participants were faced with financial decision making under conditions of uncertainty. It gave a deeper understanding of the role of anticipated regret on financial decisions. The findings from the two regret studies can be linked up to the Preliminary Disposition Effect study IFS3 and inform the design of the yr3 IS4 studies and learning interventions which focus on addressing the impact of the disposition effect on financial decision making.

2.12 IS5: Emotion Induction Experiment

IS5 aimed to use pictures to raise levels of arousal, and to then instruct participants to use either reappraisal or suppression to regulate their levels of arousal whilst engaged in the auction game. This was to determine whether reappraisal or suppression had an impact on financial decision making.

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Background of subjects | Students, most in their undergraduate years. 63 with background in economics, 45 without.
---|---
Length of intervention | Picture induction 10 seconds, music induction 45 seconds.
Type of intervention | Pictures and music
Web link to resources | Not yet available
Status of analysis | Finished
Reports available | Written up but not published
Summary of findings | Pictures and Music are useful stimuli to induce levels of high arousal. Participants in the arousal treatments reported strong levels of valence and arousal measured with the affect grid (Russel 1989). This is supported by participants’ high levels of skin conductance in the arousal treatments. Moreover, participants in the highly arousing treatment take significantly more risky decisions compared to the control group.

86 subjects were identified as reappraisers, 38 as suppressors. Again, and in line with RS1, subjects identified as suppressors place significant more aggressive bids and their financial performance is worse compared to subject using reappraisal strategies or to subjects that could not be classified.

The findings from this study feed into the yr3 studies into how the auction game can be deployed as part of a learning intervention.

### 2.13 IS3: Investor ER - Aiming Game

This study used an aiming game to investigate whether participants (investors at the NIC conference) who received explicit emotion regulation instructions are able to effectively manage their arousal levels and thereby perform better in the game. Feedback on emotional arousal during the game was provided by an EPOC headset which disturbed the targets as the subject became more aroused and therefore made it more difficult to hit them. If the subjects successfully managed their arousal levels, the targets became less blurred and easier to hit.
At BTH, the Aiming game was developed where the player’s arousal levels directly impact game performance. Hence, the more aroused participants are, the more targets become blurred and thus will be more difficult to aim and shoot. In this study, it was investigated whether participants who receive explicit emotion regulation instructions can effectively manage arousal levels and thus, perform better in the game.

This experiment informs whether emotion regulation impacts performance on an arousal based game. Hence, it is tested whether the game effectively detects the effects of emotion regulation. This is particularly important as this game may form part of the learning package as a tool for effectively learning to regulate one’s emotions.

Upon arrival in a secluded room at the conference, the EPOC (combination of EMG/EEG) was calibrated. The EPOC is used to measure participants’ arousal while playing the game. Then, participants completed the Emotion Regulation Questionnaire ERQ (Gross and Gross, 2000) Next, they were divided into two groups (with/without explicit emotion regulation instructions) and played the aiming game. Afterwards, several short questions were completed on investing history.

Participants are investors and traders at the World Money Show in London (2010). Participation was voluntary, although they did receive a book as a reward.

The game is not web-based, and is not on the web. All resources are readily available from the main researchers (M van Overveld & P Mehta)

Only a summary of the main findings was written. No paper or full article will be written as the sample size is too small for adequate publications in scientific journals. The summary report is available from the main researchers (M van Overveld & P Mehta) and main findings have been reported on the project wiki [http://xdelia.fzi.de/index.php/WP2_National_Investment_Club_Conference_13Nov2010](http://xdelia.fzi.de/index.php/WP2_National_Investment_Club_Conference_13Nov2010)

Emotion regulators were not more effective in shooting the targets than non-regulators. However, emotion regulators did report lower subjective arousal levels, but not on objective arousal measurements (EPOC). We speculate that since the EPOC may not have adequately detected differences in arousal levels, both groups received similar distortions throughout the game. The main implication is that the aiming game and the sensor to measure of arousal require further calibration in terms of sensitivity.
2.14 Emotion Regulation & Performance study: Aiming Game

This study was undertaken to complement the IS3 investor study, to obtain further information about the usefulness of the aiming game in using bio-feedback to improve emotion regulation, and to identify whether emotion regulation can be successfully trained in this way.

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| Research Questions | Can the Aiming Game help players in learning to identify and experience their emotional state?  
Can the Aiming game be used to improve players’ capability to regulate emotions?  
Can Emotion Regulation be trained in order to increase performance in stressful game tasks?  
Are emotion regulation capabilities, trained with the Aiming Game, transferable to real world setting? |
| Link to past studies | This study is an addition to the study performed at the London MoneyShow Investor Conference 2010 which also takes into consideration whether up-regulation can be trained using the Aiming Game prototype. |
| Link to future studies | Not yet available. |
| Methods used     | Laboratory experiment. |
| Number of Subjects | 20 |
| Background of subjects | Game development students |
| Length of intervention | 20-30 min in lab |
| Type of intervention | Questionnaire (ERQ) + Experiment |
| Web link to resources | In progress |
| Reports available | Not yet available. |
| Summary of findings | Not yet available. |

The findings from this study inform the redesign of the aiming game into its new guise as the Space Investors game.

2.15 WP6 NIC Investor Interviews

The investor interview study was conducted at the same time as the games studies MF-2 and IS3 at the National Investment Club Conference. As investors came out of the games room, they were invited to take part in an interview to give further information about their experiences and about their impressions of the goals of the xDelia approach. The findings complemented the data collected during the studies and was fed back to inform the design of the next field study at an investor conference, the Traders Expo in March 2011.
The findings from the investor interviews complemented the findings from the studies it ran alongside and are described in more detail in Section 5.1.

## 2.16 Learning Intervention Design Meeting

This partner meeting was held in M23 as defined in the DoW, milestone 2.5, to specify the learning interventions, identifying the role of each partner in implementing, piloting and evaluating the
interventions. A detailed plan of work was created incorporating key evaluation milestones and internal dependencies and deliverables.

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<td><strong>Summary of findings</strong></td>
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After this meeting, all partners worked on different aspects of learning intervention specifications, detailing timescales and tasks that could be fed into the DoW and the deliverables. As a result a detailed plan of work has been drawn up for Yr3 in which all resources are used effectively and all dependencies highlighted such that any delays will be identified and the impacts addressed in a timely manner.

### 2.17 Implications for Year 3

As the project moves into year three, the findings and outputs from the different types of project interventions have come together to produce a coherent approach to the design of learning interventions that will address the role of emotions in financial decision making.
2.17.1 Trader Field Studies

The Trader Field studies (TFS1 and TFS2) demonstrated the effects of stress on financial decision making in professional traders and highlighted a distinction between novice and expert traders. As a result of the interim review, the project has focused on the investor case, using the findings from the trader studies as the benchmark to inform the design of the learning interventions for investors. The trader field studies have demonstrated the usefulness of HRV as a proxy for emotion regulation and this feeds into the design of yr3 games that use HRV to give feedback on arousal states.

2.17.2 Mindfulness Studies

The investigations into the role of mindfulness (IS1, MF-1 and IS2.2) have progressed from type 1) lab-based studies using students through to type 2) field studies using members of the target population and authentic financial tasks. The outcomes from the mindfulness studies IS1, MF-1 and IS2.2 together with the findings from the disposition effect study IFS3 have identified mindfulness techniques alongside emotion regulation training as means of addressing the disposition effect as diagnosed through the two-index game. This will inform the design of a learning interventions that use mindfulness techniques to help investors to reduce their susceptibility to the disposition effect.

2.17.3 Regret Studies

The disposition effect refers to the tendency for traders to hold on to losing positions for longer than winning positions. Holding on to losses delays the realisation of the loss and consequent regret. This can maximise losses and minimise gains. The emotion of regret is an important factor in the disposition effect. If we can teach investors to recognise and counteract the disposition effect, they should be able to improve their performance.

The two regret studies, RS1 and RS2 showed a strong influence of the emotion regret on decision making. They have improved our understanding of the role of anticipated regret on financial decisions and their findings link up to the Preliminary Disposition Effect study IFS3 to inform the design of the yr3 IS4 study which focuses on the impact of using an emotion regulation learning intervention to improve the disposition effect in our target audience of investors.

2.17.4 Aiming Game Arousal Studies

The studies on arousal (IS5 and Emotion Regulation and performance Study) established the validity of feedback as a tool to train how to regulate emotions. The aiming game enables the player to monitor their own physiological arousal and thus recognise their emotional state. The aim is to use the game feedback to learn how to regulate their arousal. We then need to establish that the emotion regulation skills that give rise to improved performance in an aiming game can be translated to the real world setting of investment and trading. In yr3, Study S-M6 tests whether learned emotion regulation skills can be transferred to tasks involving financial decisions such as the auction game and the two-index game.

2.17.5 Representing the Learning Interventions in Yr 3

In order to fit the findings and outputs from these individual studies into an holistic overview that will successfully address the informal learning needs of our target group of investors, we need a way of representing our ideas and designs. WP6 have developed a set of learning design representations to make the learning interventions more explicit and shareable. Section 3 briefly describes the
Conceptual Learning Design Views that will be used in yr3 to take the work forward, using one example of a learning intervention for the investor case.
3 Design for Learning Interventions

The D&E framework gives us a framework with which to report on the project. However part of the task of evaluation is to make the whole process of the project explicit. One of the outcomes from the yr2 studies, and one of the contributions WP6 has made to the project is to articulate the design of the learning interventions through a series of Conceptual Learning Design Views. These views are based on a tool developed as part of the OU Learning Design initiative (Conole, 2010) to define the components that will go to make up the a learning intervention. There are five Learning Design views – course man, course dimensions, learning outcomes, pedagogy profile and task swimline. Together they provide a holistic representation of the learning intervention. One example learning design view for the Investor case has been worked up and is reproduced below. This is one of the learning interventions that will be carried out in yr 3. It is derived from and incorporates elements of the yr 2 studies described earlier.

3.1.1 The disposition effect learning intervention

The yr2 xDelia studies have verified that the disposition effect is one that is detrimental to investment performance but that has the potential to be improved through a learning intervention. The following sections use a series of conceptual design views to foreground the separate components that will constitute the learning intervention, revealing the pedagogical foundations that underpin each element.

The overall aim of the learning intervention is identify the extent to which learners suffer from the disposition effect, and then to give them a range of techniques to use to address this effect so that they suffer less from it in their everyday investing. Because this intervention is designed to fulfil the informal learning needs of this community of investors, the elements of the learning intervention need to be varied and optional, giving learners the control to use whatever suits them best. For example, having identified the extent to which they suffer from the disposition effect, learners can then elect to acquire propositional knowledge. This may be from watching a video, or if they prefer they can read a transcript, or look into the detail of the disposition effect. The extent to which they engage with the different elements is up to the learner. Having learned about the disposition effect, learners then have access to different yet complementary ways of improving their performance through the games. The two-index game gives them an indicator of the extent to which they are showing evidence of the disposition effect, mindfulness techniques teach them one method of managing their reactions, physiological feedback and the aiming game give them another method. These game based interventions are backed up by access to a peer learning forum and reflective diary to extend the reach of the learning intervention over time.

The following subsections show how such a complex learning intervention can be represented using the conceptual learning design tool.

3.1.1.1 Learning intervention view

The learning interventions overview categorises aspect of the intervention in terms of i) the types of guidance and support that are provided, ii) the contents and activities the learners will work through, iii) the forms of communication and collaboration, and iv) aspects of reflection and demonstration. For the disposition effect intervention this consists of the following:

1. Guidance and support: a self-directed learning pathway (up to six months)
2. Content and activities: games, didactic material, real-world practice
3. Communication and collaboration: peer discussion in the forums
4. Reflection and demonstration: diagnostic feedback, critical reflection

### Learning intervention map

- **Guidance & Support**
  - A self-directed learning pathway (up to six months)

- **Content & Activities**
  - Games, didactic material, real-world practice

- **Communication & Collaboration**
  - Peer discussion in the forums

- **Reflection & Demonstration**
  - Diagnostic feedback, critical reflection

### 3.1.1.2 Pedagogical profile

The pedagogical profile provides a breakdown of the kinds of task the learner is engaged with, in terms of assimilative (reading, viewing or listening tasks), interactive, communicative, productive, experiential and adaptive. It also indicates the amount of assessment.
3.1.1.3 Learning intervention dimensions

The dimensions view gives a more detailed breakdown of the learning interventions overview, in terms of things like the extent to which the intervention is tutor or learner centred, the amount and type of collaboration, the types of assessment and feedback, etc.
3.1.1.4 Learning outcomes

The learning outcomes view ensures there is a mapping of the activities the learner is engaged with against the learning outcomes and any assessment.

3.1.1.5 Task swimlane

The task swimlane provides an overview of the learning activities, linking each activity to the learning outcome. In the disposition effect learning intervention, the learning activities consist of the following:

Learning activities:

1. Diagnostic feedback via an e-assessment tool via a questionnaire and via calculations based on their existing trading history if they have one, and the two-index game.
2. Some propositional knowledge about what all this is about via a series of videos, whereby different video segments are delivered based on your response to the survey and calculations. Feedback becomes a vehicle for didactic delivery of content
3. Engage with two types of games iteratively – two index game (disposition effect) game getting feedback each time the extent to which they are displaying a dispositional effect and get access to a play environment where they can manage their emotional arousal in the aiming game. Each game has a number of levels of difficulty.
4. Also learning interventions about developing mindfulness, which will be delivered online, includes a tool on paced breathing meditation for example.
5. Use sensors to review their emotional status in a trading context in a day trading centre (optional).
6. Access to peer discussion so that they can come together in peer learning groups in discussion forums for peer support and peer learning.
7. Write down and review real world trading practices, engage in critical reflection, this includes recording and reviewing emotional state (for example rating yourself on the extent you have experience particular emotional states). Also make notes on what causes the emotions and what impact you think that has had on how you behave.

Year 3 of the project will be tightly focused toward the creation of learning interventions that build on the outputs from the studies and workshops of the previous two years to fulfil the aims of the project. These will be documented using the Conceptual Design Tool.
4 Discontinued Year 2 Activities

Work Package 3 is being wrapped up in response to the reviewer recommendations at the October 2010 interim review. This section therefore notes activities that were taking place, but which have been stopped.

4.1 WP3 Stakeholder Roundtable

During the lifetime of this workpackage, its focus evolved in response to external feedback from interested stakeholders. For example, discussions were underway with Barclays bank to identify ways that diagnostic elements could be added to the games they are currently developing. WP3 led an expert round table Financial Decision Making, hosted by the Consumer Financial Education Body (CFEB) at the FSA Building in November 2010. This round table event was attended by a range of stakeholders including representatives from Barclays Bank, City Bank, YouthNet, Young Scot, Fairbridge Training, and Money for Life.

One of the outcomes from this meeting with WP3 stakeholders was a plan to hold a more focused workshop in which the planned WP3 games would be trialed at the OU-IET in Milton Keynes, and stakeholders would be invited to play them. Data would be collected both on the game-play and, more qualitatively, on the perspective of the stakeholders on the xDelia approach to financial capability and how this would fit in with their own agendas.

Discussion have also taken place with the UK NHS clinic about Problem Gambling to explore the more therapeutic side of using games to address the relationship between emotions and financial decision-making. WP3 took part in a collaborative venture funded by City Foundation under their Corporate Social Responsibility program, participating in the digital media stream and WP3 have been invited by the OECD to speak at their global conference on financial literacy in the session on social marketing and behaviour change.

Thus, from the original yr1 research questions, WP3 work had evolved to fill a specific niche covering financial education and financial capability for policy makers. With the closing of WP3, the final status of the financial capability work package will be written up and evaluated in the context of the whole project in D20-6.3 Part 3.

4.2 DHPS : July 2010 – May 2011:

WP3 was put together in order to look at individual financial capability, with specific reference to young people. They worked with partners from Erasmus University, using questionnaires and surveys to collect data from the 5000 members of the Dutch Household Panel to refine which issues of financial capability should be the focus, and with partners from WP4 working on games that would address the issues of financial capabilities identified. The RQs that came out of the Year 1 Evaluation Workshop were:

1. What would a financially capable young person look like?
2. How can psychology/behavioural economics help us to understand apparently low levels of financial capability?
3. What are the barriers/hurdles to becoming financially capable, are their circumstance/attitudes/biases etc.?
4. How can learning technologies improve an individual's capability?
The DHPS study was initiated in order to find out whether emotion regulation strategies could predict financial capability in a large representative Dutch sample (5451 participants).

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<td><strong>Start and End Date</strong></td>
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<td><strong>Research Questions</strong></td>
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<td><strong>Link to past studies</strong></td>
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<td><strong>Web link to resources</strong></td>
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<td><strong>Status of analysis</strong></td>
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<td><strong>Reports available</strong></td>
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<tr>
<td><strong>Summary of findings</strong></td>
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4.3 Evaluating Physiological Correlates: July – October 2010

This study recorded psycho-physiological signals during presentation of pictures from the International Affective Picture System (IAPS) to evoke emotional reactions. (42 participants).

<table>
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<td><strong>Work Package(s)</strong></td>
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<tr>
<td><strong>Study Title</strong></td>
</tr>
</tbody>
</table>
| **Start and End Date** | Start: July 2010  
End: October 2010 |
| **Research Questions** | Evaluate physiological correlates / features reflecting emotion regulation capabilities |
| **Link to past studies** | - |
| **Link to future studies** | - |
| **Methods used** | Recording of psychophysiological signals during presentation of pictures from the international affective picture system (IAPS) to evoke emotional reactions |
| **Number of Subjects** | 42 |
| **Background of subjects** | Students from KIT |
| **Length of intervention** | Approx. 90 minutes |
| **Type of intervention** | - |
| **Web link to resources** | - |
| **Status of analysis** | Discontinued as a consequence of the Y1.5 review recommendations |
| **Reports available** | None currently available. WP3 work discontinued |
| **Summary of findings** | None currently available. WP3 work discontinued |

Although WP3 has been discontinued. The use of pictures to influence arousal has been incorporated into WP2 through IS5, where pictures from the IAPS have been introduced, together with music, to the auction game to raise arousal.
5 Other Evaluation Activities

Various WP6 studies have been conducted in and around the main project studies. Some WP6 studies built onto the studies from other parts of the project using the D&E framework. Other WP6 studies stood alone. The following subsections describe the WP6 studies in year 2.

5.1 WP6 Investor Interviews at NIC conference

As part of its evaluative remit and in response to the review recommendaitions in the October review report, WP6 aims to collect data on external stakeholder engagement. Stakeholder feedback can be collected at events held with that specific aim in mind, such as at the WP3 Stakeholder Roundtable, a type iii) stakeholder workshop described in Section 4.1. However type 2) field study interventions such as the trials of the game prototypes held at the NIC conference and described in Section 2.4 and 0 respectively also provide opportunities to gather stakeholder impressions of the xDelia approach to incorporating games as component a learning intervention as well as to gather quantitative data on their emotional responses to the prototype games themselves.

![Figure 5.1 – Design and Evaluation Framework applied to NIC Investor Conference Studies](image-url)

This section describes the WP6 stakeholder interview study conducted at the NIC conference with investors who had taken part in the IS2.2 and IS3 studies described in Section 2.
5.1.1 WP6 Investor Interview Study Aims

This study aimed to collect qualitative data on the experiences of the investors who took part in the games, and to obtain a stakeholder perspective on both the games themselves, and on what sort of learning needs investors had. The study is shown located in the D&E framework in Figure 5.1. This data will be used to help answer the new WP6 Research Question, created in response to the interim reviewers comments:

RQ12: 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?

5.1.2 Method

The investors first took part on one of the games studies - either the first person shooter, or the mindfulness casino card game. As the investors who had taken part in the games experiments left the games room, they were invited to take part in a short, 5 minute interview. Those who agreed were taken to an adjacent room and invited to sign the consent form. The consent form is reproduced in Appendix A. Before the interview began, a note was taken of which game the participant played. The interview questions were:

- Q1: What did you think of the game experience you just had.
- Q2: Do you think that games incorporating this approach to emotion regulation could help you improve your investment decisions?
- Q3: Have you any suggestions for improvement?
- Q4: How did you initially get involved in investments, how did you start learning about investing?
- Q5: How do you currently go about improving your investing skills (peer network, contact with banks, conferences such as these, online, financial papers)?

The interviewees were taken to a quiet side room where the purposes of the data collection was explained to them and where they could read and sign an informed consent form. They were then asked the interview questions and the questions and answers audio recorded and subsequently transcribed.

5.1.3 Study Sample

The interviewees were therefore largely self-selecting. Only those who both played a game and had time to be interviewed took part. Of the 38 investors who took part in the games studies at the NIC, 16 (42%) agreed to take part in interviews. The resulting sample consisted of:

- 16 interviews of which
  - 1 investor was interviewed twice because he returned after playing one of the games to try playing the other game. His feedback will therefore be very interesting.
  - 2 investors were interviewed together as a joint interview.
5.1.4 Findings

Those interviewed reported that they enjoyed the games, although the consensus was that the games were too short. There were predictable differences in the reactions to the two very different games. The Columbian Card Task (CCT) game was more complicated to play than the simple Aiming Game (AG). This was reflected in the responses, with those playing the CCT coming up with detailed suggestions and comments.

Investors who played the CCT were exposed to an audio recording (either a mindfulness tape or a neutral lord of the rings recording) and asked to fill in a questionnaire about their investment habits before playing the game. This raised their awareness of the aims of the game and this awareness was apparent in their interview responses as they reflected on the game experience:

CCT Investor2: I think the more you practice these things and the more you find out the boundaries of how you experience your emotions in different situations then when it comes to the real thing you'll be better prepared so it won't be such a surprise so you have more opportunity to manage

Players of both games wanted more player feedback to promote “understanding, doing and learning” (CCT investor13) and “variation, different types of feedback … or some other confounding factors” (AG investor8). Investors playing both games came up with suggestions for improving the game play. The CCT game was more complex and because the task was a financial one, investors had practical suggestions for improving the game play or making the task more meaningful. These included increasing the amount of money at risk, changing the odds at the start so they did not appear to be so stacked against the player and giving the player a more complex card task to really test the player’s “true analysis capability or of his true state of mind when he’s stressed” (CCT Investor11).

AG investors were divided into two groups for the study, one group was given detailed instructions and the other was not. Some of the AG investors commented that they would have liked more comprehensive instructions, however it was not possible to verify which group these investors had been placed in for the study as the IDs had been anonymised.

The interviews with the AG investors triangulates the interview data collected during BTH Play Testing Evaluation of the Aiming Game with students. The suggestions for improvement given by the AG investors at the NIC match the suggestions reported in Section 3.7.3 of D17-4.1. Namely additional targets (the investor suggested helicopters rather than planes) and greater variety of game play to make the game less monotonous.

Investors thought that the games might help improve their investment performance by making them more aware of and better able to control their emotions in a productive way. However some investors were sceptical about the usefulness of attempting to manage their emotional arousal over a short timescale because they tended to invest over longer timeframes.

“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” (CCT investor4).

Investors reported an array of existing techniques to learning about investing including reading financial magazines and papers, the internet, investment groups, conferences, courses, videos, having a mentor, reading books and watching the markets. Investors expressed admiration for professional traders and a desire to have the opportunity to learn from them. This ties in with the xDelia approach of using the Trader studies as the expert-case to inform the design of learning interventions that
consist of not only games, but a range of supporting learning techniques such as reflective diary, peer forum and video and text feedback.

5.1.5 Discussion

The investors interviewed at the NIC were positive about the concept of a games-based approach that focused on improving their emotion regulation in order to improve their investment performance. Some investors were sceptical about the usefulness of attempting to manage their emotional arousal over a short timescale because they held their investments over longer timeframes, however all reported the game play to be enjoyable and saw a role for such an approach to regulating emotions in order to make better investment decisions.

This stakeholder feedback collected from the NIC conference will be complemented by interview feedback to be collected from investors attending the Trader Expo Conference, held in London on 8th and 9th April 2011. At this conference, the xDelia project have a stand and are running a study on the two-index game with investors recruited at the conference. The investors taking part in the games study will be invited to take part in a 5 minute interview and asked the same set of questions as the NIC investor participants. The results will be fed back into the project via email for speed, in the first instance, and through the project wiki once the results are fully analysed and written up.

The Trader Expo study will build on the lessons learned from the NIC Conference studies, and aims to answer the question: Do emotion regulation strategies (i.e., re-appraisal/suppression) reduce the size of the disposition effect (or other financial biases)? This will be evaluated in D20-6.3.3.

5.2 WP6 Interdisciplinarity Interviews

This study aims to establish the partner perceptions of the project to see where these views aligned and diverged, and to get a baseline of data to inform the design of effective inter-project collaborations. It consists of a series of baseline interviews with the project partners and plans to contrast the findings from these with the findings from the follow-up interviews conducted in year 3 of the project together with the actual outputs produced at the end of the project.

In Yr1, WP6 conducted a series of interviews with representatives from each of the work package teams. The interviews were structured around a series of seven questions designed to establish partners’ initial understanding of the project. The seven question were:

- Q1: What is your role in xDelia?
- Q2: What do you think the overall goal of xDelia is?
- Q3: What is the relevance of the project to your own institution/your research interests?
- Q4: What are your perceived aspiration for xDelia?
- Q5: What for you would be indicators of success?
- Q6: What do you think might be some of the challenges of the project?
- Q7: What do you think are the strengths of the project?

These questions aimed to uncover what the partners felt were the main aims of the project and how these related to their personal and institutional motivations. This provided detailed baseline data on the different stakeholder perspectives to answer the research question: What are the different partners perceptions of for X-Delia and how well are these met?
These questions were designed to assess how closely aligned the partners’ initial perceptions of the project were at the start, and to identify any divergences before they had a chance to cause a problem later in the project. In addition, the baseline interviews formed part of a longitudinal study to track how partners’ perceptions evolve over the duration of the project and how well they achieve their goals by the end of the project. This will provide data to answer WP6 RQ2: How do the different partners perceptions of X-Delia map to what the project actually achieves? and provided input to WP6 RQ3: What are the barriers and enablers to working in this interdisciplinary context; what works well and what doesn't?

The baseline interviews were conducted over a period of several months at the start of the xDeila project. Twelve partners were interviewed. These included both principal investigators who had been involved in the project from its inception together with researchers hired in to undertake the day-to-day running of the project.

The interviews were analysed to identify emergent themes and the initial findings reported in D20-6.3 Part 1.

Follow on interviews were initiated in Yr 2, but put on hold at M24 whilst effort was redirected toward the refocusing of the DoW arising out of the review recommendations. The follow-on partner interviews will recommence in Yr3 with questions adapted to suit the changing face of the project.

In related but parallel work, 18 interviews were conducted with TEL researchers to identify issues influencing interdisciplinarity (Conole et al., 2010). They consolidated their findings into 10 key factors that influenced interdisciplinary working:

1. Technologies and users continually co-evolve.
2. TEL is an interdisciplinary field.
3. TEL researchers use a range of technologies to support research.
4. Social media are changing the way researchers work and collaborate.
5. Technologies provide the potential to break down disciplinary boundaries.
6. Many benefits to interdisciplinary working.
7. Interdisciplinary research is challenging.
8. Interdisciplinarity offers new theoretical insights and methodological innovations.
9. Current structures are barriers to interdisciplinarity.
10. Interdisciplinarity is essential for TEL research.

These factors will provide a focus for the analysis of the impact of interdisciplinarity on the project.

5.3 WP6 Survey on Technology Use

The survey on collaborative technology use on the project was initiated to collect data to support the follow-up partner interviews and help answer the WP6 research questions on the effect of mediating technologies:

- RQ3: What are the barriers and enablers to working in this interdisciplinary context; what works well and what doesn't?
- RQ4: What mediating artefacts (the evaluation framework, communication mechanisms, workshops and project meetings, deliverables) are used in the project.
- RQ5: How are we using technologies in the project for communication and collaboration and also in the research methods, and what is their impact on interdisciplinary collaboration?
18 partners completed the web survey, 15 using the web survey and 3 on a paper version of the survey. Analysis of the Technology Survey data is linked to the Interdisciplinarity interviews which have been delayed until Yr3 in order to reflect the refocusing of the project in response to the October interim review. Both will be reported in D20-6.3 Part 3.

**5.4 Conclusion**

Over the first two years, multidisciplinary work has gone on in the xDelia project. The studies have produced original research findings. These findings have identified emotions which have a detectable impact on decision making in the financial domain, pinpointed physiological responses which are linked to target emotions and demonstrated a range of emotion regulation techniques (mindfulness, bio-feedback on arousal) that are good candidates for for learning interventions aimed at improving financial decision making. Games have been developed which incorporate realistic financial tasks with enjoyable game play to address the regulation of emotion in a variety of ways. At the end of yr2, the xDelia project has a coherent plan that builds on the first two years’ work to produce and document a viable set of learning interventions during yr3. These plans are described in D18-2.4.1.

However, during the time that this work has been going on many fundamental aspects of the xDelia project have changed. The direction of work was adjusted in response to the first review in M12, with a new Description of Work being produced and agreed. At the subsequent interim review in M18, two work packages were terminated and two of the study areas (traders and financial capability) were closed in order to focus all effort on the investor case and additional deliverables requested. The project’s ability to navigate around additional requirements during execution is impressive.

Significant effort has been put into adjusting the project, particularly in response to the review team’s feedback. This adjustment has often included long debates between the xDelia partners about where the project needed to move and why. These debates have been conducted in a variety of ways. Some have involved F2F meetings, often followed up by video-conferences and email discussion to refine the details. The role of technologies in supporting these collaborations has been key, and has provided a clear record of the negotiations that have taken place. Data includes:

- Notes taken during the review meetings
- Review reports
- Email exchanges
- Recorded video-conferences
- Reflective Evaluation Journal (Poth and Shulha, 2008)
- Follow-on Partner Interviews

The end product of these debates include revised Description of Work and additional deliverables such as D9, D18 and D23 that reflect the outcomes. Much valuable reflection has been devoted to the accommodation of the changes in xDelia and WP6 will be the instrument to reflect the mechanisms of the debate; the doubt, the options, the questions and the negotiations that were undertaken before the official, polished (new) research questions and plans were developed.

The studies and workshops from yr2 provide a sound basis for moving into yr3. There is an implementation plan for a series of targeted learning interventions which incorporates evaluation as an integral part of the process. As we enter yr3, xDelia partners have developed good working relationships that cross not only disciplinary boundaries, but cultural and institutional boundaries as well.
6 Appendix A: Investor Interview Consent Form

The investor interview consent form is reproduced below.

Consent form – National Investment Club Conference

November 13, 2010

Introduction

Thank you for agreeing to be interviewed during the NIC Conference on 13th November, 2010. We shall be taking short video and stills images of the game play, and your interview will be audio recorded and transcribed for analysis.

The results of the analysis will be included in the xDella project deliverable documents, journal and conference papers, presentations and the xDella website. We may quote from the audio recordings in these publications, but the quotes will anonymised and not attributable to individuals.

Confidentiality

The information will be kept confidential. Data will be stored securely. All work will adhere to the OU Research Ethical practices guidelines:

http://www.open.ac.uk/research/ethics/index.shtml

Contact Information

If you have questions at any time about the interviews you may contact the researcher, Gill Clough, at g.m.clough@open.ac.uk.

Consent

I have read the above information. I agree to take part in this interview.

Interviewee’s name (please print)

________________________

Interviewee’s signature

________Date 13 Nov, 2010
7 Appendix B: Partner Consent Form

The following consent form was signed by all partners attending the WP2 Games workshop in August 2010

Consent form – WP2 Games Workshop

Introduction

We shall be making video, stills and audio recordings during the WP2 Games Workshop on 5th and 6th August, 2010. Images and video from the workshop may be included in deliverables, journal and conference papers, presentations and the xDELLA website. We may quote from the audio recordings in these publications, but the quotes will anonymised and not attributable to individuals.

Confidentiality

The information will be kept confidential. Data will be stored securely. All work will adhere to the OU Research Ethical practices guidelines:

http://www.open.ac.uk/research/ethics/index.shtml

Contact Information

If you have questions at any time about the study you may contact the researcher, Gill Clough, at g.m.clough@open.ac.uk.

Consent

I have read the above information. I agree to participate in this study.

Participant’s name (please print) ________________________________________________

Participant’s signature ______________________________ Date ______________
8 Appendix C: Technology Web Survey


Welcome to the xDelia Technology use survey. This survey aims to collect a snapshot of our usage of collaborative technologies after the first year of the project.
We will use the information you give us to evaluate how we are using these technologies. All data will be anonymised and may be included in project deliverables, papers and conference presentations.
Thank you for taking the time to complete the survey - it should take no more than 10 minutes.
Comments are optional – feel free to add a text response or not.

The Online version of this survey can be found at:
http://www.surveymonkey.com/s/xDeliaWP6TechnologySurvey

Q1: Name:

Q2: Please select the work package that most of your xDelia work falls under:
- [ ] WP1
- [ ] WP2
- [ ] WP3
- [ ] WP4
- [ ] WP5
- [ ] WP6
- [ ] WP7

Q3: Much xDelia work involves collaboration between work packages. Please select all work packages that you collaborate with. By collaboration, we mean "working together with another or others on a joint project": (please select none, or one or more work packages)
- [ ] WP1
- [ ] WP2
- [ ] WP3
- [ ] WP4
- [ ] WP5
- [ ] WP6
- [ ] WP7

Q4: Over the past 30 days, on average, approximately how often have you received emails related to xDelia?
- [ ] Three or more times a day
- [ ] Once or twice a day
- [ ] Three or more times a week
- [ ] Once or twice a week
- [ ] Three or more times a month
- [ ] Once or twice a month
Q5: In the past 30 days, on average, approximately how often have you written emails related to xDelia?
- Three or more times a day
- Once or twice a day
- Three or more times a week
- Once or twice a week
- Three or more times a month
- Once or twice a month
- Not in the past month
- Never

Q6: Over the past 30 days, on average, approximately how often have you accessed the xDelia wiki to read information?
- Three or more times a day
- Once or twice a day
- Three or more times a week
- Once or twice a week
- Three or more times a month
- Once or twice a month
- Not in the past month
- Never

Q7: Does your role on xDelia need you to enter information into the wiki?
- Yes
- No

Q8: Over the past 30 days, on average, approximately how often have you accessed the xDelia wiki to modify or add new text to an existing wiki page?
- Three or more times a day
- Once or twice a day
- Three or more times a week
- Once or twice a week
- Three or more times a month
- Once or twice a month
- Not in the past month
- Never

Q9: Over the past 30 days, on average, approximately how often have you created a new wiki page?
- Three or more times a day
- Once or twice a day
- Three or more times a week
- Once or twice a week
Q10: Over the past 30 days, on average, approximately how often have you downloaded a document from the SVN repository?
- Three or more times a day
- Once or twice a day
- Three or more times a week
- Once or twice a week
- Three or more times a month
- Once or twice a month
- Not in the past month
- Never

Q11: Over the past 30 days, on average, approximately how often have you uploaded a document to the SVN repository?
- Three or more times a day
- Once or twice a day
- Three or more times a week
- Once or twice a week
- Three or more times a month
- Once or twice a month
- Not in the past month
- Never

Q12: Over the past 30 days, on average, approximately how often have you participated in an Xdelia video conference (Adobe connect, skype or flashmeeting)?
- Three or more times a day
- Once or twice a day
- Three or more times a week
- Once or twice a week
- Three or more times a month
- Once or twice a month
- Not in the past month
- Never

Q13: Have you ever provided text or images for inclusion on the xDelia website?
- Regularly (on a weekly basis)
- Regularly (on a monthly basis)
- More than once, when I had xDelia news I thought should be publicised on the website
- More than once, when requested by the website developer
- Never
Q14: Over the past 30 days, on average, approximately how often have you used Google Wave for collaboration related to xDelia?
- [ ] Three or more times a day
- [ ] Once or twice a day
- [ ] Three or more times a week
- [ ] Once or twice a week
- [ ] Three or more times a month
- [ ] Once or twice a month
- [ ] Not in the past month
- [ ] Never

Q15: Do you ever use Doodle poll to schedule participants for an xDelia collaboration?
- [ ] Yes
- [ ] No

Q16: Do you ever use Doodle poll to enter your availability for an event set up by other partners on xDelia?
- [ ] Yes
- [ ] No

Q17: Have you used Dropbox?
- [ ] I do not know what Dropbox is
- [ ] I know what Dropbox is, but I don’t use it
- [ ] I have used Dropbox, but not for xDelia
- [ ] I have used Dropbox exclusively for xDelia
- [ ] I have used Dropbox for xDelia and for other reasons

Q18: Have you used Scrumworks?
- [ ] I do not know what Scrumworks is
- [ ] I know what Scrumworks is, but I don’t use it
- [ ] I have used Scrumworks, but not for xDelia
- [ ] I have used Scrumworks exclusively for xDelia
- [ ] I have used Scrumworks for xDelia and for other reasons

Q19: Have you used Cloudworks?
- [ ] I do not know what Cloudworks is
- [ ] I know what Cloudworks is, but I don’t use it
- [ ] I have used Cloudworks, but not for xDelia
- [ ] I have used Cloudworks exclusively for xDelia
- [ ] I have used Cloudworks for xDelia and for other reasons

Q20: Have you used Compendium?
- [ ] I do not know what Compendium is
- [ ] I know what Compendium is, but I don’t use it
- [ ] I have used Compendium, but not for xDelia
I have used Compendium exclusively for xDelia
☐ I have used Compendium for xDelia and for other reasons

Q21: Diigo is a collaborative tool that allows you to highlight web pages, create sticky notes and online bookmarks that can be shared by anybody, or limited to a specific group or team.
☐ I do not know what Diigo is
☐ I know what Diigo is, but I don’t use it
☐ I have used Diigo, but not for xDelia
☐ I have used Diigo exclusively for xDelia
☐ I have used Diigo for xDelia and for other reasons

This question asks you about open blogging practices with respect to xDelia. Open blogs are blogs which may be viewed by anyone with access to the internet.
Q22: Do you blog in an open blog?
☐ I do not blog
☐ I blog in an open blog, but I do not mention xDelia
☐ I blog in an open blog, and I sometimes mention xDelia
☐ I have an open blog dedicated to xDelia

Q23: This question asks you about dark blogging practices with respect to xDelia. Dark blogs are private or closed blogs which have a restricted readership.
Do you blog in a closed blog?
☐ I do have any closed blogs
☐ I blog in a closed blog, but I do not mention xDelia
☐ I blog in a closed blog, and I sometimes mention xDelia
☐ I have a closed blog dedicated to xDelia

This question asks you about your public microblogging practices with respect to xDelia. Microblogs allow posts of up to 140 characters often with image and GPS support. Examples of microblogs include Twitter and Tumblr.

Q24: Do you microblog?
☐ I do not microblog
☐ I have a microblog account, but I seldom post anything
☐ I microblog, but I do not mention xDelia
☐ I microblog, and I occasionally mention xDelia
9 References


D20-6.3.2 – Evaluation report – Part 2

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