AmI Support for the Trading Process: Self-Aware Trader Model

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Abstract. Decision making in trading can be compromised when traders are under stress. In this paper is presented a case study where ambient intelligence has been used to provide traders with self-awareness of their stress levels. We illustrate how using specific stress sensors improved the results of the trading process by avoiding bad decision making at crucial moments.

Keywords: AmI, Stress Awareness, Trading Process, Stressful Decision Making.

1. Introduction

Decision making in the trading process is a clear example of an activity where risk management in real time is important. Risks have a high impact in decision making because they can undermine our capability to make safe decisions. Nowadays there are several tools to help traders in their daily operative and although this is really good and helpful, the major risk source is missing, the trader's state-of-mind self-awareness. A trader who is self-aware of her/his own stress can have a more effective and coherent decision making.

Ambient Intelligence as an emerging area focused on building digital environments that proactively, but sensibly, support people in their daily lives [1] is relevant to the problem. Technical studies [2] have proven that stress produces biometric changes in the human body and in the effectiveness of the decision making.

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These changes can be measured with AmI support by means of sensors to bring self-awareness to the trader. We illustrate our system in this paper through a case study showing how Self-Aware traders improve their performance and results. Next section explains how decision making is impaired under stress. Section three shows the Self-Aware trader model. The case study performed is described in section four. Finally, conclusions and future work are presented.

2. Motivations for a Trader

Good judgment during decision making can be severely impaired by stress [3]. The most accepted theory is that under stress we scan fewer alternatives searching the solution of a problem [4]. Selten et al [5] explain that when we do decision-making we use a toolbox of strategies and we apply the strategy with the most adaptive heuristic available.

Decision making performed during trading is in real time and good timing is also crucial. This relates to stress because the search of alternatives is truncated by time limitations [6]. In addition to time limitations, decisions made during trading are inter-related and there is evidence that individuals tend to rely on previous responses regardless of their success [7], for this reason when a trader has a lost due to a wrong decision that can negatively affect the next decision.

All this body of research supports that decision making is degraded under stressful conditions. In particular, for the trading profession, detecting the moment in which the trader starts to become overwhelmed by stress is very important to avoid possible mistakes in the operations. The problem is that when the trader is under stress, the trader himself does not realize that (In psychological terms this is named illusion of control). However, given that stress also has a biological manifestation; it can be measured with Ami support through current state of the art sensing technology [8].

In this research line, Lo and Repin [9] reported with some experiments that physiological variables associated with the autonomic nervous system are highly correlated with market events. We continue in this direction with one more step. Helping traders to understand their mental state in real time as part of the trading information (news, charts, clients' accounts balance) can lead to safer decision making. In the next section we apply this concept in the Sel-Aware Trader model.

3. Self-Aware Trader Model

According to [10] when you're experiencing stressful emotions, whether you're conscious of them or not, higher brain processes become seriously compromised. This phenomenon is called *cortical inhibition*. In the same study this cortical inhi-

bition is tested with the impact of stress on the cardiovascular system in real time. The more stable the frequency and shape of the waveform of the heart rate, the more coherent the system becomes. In physiological terms, coherence describes the degree to which respiration and heart rate oscillate at the same frequency. The HeartMarth's sensor with Emwave software allows measuring this coherence/stress level in real time with only one sensor in the ear and the data can be easily shown in real time. It is an USB Plethysmographic pulse sensor for ear, optionally for finger with a sample rate of 360 samples/sec. The gain (increase needed for the amplitude of the signal) setting adjusts automatically via LED duty cycle (ratio between the pulse duration and the period of a rectangular waveform). The photo diode gain adjustment and the operating range is 30 - 140 beats/sec.

Guided by previous considerations [11] we arrive to a system model (Fig. 1) with the following features:

- The stress/coherence level will be processed in real time with the biometric wearable and not invasive Heartmarth sensor.
- An alert will only be shown to the trader when there is an indication that her/his stress level jeopardizes decision-making. This alert will disappear when the state of the trader comes back to a normal stress/coherence level, otherwise, the message "coherence/stress level in risk" is shown.

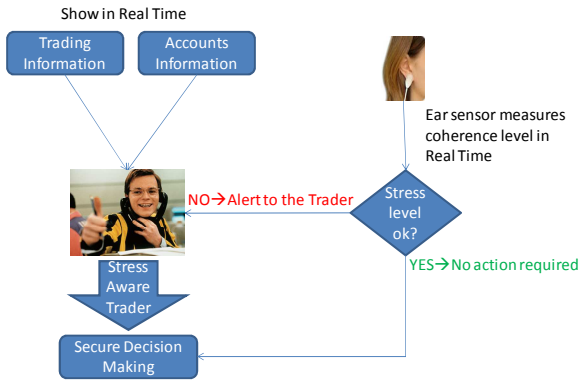

Fig.1. Self-Aware Trader Model.

The way in which the trader manages this information will depend on the context of the trader. If the trader is a self-employed person the action of stopping or continuing with the operation could be managed by him/herself. However, if the context is an investment bank, someone else can decide to stop the operative.

In both cases, the data sent through the sensor support alerts to the trader in real-time in an unobtrusive way. This is aligned with fundamental AmI principles. Independently if the operative is stopped or not, now we have a self-aware trader, therefore we have a safer decision making. Next section shows a case study with this model.

4. Case Study

The case study consists of a trader working in the financial market from a computer through internet (this is the most common case for traders in US). The stress sensor is connected in the trader's ear and we depict some significant moments of the trading session and how the sensed data and increased self-awareness influence the results of the trading exercise.

4.1 Scenario Setup

The equipment used by the trader is a laptop with internet connection, the HeartMath stress relief system (stress sensor) developed and manufactured by Quantum Intech, Inc. and the Emwave Pc (V1.0) software to see the stress level. The experiments have been done in the Spanish financial market, and all necessary information for the trading process (price of shares, charts, news...) has been extracted from Infobolsa web (http://www.infobolsa.es/). The trader who deploys the experiment is a non professional trader, but has 8 years of experience in this market trading for himself. To avoid problems with the income tax, commissions, and other effects of the trading process, the experiments have been done without real money. However, decision making is performed in real time in the real market and the aim to beat the market and win (play) money, provides motivation and a stress source in our trader.

4.2 Experiments with IBEX 35 Shares without Self-Aware Trader Information Support

With this experiment we want to know if in the crucial moments of trading with shares (buying and selling), the trader's coherence level is affected and how that changes the decision making process. In this experiment, the Self-Aware information is not shown to the trader. The experiment duration is 1hour 30 minutes. In the next table, we can see the operations done by the trader (21/04/2010):

Table 1. Share Trading.

Buy Time	Share	Price	Sell Time	Price
12:00	TELEFONICA	17.380	13:23	17.390
12:05	BBVA	10.970	13:22	10.980
12:06	SANTANDER	10.305	13:14	10.32
12:20	ABENGOA	20.10	13:04	20.27

Fig.2 shows the trader's coherence during trading time. The time is represented on axis X. The coherence level, as the Emwave program names it, Accumulated Coherence Score is shown in axis Y. When the coherence is in safe mode the score grows up, when the coherence enter in an unsafe mode, it decreases.

Fig.2. Coherence Score in Session 1.

We can see that the first 20 minutes of buying operations the stress of the trader prevents achieving good coherence levels (the lines in the graphic remains low). Later on, next half an hour of the experiment shows the time when the trader was waiting for the optimal selling point and that inactivity allows a high level of coherence to be reached, which is reflected on the graphic growing up. Finally, the stress again comes back when the trader tries to sell the shares at an optimal prize. The conclusion of the experiment is that the trader's body and coherence changes naturally reflect the crucial moments (buying and selling of shares).

4.3 Experiments with IBEX 35 Index Futures without Self-Aware Information Support

In this other experiment, the trader operates with "futures" in IBEX-35 Index. The Index is an indicator formed by the principal companies of the national market, in US for example is Down Jones Index, in Spain it is formed by the 35 more important national companies and it is the IBEX-35. This index has a prize and moves it depending on the movement of the companies that component it. If the trader thinks that this index will go up, then the trader can buy an IBEX-35 "future" and sell it when the trader thinks that the index will go down. In the opposite case then trader can sell a "future" and buy it when s/he thinks the market could go up. In this operative each point up or down represents significant money and the movements are very fast (unlike in the shares trading). It forces traders to continue operations and increases the stress moments. Table 2 indicates the operations most representative for the experiment in 1 hour 30 minutes (22/04/2010). Taking into account that the first 20 minutes the trader considers not to make any operation, but the Emwave software is running and recording the coherence level. In this experiment, the information for Self-Awareness is not shown to the trader.

Table 2. Future Trading without Support

Open Time	Prize Open	OP	Close Time	Prize Close	OP	Points
16:21	10808.30	Buy	16:26	10830.20	Sell	+21,9
16:27	10843.10	Sell	16:31	10848.30	Buy	- 5,2
16:32	10849.90	Buy	16:39	10816.60	Sell	-33,3
16:45	10801.00	Buy	16:49	10828.20	Sell	+27,2

In Fig.3a, we can see the coherence score during the trading process and in Fig.3b the IBEX-35 chart. This chart represents the movements of the Index's prize (axis Y) during the session time (axis X) represented by the hour.

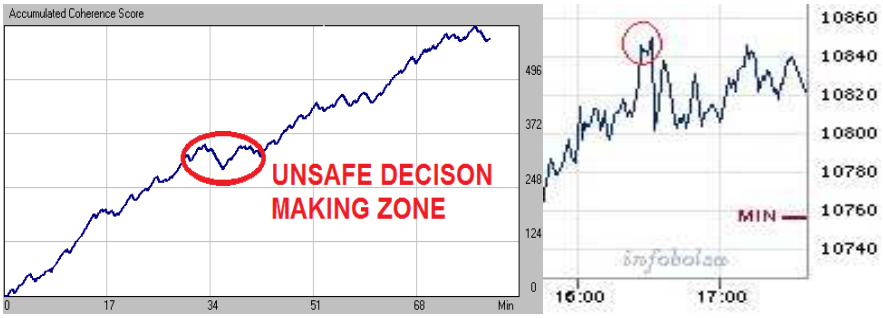

Fig.3. Coherence Score in Session 2 (a) and Chart of IBEX-35 in session 2 (b)

We can see a frequent trading risk situation, at 16:27. The trader believes that 10843 is a good level to sell (corresponding with the first top of the graphic), then the trader sells. However, IBEX go up some points breaking the trader strategy, so the trader buys losing some points. The trader tries immediately to change of strategy, he knows that he was wrong and do not want to lose this crucial moment, now the trader is very stressed and his decision making is unsafe. The market has done a "false break" (circle in red in Fig 3.b) and the trader has bought in a rushed decision (circle of Fig 3.a). The trader loses 37 points in total. The Self-Aware information could have helped to avoid this mistake.

4.4 Experiments with IBEX 35 Index Futures with Self-Aware Information Support

This experiment is conducted to show the favorable impact in the trading process when the trader has access to the self-aware information support. This session was the most difficult session for trading during the experiments, due to the Greece debt news at the time of the exercise. The Index suffered abrupt variations in seconds. Table 3 indicates the operations in 1 hour (23/04/2010). In this table, the number of sequence of operation has been added for a better tracking.

Table 3. Future Trading with Support

Open Time	Value Open	OP/nº	Close Time	Value Close	OP/nº	Points
16:25	10948.60	Sell/1	16:28	10948.60	Buy/2	0
16:31	10947.30	Buy/3	16:44	10952.80	Sell/4	+5,5
16:59	10921.70	Buy/5	17:01	10934.20	Sell/6	+12,5
17:03	10906.20	Buy/7	17:07	10923.70	Sell/8	+17,5

In Fig. 4 a) we can see the coherence score; in this case we have added numbers corresponding just with the 8 moments when trader made a decision to buy or sell. Fig. 4 b) shows the IBEX-35 chart.

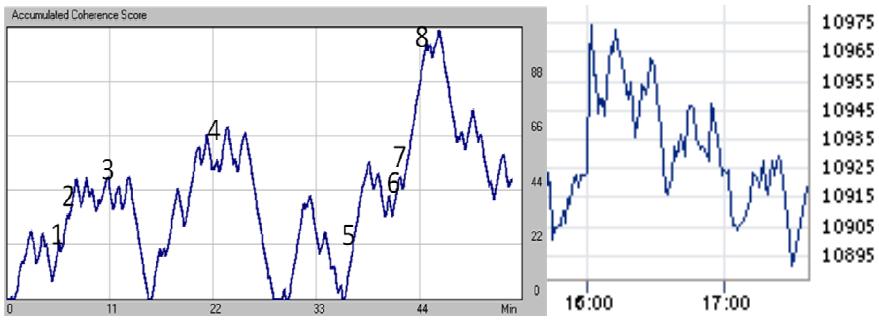

Fig.4. Coherence Score in Session 3 (a) and Chart of IBEX-35 in session 3 (b)

In this session, we can see the high impact of the news and the abrupt movements of the Index in the coherence of the trader. However, in this case, the trader has access to feedback from the system on his coherence levels and based on that the trader decides to make decisions only when he believes to be in a safe state avoiding, in this case, bad operations.

After the experiments, we achieved the following conclusions: a) Previous losses, fear to lose a great trading movement, news, time restrictions, and many other factors have high impact in the trader's decision making; b) The more difficult the market is, the more important becomes for a trader to be Self-Aware of her/his level of stress; c) The greatest losses are the result of a wrong decision made at crucial time where being Self-Aware is very important. d) Traders with AmI support, Self-Aware Traders, improve significantly their results.

5. Conclusions and Future work

A trader's mental state could be the most important information to know during trading. Currently this information is not usually available. We have conducted experiments to illustrate how to reduce the chances to fall when stress can ad-

versely influence decision making in trading. Technological support based on sensors that facilitate context-awareness can give traders a Self-Awareness that is useful to avoid mistakes at crucial moments. Context-awareness in this case is achieved by feeding back to the trader their perception of the world of finances. The first experiment with shares, where the movement in the market was slower shows less impact. However, in the following experiments where the movements were very quicker and the stress was higher the advantages are more noticeable: decision making for Self-Aware traders is safer. Our future research will be focused on extending the Self-Aware Trader concept to a group of traders creating Group-Aware information. Besides, we will implement a system where this AmI support can be better integrated with the trading process.

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