EMOTION REGULATION AND TRADER PERFORMANCE

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Abstract

We review research on emotions and financial decision making, with a particular emphasis on the role of emotion regulation and on traders in financial markets. We argue that variability in emotion regulation is a good candidate to explain important intra and inter-individual variability in susceptibility to key decision-making biases and hence in financial performance of market actors. We develop hypotheses concerning these relationships and describe the results of an investigation of the role of emotion regulation (operationalized as heart rate variability (HRV)) in relation to the expertise of professional traders in investment banks. We find a significant association between trader experience and HRV.

Trading and emotion regulation: The heart of financial decision-making?

Introduction

Neo-classical financial economics has been a prime influence on research into markets and market behavior. Traders within such markets are understood by financial economists to be profit maximisers who act on price information which summarizes all available knowledge about asset values (Fama 1991; Fama 1998). Such markets are understood to be transparent and have low transaction costs such that profit opportunities are only fleetingly available and market imperfections are eradicated (MacKenzie 2006). Within this paradigm there are strong assumptions about investor rationality and the nature of investor preferences.

In the last two decades, understanding of markets and market behavior has been changed by the advent of behavioral finance (Thaler 1993; De Bondt, Palm et al. 2004), which has drawn upon the insights of cognitive psychology to incorporate cognitive biases, into models of financial decision making, modeling investor behavior and explaining some well-known deviations of market behavior from the predictions of the efficient markets hypothesis – a mainstay of the neo-classical paradigm (Fama 1991). However, within this field of study, until recently, the main role accorded to emotions is that they are an interference with rational cognition, or are accorded a utility in anticipated future outcomes rather than being central to choice and action (Shefrin 2000).

More recent work has begun to show the importance of emotion in understanding financial decision-making and risk behavior more generally (Damasio 1994; Finucane, Alhakami et al. 2000; Bechara and Damasio 2005). The trader practitioner literature is full of references to emotion and 'market sentiment'; for example, "Trading is emotion. It is mass psychology, greed and fear." (Marcus in Schwager 1993: 49). Advances in neuroscience are also demonstrating that, as Phelps (2006: 46) concludes in a recent review, the mechanisms of emotion and cognition are intertwined; from early perception to complex reasoning.

There is evidence both of emotion playing a biasing role on judgment which is detrimental to human performance and of emotions playing a role which enhances performance. First, emotions can bias information retrieval. For example, Meyer, and colleagues(1990) offer evidence that it is most easy to recall experiences which are congruent with current emotional state. Second, emotions can directly bias the cognitive

processes engaged in decision-making(Shiv, Loewenstein et al. 2005). For example, Lerner and Keltner (2001) show fear to increase risk perception (and decrease riskiness of choices) and anger to reduce risk perception (and increase riskiness of choices). Lo, Repin and Steenbarger (2005) found some clear associations between day-traders' emotions (as measured by an emotional-state survey), their decision making, and performance (N=80). Investors who experienced more intense positive and negative emotional reactions to gain and loss were poorer performers than those with more attenuated emotional responses.

However, there is also evidence that the use of emotional cues offers an important advantage in everyday decision-making (Brickner 1932; Bechara and Damasio 2005). There is some evidence too which supports the idea that emotions may support effective decision-making in a financial context. For example Seo and Barrett (2007) carried out a study of investment club members (N=101), using an internet-based investment simulation accompanied by emotional-state surveys. They found that individuals who experienced more intense emotions achieved higher decision-making performance. There is some degree of support for two contrasting perspectives. The first suggests that emotions primarily interfere with rational assessment of information and risk. The second that emotions by representing experience gained across many relevant prior situations are an aid to navigation in complex information environments. Accounts of emotions as bias focus primarily on the role of non-relevant emotions. By contrast, accounts of emotions as information focus primarily on the role of emotions in encapsulating prior relevant experience. In principle, these two perspectives may not then be in contradiction.

Emotion regulation and financial behavior

The recent literature on emotion regulation makes it clear that humans do not just experience emotions; we actively regulate them (Gross 2002; Gross and Thompson 2007). Further there is evidence of both trait and state variability in emotion regulation effectiveness. It thus seems likely that the regulation of emotion (e.g. down-regulating non-relevant emotions while remaining sensitive to relevant emotions) may play an important role in moderating emotion effects on performance.

Behavioral finance has been primarily concerned with examining the role of well-known cognitive biases in perception and management of risk in underpinning departures in aggregate market behavior from the joint predictions of the efficient markets hypothesis and

the capital asset pricing model. Thus the focus has been on the existence in the general population of such biases as the disposition effect, path dependence and loss aversion. However, it is also clear that there is considerable individual variability in propensity to such biases.

Very recently empirical research has begun to address the possible role that emotion regulation processes may play in individual susceptibility to emotion driven decision biases such as loss aversion and the disposition effect. A large scale qualitative field study of investment bank traders (Fenton-O'Creevy, Nicholson et al. 2005; Fenton-O'Creevy, Soane et al. 2008) showed important differences between novice and expert traders in emotion regulation strategies and showed many traders and their managers to be much concerned with the regulation of emotion to avoid adverse impacts of strong emotions on trading decisions. A recent laboratory study (Sokol-Hessner, Hsu et al. 2009) showed loss aversion to be reduced by adopting an intentional cognitive approach to emotion regulation[7]. Directing subjects to adopt such a strategy resulted in lower arousal relative to losses (as measured by skin conductance) and in lower behavioral loss aversion compared to a control group. Another recent laboratory study (Heilman, Crisan et al.) showed an (instructed) intentional cognitive approach to emotion regulation to reduce the impact of induced emotions on risk aversion and on performance in the pre-hunch/hunch stage of the Iowa Gambling Task such that risk aversion was reduced and performance in the gambling task was greater relative to a control group.

Gross and colleagues (Gross 2007) have developed a staged model of emotions, which distinguishes between strategies for emotion regulation which intervene at different stages of the emotion process. A self-report measure, the Emotion Regulation Questionnaire, identifies habitual approaches to emotion regulation: reappraisal, in which an intentional cognitive reappraisal of the stimulus affects the emotion response; and response modulation (or expressive suppression) in which expression of an experienced emotion is effortfully modulated.

Such self-report measures are easy to administer and have been successfully linked in research to important outcomes. However, they depend on subjects' awareness of their habitual strategies (which may be pre-conscious) and on subjects' motivation to be honest in their self report. Thus physiological measures are highly desirable since they do not depend

[7] In terms of Gross and Thompson's (2007) framework this would be a reappraisal strategy

on accuracy of subjects self-assessment and may encompass pre-conscious as well as conscious emotional states.

One important physiological measure which has recently been linked to emotion regulation is heart rate variability (HRV). The autonomic nervous system can be subdivided into the (excitatory) sympathetic and (inhibitory) parasympathetic sub-systems (SNS and PNS respectively). These interact, often antagonistically, to produce variation in physiological arousal. During periods of stability and low stress the PNS is dominant and maintains a lower degree of physiological arousal and lower heart rate. During physical or psychological stress the SNS becomes dominant increasing physiological arousal and heart-rate. Effective emotion regulation requires the ability to adjust physiological arousal on a moment by moment basis (Gross and Thompson 2007). Heart-rate variability provides a measure of the moment by moment interaction of the SNS and PNS yielding information about autonomic flexibility and thus regulated emotion responding. HRV can be considered a proxy for the central autonomic network's regulation of the timing and magnitude of an emotional response via inhibition, in response to context(Appelhans and Luecken 2006; Moses, Luecken et al. 2007; Utsey and Hook 2007; Geisler and Kubiak 2009; Hansen, Johnsen et al. 2009). Higher levels of HRV have been associated with constructive coping in university students and lower HRV with the use of repressive coping strategies, anxiety, depression and rigid attentional processing of threat (Appelhans and Luecken 2006).

While early studies have focused on resting HRV as providing a global assessment of regulatory capacity, recent studies have demonstrated the utility of HRV in providing a task-related, moment by moment, assessment of regulation (Moses, Luecken et al. 2007) and suited to field studies of task performance (Segerstrom and Nes 2007).

Understanding trader performance

Assessing trader expertise

We have good reason to believe that traders in investment banks have particular opportunities for profit that arise from lower than average transactions costs, timing advantages and some access to short-lived information advantage relative to most market actors. Further, exploiting these advantages requires skill and it is reasonable to assume that skill levels vary between traders. Thus is makes sense to think in terms of expertise in trading and to hypothesize that susceptibility to a range of decision biases will detract from skilled

trader performance. While differences in trader skill will influence financial outcomes, the relationship between skill and financial outcomes will not be straightforward and we need to be careful which measures of performance we adopt. While skill will be one element which predicts financial performance, there are important other elements. First, trader profit and loss (P&L) needs to be understood in relation to risks taken. Second, it needs to be understood in relation to market conditions. One trader may make a greater return than another, not because of greater skill, but because they are operating in different market conditions. Third, trader performance needs to be understood in relation to the risk limits they operate within. A trader given higher limits may perform better by making the same trades but for larger sums than a colleague with lower risk limits. Finally there will be a large random element in traders' daily P&L. For these reasons a simple financial measure such as daily P&L may not be a good measure of traders' performance. While experience is not expertise (Ericsson 2006); in the case of traders, poor performance tends to lead to exit from the trading role. Thus experience is likely to be strongly correlated with expertise. Hence, we take tenure in a trading role as a primary indicator of expertise. In making remuneration decisions, investment banks typically consider (longer–term) financial performance as a major element but make adjustments for the elements highlighted above. Further the operation of the labor market will tend to set a reasonably efficient price (at least in ranking terms) for trader skill. Thus a reasonable proxy for global trader performance may be total annual remuneration. An approach in previous research (Fenton-O'Creevy, Nicholson et al. 2003; Fenton-O'Creevy, Nicholson et al. 2005) has been to classify traders in terms of total remuneration. Thus we can use total annual remuneration as another measure of trader expertise.

Hypotheses

There is now empirical evidence, from laboratory studies, for a positive relationship between intentional cognitive approaches to emotion regulation and decision performance for decisions under risk and uncertainty. There is also a substantial body of interview data which suggests many expert traders and trader managers to believe effective emotion regulation to be important to effective trading performance(Fenton-O'Creevy, Soane et al. 2010 ; Vohra and Fenton-O'Creevy 2011). However findings from laboratory studies with naïve subjects do not necessarily translate into the behavior of expert performers in real world performance domains (Todd and Gigerenzer 2007), and interview data relies on informants insight into their own emotion states. Thus we seek to examine whether such effects of emotion

regulation on decision-making performance hold for the case of real world trading by professional financial traders.

Thus we test:-

H1: Higher(high frequency) heart rate variability whilst trading will be associated with higher trader expertise as measured by a) tenure as a trader; b) total annual remuneration.

Methods

Sample

We collected data from 28 traders from trading floors in two European headquartered investment banks. Traders ranged in experience from a few weeks to 25 years. All traders were market makers, standing ready to provide a price for those wishing to buy or sell the assets they trade. The majority were trading foreign exchange or related derivatives with 5 trading equities. All had some discretion to take proprietary risk (i.e. take a position on behalf of the bank).

Procedure

The research team spent time on each trading floor prior to commencing data collection. The team were introduced by a senior manager in each bank and traders were recruited as volunteers to participate in the study following a presentation and discussion about the purpose and process of the research. Each participant was interviewed and provided detailed information on their background, experience, and current job.

We collected data on each trader for between two and five days trading. While it is not possible to provide a standard stimulus as one might in an experimental setting, we wished to find ways of capturing trader reactions to market events. Usefully, activity and prices in financial markets are often affected significantly by news releases relevant to asset values. Some of these news releases (for example employment and GDP statistics) happen at fixed times in the calendar. Thus where possible and on at least two days for each trader, we captured data on days when a news release was planned. We also captured overnight data for each trader to establish a resting baseline for HRV.

Each trader was equipped with a Camntech Actiwave Cardio heart rate sensor, which was worn throughout the trading day. The sensor captures heart-beat information at 1024 HZ (ie with better than millisecond accuracy). The sensor also contains a built in accelerometer which captures data on physical movement.

Not all data was usable since over the course of a day sensor electrodes can be dislodged. In total we captured usable data on 28 traders for 153 trader-days of trading activity including 12 news events. Of the 153 trader-days heart rate recordings, 58 included news events.

Measures

Heart- rate variability: We used the frequency-based technique of power spectral analysis. The power spectrum of heart beats is separated into two bands the high frequency (HF) between .15-.40 Hz and low frequency (LF) between .04-.15 Hz. The HF primarily reflects cardiac parasympathetic influence. The LF reflects both SNS and PNS activity (Force ; Appelhans and Luecken 2006; Geisler and Kubiak 2009). The power spectrum was analyzed using a Lomb-Scargle transform due to irregular sampled time series (Saini, Singh et al. 2009). Artefacts were removed using a threshold so that if the inter beat interval (IBI) was 20% different to the previous IBI, it was not included in the HRV calculation. A moving five minute window was used to calculate HRV at one minute intervals for each trader. Planned news release event data was defined as the period from 30 minutes before to 30 minutes after the release. We calculated mean HF HRV for the whole trading day (excluding planned news releases) and for the news release periods. Daily HRV and news event HRV were aggregated (by taking the mean for each trader) for analysis at the trader level across all days and across all news events.

Heart rate: We collected heart rate data using a one minute moving window with a heart rate value being recorded every 20 seconds.

Experience: Total tenure in any professional trading role (in years).

Total Remuneration: Trader remuneration is held as highly confidential by the banks and especially in the current climate of public interest in trader bonuses it proved impossible to collect actual remuneration data. Both banks provided a score based on trader remuneration relative to median pay in the bank. However without information on relative pay levels between the banks there remain some problems of comparability and our measure is weak. At the time of writing we are seeking to improve the measure.

Findings

To test our hypothesis we first calculated correlations between High Frequency HRV, experience and remuneration (Table 1). We see that Experience (but not Remuneration) shows a significant positive correlation with mean HF HRV across the trading day, excluding news events and with HF HRV during news events. We calculated all correlations at the trader level (ie N=28) not at the level of measurement episodes (N=153).

We also find a significant negative correlation between resting HRV and experience. This is consistent with evidence in prior research that HRV declines with age (Umetani 1998), since age and experience are highly correlated.

Table 1: Pearson Correlations. Means (std deviations) on diagonal

	1	2	3	4	5
1. Resting HF	.090(.041)				
2. HF - news events	.410*	.062(.031)			
3. HF - non news event	.393*	.889**	.064 (.029)		
4. Experience (yrs)	-.306	.183	.407*	7.04 (6.21)	
5. Total remuneration (standardised)	-.284	-.086	-.082	.420*	73.46 (50.49)

*. Correlation is significant at the 0.05 level (1-tailed).

**. Correlation is significant at the 0.01 level (1-tailed).

Controlling for resting HRV made no difference to the sign or significance of correlations between task based HRV and performance..

Having tested our primary hypothesis we conducted a more exploratory examination of the data. In particular we examined differences in HRV between news event and non-news event periods, looking in detail at HRV charts for each trader over each day. Figure 1 shows HF HRV for news events and other periods, for traders partitioned into low (<4 years) medium and high experience (>9 years) groups[8] . The low experience group typically have lower HRV throughout the trading day but show Peaks around particular periods of activity, most especially news events. In contrast more experienced traders tend to show less difference in HRV levels across the day maintaining high HRV for longer periods.

[8] We made two exceptions in this classification since we felt the traders to be anomalous. We excluded a trader from the low experience group who was considered to be an exceptionally strong performer by managers and we excluded a trader from the top group who was on a very low pay grade and considered a weak performer by managers. Both showed HRV patterns which were atypical for their groups.

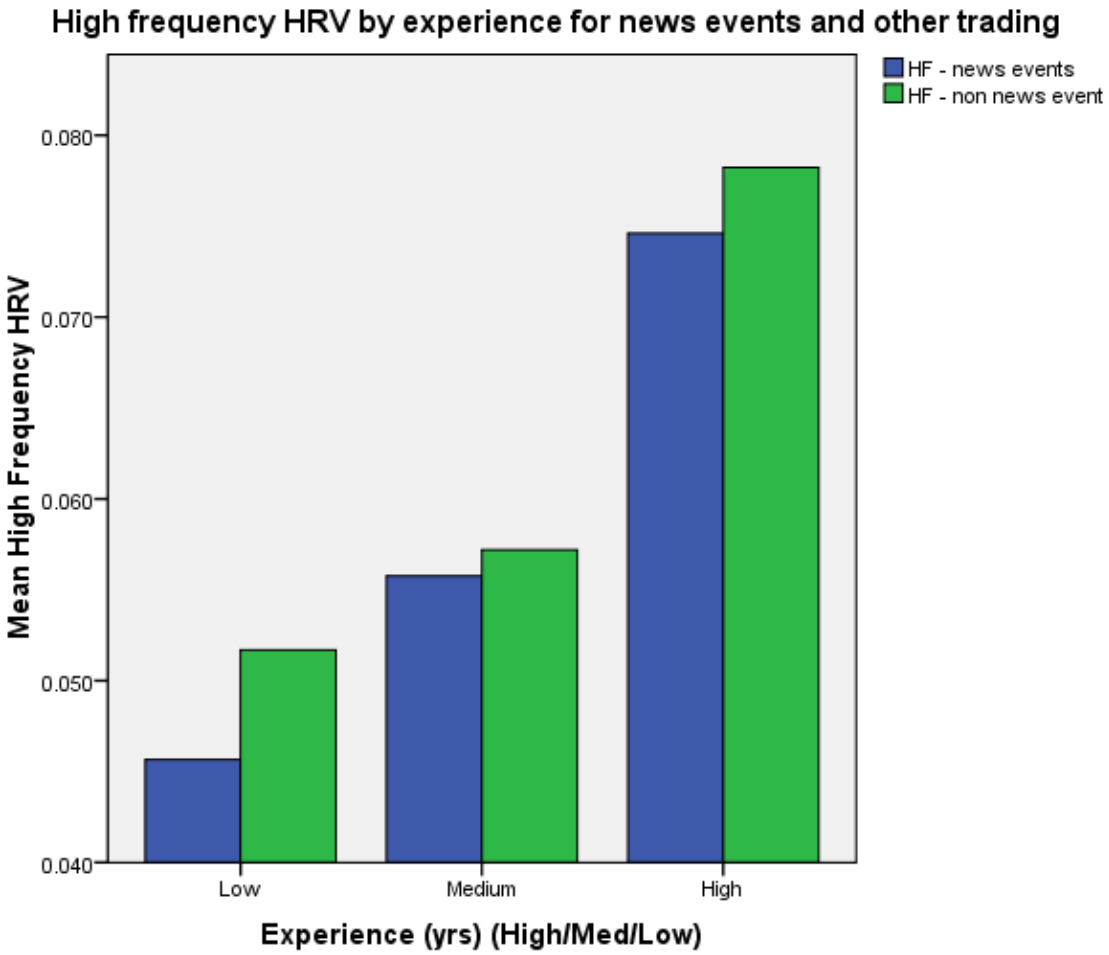

Figure 1

We also looked at the way in which physiological reactions unfold across a trading episode. Figure 2 shows mean HRV across all news events for the period from one hour before to one hour after the news event. We show this separately for the low experience and high experience groups. The chart shows mean HF HRV calculated each minute over a period of five minutes. Thus HRV levels at a specific time on the chart always show HRV calculated over the next five minutes. The bold vertical line show the time of the news release.

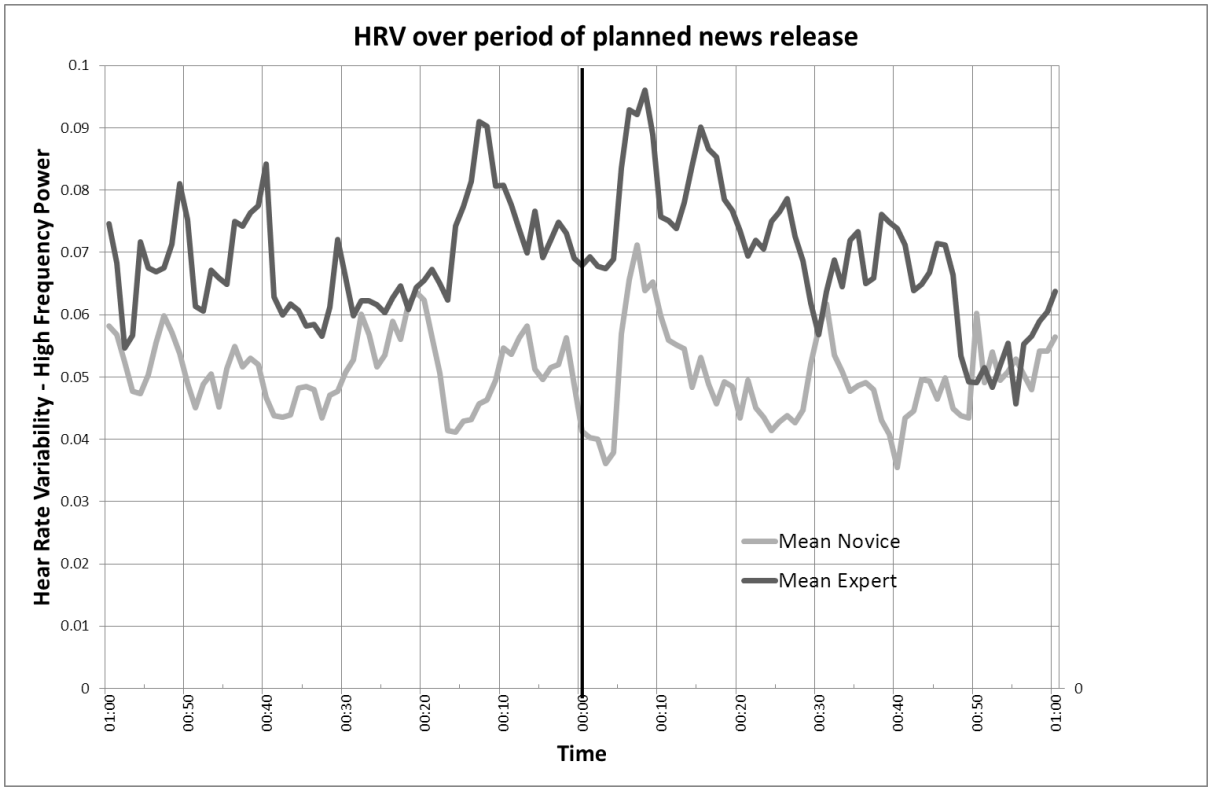

Figure 2

For both groups HRV peaks within 10 minutes of the news release. However, for the novice group there is a large dip in HRV in the period immediately following the news release. In the expert group HRV declines slowly from its peak following the news release across the next hour. In the novice group this decline happens more rapidly; across a fifteen minute period. Figure 3 Shows heart rate for the same two groups averaged over news events. HR is calculated every 20 seconds from one minute of heartbeat data and shown relative to average heart rate over the period (to adjust for inter-trader differences in base heart-rate). This strong peak in HR corresponds with the marked decline in HF HRV for novices. The key difference which can be observed is in the anticipatory increase in HR for novices prior to the event and in the size of the peak in HR at the event.

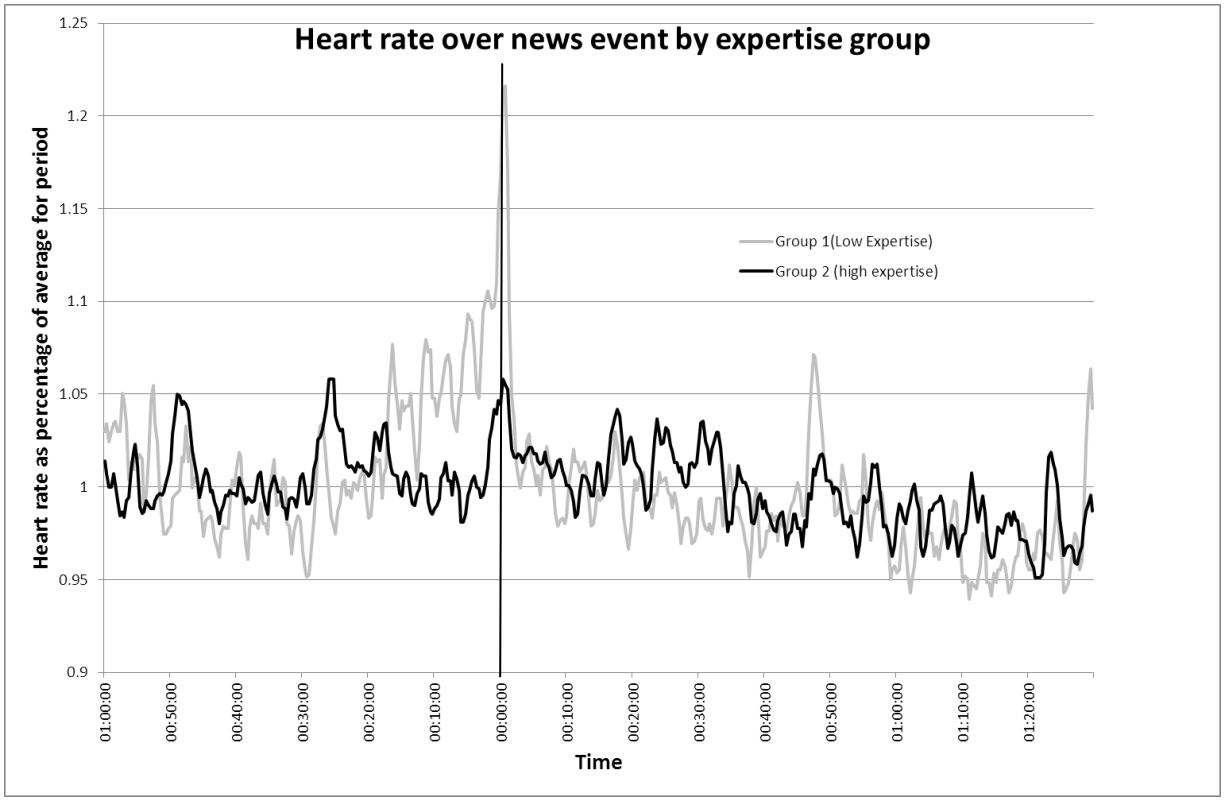

Figure 3

Discussion and conclusions

Our hypothesis for a relationship between trader expertise and emotion regulation is supported by our finding of a positive association between trading experience and mean HRV whilst trading.

A more qualitative examination of HRV patterns across the trading day suggests a key difference between low and high experience traders, is in the period for which peaks of HRV are maintained. For experienced traders significant peaks in HRV show a slow decline and are maintained over significant periods. Inexperienced traders in contrast tend to show more rapid decline from peaks of HRV associated with news events.

We did not find an association between remuneration and HRV. However, at the time of writing, there are problems of comparability for this measure between traders in the two banks. Thus this may be a weakness of the measure.

The different patterns of peaks and decay in novices and experts are consistent with prior findings that self-regulatory capacity can become exhausted like a muscle, but that like a muscle it can be trained (Baumeister, Bratslavsky et al. ; Muraven and Baumeister ; Baumeister, Gailliot et al.). This provides support for the idea that emotion regulation may be an important element of trader expertise and that traders learn to regulate their responses over time. Our finding that experience is related to task related HRV is strengthened by the comparison with the results for resting HRV. We find that consistent with research on HRV and aging, resting HRV declines with experience. However, task related HRV increases with experience.

The study has some important limitations which should be addressed in future research. First, in this study experience is used as a proxy for expertise. While we have argued that there are reasons to expect trader expertise to be strongly correlated with experience, future research may benefit from more direct, performance related, measures of expertise. Second, the sample size is small; however, the data for each trader are based on measurement of significant periods of trading.

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