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How to cite:

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Version: Accepted Manuscript

Link(s) to article on publisher's website:
http://dx.doi.org/doi:10.1016/j.joep.2018.01.003

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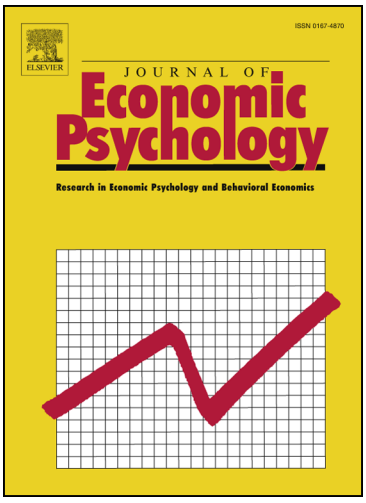

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PII: S0167-4870(17)30413-0
DOI: https://doi.org/10.1016/j.joep.2018.01.003
Reference: JOEP 2053

To appear in: *Journal of Economic Psychology*

Received Date: 14 July 2017
Revised Date: 16 January 2018
Accepted Date: 17 January 2018

Please cite this article as: Richards, D.W., Fenton-O'Creevy, M., Rutterford, J., Kodwani, D., Is the disposition effect related to investors' reliance on System 1 and System 2 processes or their strategy of emotion regulation?, *Journal of Economic Psychology* (2018), doi: https://doi.org/10.1016/j.joep.2018.01.003

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Title: Is the disposition effect related to investors' reliance on System 1 and System 2 processes or their strategy of emotion regulation?

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Abstract:

We report research on investor susceptibility to the disposition effect, a financial decision-making bias where investors have a greater propensity to realize gains than realize losses. Despite theoretical arguments for the influence of emotions, research on susceptibility to this bias, on real investors, has relied primarily on socio-demographic explanations. Some experimental research on student populations has considered emotions more directly, but has not addressed differences in individual susceptibility and has not examined genuinely consequential investor behaviour in real markets. Our research addresses this gap by predicting susceptibility to the disposition effect based on investors' reliance on intuitive (emotion mediated) cognition (System 1), analytical cognition (System 2) and the strategies they use to regulate their emotions. Using investors' trading records from a UK sample, we measure their susceptibility to the disposition effect and assess, through a questionnaire, their reliance on Systems 1 and 2 cognitive processes and use of two emotion regulation strategies. Investors with higher reliance on System 1 processes have greater disposition effect, but reliance on System 2 processes is not related to the disposition effect. Investor reliance on reappraisal (an emotion regulation strategy of changing a situation's meaning to alter its emotional impact) reduces their disposition effect. However, the use of expressive suppression (a strategy that inhibits emotion expressive behaviour) does not show a statistically significant relationship with this bias. These results suggest that investors' intuitive emotional reactions explain susceptibility to bias, and that effective strategies of regulating emotions enable this bias to be overcome.

Key words: Disposition effect; dual-process theory; emotion regulation; financial decision-making bias; behavioral finance

JEL: D81; D1; G11; G2

PsychINFO: 3000; 3100; 3920

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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Highlights:

Survey responses and trading data are analysed to research the disposition effect.

Investors who rely more on System 1 cognitive processes show more disposition effect.

Investors who use reappraisal emotion regulation exhibit less disposition effect.

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1. Introduction

On average, individual investors have a greater propensity to realize gains than realize losses, a phenomenon known as 'the disposition effect' (Shefrin & Statman, 1985). The disposition effect illustrates a deviation from the expectations of normatively rational models of decision-making. There is strong evidence for the pervasiveness of the disposition effect, both in naturalistic market settings and in laboratory experiments. There is also clear evidence of large individual differences in susceptibility to such effects (Chen, Kim, Nofsinger, & Rui, 2007; Dhar & Zhu 2006; Lehenkari, 2012; Seru, Shumway, & Stoffman 2010). This variability is important because greater disposition effect is correlated with poorer investment performance for individual investors (Odean, 1998; Seru, et al., 2010).

Research on the disposition effect investigates both the contexts in which this bias is more likely to arise and characteristics of individual investors which make them more susceptible to this bias. Theoretical explanations of the disposition effect include: prospect theory, mental accounting and the role of emotions such as regret and elation in shaping behaviour (Shefrin & Statman, 1985). More recently, research has questioned whether prospect theory can explain the disposition effect (Lehenkari, 2012); and experimental research indicates the importance of emotions in why this bias occurs (Summers & Duxbury, 2012). Despite the importance of emotions in many explanations of the disposition effect, research on investor susceptibility to the bias has not directly investigated the influence of emotions or regulation of emotions in an ecologically valid setting.

Research on investor differences in the disposition effect focuses on sophistication (Dhar & Zhu, 2006; Feng & Seasholes, 2005), experience (Seru et al., 2010) and stop loss use (Richards, Rutterford, Kodwani, & Fenton-O'Creevy, 2017). Experimental research (typically with student rather than investor samples) indicates that emotions (Goulart et al., 2013) and

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regulatory focus (Kim & Young, 2016) bear relevance for students' susceptibility to this bias but lacks the ecological validity of studies considering investor behaviour with significant financial consequences in real markets. Therefore, we address a gap in the literature by combining records of real investor behaviour (real market trades) with psychometric data to research whether investors' reliance on emotional and cognitive processes, and investors' strategies for regulating emotions, predict their susceptibility to the disposition effect when making consequential decisions in real markets.

There is strong evidence of the influence of emotion, and the importance of its effective regulation, in human decision-making. Drawing on this evidence, we advance arguments for, and then present evidence on, the influence of individual differences in reliance on cognition, emotion and regulation of emotion on differences in disposition effect susceptibility. The data in our study were collected from real UK investors improving the ecological validity of findings. The study combines their stock market trading records with psychometric questionnaire measures. Our research contributes to the body of literature that predicts susceptibility to, and de-biasing of, the disposition effect. Our contribution is to show that investors with higher habitual reliance on intuitive, emotional thinking processes are more susceptible to the disposition effect, but investors with higher habitual use of reappraisal-based emotion regulation are less susceptible.

2. Theory

2.1 The disposition effect

There is robust evidence for the disposition effect. It is observed in both trading experiments (Frydman & Rangel, 2014; Summers & Duxbury, 2012; Weber & Camerer, 1998) and investor trading records (Feng & Seasholes, 2005; Odean, 1998; Seru et al., 2010). Progressively, research on the disposition effect has diverged into two strands; one which

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identifies the mechanisms through which the disposition effect occurs at the group level and the other which investigates causes of variability between individuals in the disposition effect. In the former strand, emotions, such as regret and elation, are theorised as causal factors for the disposition effect (Summers & Duxbury, 2012). In the latter strand, with the exception of a few experimental studies which use student samples rather than examine real investor behaviour (e.g. Goulart et al., 2013), there has been little systematic attention to the influence of emotions. Our research investigates investors' reliance on emotionally influenced cognitive processes, and investors' strategies for regulating emotions, as an explanation of investor variability in the disposition effect. The study goes beyond prior experimental research to investigate the behaviour of real investors making consequential decisions in real markets.

2.1.1. Explanations of the disposition effect

A commonly adopted explanation of the disposition effect derives from prospect theory, mental accounting and regret avoidance (Shefrin & Statman, 1985). Shefrin and Statman (1985) argued that prospect theory implies that perceptions of utility, and hence behaviour, are influenced by changes in value relative to a reference point and that investors adopt the purchase price of a stock as a reference point. The prospect theory utility curve leads to the expectation, in the domain of gains, that investors will be risk averse and will sell a stock to reduce uncertainty. In the domain of losses, investors' risk tolerance increases, encouraging them to hold stock in order to avoid crystallising that loss. The mental accounting argument proposes that people segregate investments in separate mental accounts and investors treat each stock individually, rather than considering overall portfolio wealth (which would offset losses against gains). Finally, Shefrin and Statman posit that turning a paper loss into a crystallised loss induces regret, which deters selling at a loss and creates a disposition effect.

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2.1.2 Beyond prospect theory: emotion-based explanations of the disposition effect

More recently, research has questioned whether prospect theory can adequately explain the disposition effect. Barberis and Xiong (2009) critique the prospect theory explanation of the disposition effect by finding that a prospect theory based utility function in conjunction with mental accounting predicts a disposition effect in only a limited set of circumstances. It fails to predict a disposition effect, or predicts the reverse, when expected returns are high or number of trading periods are low. They argue that prospect theory and mental accounting alone are insufficient to fully explain the disposition effect. This can only be recovered by assuming differential utility of *realised* gains and losses versus paper gains and losses. The most plausible explanation of different perceived utilities for realised versus paper gains and losses involves their differential emotional impact. Ben-David and Hirshleifer (2012) investigate whether the size of the gain or loss influences the preference for selling stocks across different time durations. Contrary to prospect theory, they find a decreased likelihood of selling stocks at break-even and that, as the size of a loss increases, the preference for selling does not decrease.

Lehenkari (2012) also critiques the prospect theory explanation of the disposition effect; as she finds a greater disposition effect occurs with purchased, as opposed to inherited, stocks. Lehenkari interprets these results as implying that emotions may cause the disposition effect (with greater emotional investment in in purchased stocks) but the research she reports on does not directly measure emotions. In an experimental study on students, Summers and Duxbury (2012) measure emotions and find that regret, at least, partially explains the disposition effect. They found that, if a participant had purchased stock as opposed to inheriting it, and that stock decreased in value, then this induced regret (as opposed to disappointment) and increased the disposition effect. However, the purchase versus inherit conditions made no difference to the tendency to sell winners; both the elation of a gain in an

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inherited stock and rejoicing in the gain in a purchased stock were associated with this tendency.

2.1.3. Explanations of variation in individual susceptibility to the disposition effect

Disposition effect research on real investor behaviour that has investigated factors which influence susceptibility to the bias has usually focussed on demographic variables. Dhar and Zhu (2006) show that sophisticated investors exhibit less disposition effect, a finding replicated in other research (Boolell-Gunesh, Broihanne, & Merli, 2009; Brown, Chappel, Da Silva Rosa, & Walter, 2006; Feng & Seasholes, 2005). The influence of experience in mitigating the disposition effect has been investigated but findings are more mixed. Feng and Seasholes (2005) find that experience reduces the disposition effect of Chinese investors yet Chen et al., (2007) find an inconsistent relationship between experience and susceptibility to bias. Seru et al., (2010) find that experience measured by years spent investing has a small influence on reducing the disposition effect but experience measured by cumulative trading frequency has more influence at reducing this bias. Finally, Nolte (2012) and Richards et al., (2017) show that use of stop losses can reduce the disposition effect of traders and investors, respectively.

Overall, studies of real investor behaviour have shown great variability between investors in the disposition effect but are limited in the range of explanatory variables they could examine by the paucity of information available in the trading data. Despite emotions being attributed as a cause of this bias (Shefrin & Statman, 1985) and some experimental evidence, using student samples, for the role of emotions (Summers & Duxbury, 2012), this research has not effectively examined whether individual differences in use and regulation of emotion and cognition could explain investors' susceptibility to this bias. Our research addresses this gap using data from real markets.

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Next, we argue that variability in use of automatic emotion-mediated thinking versus more effortful mental simulation, and variability in effective regulation of emotions, underpins the extent to which investors are susceptible to the disposition effect.

2.2 Emotions in human cognition

There is substantial evidence over two decades of emotion and neuroscience research that emotions are a pervasive influence on human choice and decision-making, sometimes helpful, sometimes harmful. The evidence further suggests that cognition and emotion are not separate processes, but inextricably intertwined from perception though to action (Lerner, Li, Valdesolo, & Kassam, 2015; Phelps, 2006; Phelps, Lempert, & Sokol-Hessner, 2014). Emotions influence decisions via changes in the content and depth of thought (directing attention) and the content of implicit goals (motivating action) (Lerner et al., 2015). As Slovic, Finucane, Peters, and MacGregor, (2007) note, emotions act as a rapid route to accessing relevant accumulated experience. They are on the one hand an indispensable tool for human rational decision-making and action, allocating attention, on the basis of experience, and motivating action. On the other hand, just as we can make errors of calculation, we are prone to errors of emotion. This view is reinforced by research on emotions in investment decision-making focussed on performance rather than the disposition effect; which has found that emotions can be both harmful and beneficial to performance (Lo, Repin & Steenbarger, 2005; Seo & Barret, 2007).

To investigate the influence of emotion and cognition on the disposition effect, we use a dual process theory framework. Dual process theory (Evans, 2008) is increasingly used to offer insights into human behaviour in economic contexts (Alós-Ferrer, & Strack, 2014). The theory distinguishes human information processing into two types of thinking with different characteristics and roles. System 1 refers to automatic, associative information processing

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mediated through the emotion systems, and does not require conscious initiation (Evans & Stanovich, 2013). System 2 allows for the decoupling of cognitive representations from the immediate situation and for mental simulation of the situation and hypothetical futures. It is effortful, reflective, and generally slow and requires the use of working memory (Stanovich & West, 2000). A key role for System 2 is to intervene and regulate System 1 in situations where automatic, habituated or instinctive responses are inappropriate. System 2 then produces more situationally appropriate responses, an approach which is referred to as a "default interventionist" (Evans & Stanovich, 2013, p. 227). We use the terms System 1 and System 2 throughout as they are commonly adopted in research literature on economic behaviour, but note that some scholars increasingly prefer Type 1 and Type 2 to indicate that no single brain system underlies either type of processing, and the multiple systems, drawn on in each process, overlap significantly (Evans & Stanovich, 2013).

A dual process theory framework is relevant to explaining susceptibility to the disposition effect as it can be used to explain loss aversion and there are reliable interpersonal differences in use of System 1 and System 2. Schneider and Coulter (2015) present a dual process theory framework. Based on an extensive review, they argue that when a decision is easy to evaluate and involves affective valuations, then System 1 processes are more commonly adopted. They show that use of System 1 processes creates a loss-averse preference, similar to the disposition effect. However, when a decision is difficult to evaluate and does not involve emotion, System 2 processed are more commonly adopted. They show that use of System 2 processes creates a loss-neutral preference.

There is evidence of significant persistent individual differences in reliance on System 1 and System 2 processes. Epstein, Pacini, Denes-Raj and Heier (1996) constructed a self-report measure called the Rational Experiential Inventory (REI) to assess the individual reliance on the System 1 and System 2. Epstein et al., (1996) found stable individual differences in the

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extent to which people rely on each system and subsequent research has replicated this finding (Akinci & Sadler-Smith, 2013; Hodgkinson & Sadler-Smith, 2003a; Hodgkinson, Sadler-Smith, Sinclair, & Ashkanasy, 2009).

2.2.1 System 1 and the disposition effect

We propose that reliance on System 1 processes increases the disposition effect because System 1 processes use the most emotionally salient information, whether a stock is at a gain or a loss, to create intuitive loss-averse reactions. Investors do not only have financial goals, they have hedonic goals and the latter are served by avoiding the regret induced by crystalising a loss through a sale and savouring the rejoicing or elation consequent on realising a gain. Frydman and Rangel (2014) show that the greater the saliency of gains and losses, the greater the disposition effect. There are now several experimental studies that implicate emotions as a mechanism creating the disposition effect. Summers and Duxbury's (2012) research suggests that regret emotions, associated with a sense of responsibility for the trade and its outcome, are the mechanism for generating loss-averse behaviour underlying the loss element of the disposition effect. In contrast, the desire to crystallise gains and savour the elation or rejoicing they generate underlies the apparent risk aversion on the upside. Similarly, Aspara and Hoffman (2015a) found that reducing a participant's belief that they were personally responsible for investment decisions, and hence the emotional salience of cues, reduced the disposition effect. Goulart et al., (2013) investigated the psychophysiological correlates of the disposition effect by measuring the skin conductance response of 40 participants while they completed a simulated trading task. They found that the participants with high disposition effect had higher skin conductance responses, suggesting greater emotional automatic reactions are associated with this bias.

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Taken together, these results offer support for an association between greater reactivity to emotionally salient cues and the disposition effect. Thus, we hypothesise:

> Hypothesis 1: Investors who are more reliant on System 1 processes will exhibit the disposition effect to a greater extent than investors who are less reliant on those processes.

2.2.2 System 2 and the disposition effect

Through systematic reliance on System 2 processes, an investor may reduce their susceptibility to the disposition effect because a role of System 2 is to act as a default interventionist and correct bias arising from automatic, emotion-mediated decision processes (Evans & Stanovich, 2013). In a review of prior research, Schneider and Coulter (2015) argue that use of System 2 processes promotes neutral risk preference. The influence of deliberate cognitive processes in reducing the disposition effect has also been addressed by research using experimental trading simulations. Lee, Park, Lee and Wyer (2008) showed the relevance of effortful cognition to the disposition effect, because they found that requiring participants to calculate the expected values of risk-reward scenarios (e.g. either $100 with a 30% chance or $200 with a 70% chance) prior to trading decreased their susceptibility to the disposition effect. Aspara and Hoffman (2015b) found that increasing participants' savings goals reduced the disposition effect. An explanation of this effect may be that savings goals promote a cognitive strategy of considering overall wealth, rather than focusing on specific stock reference points to evaluate gains and losses.

Drawing on these arguments and findings, we propose that reliance on System 2 cognition decreases the disposition effect because investors will rely less on the emotional impact of cues. Thus, we hypothesise:

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Hypothesis 2: Investors who are more reliant on System 2 processes will exhibit the disposition effect to a lesser extent than investors who are less reliant on those processes.

2.3 Emotion regulation and the disposition effect

We have argued that the emotional impact of gains and losses, and their crystallisation, play an important role in generating a disposition effect. Hence, it follows that more or less effective individual strategies for regulating emotions should also play a role. If the disposition effect is partially caused by reactions to the emotional salience of information, then an effective strategy for regulating emotions will reduce the extent to which this bias is exhibited.

Emotion regulation is "the heterogeneous set of processes by which emotions are themselves regulated" (Gross & Thompson, 2007 p. 7). We study emotion regulation because there is evidence that effective emotion regulation positively influences financial decision-making (Fenton-O'Creevy et al., 2012; Fenton-O'Creevy, Soane, Nicholson, & Willman, 2011; Seo & Barrett, 2007). Seo and Barret (2007) found that investment club members who were better able to identify and distinguish emotions (a marker of effective emotion regulation) had higher decision-making performance. Fenton-O'Creevy et al., (2011) showed that high-performing expert traders have emotion regulation strategies that differ, and are more effective, from those of low-performing novice traders. Moreover, Fenton-O'Creevy et al., (2012) showed that high frequency heart rate variability (a marker of effective moment-by-moment task-related emotion regulation) was positively correlated with trader expertise.

Lee et al., (2008) manipulated participants' regulation of emotions (reappraisal of the emotional meaning of an event) by asking them to trade as if the investment were owned by another person (a form of cognitive reappraisal to regulate emotion), and found a reduction in

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disposition effect. Kim and Ha (2016) found that an individual's self-regulatory focus influences the extent to which they have a disposition effect. This research suggests the relevance of effortful emotion regulation in susceptibility to the disposition effect but further evidence is needed.

The emotion regulation model we utilise is outlined by Gross (2002), who distinguishes different stages at which emotion regulation may occur over an emotion event. Research has particularly focused on the differences between two emotion regulation strategies: cognitive reappraisal, which is a strategy to influence the nature of the emotion response, and expressive suppression, which occurs later in the emotion process (Gross, 2002). Both draw on System 2 processes. The first involves cognitively changing a situation's meaning in a way that alters its emotional impact. The latter involves effortful inhibition of ongoing emotion-expressive behaviour. As reappraisal emotion regulation is an antecedent strategy, it has a larger influence on changing an emotional experience (Bebko, Franconeri, Ochsner, & Chiao, 2011; Gross & John, 2003; John & Gross, 2004). Expressive suppression is a less effective strategy for reducing emotion because it responds after an emotion is experienced. It is less effective in reducing experience of negative emotion and more cognitively effortful, absorbing limited System 2 capacity (Gross & John, 2003).

Experimental research into emotion regulation in monetary decision-making has found that reappraisal substantially reduces loss aversion and decreases emotional reactions to gains and losses. Sokol-Hessner et al., (2009) examined the effect of priming student respondents (n=30) with reappraisal instructions prior to making a series of forced choices between a binary gamble (p=0.5) and a certain outcome (p=1). They found that reappraisal instructions reduced participants' loss aversion. Yang, Gu, Tang and Luo (2013) presented student participants (n=36) a choice between betting a small or a larger monetary amount in a series of gambles under a control and an emotion regulation condition. They subsequently showed

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participants whether they had experienced a gain or loss; measuring emotion reactions via electroencephalogram (EEG) and self-report. They found the reappraisal condition reduced emotional reactions for gains and losses measured via both formats. Overall, there is experimental evidence that use of reappraisal is effective at lessening the emotional experience (Bebko et al., 2011), reduces loss aversion (Sokol-Hessner et al., 2009) and the emotional reaction to losses and gains (Yang et al., 2013), so we predict that reappraisal would reduce the disposition effect. We hypothesise:

> Hypothesis 3: Investors' use of reappraisal emotion regulation when investing is inversely associated with the extent of disposition effect in their trading.

There is less research that focuses on the influence of expressive suppression on monetary decisions. In one experimental study, Heilman et al. (2010) looked at the influence of reappraisal and expressive suppression on risk-seeking behaviour. After priming participants with fear and disgust to reduce risk-seeking behaviour, they had participants reappraise or suppress exhibiting their emotions. They found that reappraisal increased participants' risk-seeking behaviour, but behaviour following expressive suppression did not significantly differ from that of a control group. They inferred that reappraisal effectively changed the emotional experience, so participants' risk-seeking behaviour changed accordingly, but that, as expressive suppression did not alter the emotional experience, their risk preferences did not change from the control group. However, Gross and John (2003) found that people who habitually use expressive suppression experience more negative emotions. There is also evidence that rather than reduce the impact of emotionally salient cues, expressive suppression induces greater activation in brain regions associated with the generation of emotions such as the amygdala (Gross & John, 2003).

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Thus, there is mixed evidence to date on the likely role of expressive suppression in decision-making and there is uncertainty of its influence in investment behaviour. It could be suggested that expressive suppression will increase the emotional impact from gains and losses, so it might play a role amplifying emotional effects in investment. Hence, in our study we also explore the role that may be played by expressive suppression but make no hypothesis regarding it.

3 Data and Methods

3.1 Data

The study combines stock market investor trading data with investor responses to an online questionnaire. Trading data is used to calculate susceptibility to the disposition effect, and the online questionnaire measures investors' habitual reliance on System 1, System 2, reappraisal and expressive suppression. Trading records were obtained from a brokerage company which provides an online and telephone trade execution service to investors in the UK. The brokerage firm provided trading records for 7,828 investors over the period 4th July 2006 to 14th December 2009. The sales manager at the brokerage company selected this sample of investors on the basis that they were active investors with at least two trades per year, had an email address and had given consent to be contacted for marketing purposes.

From the larger dataset, a smaller sample of investors was chosen to be invited to complete the questionnaire because some investors did not complete enough trades to exhibit a disposition effect. Investors were selected if they had purchased and sold two different stocks, a constraint utilised in other research on the disposition effect (e.g. Odean, 1998). We omitted investors younger than 19, at the request of the brokerage firm, and those missing data on their gender or age. This left a sample of 4,125 investors. Whilst the reduction from 7,828 investors to a sample of 4,125 investors may seem large as 47% of investors have been

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removed, this proportion is relatively minor when compared to other research on the disposition effect. Dhar and Zhu (2006) remove 81% of their investors (from n= 77,935 to n= 14,872) and Seru et al., (2010) remove 96% of their sample (from n= 322,454 to n=11,979 investors). However, it is important to note that the generalizability of this research is only for actively trading investors and not all investors. Investors who trade actively tend to be younger, male, and are more likely to use stop losses (Barber & Odean, 2001; Korniotis & Kumar, 2011; Richards & Willows, 2017).

On 1st February 2010 the brokerage firm wrote to each investor, informing them of the research and giving them the opportunity to withdraw. Any investors who withdrew from the research contacted the brokerage firm directly, so their number is unknown. Two weeks later the brokerage firm emailed the investors a web link to our questionnaire, and a reminder was emailed on 3rd March 2010. The questionnaire closed on 17th March 2010. The method of matching each investor's questionnaire response to their trading records was to embed each investor's unique identification number in their web link. When the questionnaire closed, 283 responses could be matched to the relevant trading data. One investor's response was omitted because they had answered '1' for all of the questions. For all investors who responded to the online questionnaire, stock holding on the 4th July 2006 was supplied by the brokerage firm. We are able to track each of these investors' portfolios over the investment period by combining the holding data with the transaction data. The final data set contains 282 investors who had completed 19,888 transactions. Finally, daily stock price data over the period July 2006 – December 2009 was obtained using Datastream, with foreign stocks being converted into pounds sterling. Adjustments for corporate actions were made and details are available from the lead author upon request. The sample period covers the financial crisis of 2007- 2008, during which major market fluctuations occurred. To test for the influence of these fluctuations, market return (FTSE 100) and market volume (FTSE 100 Volume)

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variables were included in our analysis. However, the inclusion of these variables did not make a significant difference to the findings presented and have been omitted.

A comparison between the sample of responding investors and invited non-responders, is presented in Table 1 to examine response bias. It compares the investors on disposition effect, age, gender, stop loss use, sophistication, trading frequency and value traded on average (£). An investor level disposition effect measure is calculated using a Trading Gains Indicator (TGI) and a Trading Loss Indicator (TLI), which are defined in section 3.3. The disposition effect for this comparison purposes was calculated using the following formulae:

$$\textit{Proportion of gains sold (PGS)} = TGI_{r,i} / TGI_{d,i} \quad (1)$$

$$\textit{Proportion of losses sold (PLS)} = TLI_{r,i} / TLI_{d,i} \quad (2)$$

$$\textit{Disposition effect} = \ln(PGS / PLS) \quad (3)$$

Where $TGI_{r,i}$ is the number of stocks sold when at a gain by investor "*i*" and $TGI_{d,i}$ is the number of days that stocks were held at a gain by investor "*i*". $TLI_{r,i}$ *is* the number of losses sold by investor "*i*" and $TLI_{d,i}$ is the number of days that stocks were held at a loss by investor "*i*".

The descriptive statistics indicate the investors in the sample are not statistically different to investors invited to respond in terms of their disposition effect, use of stop losses, sophistication, and mean value traded. However, respondents tend to be younger, trade more and are more likely to be male. Further investigation of the distribution of age and trading frequency showed that there was a similar spread of values between the sample and those invited to respond. Whilst there is a modest but statistically significant difference in age and trading frequency between respondents and non-respondents, there is enough variability in these values to make adequate inferences. For gender, it is important to consider that a higher proportion of men responded to the survey when interpreting results.

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Table 1

Descriptive statistics for the sample of investors and those invited to respond

	Non-respondents	Respondents	Significance test
Mean disposition effect[a]	.66	.59	*t*= .74
Mean age[b]	51.62	53.27	*t*= -1.90*
Proportion of men[b]	79.91%	89.36%	χ^2= 14.99**
Proportion of stop loss users[b]	24.67%	24.47%	χ^2= 0.01
Proportion of sophisticated[b]	24.80%	22.70%	χ^2 = .6294
Mean log(number of trades)[b]	3.86	3.96	t=-1.77*
Median value traded per transaction	£1248.16	£1100.23	z = 1.82

Note **, * - significant at p < .01 and p < .05 level

[a]=Non-respondent (n= 2,341) and respondents (n= 178)

[b]= Non-respondent (n= 3,842) and respondents (n= 282)

t= students t-test, χ^2= Chi squared test, z= Wilcoxon signed-rank test.

3.2 Analysis model

There are two major methods used to calculate the disposition effect: one developed by Odean (1998) and a survival analysis approach developed by Feng and Seasholes (2005). Although Odean's (1998) approach is common, Feng and Seasholes (2005) illustrate that Odean's method works well for the disposition effect on average, but not for analysis at the individual level. Some of the issues with Odean's method include: exclusion of investors who only sell gains or only sell losses, individual measures of disposition effect are not smooth and as the method bunches values around 1 or -1, the measure is highly influenced by number of stocks an investor has in their portfolio and it only uses information on days in which stocks are sold (ignoring data on days in which stocks are held). An additional advantage of the Feng and Seasholes method, is that by paying separate attention to influences on realising gains and influences on realising losses, it supports examining whether antecedents of the

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disposition effect operate primarily through changing propensity to realise gains, or losses, or both.

We adopted a survival analysis approach hypotheses but have improved on the methodology Feng and Seasholes (2005) introduced. Feng and Seasholes' survival analysis methodology uses investors' transactions as the unit of analysis and assumes transactions are independent. This assumption is not always correct, as each investor completes multiple transactions and each investor's trading pattern will influence the decision to sell. To control for the multi-level nature of the data, we adopted a shared frailty model to calculate the conditional probability that each investor will sell stock.

In our model, *i* refers to an investor who first purchases stock and starts a transaction *k*. We include the factor α_i to estimate the investor level variance of frailty. When a transaction starts, time *t* is equal to one and *t* increases by one for each day the UK stock market was open. Survival time, T, is value of *t* when the stock is first sold or when the data on the transaction can no longer be included (it has been right-censored). Right-censoring occurs when an investor has not sold before the observation period ends or a transaction in which the company owned by an investor underwent a corporate action (details are available in the supplementary material).We measure T by having a sale covariate which takes the value of zero when a stock is held, the value of one on the day it is first sold and the value of two to indicate that the transaction is right censored.

Like, Feng and Seasholes (2005) and Chen et al., (2007) we used a Weibull distribution to estimate the shared frailty conditional hazard model. The hazard model is:

$$h_{ik}(t|\,\alpha_i) = \alpha_i h_{ik}(t) \qquad (4)$$

$$\alpha_i h_{ik}(t) = \alpha_i \exp(X_{ik}\beta) p t^{1-p} \qquad (5)$$

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$h_{i,k}(t|\ \alpha_i)$ is investor *i's* probability of selling stock *k* at time *t*, conditional on both not selling until time *t* and the frailty variance factor α_i. $h_{ik}(t)$ is the baseline hazard function, which is a parametric model calculated using a Weibull function pt^{1-p}. p in a Weibull model is a shape parameter estimated from the data and $p > 1$ means that the hazard increases as time increases, $p < 1$ means that the hazard decreases as time increases and $p = 1$ means the hazard is constant over time. We include both investor and transaction based covariates expressed as X_{ik} and these are both fixed covariates and time-varying covariates. The appropriateness of a Weibull model was assessed using graphs of the log-log survival function over log analysis time and these tests confirmed that a Weibull proportional hazard specification fits our analysis (the graphical tests are available in the supplementary material). Section 3.3 explains how the dependant covariates, gains and losses, were calculated.

3.3 Gains and losses

For each transaction an investor made, we calculate a dummy variable to indicate gains or losses on a daily basis. Gains and losses were calculated by comparing a share volume weighted average purchase price (SVWAPP) to the daily stock prices (Grinblatt & Keloharju, 2001). If the SWVAPP is below the daily low stock price there is a gain, and if the SVWAPP is above the daily high stock price there is a loss. If the SVWAPP is between the daily high and daily low stock price, it is considered a break even. We calculated a Trading Gain Indicator (TGI) that takes the value of one when a stock is at a gain and zero otherwise, and a Trading Loss Indicator (TLI), which takes the value of one when a stock is at a loss and zero otherwise. To measure the disposition effect, the TGI and TLI were analysed to ascertain whether they increased (a hazard ratio above the value of 1) or decreased the propensity to sell stock (a hazard ratio below the value of 1).

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To test our research hypotheses, we interacted both the TGI and TLI with other independent covariates and control covariates. The interaction terms of these covariates with the TLI and TGI, show whether the covariate increases or decreases the propensity to sell stocks trading at a loss or gain, respectively. We also included the control and independent covariates as main effects. Next, we outline the measurement of the independent covariates and then control covariates.

3.4 System 1 and System 2

There is some debate about whether reliance on System 1 processes and System 2 processes should be measured using a unifactorial or bipolar instrument (Hayes, Allinson, Hudson & Keasey, 2003; Hodgkinson & Saddler-Smith 2003a, 2003b; Pacini & Epstein., 1999). Unifactorial instruments measure an individual's reliance on cognitive processes as being either System 1 or System 2. Bipolar instruments measure cognitive styles separately, so an individual can be either high or low in System 1 and System 2 independently. This research adopted a bipolar instrument because a bipolar instrument reflects concurrent use of both methods of processing information (Hodgkinson & Saddler-Smith 2003a, 2003b). The instrument (the REI-S24) is a shortened version of the Rational-Experiential Inventory (REI: (Norris & Epstein, 2009; Pacini & Epstein, 1999)). It incorporates personality-level scales which identify levels of reliance on System 1 processes (experiential scale) and System 2 processes (rational scale). Both main scales have subscales which distinguish between self-rated ability at, and preference for, each method of information processing; the rational ability subscale, rational preference subscale, experiential ability subscale and experiential preference subscale. Norris and Epstein (2009) found that the REI-S24 is a valid substitute for the REI, with adequate reliability. Alpha reliability coefficients for the rational scale, rational ability subscale, rational preference subscale, experiential scale, experiential ability subscale and experiential preference subscale are .74, .77, and .76, .74, .77, and .75

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respectively. This shows adequate reliability, taking into consideration that the number of items in each scale is 12 and each subscale is 6 (Cortina, 1993). The items used in the scale are available in the supplementary material.

3.5 Emotion regulation

The emotion regulation questionnaire (ERQ: Gross & John, 2003) was used to measure reappraisal and expressive suppression. The ERQ consists of six items for reappraisal and four items for expressive suppression. The alpha reliability in our sample was 0.73 for both scales, suggesting adequate internal validity (Cortina, 1993). Gross and John (2003) measured re-test reliability across a three-month period and found alpha reliability coefficients of .69 for each scale, showing good reliability over time.

3.6 Control covariates

We also include control covariates that have been shown to mitigate the disposition effect. These are; Experience (self-reported number of years of investment experience); Investor sophistication (a dummy covariate for investors who trade warrants or diversify internationally); Investor sophistication (a dummy covariate for investors who trade warrants (Richards et al., 2017) or diversify internationally (Boolell-Gunesh, et al., 2009)); and Gender (a dummy variable with one for male and zero for female investors). Table 2 contains the correlations, mean and standard deviations of the independent variables and control variables.

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Table 2

Mean, Standard Deviation and Correlations of Independent Variables

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1.Sophistication	.22	.42											
2. Years of experience	14.73	11.99	.06										
3. Number of stop loss transactions	2.75	10.47	.08	.01									
4. Gender- Male	.89	.30	.02	.10	.03								
5. Experiential scale	3.22	.55	.00	-.23**	-.02	-.10							
6. Rational scale	3.88	.54	.02	-.04	.09	.11	-.10						
7. Reappraisal	4.59	.87	.10	-.05	.03	-.03	-.01	.18**					
8. Expressive Suppression	3.90	1.11	-.05	.09	-.02	.09	-.19**	-.02	-.05				
9. Experiential ability subscale	3.14	.64	-.01	-.22**	-.05	-.12	.90**	-.03	.01	-.20**			
10. Experiential preference subscale	3.31	.58	.03	-.21*	.00	-.06	.92**	-.15*	-.03	.15*	.67**		
11. Rational ability subscale	4.05	.56	.01	-.03	.06	.09	-.08	.90**	.14*	.00	.01	-.15*	
12. Rational preference subscale	3.70	.62	.03	-.04	.10	.10	-.10	.92**	.18**	-.04	-.05	-.13*	.66**

Note. SD= Standard Deviation, n= 282, ** p< 0.01, * p< 0.05

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4. Results

Using survival analysis to analyse the disposition effect involves running separate models of the TLI and the TGI. Independent covariates are included in each of these models to ascertain if they increase or decrease the tendency to sell losses (TLI) or gains (TGI). The findings for the TLI are presented in Table 3 and the findings for the TGI are presented in Table 4. Within these tables, the results containing only the four control covariates are outlined in column 1 and the results containing all independent covariates are in column 2.

4.1 Disposition effect

We begin with the results presented for the disposition effect; outlined in Column 1 of both tables. The hazard ratio for the TLI is significantly below 1 indicating that when stocks are at a loss, they are less likely to be sold. The hazard ratio for the TGI is significantly above 1, indicating that when stocks are at a gain, they are more likely to be sold. However, the results for the TLI and TGI when all the independent covariates are included (Column 2) are no longer at a statically significant level. The lack of statistical significance may occur due to the limited sample size and the number of variables included in the analysis or due to the effects of gains and losses on survival time being primarily mediated via their interactions with covariates. Overall, this does not influence the interpretation of the influence of other independent covariates on the disposition effect since there are significant interaction effects with the TLI and TGI.

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Table 3: Hazard ratios for the Trading Loss Indicator (TLI) and independent variables

	Model 1	**Model 2**
TLI	.5005**	1.0952
(Z-stat)	(-6.41)	(0.21)
TLI x Sophistication	1.2361**	1.2076*
(Z-stat)	(3.02)	(2.53)
TLI x Experience	.9946*	.9882**
(Z-stat)	(-2.26)	(-4.17)
TLI x Stop loss transaction	4.1461**	4.0233**
(Z-stat)	(15.18)	(14.77)
TLI x Gender	.6529**	.6598**
(Z-stat)	(-3.86)	(-3.68)
TLI x Experiential Scale		.7103**
(Z-stat)		(-4.83)
TLI x Rational Scale		1.0030
(Z-stat)		(0.05)
TLI x Reappraisal		1.0833
(Z-stat)		(1.94)
TLI x Expressive Suppression		1.0076
(Z-stat)		(0.23)
Sophistication	.6913*	.6653*
(Z-stat)	(-2.22)	(-2.43)
Experience	.9805**	.9849**
(Z-stat)	(-3.90)	(-2.75)
Stop Loss Transaction	1.5213**	1.5397**
(Z-stat)	(5.99)	(6.16)
Gender	1.4079	1.3528
(Z-stat)	(1.47)	(1.29)
Experiential Scale		1.3461*
(Z-stat)		(2.13)
Rational Scale		1.1668
(Z-stat)		(1.24)
Reappraisal		1.0173
(Z-stat)		(0.20)
Expressive Suppression		.9433
(Z-stat)		-0.92
p	.9559**	.9570**
(Z-stat)	(-4.16)	(-4.06)
θ	1.1961**	1.1863*
(Z-stat)	(2.09)	(1.99)

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Note. This table contains the hazard ratios associated with investors' tendency to sell/hold stocks at a loss. A survival model with a shared frailty gamma function and a Weibull distribution is used. The dependent variable takes the value of 0 every day a stock is held by an investor, 1 on the first day it is sold and 2 when it is right censored. The independent variables include a trading loss indicator (1= loss and 0 = not loss), a sophistication dummy, investment experience in years, a stop loss transaction dummy, a gender dummy (1= male, 0= female), two Rational Experiential Inventory (REI-S24) scales –rational scale, experiential scale, and two emotion regulation question (ERQ) scales –reappraisal and expressive suppression. The data is from a sample of 19,888 positions made by 282 investors over the period July 2006 to December 2009. It was provided by a brokerage firm in the UK. Z-stats are shown in the parentheses below the hazard ratios. ** $p< 0.01$, * $p< 0.05$

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Table 4: Hazard ratios for the Trading Gain Indicator (TGI) and independent variables

	Model 1	Model 2
TGI	2.4398**	.7759
(Z-stat)	(8.64)	(-0.64)
TGI x Sophistication	.8607*	.8732
(Z-stat)	(-2.24)	(-1.91)
TGI x Experience	1.0064*	1.0123**
(Z-stat)	(2.80)	(4.52)
TGI x Stop loss transaction	.2714**	.2777**
(Z-stat)	(-13.69)	(-13.40)
TGI x Gender	1.1852	1.1450
(Z-stat)	(1.62)	(1.26)
TGI x Experiential Scale		1.4268**
(Z-stat)		(5.33)
TGI x Rational Scale		1.1065
(Z-stat)		(1.69)
TGI x Reappraisal		.9114*
(Z-stat)		(-2.37)
TGI x Expressive Suppression		.9929
(Z-stat)		(-0.23)
Sophistication	.7849	.7433
(Z-stat)	(-1.43)	(-1.73)
Experience	.9753**	.9745**
(Z-stat)	(-4.85)	(-4.50)
Stop Loss Transaction	4.7833**	4.7328**
(Z-stat)	(23.89)	(23.63)
Gender	1.1408	1.1166
(Z-stat)	(0.55)	(0.46)
Experiential Scale		1.0024
(Z-stat)		(0.02)
Rational Scale		1.1306
(Z-stat)		(0.96)
Reappraisal		1.0996
(Z-stat)		(1.05)
Expressive Suppression		.9479
(Z-stat)		(-0.81)
p	.8761**	.8769**
(Z-stat)	(-10.89)	(-10.81)
θ value	1.2088*	1.1997*
(Z-stat)	(2.21)	(2.12)

Note. This table contains the hazard ratios associated with investors' tendency to sell/hold stocks at a gain. A survival model with a shared frailty gamma function and a Weibull distribution is

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used. The dependent variable takes the value of 0 every day a stock is held by an investor, 1 on the first day it is sold and 2 when it is right censored. The independent variables include a trading gain indicator (1= gain and 0 = not gain), a sophistication dummy, investment experience in years, a stop loss transaction dummy, a gender dummy (1= male, 0= female), two Rational Experiential Inventory (REI-S24) scales –rational scale, experiential scale, and two emotion regulation scales –reappraisal and expressive suppression. The data is from a sample of 19,888 positions made by 282 investors over the period July 2006 to December 2009. It was provided by a brokerage firm in the UK. Z-stats are shown in the parentheses below the hazard ratios. ** $p< 0.01$, * $p< 0.05$

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4.2 Gender, sophistication, experience and stop loss use with the disposition effect

Henceforth, only the results presented in column 2 of tables 3 and 4 are interpreted. The results show that sophisticated investors are less prone to the disposition effect. This occurs only in relationship to trading losses, where sophisticated investors are more likely to sell a loss than other investors. This supports other research which has found that sophisticated investors exhibit less disposition effect (Dhar & Zhu, 2006; Boolell-Gunesh, et al., 2009; Brown, et al., 2006; Feng & Seasholes, 2005).

For use of stop losses, the results indicate that when stop losses are used, investors are more likely to sell a loss and less likely to sell a gain. Overall, the use of stop losses decreases the disposition effect.

For experience an unexpected result occurred. An increase in experience is associated with *increased* disposition effect. The results indicate that a 1 year increase in experience decreases the sale of losses by 0.5% and increases the sale of gains by 0.6%, relative to baseline. This differs from previous research which found that experience decreased the disposition effect (Feng & Seasholes, 2005; Seru et al., 2010) or had an inconsistent influence on bias (Chen et al., 2007). A possible reason for the difference in our findings to other research is our measure of experience. We have measured experience by the number of years spent investing. Seru et al., (2010) found that experience measured by the number of cumulative trades has more influence in curbing the disposition effect than experience measured by the number of years trading.

A second unexpected result is that men are more prone to the disposition effect than women because they are more likely to hold losses longer. This finding differs from other research that found women are more susceptible to the disposition effect (Feng & Seasholes, 2005; Frino,

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Lepone, & Wright, 2015; Shu, Yeh, Chiu & Chen, 2005) or that gender has no effect (Barber, Yi-Tsung, Yu-Jane & Odean, 2007). However, this result needs to be treated cautiously because men are significantly over-represented in our study. Nonetheless, these inconsistent findings about gender differences in the disposition effect prevent a solid conclusion about men's or women's susceptibility to it. As the inconsistent findings are spread across different countries, it suggests that gender differences in this bias may be culturally, as opposed to biologically, determined.

4.3 System 1 and System 2 and the disposition effect

Examining results relevant to System 1, the hazard ratio for the interaction between the TLI and the experiential scale is below 1 and hazard ratio for the interaction between the TGI and the experiential scale is above 1. Those investors who score higher on the experiential scale are less likely to sell a loss and more likely to sell a gain. This supports hypothesis 1, that investors who report high reliance on System 1 are more susceptible to the disposition effect. In relation to System 2, neither the hazard ratio for the interaction between the TLI and the rational nor the hazard ratio for the interaction between the TGI and the rational scale are statistically significant. Thus hypothesis 2 is unsupported. That is, investors higher in System 2, are not significantly less susceptible to the disposition effect.

4.4 Reappraisal and expressive suppression and the disposition effect

The results for reappraisal support hypothesis 3, that those investors who make greater use of reappraisal are less susceptible to the disposition effect. The hazard ratio for the interaction between the TGI and reappraisal is below 1 and statistically significant. The hazard ratio for the interaction between the TLI and reappraisal is above 1 and is on the borderline of statistical

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significance (h(t) = 1.0833, p = 0.05). Overall, there is evidence to support that those investors who use reappraisal emotion regulation to a greater extent are less susceptible to the disposition effect.

In relation to expressive suppression emotion regulation, no hypothesis was formed from the literature review. In the analysis, the interaction of the TLI with expressive suppression and the interaction of the TGI with expressive suppression, are both not statistically significant. Therefore, there is no evidence to show that use of expressive suppression increases or decreases susceptibility to the disposition effect.

4.5 Subscales of the REI-S24 with the disposition effect

Finally, an issue encountered when measuring System 2, was that many investors rated themselves highly on the rational scale of the REI-S24. This was apparent on the rational ability subscale in particular. For this reason, we investigated the influence that the REI-S24 subscales have on the disposition effect. The subscales are the experiential ability subscale, experiential preference subscale, rational ability subscale and rational preference subscale. Full results are omitted for brevity but are available in the supplementary material. The results indicate that the rational ability and rational preference subscales have contradictory effects on the disposition effect. The rational ability subscale is associated with a decrease in the selling of losses and an increase the selling of gains. However, the rational preference scale is associated with an increase in the selling of losses and a decrease in the selling of gains. Overall, the subscale analysis indicates that investors with high self-rated ability at using System 2 have more disposition effect and that investors with high self-rated preference for System 2 have less disposition effect.

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5. Discussion

Research on the disposition effect can be categorised broadly into two agendas; research that explains the mechanism of why the bias occurs and research that predicts individual susceptibility to this bias. Explanations of the disposition effect have highlighted that emotions are an integral aspect of why this bias occurs (Summers & Duxbury, 2012). However, research focusing on individual susceptibility (and, in particular, research examining real investor behaviour) has not investigated whether individual differences in emotion (or cognition) explain the extent to which investor is more (or less) prone to this bias. Our research addresses this gap; and does so in relation to investors making consequential decisions in real markets, rather than simulated markets. We studied individual differences in reliance on emotion and cognitive processes as predictors of susceptibility to the disposition effect. Where previous research on this topic has been obtained from experimental trading simulations, our paper uses actual investors' trading data and individual measures of psychological traits. This increases the ecological validity of findings and allows the investigation of individual differences as predictors of bias in a real world setting.

We use dual process theory as a conceptual framework as it distinguishes human information processing into two types of thinking with different characteristics and roles: System 1 and System 2. System 1 refers to associative information processing mediated through the emotion systems, and we argued that use of System 1 would increase susceptibility to the disposition effect. We find that investors who report higher reliance on System 1 processes were more susceptible to the disposition effect. An implication of this finding is that it shows that reliance on low-effort emotion-mediated cognitive processes can increase susceptibility to this real-world

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bias. In relation to investors, this finding suggests that faith in intuition is misplaced as it leads to more biased decision-making.

The other side of dual process theory is System 2, which refers to effortful and reflective cognitive processes. System 2 allows for the decoupling of cognitive representations from the immediate situation and for mental simulation of the situation and hypothetical futures. Importantly, use of System 2 processes reduces loss aversion (Schneider & Coulter, 2015) and can be utilised to correct errors identified in System 1 processes as it acts as a default interventionist (Evans & Stanovich, 2013). Therefore, we argued that use of System 2 processes would reduce the disposition effect. However, our findings reveal that investors who report more reliance on System 2 processes do not have less disposition effect. This finding does not support a default interventionist element for System 2 in the disposition effect. The reasons for this finding are unknown. It could be that use of System 2 does not reduce the disposition effect due to an investor not perceiving a problem that needs correcting. An alternative explanation is that System 2 processes are not risk-neutral for the disposition effect. Finally, as suggested by the subscale findings, it may be that the explanation lies in how reliance on System 2 is measured.

After further analysis of the System 2 measure, we found that self-rated ability at using System 2 processes increased the disposition effect but preference for System 2 processes decreased the disposition effect. This highlights the difficulty in measuring reliance on System 2 processes amongst investors as they may have unrealistic perceptions of their ability at analytical cognition. An explanation of this finding could be that over-confidence in analytical thinking may influence the disposition effect because those overconfident in their abilities may not detect bias in their decision-making and thus do not intervene to correct it. This explanation is plausible considering that experience did not reduce the disposition effect in our research.

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We posit that, if emotions are a cause of the disposition effect, then investors with effective emotion regulation strategies will be less susceptible to this bias. Using an emotion regulation model outlined by Gross (2002), we investigate whether habitual use of reappraisal and expressive suppression emotion regulation are related to susceptibility to the disposition effect. We hypothesised that investors who used a reappraisal strategy would exhibit less bias. The findings supported this hypothesis as investors who habitually make greater use of reappraisal are less susceptible to the disposition effect. Our research supports the view that emotions have a significant influence on investment decisions and that effective regulation of emotions can lead to less bias (Fenton-O'Creevy et al., 2011; 2012).

The other emotion regulation strategy we investigated was expressive suppression. This is an emotion regulation strategy that prevents emotionally expressive behaviour. We explored the influence of expressive suppression on the disposition effect and did not find a significant relationship between it and the trading of gains or losses. There seems to be no direct influence for expressive suppression on the disposition effect.

5.1 Practical implications

This research highlights the relationship between emotions and investing. Investors may often rely on intuition or 'gut feel' to make investment decision, especially in a market where an overwhelming amount of information is available. However, conventional wisdom suggests investors should not let emotions drive decisions. Whilst well-intentioned, such advice is vague and difficult to apply. Our research illustrates a specific situation in which emotions can influence investors towards bad decisions. Emotions may increase reluctance to sell losses or eagerness to realise gains.

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In addition our research offers insights into how an investor can overcome such bias. Investors may seek to quash emotions when making an investment decision, but such strategies are very difficult to implement when emotion and cognition are intertwined. Instead, the practice of reappraising emotions associated with decisions, by putting decisions in context of broader financial goals (Aspara & Hoffman, 2015b) or overall financial wealth, may achieve better results. For example, investors may experience a significant loss on one investment decision. This may hurt them when money is lost, but it can be inconsequential compared to the value of their property or earnings over an investment career.

5.2 Limitations and future research

The methods employed in this research have both strengths and limitations. Strengths are that this methodology offers strong ecological validity and has better measurement validity than research adopting proxies as measures of constructs. It also collects attitudinal data separately from data on trading, avoiding problems with common method variance. However, a limitation is that only 282 investors responded to the survey, which indicates a response rate of 6.8%. The small sample size is a limitation of this research. However, a comparison of survey respondents to non-respondents, suggests very similar levels of disposition effect and adequate variability in the key variables. Where the differences are of most concern is in relation to gender, suggesting the findings in relation to gender and disposition effect should be treated with caution. Another limitation is that there is a time lag between the behaviour measured in the trading data and the collection of the questionnaire data that potentially introduces inaccuracy. However, this concern is mitigated, since the questionnaire measures traits which are typically stable over time.

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Finally, future research could investigate specific cognitive strategies and/or emotions in investment decision-making processes. We found that in general System 2 processes did not decrease bias. However, reappraisal emotion regulation, which is a specific System 2 process, did decrease the disposition effect. This suggests that investigation of specific cognitive strategies, as opposed to general cognitive strategies, is needed to understand how cognition reduces susceptibility to bias. This argument could also be applied to emotion and emotion regulation, where investigation of specific emotions and emotion regulation strategies, are needed to understand their relationship to this bias.

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References:

Akinci, C., & Sadler-Smith, E. (2013) Assessing Individual Differences in Experiential (Intuitive) and Rational (Analytical) Cognitive Styles. *International Journal of Selection and Assessment*, 21(2): 211-221.

Alós-Ferrer, C. & Strack, F. (2014) From dual processes to multiple selves: Implications for economic behavior. *Journal of Economic Psychology* 41, 1-11.

Aspara, J., & Hoffmann, A. O. I. (2015a) Cut your losses and let your profits run: How shifting feelings of personal responsibility reverses the disposition effect. *Journal of Behavioral and Experimental Finance*, 8: 18-24.

Aspara, J., & Hoffmann, A. O. I. (2015b) Selling losers and keeping winners: How (savings) goal dynamics predict a reversal of the disposition effect. *Marketing Letters*, 26(2): 201-211.

Barber, B. M., & Odean, T. (2001). Boys will be boys: Gender, Overconfidence, and Common Stock Investment. *The Quarterly Journal of Economics*, *116*(1), 261-292.

Barber, B. M., Yi-Tsung, L., Yu-Jane, L., & Odean, T (2007) Is the aggregate investor reluctant to realise losses? Evidence from Taiwan. *European Financial Management* 13(3), 423-447.

Barberis, N., & Xiong, W. (2009) What Drives the Disposition Effect? An Analysis of a Long-Standing Preference-Based Explanation. *The Journal of Finance*, 64(2): 751-784.

Bebko, G. M., Franconeri, S. L., Ochsner, K. N., & Chiao, J. Y. (2011). Look before you regulate: Differential perceptual strategies underlying expressive suppression and cognitive reappraisal. *Emotion*, 11(4): 732-742.

Ben-David, I., & Hirshleifer, D. (2012) Are Investors Really Reluctant to Realize Their Losses? Trading Responses to Past Returns and the Disposition Effect. *Review of Financial Studies*, 25(8): 2485-2532.

Boolell-Gunesh, S., Broihanne, M. H., & Merli, M. (2009) Disposition effect, investor sophistication and taxes: Some French specificities. *Revue de L'association Française de Finance* 30(1), 51-78.

Brown, P., Chappel, N., Da Silva Rosa, R., & Walter, T. (2006) The Reach of the Disposition Effect: Large Sample Evidence Across Investor Classes. *International Review of Finance*, 6(1/2): 43-78.

Chen, G., Kim, K. A., Nofsinger, J. R., & Rui, O. M. (2007) Trading performance, disposition effect, overconfidence, representativeness bias, and experience of emerging market investors. *Journal of Behavioral Decision Making*, 20(4): 425-451.

ACCEPTED MANUSCRIPT

Cortina, J. M. (1993) What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology* 78(1), 98-104.

Dhar, R., & Zhu, N. (2006) Up Close and Personal: Investor Sophistication and the Disposition Effect. *Management Science*, 52(5): 726-740.

Epstein, S., Pacini, R., Denes-Raj, V., & Heier, H. (1996) Individual differences in intuitive-experiential and analytical-rational thinking styles. *Journal of Personality and Social Psychology* 71(2), 390-405.

Evans, J. S. B. T. (2008) Dual-Processing Accounts of Reasoning, Judgment, and Social Cognition. *Annual Review of Psychology* 59(1), 255-278.

Evans, J. S. B. T., & Stanovich, K. E. (2013) Dual-process theories of higher cognition: Advancing the debate. *Perspectives on Psychological Science* 8(3), 223-241.

Feng, L., & Seasholes, M. (2005) Do investor sophistication and trading experience eliminate behavioral biases in financial markets? *Review of Finance* 9(3), 305-351.

Fenton-O'Creevy, M., Lins, J. T., Vohra, S., Richards, D. W., Davies, G., & Schaaff, K. (2012). Emotion regulation and trader expertise: Heart rate variability on the trading floor. *Journal of Neuroscience, Psychology, & Economics* 5(4), 227-237.

Fenton-O'Creevy, M., Soane, E., Nicholson, N., & Willman, P. (2011) Thinking, feeling and deciding: The influence of emotions on the decision making and performance of traders. *Journal of Organizational Behavior* 32(8), 1044-1061.

Frino, A., Lepone, G., & Wright, D. (2015) Investor characteristics and the disposition effect. *Pacific-Basin Finance Journal* 31, 1-12.

Frydman, C., & Rangel, A. (2014) Debiasing the disposition effect by reducing the saliency of information about a stock's purchase price. *Journal of Economic Behavior and Organization* 107, Part B, 541-552.

Goulart, M., Da Costa Jr, N., Santos, A., Takase, E., & Da Silva, S. (2013) Psychophysiological correlates of the disposition effect. *PLoS ONE* 8(1), 1-4.

Grinblatt, M., & Keloharju, M. (2001) What makes investors trade? *The Journal of Finance*, 56(2), 589-616.

Gross, J. J. (2002) Emotion regulation: Affective, cognitive, and social consequences. *Psychophysiology* 39(3), 281-291.

Gross, J. J., & John, O. P. (2003) Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology* 85(2), 348-362.

ACCEPTED MANUSCRIPT

Hayes, J., Allinson, C. W., Hudson, R. S., & Keasey, K. (2003) Further reflections on the nature of intuition-analysis and the construct validity of the Cognitive Style Index. *Journal of Occupational and Organizational Psychology* 76, 269-278.

Heilman, R. M., Crisan, L. G., Houser, D., Miclea, M., & Miu, A. C. (2010) Emotion regulation and decision making under risk and uncertainty. *Emotion* 10(2), 257-265.

Hodgkinson, G. P., & Sadler-Smith, E. (2003a). Complex or unitary? A critique and empirical re-assessment of the Allinson-Hayes Cognitive Style Index. *Journal of Occupational and Organizational Psychology* 76, 243-268.

Hodgkinson, G. P., & Sadler-Smith, E. (2003b) Reflections on reflections . . . on the nature of intuition, analysis and the construct validity of the Cognitive Style Index. Journal of *Occupational and Organizational Psychology* 76, 279-281.

Hodgkinson, G. P., Sadler-Smith, E., Sinclair, M., & Ashkanasy, N. M. (2009). More than meets the eye? Intuition and analysis revisited. *Personality and Individual Differences*, 47(4): 342-346.

John, O. P., & Gross, J. J. (2004) Healthy and Unhealthy Emotion Regulation: Personality Processes, Individual Differences, and Life Span Development. *Journal of Personality*, 72(6): 1301-1334.

Kim, Y. D., & Ha, Y.-W. (2016) Who is afraid of disposition of financial assets? The moderating role of regulatory focus in the disposition effect. *Marketing Letters*, 27(1): 159-169.

Korniotis, G. M., & Kumar, A. (2011). Do older investors make better investment decisions? *Review of Economics and Statistics*, 93(1), 244-265.

Lee, H. J., Park, J., Lee, J. Y., & Wyer, R. S. (2008) Disposition effects and underlying mechanisms in e-trading of stocks. *Journal of Marketing Research* 45(3), 362-378

Lehenkari, M. (2012) In search of the underlying mechanism of the disposition effect. *Journal of Behavioral Decision Making*, 25(2): 196-209.

Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015) Emotion and decision making. *Annual Review of Psychology*, 66 (1): 799-823

Lo, A. W., Repin, D. V., & Steenbarger, B. N. (2005) Fear and greed in financial markets: A clinical study of day-traders. *American Economic Review* 95(2), 352-359.

Norris, P., & Epstein, S. (2009) A short form of an inventory for measuring intuitive-experiential and analytical-rational thinking style. Unpublished Working paper. Pacific University.

Nolte, I. (2012) A detailed investigation of the disposition effect and individual trading behavior: a panel survival approach. *The European Journal of Finance*, 18(10): 885 - 919.

ACCEPTED MANUSCRIPT

Odean, T. (1998) Are investors reluctant to realize their losses? *The Journal of Finance*, 53(5), 1775-1798.

Pacini, R., & Epstein, S. (1999) The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. *Journal of Personality and Social Psychology* 76(6), 972-987

Phelps, E. A. (2006) Emotion and cognition: Insights from Studies of the Human Amygdala. *Annual Review of Psychology*, 57(1): 27-53.

Phelps, E. A., Lempert, K. M., & Sokol-Hessner, P. (2014) Emotion and decision making: multiple modulatory neural circuits. *Annual Review of Neuroscience*, 37: 263-287.

Richards, D. W., Rutterford, J., Kodwani, D., & Fenton-O'Creevy, M. (2017) Stock market investors' use of stop losses and the disposition effect. *The European Journal of Finance*, 23(2), 130 - 152

Richards, D. W., & Willows, G. D. (2017). Who trades profusely? The characteristics of individual investors who trade frequently. *Global Finance Journal* 35, 1-11 doi:http://doi.org/10.1016/j.gfj.2017.03.006

Schneider, M. & Coulter. R. A. (2015) A Dual Process Evaluability Framework for decision anomalies. *Journal of Economic Psychology* 51, 183-198.

Seo, M.G., & Barrett, L. F. (2007) Being emotional during decision making- good or bad? An empirical investigation. *Academy of Management Journal* 50(4), 923-940.

Seru, A., Shumway, T., & Stoffman, N. (2010) Learning by trading. *Review of Financial Studies*, 23(2) 705 -739.

Shefrin, H., & Statman, M. (1985) The disposition to sell winners too early and ride losers too long: Theory and evidence. *The Journal of Finance* 40(3), 777-790.

Shu, P. G., Yeh, Y. H., Chiu, S. B., & Chen, H. C. (2005) Are Taiwanese individual investors reluctant to realize their losses? *Pacific-Basin Finance Journal* 13(2), 201-223.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007) The affect heuristic. *European Journal of Operational Research*, 177(3): 1333-1352.

Sokol-Hessner, P., Hsu, M., Curley, N. G., Delgado, M. R., Camerer, C. F., & Phelps, E. A. (2009) Thinking like a trader selectively reduces individuals' loss aversion. *Proceedings of the National Academy of Sciences of the United States of America* 106(13), 5035-5040.

Stanovich, K. E., & West, R. F. (2000) Individual differences in reasoning: Implications for the rationality debate? *Behavioral and Brain Sciences*, 23(05), 645-665.

ACCEPTED MANUSCRIPT

Summers, B., & Duxbury, D. (2012) Decision-dependent emotions and behavioral anomalies. *Organizational Behavior and Human Decision Processes* 118(2), 226-238.

Weber, M., & Camerer, C. F. (1998) The disposition effect in securities trading: an experimental analysis. *Journal of Economic Behavior and Organization* 33(2), 167-184

Yang, Q., Gu, R., Tang, P., & Luo, Y.-J. (2013) How does cognitive reappraisal affect the response to gains and losses? *Psychophysiology*, 50(11): 1094-1103.

ACCEPTED MANUSCRIPT