

ERASMUS UNIVERSITY ROTTERDAM  
ERASMUS SCHOOL OF ECONOMICS  
Master Thesis MSc Behavioural Economics

---

# Nudging the Disposition Effect: Exploring the Influence of Intuitive and Rational Decision Styles

Daniele Spina (657623)

---



---

|                     |                   |
|---------------------|-------------------|
| Supervisor:         | Dr. JA de Jong    |
| Second assessor:    | Saeed Badri       |
| Date final version: | 25th October 2023 |

---

The views stated in this thesis are those of the author and not necessarily those of the supervisor, second assessor, Erasmus School of Economics or Erasmus University Rotterdam.

# CONTENTS

|   |    |
|---|----|
| Abstract.....   | 4  |
| 1 Introduction.....   | 5  |
| 2 Literature Review .....   | 8  |
| 2.1 The Disposition Effect.....   | 8  |
| 2.2 Mitigating the disposition effect: the use of “nudges”.....   | 9  |
| 2.3 Individual differences in susceptibility to the disposition effect .....  | 10 |
| 2.3.1 Impact of personality and cognitive traits .....  | 10 |
| 2.4 Rational and Intuitive decision-making styles.....  | 11 |
| 2.5 The role of decision styles on disposition effect .....   | 12 |
| 2.5.1 Intuitive decision style and the disposition effect.....  | 12 |
| 2.5.2 Rational decision style and the disposition effect.....   | 13 |
| 2.6 Impact of decision styles on nudge effectiveness.....   | 14 |
| 2.6.1 Cybersecurity.....  | 14 |
| 2.6.2 Food purchasing behaviour .....   | 15 |
| 2.6.3 Health and Nutrition.....   | 15 |
| 2.6.4 Other contexts.....   | 15 |
| 2.6.5 Finance .....   | 16 |
| 2.7 Impact of decision styles on two nudges aimed at reducing disposition effect: the Tax Saliency Treatment and the Purchase Price Saliency Treatment..... | 16 |
| 2.7.1 Intuitive decision style and the Tax Saliency Treatment.....  | 16 |
| 2.7.2 Rational decision style and the Tax Saliency Treatment.....   | 17 |
| 2.7.3 Intuitive decision style and the Purchase Price Saliency Treatment .....  | 18 |
| 2.7.4 Rational decision style and the Purchase Price Saliency Treatment .....   | 18 |
| 3 Experimental design .....   | 19 |
| 3.1 Participants and procedure.....   | 20 |
| 3.2 Pre-experimental questionnaire .....  | 20 |
| 3.2.1 Rational and Intuitive decision styles.....   | 20 |
| 3.3 Basic design of the trading game.....   | 21 |
| 3.3.1 Price chronology and active trading sessions .....  | 21 |
| 3.3.2 Tax implications .....  | 22 |
| 3.3.3 Stock Price Determinants: Markov Chains .....   | 22 |
| 3.4 Experimental conditions .....   | 24 |
| 3.5 Measuring the disposition effect.....   | 24 |
| 3.6 Additional variables.....   | 25 |
| 4 Methods .....   | 26 |

|       |  |    |
|-------|--|----|
| 4.1   | Testing the impact of rational and intuitive decision styles on disposition effect.....  | 26 |
| 4.2   | Replicating findings of Frydman and Rangel (2014) and Bazley et al. (2022).....          | 27 |
| 4.3   | Testing the impact of rational and intuitive decision styles on nudges effectiveness ... | 27 |
| 5     | Results .....  | 28 |
| 5.1.1 | Demographics.....  | 30 |
| 5.1.2 | Demographic distribution across treatment groups .....                                   | 32 |
| 5.1.3 | Decision styles.....   | 33 |
| 5.1.4 | Decision styles distribution across treatment groups.....                                | 33 |
| 5.2   | Disposition Effect Analysis:.....  | 34 |
| 5.3   | Correlation Analysis .....   | 35 |
| 5.4   | Testing nudges effectiveness .....   | 36 |
| 5.5   | Regression Analysis .....  | 36 |
| 5.5.1 | Assumptions and Validations .....  | 36 |
| 5.5.2 | Influence of decision styles on disposition effect:.....                                 | 38 |
| 5.5.3 | Influence of decision styles on nudges effectiveness: .....                              | 40 |
| 6     | Discussion.....  | 42 |
| 6.1   | Interpretation of Key Findings.....  | 42 |
| 6.1.1 | Disposition Effect.....  | 42 |
| 6.1.2 | Influence of Decision Styles on disposition effect .....                                 | 42 |
| 6.1.3 | Effectiveness of Nudges .....  | 43 |
| 6.1.4 | Unexpected Findings .....  | 44 |
| 6.2   | Implications .....   | 44 |
| 6.2.1 | Importance of Replication .....  | 45 |
| 6.2.2 | Re-evaluating the root causes of disposition effect .....                                | 45 |
| 6.2.3 | Broader Implications on nudges .....   | 45 |
| 6.3   | Limitations.....   | 46 |
| 6.3.1 | Sample size and representativeness .....   | 46 |
| 6.3.2 | Nudging Effectiveness.....   | 46 |
| 6.3.3 | Decision Style Self-Assessment .....   | 46 |
| 6.3.4 | Experimental Environment.....  | 47 |
| 7     | Conclusion.....  | 47 |
|       | References.....  | 48 |
|       | Appendix.....  | 54 |

## **Abstract**

The disposition effect, defined as the tendency to prematurely realize gains while holding onto losing assets, is one of the most documented biases in investors behaviour. While trading platforms could make use of nudges to debias disposition effect, one-size-fits-all approaches potentially harming their clients are likely to discourage their implementation. This highlights the need of further studies towards nudges personalization in the financial realm. This research contributes filling this gap by exploring the influence of individual decision-making styles on the effectiveness of such nudges. Using an experimental framework directly built on studies by Frydman and Rangel (2014) and Bazley et al. (2022), we tested two specific nudges in a three-treatments experimental trading game. These nudges aimed at reducing the disposition effect either by decreasing the saliency of a stock's purchase price or by explicitly showing the tax consequences of selling. Participants' intuitive and rational decision-making styles were measured using the RIDSS developed by Hamilton, Shih, and Mohammed (2016). Results, however, indicated that neither the two nudges, nor decision styles, significantly impacted the disposition effect. This study shows how robust and resilient the disposition effect actually is, highlighting at the same time that our understanding of this bias is still limited. Finally, this research underlines the importance of replication in the still immature field of behavioural economics.

Keywords: disposition effect, nudge, rational, intuitive, decision styles, trading

# CHAPTER 1

## INTRODUCTION

Across the vast literature studying the systematic behavioural biases that affect investors and their trading performance, the disposition effect is arguably one of the most robust and well-documented (for a comprehensive review, see Pleßner, 2017). First defined by Shefrin and Statman (1985) as the tendency to realize gains too early while holding onto losers for too long, it leads to a suboptimal trading strategy associated with poor trading performance (Odean, 1998; Shumway & Wu, 2005).

Despite being one of the most explored topics in behavioural finance, attempts to “debias” the disposition effect have been limited to experimental settings. They usually made use of “nudges” (e.g. Thaler & Sunstein (2008)), interventions aimed at influencing individuals’ behaviour by acting on their cognitive bias, without limiting or forcing options (Sunstein, 2014). Interestingly, despite the promising results obtained by these studies, trading platforms and brokerage accounts never implemented such strategies to help individual investors overcome this bias. This is surprising, given the feasibility of the treatments and the successful implementation of similar interventions in other financial fields (Thaler & Sunstein, 2008; Halpern, 2015).

One possible explanation for this is the need for a more comprehensive understanding of the effectiveness of such strategies and their potential drawbacks. As a matter of fact, nudges often adopt a one-size-fits-all approach, which leads to the so-called “problem of heterogeneity” (Mills, 2020, 2022). In fact, as individuals differ in how they process information, tackle challenges and make decisions, their susceptibility to interventions designed to guide their decision-making in a specific direction may also differ. Before employing a nudge, it is crucial to assess whether it benefits those individuals who need the most help and, importantly, whether it carries any unintended negative consequences. Sunstein (2022) suggests that certain nudges may be unhelpful or even harmful to specific identifiable groups, emphasizing the importance of targeted or personalized nudging. A good example is provided by Halpern (2015), who described a field experiment that used letters emphasizing social norms of neighbourhoods’ tax payment rates to reduce tax evasion. Although it was successful for most tax-payers, it caused a negative reaction among the top 5% of debtors, who held the largest debts.

It is clear how, for trading platforms and brokerage accounts, this is not an acceptable risk, given their clients’ finances are at stake. Implementing a nudge that, while beneficial for some, might financially disadvantage a significant share of their clients, would result in an irreversible loss of reputation and trustworthiness.

Targeting and personalization of nudges has been primarily explored in the context of cybersecurity (Malkin, Mathur, Harbach, & Egelman, 2017; Warberg, Acquisti, & Sicker, 2019, November; Peer, et al.,

2020; Qu, et al., 2022), while studies investigating individual differences in the effectiveness of behavioral interventions have also been carried out in the fields of food purchasing behaviour (Wensing et al., 2020; Ingendahl et al., 2021; Taufik et al., 2022) and healthy habits (van der Molen, et al., 2021; König, et al., 2018). On the other hand, research around financial nudges and individual investors' susceptibility to them is, to the best of our knowledge, almost non-existent.

The aim of this paper is to contribute to fill this gap in the existing literature by assessing the effectiveness of nudges in mitigating the disposition effect among different individuals. Given that nudges operate by influencing decision-making, this study will explore how individuals differ in their decision-making processes by measuring intuitive and rational decision styles.

In other terms, we attempt to answer the following question: *how do intuitive and rational decision-making styles influence the effectiveness of nudges designed to mitigate the disposition effect?*

In particular, our study focuses on two different types of nudges which aim at reducing disposition effect of those subject to them.

The first does that by decreasing the saliency of the purchase price of a stock, that represents the reference point for categorizing the position on a stock as at gain or at loss. A reduced attention to this reference point is likely to diminish the emphasis on the current status of the investment (whether at a gain or at a loss). In turn, this should allow the investor to focus more on the expected value of the stock, as a result decreasing the biases associated with gains and losses.

The second aims to achieve the same goal by increasing the awareness of the tax consequences of selling. Not acknowledging them is, in fact, one of the main factors why investors displaying high levels of disposition effect tend to underperform. In fact, disposition effect goes against the optimal strategy in presence of taxes of realizing losses as soon as possible while deferring gains (Constantinides, 1983), meaning that investors who exhibit greater levels of this bias end up paying higher capital gains taxes.

The two nudges are examined by replicating two studies implementing each one of these in an experimental setting: Frydman and Rangel's (2014) study, which employed a treatment reducing the saliency of the purchase price of stocks, and Bazley, Moore, and Vosse's (2022) study, which made use of a treatment increasing the awareness around the tax implications of selling. Both studies build directly on an earlier experiment conducted by Weber and Camerer (1998), making use of a stock trading laboratory experiment in which subjects are asked to trade three fictional assets, with the treatments implemented to mitigate the disposition effect being the only difference between the two.

Our research follows closely the very same experimental framework, adopting a three-treatments approach: a control group without any nudges, one treatment group adopting the nudge from Frydman and Rangel (2014) that reduces purchase price saliency, and another treatment group implementing the nudge from Bazley, Moore, and Vosse (2022) that increases the saliency of taxes.

An important difference between the studies we replicate and ours lies in the way the experiment was

administered. In fact, in order to make up for the resource constraint typical of a master's thesis research, we reproduce this experimental framework on the Qualtrics XM Survey platform, allowing participants to engage in the experiment using their own devices. Despite the great effort required to render on a survey platform an experiment that is meant for a laboratory setting, this adaptation inevitably introduces a set of limitations, which will be discussed more in detail in Section 8.3.

However, our research has a significantly different scope compared to the studies we replicate. Rather than only testing for the effectiveness of the two nudges, we are primarily interested in the role decision styles may have in influencing such effectiveness. In order to explore this, participants' decision styles are measured using the rational and intuitive decision styles scale (RIDSS) developed by Hamilton, Shih, and Mohammed (2016), which was administered through a questionnaire preceding the trading game. By examining the interplay between decision styles, the disposition effect, and nudges trying to mitigate it, this research not only aims to offer a new approach within behavioural finance, but also wants to expand the investigation of decision styles—a construct that has not received sufficient attention so far.

We hypothesized that individuals scoring higher on the intuitive decision style scale would both exhibit higher levels of disposition effect and display greater susceptibility to the two nudges, compared to those with lower scores on the same scale. Conversely, we hypothesized the opposite trend for participants scoring higher on the rational scale. To test these hypotheses, we employed an OLS regression, featuring disposition effect as dependent variable, and decision styles, treatment binary variables, and their interactions as the independent variables of interest.

The disposition effect was observed to be at 8.45% across all participants, indicating a slight tendency to realize gains while holding onto losses. Unexpectedly, neither the Purchase Price Saliency Treatment nor the Tax Saliency Treatment seemed to have any impact at all on the disposition effect. This outcome severely limited this study's capacity to address the research question. Moreover, the regression analysis revealed also minimal to none influence of both intuitive and rational decision-making styles on the disposition effect. Only rational decision-making style presented a weak positive correlation with disposition effect, going in an opposite direction to our expectations.

While the study offered valuable insights and some unexpected results, it primarily highlighted the challenges related to understanding behavioural biases and the effectiveness of interventions aimed at reducing them.

The following sections of this thesis are organized as follows. Section 2 reviews the relevant literature and sets up the hypotheses of the study. In Section 3, the experimental framework is explained, including the design of the trading game and the different experimental conditions. Section 4 outlines the methods adopted to test the hypotheses and replicate the findings of previous studies by Frydman and Rangel (2014) and Bazley et al. (2022). Section 5 presents the results, while Section 6 discusses the key findings, the implications of this study, and its limitations. Finally, in Section 7 we draw conclusions from the research findings and suggest potential future investigations.

## CHAPTER 2

# LITERATURE REVIEW

### 2.1 The Disposition Effect

The disposition effect stands out in the realm of behavioural finance as perhaps the most robust and documented bias. It refers to the tendency of investors to sell their winning stocks too early while holding onto their losing ones for too long, often leading to suboptimal trading performance (Odean, 1998; Shumway & Wu, 2005). This tendency was first identified and defined by Shefrin and Statman in 1985.

Several theories have been proposed to explain the disposition effect. In their first formulation of the disposition effect, Shefrin and Statman (1985) proposed as its theoretical basis Kahneman and Tversky's prospect theory (1979). They suggest that investors base their perceptions and behaviours on the purchase price of a stock as a reference point. In line with the S-shaped prospect theory's utility function, in the realm of gains, investors become risk-averse, leading them to sell stocks to avoid potential losses. Conversely, when faced with losses, they display increased risk tolerance, holding onto stocks in hopes of avoiding realized losses.

Another characteristic of the prospect theory's utility function is its steeper curve in the realm of losses, a concept known as "loss aversion". This feature, which means that the pain felt for a loss is greater than the joy felt for the equivalent profit, may also contribute to the disposition effect. In fact, while investors might hold for long onto a losing stock in the hopes it will recover, they might not be as patient when a stock is gaining value, since they don't feel the same urgency about potential profits. This ultimately means that, the more loss-averse an individual is, the more likely they'll display disposition effect.

Finally, the mental accounting perspective suggests that individuals tend to see each stock in isolation, rather than as part of a broader portfolio, which can further amplify the disposition effect.

However, a growing number of studies doubt that the prospect theory is capable of explaining the disposition effect (Pleßner, 2017), failing to predict the bias especially when expected returns are high or number of trading periods are low (Barberis & Xiong, 2009)

Realization utility models have recently emerged as the main theoretical framework explaining the disposition effect. Research has shown how investors experience a burst of pleasure when realizing capital gains (Frydman et al., 2014). This is consistent with study by Summers & Duxbury (2012), showing that emotions are associated with disposition effect: the higher tendency of selling of winners seems to occur due to the emotional response to experiencing a positive outcome. This leads to the desire to realize gains, resulting in a risk averse behaviour when stocks are increasing in value. In contrast, emotions of regret,



which are caused by a sense of responsibility about one's investment decisions and their outcomes, are the what drives loss-averse behaviour, resulting in a higher retention of stocks losing in value.

Lastly, another potential driver for disposition effect is cognitive dissonance, which is the discomfort triggered by the person's belief clashing with new, contradicting, information (Festinger, 1962). In the case of the stock trading, this discomfort may arise when an investor's belief that they made a good investment choice is contradicted by the fact that they're losing money on the position (Chang, Solomon, & Westerfield, 2016). This can lead to the investor holding onto the losing asset for too long in an attempt to avoid the discomfort of realizing a loss.

## **2.2 Mitigating the disposition effect: the use of “nudges”**

Efforts to mitigate the disposition effect have been carried out through various approaches, although exclusively in experimental settings. Weber and Camerer (1998) implemented a strategy of automatically selling all stocks within an experimental portfolio at the end of a holding period, allowing participants to buy them back at the beginning of the next period. This approach was shown to significantly reduce the disposition effect. Despite the theoretical relevance of this finding, the associated transaction costs of such strategy would completely erode the profitability of the investments.

Building on the work by Weber and Camerer (1998), the study by Fischbacher et al. (2017) achieves greater practical relevance by investigating the impact of automatic selling devices on disposition effect. This time, investors were given the opportunity to make decisions regarding the automatic selling of their assets through the implementation of a stop-loss mechanism. The findings revealed that this approach effectively mitigates the disposition effect displayed by investors. This intervention can be classified as a “nudge” (Thaler & Sunstein, 2008), as it is aimed to lead investors towards a more rational decision-making without restricting their freedom of choice.

Additional studies have explored the use of nudges in experimental settings to debias the disposition effect. For example, the research conducted by Rubaltelli et al. (2005) focuses on expressing returns as a percentage of the variation between the purchase price and the current value, rather than as a monetary difference. This approach significantly reduced the disposition effect, showing how framing the returns in a different manner could influence investors' decision-making.

Two more studies that further explored methods to reduce the disposition effect are the ones on which this research directly builds. Frydman and Rangel (2014) conducted a study that investigates the potential reduction of the disposition bias when the purchase price of the stock is not salient. They explored two conditions: a "high-saliency" condition where subjects were presented with both the purchase price and the current stock value and asked about their willingness to sell, and a "low-saliency" condition where the purchase price was not displayed on the trading screen. In the "low-saliency" treatment, the researchers observed a 25% smaller disposition effect compared to the "high-saliency" condition.

Bazley et al. (2022), on the other hand, investigated the impact of increasing individuals' awareness of the tax implications of selling on reducing the disposition effect. Their findings indicated that by enhancing the saliency of taxes, the disposition effect decreased by 22% to 47%. This decrease was due both to a reduced willingness to realize gains and to an increased propensity to realize losses, which ultimately led to better trading performance without a concurrent increase in total trading activity.

## **2.3 Individual differences in susceptibility to the disposition effect**

In past literature, when studying the potential role of individual differences in displaying the disposition effect, the main focus has been on demographic variables.

Cheng et al. (2013) observed that women and older traders tend to display a stronger disposition effect compared to their male and younger counterparts. Rau (2014), in an experiment based on Weber and Camerer's (1998) framework, found that female investors realize fewer capital losses and display significantly higher disposition effect and loss aversion than men.

Studies by Da Costa Jr et al. (2013) and Dhar and Zhu (2006) have demonstrated that trading experience and financial literacy can reduce the disposition effect. These findings suggest that active participation in financial markets and gaining hands-on experience can lead to a more rational approach to trading.

It appears that, as an investor acquires additional information about a specific investment, their susceptibility to disposition effect decreases. Kuo et al. (2013) demonstrated that studying relevant investment information helps reducing the disposition effect among individual investors, while Shapira and Venezia (2001) revealed that investors who receive professional advice exhibit weaker disposition effect.

### **2.3.1 Impact of personality and cognitive traits**

More limited is the existing literature on how the disposition bias is impacted by individual differences in investors' personality, cognitive and decisional processes. This is quite striking considering that behavioural finance presupposes that investor decision-making is influenced by psychological, cognitive and emotional factors (Barberis & Thaler, 2003; Hirshleifer, 2015). Recent studies, such as Durand et al., (2008; 2013a; 2013b; 2019), Lin and Lu (2015), Patterson and Daigler (2014), have found a significant influence of investor's personality traits and risk-taking attitude on the likelihood of displaying cognitive biases and on the investment decision process.

Emotional stability in particular seems to play a crucial role in financial behaviour (Gambetti & Giusberti, 2019; Donnelly, Iyer, & Howell, 2012). This is closely related to the exhibition of the disposition effect, as emotional impact (Frydman et al., 2014; Summers & Duxbury, 2012; Richards et al., 2018) and cognitive dissonance (Chang, Solomon, & Westerfield, 2016) triggered by realized and unrealized gains and losses are potential explanations of the disposition effect. Summers and Duxbury (2012) further explored the impact of specific emotional responses on the disposition effect, revealing that regret and

euphoria serve as two key factors of the decision-making process. Regret often leads to the retention of losing shares, while euphoria can lead to realizing gains.

Studies by Cecchini et al. (2019) and Ahmad (2020) investigated the relationship between personality traits and disposition effect. Both studies found a positive association between the personality trait *extraversion* and the bias. Interestingly, these studies came to opposite conclusions when examining the impact of the trait *conscientiousness* on the disposition effect. Cecchini et al. (2019) found a negative association between the personality trait and the bias, while Ahmad (2020) reported a strongly positive association instead. Such difference in results might be attributed by the different methods employed by the two studies, as Cecchini et al. (2019) implemented an experimental trading setting, while Ahmad (2020) measured the disposition effect using a survey-based approach.

Furthermore, Durand et al. (2013a) demonstrated that investors exhibiting higher level of optimism, sociability and assertiveness are more likely to display disposition effect and realize early profit.

Lastly, of particular interest to this research are the findings of Richards et al. (2018). The authors explored the connection between the disposition effect and investors' cognitive processes, specifically their reliance on intuitive, emotion-driven thinking (System 1) and rational, analytical reasoning (System 2), cognitive processes which align closely with the intuitive and rational decision styles. Richards and colleagues noted that investors who heavily rely on System 1 tend to display a more pronounced disposition effect. In contrast, a stronger reliance on System 2 does not seem to be associated with this bias.

## **2.4 Rational and Intuitive decision-making styles**

The term “decision-making style” is defined by Harren (1979) as the “*individual’s characteristic mode of perceiving and responding to decision-making tasks, or the manner in which the person goes about making decisions*”. It is well-known that individuals differ in the way they make decisions, ranging from thorough analysis of available information to intuitive judgments. Some individuals rely on rational and systematic processes, while others employ emotions-based and unsystematic approaches. Although several typologies of decision styles have been proposed (Scott & Bruce, 1995; Driver, Brousseau, & Hunsaker, 1998; Harren, 1979), there is significant overlap and widespread consensus about what can be considered the two fundamental decision styles: the intuitive and the rational one.

The intuitive decision style is characterized by the use of a fast and instinctive decision-making process (Harren, 1979) that is primarily based on hunches and feelings (Scott & Bruce, 1995), and it tends to be heuristics and experience-based (Kahneman, Thinking, fast and slow, 2011). The rational decision style, on the other hand, adopts a slower and rule-governed decision-making process (Hamilton, Shih, & Mohammed, 2016), characterized by a thorough search for information and a logical evaluation of alternatives (Scott & Bruce, 1995).

These decision styles are closely related to the corresponding cognitive styles (Thunholm, 2004), which reflect individual differences in perceiving and processing information in different contexts

(Kozhevnikov, 2007). Similarities can be drawn with the duality of the Intuitive-Experiential and Analytical-Rational thinking styles (Epstein, Pacini, Denes-Raj, & Heier, 1996) and of the System 1 and System 2 processes (Kahneman, Thinking, fast and slow, 2011). However, whereas cognitive styles can be considered a broader concept, capturing general information processing and problem solving, decision styles more narrowly focus on decision-making processes (Hamilton, Shih, & Mohammed, 2016).

Multiple studies provide strong evidence supporting the notion that intuitive and rational processes are independent and orthogonal dimensions, representing distinct systems with complementary functions that can therefore interact synergically (Denes-Raj & Epstein, 1994; Nygren & White, 2002; Baldacchino, Ucbasaran, & Cabantous, 2022; Wang, Highhouse, Lake, Petersen, & Rada, 2017; Hodgkinson & Clarke, 2007; Hamilton, Shih, & Mohammed, 2016; Akinci & Sadler-Smith, 2013). These findings highlight that individuals can possess varying inclinations towards both intuitive and analytical decision-making. Consequently, it is widely accepted that these two constructs do not exist as opposing ends of a bipolar continuum, but rather as separate dimensions that operate in tandem. Individuals can exhibit high or low scores on both dimensions, reflecting different propensities towards one or the other style or a balanced integration of both, showing the dynamic nature of decision-making processes.

## **2.5 The role of decision styles on disposition effect**

### **2.5.1 Intuitive decision style and the disposition effect**

An individual with an intuitive decision-making style relies more on hunches and feelings (Scott & Bruce, 1995), and hence tends to rely more on System 1 processes, which are fast, automatic, and heuristic-based (Kahneman, 2011).

Their emotion-driven approach closely aligns with the realization utility model, making them particularly prone to the gratification that comes from capitalizing on gains and to the feeling of regret from realizing losses. Such enhanced emotional response can drive them to sell winning stocks prematurely, while at the same time causing reluctance to let go of losing share. Indeed, individuals relying more heavily on System 1 processes have been found to exhibit greater disposition effect (Richards et al., 2018).

Given their higher reliance on heuristics, intuitive decision-makers might be more susceptible to the mental accounting bias. They are more likely to treat each stock separately, evaluating its performance individually rather than it in the context of the broader portfolio, amplifying the disposition effect.

Moreover, their inclination to rely on hunches and feelings might make them more susceptible to cognitive dissonance, as demonstrated by Allahyani (2012). Hence, intuitive decision-makers may be also more prone to the psychological discomfort arising by the acknowledgment of having made a poor investment choice (Chang, Solomon, & Westerfield, 2016).

Thus, we hypothesize:

**Hypothesis 1a:** *Individuals high on intuitive decision-making scale exhibit a larger disposition effect.*

### **2.5.2 Rational decision style and the disposition effect**

Rational decision-makers engage in intentional and analytical thinking (Hamilton, Shih, & Mohammed, 2016), preferring to systematically analyse information and evaluate evidence (Scott & Bruce, 1995). Due to this logical approach, they might be less susceptible to the emotional highs and lows that contribute to the disposition effect, such as the euphoria of gaining a profit or the pain of realizing a loss.

Rational thinkers' tendency to analyse information systematically implies that they might be less affected by the mental accounting bias, meaning that they're more likely to assess the performance of an investment in relation to their entire portfolio, rather than considering stocks in isolation. They are in fact found to be less susceptible to heuristics in decision making (Shiloh, Salton, & Sharabi, 2002).

The study by Wong, Kwong, and Ng (2008) reveals how individuals scoring high on the Pacini and Epstein's (1999) rational inventory are more prone to the escalation of commitment bias compared to those scoring low. Escalation of commitment (EOC), as described by Staw (1997), refers to the increased commitment in situations "*where losses have been suffered, where there is an opportunity to persist or withdraw, and where the consequences of these actions are uncertain*". This apparently counterintuitive finding can be understood through the lens of cognitive dissonance theory, which posits that people feel discomfort when confronted with conflicting beliefs and actions. To ease this discomfort, they might reinforce their original choices, even if they are flawed. The rational system could in fact rationalize biases determined experientially and emotionally (Epstein, 2003), resulting in maladaptive determinations, such as the confirmation bias.

As mentioned in Section 2.1, loss aversion might also be positively correlated to disposition effect. Although there is no direct evidence of a relation between decision-making style and loss aversion, Boyce, Wood, and Ferguson (2016) find how individuals high on the personality trait of conscientiousness, which is found to predict rational decision-making style (Riaz, et al., 2012; El Othman, et al., 2020; Wang, Highhouse, Lake, Petersen, & Rada, 2017) exhibit larger loss aversion. Supporting a link between loss aversion and disposition effect, Ahmad (2020) finds that individuals high on conscientiousness exhibit stronger disposition effect.

Previous research on rational decision style provides contrasting evidence, not outlining a clear picture of what type of influence it may have on the display of disposition effect. However, as the number of studies which doubt that the prospect theory is capable of explaining the disposition effect is growing (Pleßner, 2017) and we consider the emotional responses as the main drivers of the disposition effect, we hypothesize that:

**Hypothesis 1b:** *Individuals high on rational decision-making scale exhibit a smaller disposition effect.*

## **2.6 Impact of decision styles on nudge effectiveness**

Getting closer to the central research question of our study, this research is closely aligned with existing studies that examine how individual differences in decision styles may impact the effectiveness of nudges. This body of research, just like the present study, aims to address the “problem of heterogeneity” (Mills, 2020, 2022) in behavioural nudges, trying to overcome the one-size-fits-all approach. Existing studies in this domain commonly employ the General Decision-Making Style (GMDS) scale and the Need for Cognition (NFC) scale. Although the latter is not a direct measure of decision styles, it is closely related to the rational dimension. Notably, the rational scale in the Rational-Experiential Inventory (REI: Epstein et al., 1996), widely recognized as the most established measure for intuitive/rational thinking styles, is assessed through the Need For Cognition scale. Furthermore, empirical evidence (Bavolár & Mihál, 2019) reinforces the correlation between NFC and the rational decision-making style.

### **2.6.1 Cybersecurity**

The relationship between decision styles and the effectiveness of nudges has been widely investigated in the field of cybersecurity (Malkin et al., 2017; Warberg, Acquisti, & Sicker, 2019; Peer et al., 2020; Qu et al., 2022). While the studies by Malkin et al. (2017) and Warberg, Acquisti, & Sicker (2019) couldn't find strong and significant correlations between decision-making style and nudges effectiveness, the research by Peer et al. (2020) gets to a different conclusion. Their study introduced a novel approach that administered personalized online password nudges to users based on their decision-making style. The results demonstrated that personalized nudging led to significantly greater effects compared to one-size-fits-all nudges, resulting in up to four times better outcomes (Peer, et al., 2020).

### **2.6.2 Food purchasing behaviour**

Other studies have explored the relationship between decision-making styles and nudge effectiveness in the context of food purchasing behaviour (Wensing et al., 2020; Ingendahl et al., 2021; Taufik et al., 2022). The results obtained by Wensing et al. (2020) suggest a cognitive style-based division in the effectiveness of different nudging strategies. Individuals low on NFC are more impacted by visually striking and emotionally evoking nudges, as these approaches better align with their less analytical thinking style. In contrast, those high on NFC are more influenced by information-rich nudges that better fit their preference for systematic decision-making processes.

The study by Ingendahl et al. (2021) examines how individual differences in Need for Cognition (NFC) and Need for Uniqueness (NFU) moderate the effectiveness of defaults and social influence nudges in an online shopping scenario. The authors found a small tendency for NFC to negatively impact nudging effectiveness, which was not affected on the other hand by NFU. Conversely, Taufik et al. (2022) found no

significant interaction between GDMS and the effect of the default nudge on choices for a plant-based meat.

### **2.6.3 Health and Nutrition**

The studies by van der Molen et al. (2021) and König (2018) investigated the mediating role of decision-making styles on the susceptibility to nudges promoting a healthier nutrition and behaviour. Van der Molen et al. (2021) revealed that the effects of the nudging and pricing conditions on healthy food purchases were not influenced by GDMS. On the other hand, König's insightful results indicated how nutrition and fitness apps are especially appealing to individuals with a deliberative decision-making style. Conversely, the design of current available apps seems not to match well with the intuitive decision-making style, which may pose a significant barrier for individuals with this trait. This study highlighted how targeting apps design to users' decision-making styles could effectively improve adoption rates.

### **2.6.4 Other contexts**

Further studies explore the relationship between decision-making styles and nudges effectiveness in the domains of online political advertising space (Mills, 2020), hiring decision-making (Shu, 2018) and the use of visualizations to decrease the decoy effect (Jeong et al. 2021).

### **2.6.5 Finance**

In the financial realm, the study by Gambetti et al. (2022) stands as the only one exploring the relationship between decision-making styles and nudges to our knowledge. It investigates the role of default options in the relationship between trait anxiety, decision-making styles, and financial decisions. The findings reveal that default options can facilitate investment decisions for anxious, avoidant, rational, and dependent individuals.

## **2.7 Impact of decision styles on two nudges aimed at reducing disposition effect: the Tax Saliency Treatment and the Purchase Price Saliency Treatment**

The effectiveness in reducing the disposition effect of the two nudges of interest in this study, namely the Tax Saliency Treatment and the Purchase Price Saliency Treatment, may be significantly influenced by individuals' decision-making styles. In sections 2.7.1 and 2.7.2 we focus respectively on intuitive and rational decision makers' potential responsiveness to the treatment increasing the awareness of the tax consequences of selling. In sections 2.7.3 and 2.7.4 we will explore the potential impact of intuitive and rational decision-style on the susceptibility to the treatment decreasing the saliency of the purchase price of a stock.

### **2.7.1 Intuitive decision style and the Tax Saliency Treatment**

Intuitive decision-makers operate predominantly using fast, heuristic-based processes, being greatly influenced by impressions and gut feelings (Kahneman, 2011; Epstein et al., 1996). Hence, they are expected to respond positively to salient information, as it aligns with their cognitive preferences.

According to Epstein and Pacini (2001), visualization plays a crucial role in influencing human irrationality by appealing to the intuitive-experiential system. For decision-makers who rely heavily on this system, visually highlighting tax implications of selling might simulate the real-world emotional impact of these taxes, driving their choices.

Moreover, the way information is processed and used may vary across individuals displaying different levels of intuitive decision-making. Highly intuitive thinkers might adopt a more impressionistic approach, which is less capacity-demanding (Riding et al., 2003). This might result in them developing a less robust working memory, which has been proven to play a role in resisting framing effects and more effectively applying decision rules in normative ways (Del Missier, et al., 2013). Therefore, they might especially benefit from the Tax Saliency Treatment, as it continually reinforces a key piece of information they should take into account in their decision-making, ultimately nudging them toward a more balanced trading decision and compensating for potential heuristic shortcuts.

In conclusion, the Tax Saliency Treatment might be particularly effective for intuitive decision-makers, acting as a counterbalance to their natural tendencies. By exploiting their reliance on emotions and visual cues, while also continually redirecting their focus, the treatment may significantly mitigate the disposition effect among these individuals. Hence:

**Hypotesis 2a:** *Individuals with high scores on the intuitive decision-making scale will experience a greater relative reduction in the disposition effect following the Tax Saliency Treatment compared to those with low scores on the intuitive scale.*

### **2.7.2 Rational decision style and the Tax Saliency Treatment**

As rational decision-maker tend to engage in intentional and logical thinking (Hamilton, Shih, & Mohammed, 2016), systematically analysing information and evaluating evidence (Scott & Bruce, 1995), they should be less influenced by emotional or heuristic cues. The increased saliency of tax implications, therefore, might be less impactful for this group as they would already take such factors into account, regardless of their emphasis.

As per Epstein and Pacini (2001), visualization primarily affects the intuitive-experiential system, leaving the analytical-rational system relatively unaffected. So, while the visualization of tax consequences might emotionally impact those inclined towards intuitive thinking, rational decision-makers may be relatively less impacted by it.



Evidence suggests those with a high Need For Cognition (NFC) maintain focus due to intrinsic motivation in cognitive activities (Thompson, Chaiken, & Hazlewood, 1993), engage in longer processing times (Peltier & Schibrowsky, 1994) and have superior information retention and recall performance (Peltier & Schibrowsky, 1994; Kuo, Horng, Lin, & Lee, 2012; Lassiter, Briggs, & Slaw, 1991). Given the association between NFC and the rational decision-making style (Bavořár & Mihál, 2019), it can be argued that rational decision-makers exhibit better concentration and reduced distractions. This would allow them to more effectively remember crucial information, such as the tax implications of selling, without the need of constant reminders. As a result, those lower on the rational scale could be the primary beneficiaries of the Tax Saliency Treatment, as it serves as reminder of important information they might otherwise overlook or misremember.

In summary, rational decision-makers, with their innate inclination for analysis and detail-oriented approach, might be less influenced by the Tax Saliency Treatment, given that they would naturally take into account such implications, regardless of their visual emphasis. Conversely, individuals less inclined toward rational decision style might find the treatment more impactful.

**Hypothesis 2b:** *Individuals with high scores on the rational decision-making scale will experience a smaller relative reduction in the disposition effect following the Tax Saliency Treatment compared to those with low scores on the rational scale.*

### **2.7.3 Intuitive decision style and the Purchase Price Saliency Treatment**

As mentioned earlier, displaying information visually speaks directly to the intuitive-experiential system (Epstein & Pacini, 2001). Thus, decision-makers who predominantly use their experiential system could be more deeply influenced by the emotional impact of seeing gains or losses highlighted on the trading screen. Hiding this information might be especially helpful for this group.

Purchase price also provides a reference point that influences trading decisions. Intuitive decision-makers, who more heavily rely on heuristics associated with System 1 thinking, might be more susceptible to its anchoring effect. The lack of visible purchase price could therefore reduce this cognitive bias.

Research by Gaeth and Shanteau (1984) suggests how increasing cognitive effort can reduce the influence of irrelevant information on decision making. Intuitive decision-makers tend to rely more on System 1 thinking, which is related to a more impressionistic approach in processing information (Riding et al., 2003), is more prone to judgment errors (Kahneman, 2003) and can result in not adhering to normative models (Soll, Milkman, & Payne, 2015; Morewedge & Kahneman, 2010; Larrick, 2004). Salient cues like the purchase price of a stock could shift their focus to what is in fact an irrelevant information, especially if an emotional weight is attached to it. By removing the purchase price, and thus the heuristic cue associated to it, intuitive decision-makers might be able to engage in a more deliberate assessment of all the available information.

In essence, the Purchase Price Saliency Treatment might nudge these individuals to rely less on heuristic cues and emotional attachments and potentially push them towards a more analytical, rational approach. Hence:

**Hypothesis 3a:** *Individuals with high scores on the intuitive decision-making scale will experience a greater relative reduction in the disposition effect following the Purchase Price Saliency Treatment compared to those with low scores on the intuitive scale.*

#### **2.7.4 Rational decision style and the Purchase Price Saliency Treatment**

Highly rational decision-makers, due to their inherent analytical and intentional information processing, might already be less influenced by the anchoring effect of the purchase price.

Studies by Bergman et al. (2010) and Welsh et al. (2014) support this, finding that those with higher cognitive abilities and a more rational approach to problems are less susceptible to anchoring bias.

This can relate more broadly to the reduced susceptibility to irrelevant information.

Gaeth and Shanteau (1984) discuss the role of increased cognitive effort in mitigating the impact of irrelevant information on decision-making. Larrick (2004) found that encouraging participants to think analytically effectively reduced various biases, including the impact of irrelevant information presented as an anchor. Rabinovitch, Bereby-Meyer, and Budescu (2022), on the other hand, suggest how the ability to override irrelevant information derives, rather than from deliberative thinking or, in other words, by activating the System 2 processes, by a naturally more logical and reflective way of thinking of the individual. In any case, rational decision-makers should be better equipped to ignore or override irrelevant information.

As previously noted, highly rational decision-makers tend to pay greater attention to detail, demonstrate better concentration, and make decisions based on a more comprehensive assessment of available information (Greco & McClung, 1979; Thompson, Chaiken, & Hazlewood, 1993). Additionally, they can potentially count on superior information retention abilities (Peltier & Schibrowsky, 1994; Kuo, Horng, Lin, & Lee, 2012; Lassiter, Briggs, & Slaw, 1991), being more likely to remember the purchase price even when it's not explicitly displayed. Hence, even when the purchase price is not shown on the trading screen, its influence might persist in their decision-making process.

In conclusion, while the Purchase Price Saliency Treatment aims to reduce the disposition effect by targeting the anchoring bias associated with the stock's purchase price, its effectiveness might be lower for rational decision-makers. Consequently, the treatment's role in mitigating the disposition effect may be less significant to those high on the rational decision style scale, compared to those scoring lower. This leads to our last hypothesis:

**Hypothesis 3b:** *Individuals with high scores on the rational decision-making scale will experience a smaller relative reduction in the disposition effect following the Purchase Price Saliency Treatment compared to those with low scores on the rational scale.*

# CHAPTER 3

## EXPERIMENTAL DESIGN

### 3.1 Participants and procedure

Before starting the collection of observations, approval was obtained through the ethical thesis check. Participants were recruited through various channels, including word-of-mouth, social networks, instant messaging, and QR codes. The experiment was conducted using the Qualtrics Survey XM platform, with participants accessing the survey on their own devices through a provided link. This link randomly assigned each participant to one of the three treatment conditions: the Control Group condition, the Purchase Price Saliency Treatment, or the Tax Saliency Treatment. To motivate participants to perform to the best of their abilities during the experiment, the chance to win a €50 gift card from a well-known air travel company was offered as a reward. The probabilities of winning this reward were weighted to participants' performance in the trading game.

Though ideal sample size aspirations were affected by research constraints, the targeted sample size for each condition, determined through a power calculation, aimed for a power level of 80% with a significance level of 5%. Since previous research on the topic is limited, making this study exploratory in nature, it was challenging to predict an effect size. Therefore, the power calculation employs a medium effect size as defined by Cohen's (2013) guidelines, with an r-squared value of 0.09. As a result, a sample size of 86 participants per condition was considered necessary. Unfortunately, such target was not met. This research managed to gather a total of 169 participants. Out of these, 4 were dismissed due to survey incompleteness, and an additional 11 were excluded due to a survey completion time exceeding thirty minutes, potentially indicating distractions, interruptions, or disengagement during the survey process. This resulted ultimately in 154 valid participants, evenly distributed across the three conditions: 50 in the Control Group, 51 in the Purchase Price Saliency Treatment, 53 in the Tax Saliency Treatment.

Falling short of the target sample size introduces constraints on the study's scope and robustness, marking a notable limitation for the present research.

The experiment was available in two languages: Italian and English.

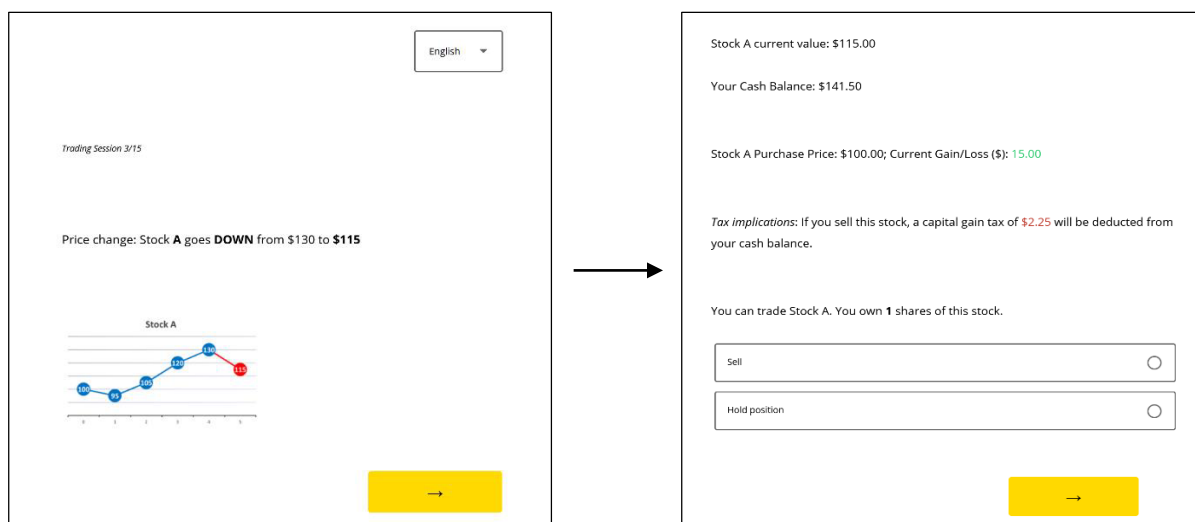
### 3.2 Pre-experimental questionnaire

At the beginning of the experiment, participants were informed that, by proceeding, they gave consent for their data to be used for experimental purposes. Afterwards, they were directed to a questionnaire featuring demographic questions and the rational and intuitive decision styles scale (RIDSS, Hamilton, Shih, &

Mohammed, 2016). The questionnaire began by asking respondents to provide details on their age, gender, and education level. It also assessed their financial knowledge and experience using two distinct 4-point ordered scale questions.

### 3.2.1 Rational and Intuitive decision styles

Before engaging in the trading game, participants decision styles were assessed through the rational and intuitive decision styles scale (RIDSS) developed by Hamilton, Shih, and Mohammed (2016). The RIDSS was chosen over the General Decision Making Style (GDMS) scale as it was shown to be more reliable and have less ambiguous items (Hamilton, Shih, & Mohammed, 2016). Additionally, it focuses specifically on capturing rational and intuitive decision styles, providing a comprehensive understanding of decision-making that includes both cognitive and affective dimensions. The scale consists of 10 items, with 5 items representing each decision style. Participants rated their agreement with each item on a 5-point Likert scale, with 1 representing "strongly disagree" and 5 representing "strongly agree".



**Fig. 1.** Example screens from the Tax Saliency Treatment condition. On the left, the price update screen displays all fluctuations in the value of a randomly selected stock since the beginning of the experiment, highlighting its latest change. On the right, the trading screen allows participants to trade the stock. The information presented on this screen varies depending on the treatment condition.

### 3.3 Basic design of the trading game

The experimental design builds directly on the ones of Frydman and Rangel (2014) and Bazley, Moore, and Vosse (2022). All participants took part in an experimental market setting, in which they had the chance to trade three fictional stocks: A, B, and C. After the initial questionnaire, and before the start of the experiment, participants received detailed instructions (see Appendix C) explaining the market dynamics, the price updates process, and other experiment-related details. Each participant's initial trading capital was set at \$350 in experimental currency, with initial holdings consisting in one share of every stock (each priced at \$100) along with \$50 liquid cash.

### 3.3.1 Price chronology and active trading sessions

The experiment's preliminary phase consisted of nine trials known as the *price chronology sessions*. Throughout these trials, participants were only exposed to stock price fluctuations and were not allowed to buy or sell stocks. This phase allowed investors to gain a better understanding of the stock price movement before making their trading decisions. Active trading was then enabled in the following fifteen *trading sessions*, spanning from trial 10 to trial 24.

Each trading session was divided into two separate stages: a price update screen and a trading screen. In the price update screen, one of the three stocks was randomly selected, and participants were shown the price change for that particular stock. Price updates only occurred during this screen, which displayed all the fluctuations in the stock value since the beginning of the experiment, making sure that investors are aware of the complete price path for each stock.

In the trading screen, participants were now able to trade the stock. No new information was provided on the trading display. The three experimental conditions differ based on the type of information shown on this screen (for more details, see Section 3.4).

Throughout the experiment, participants could hold either one or zero shares of each stock in their portfolio. They could therefore decide whether to sell a stock if they already owned it, or to purchase the stock if they didn't.

Transactions took place at the current market price. To prevent liquidity constraints, participants were allowed to have negative cash balances, allowing them to buy stocks regardless of immediate cash availability.

### 3.3.2 Tax implications

Following the design by Bazley, Moore, and Vosse (2022), selling stocks during the trading sessions triggered tax implications. When participants sold a stock, the cash they received was adjusted to account for these implications. If a stock was sold at a profit, meaning it had increased in value, a capital gains tax of 15% was charged on the profit. Conversely, if a stock was sold at a loss, the deficit from that loss was reduced by 15%.

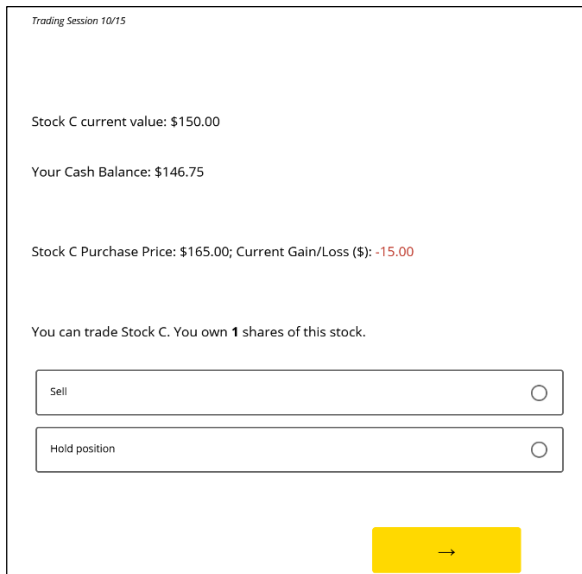
### 3.3.3 Stock Price Determinants: Markov Chains

The stock prices fluctuated following a two-state Markov chain, consisting of a *good state* and a *bad state*. For a specific stock  $i$  during trial  $t$ , the probability of a price increase was 70% if the stock was in the good state, and 30% if it was in the bad state. Conversely, the probability of a price decrease was 30% in the good state and 70% in the bad state. The price process for each stock was independent of the Markov chains of the other stocks. The magnitude of price change was randomly chosen between \$5, \$10, or \$15, with equal probability, irrespective of the direction (increase or decrease).

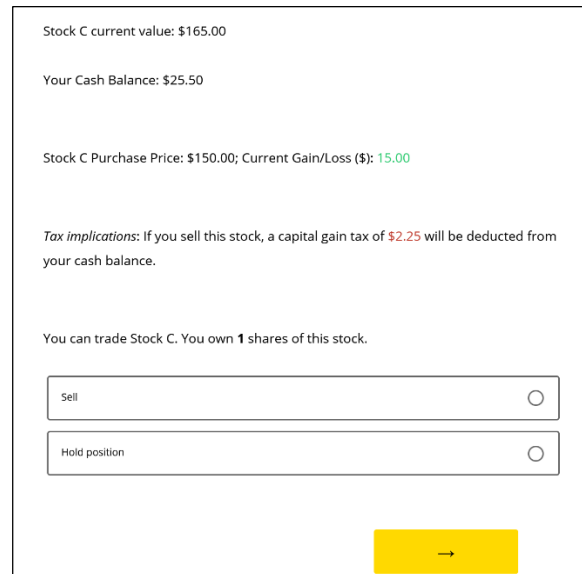
The underlying state of each stock was independent from the ones the other two stocks. Before trial 1, each stock was randomly assigned to a state. Afterward, a stock's state remains the same as the previous

trial with a probability of 80%, opposed by a 20% probability of a state switch. While participants received extensive instructions about how the Markov chain mechanism worked, they were not explicitly informed about the current stock's state for each trial. Instead, they could attempt to deduce it on the base of historical stock prices.

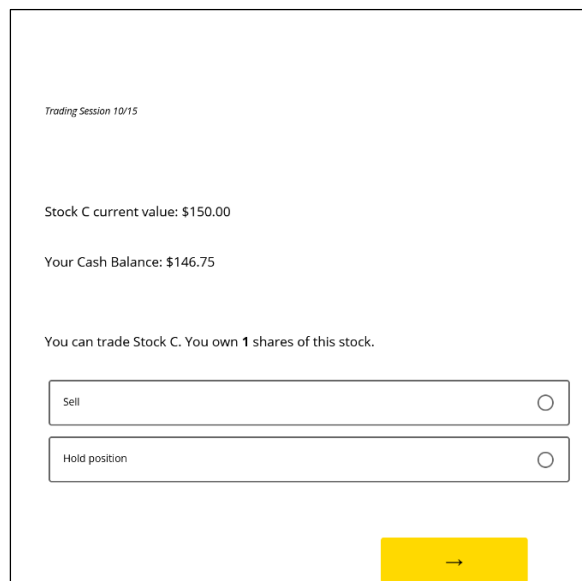
To accommodate the limitations of the Qualtrics Survey platform, which was not able to reproduce the two-state Markov chain in real time, three scenarios with distinct price paths for each stock have been randomly pre-generated and subsequently randomly allocated among the subjects.



**Fig. 2.** Trading screen for the Control Group condition. Displays the current stock price, last purchase price, and the corresponding paper gain or loss.



**Fig. 3.** Trading screen for the Tax Saliency Treatment. Presents the current price, purchase price, associated paper gain or loss, and the tax implications of selling.



**Fig. 4.** Trading screen for the Purchase Price Saliency Treatment. Features only the current stock price, omitting details of purchase price and tax implications.

### 3.4 Experimental conditions

Each subject is randomly assigned to one of the three experimental conditions: the Control Group, the Purchase Price Saliency Treatment, or the Tax Saliency Treatment.

In the Control Group condition, when a stock was owned, the trading screen displayed the current stock price along with the last purchase price and the associated paper gain or loss.

In the Purchase Price Saliency Treatment, only the current stock price was displayed, with no mention of the purchase price.

In the Tax Saliency Treatment, in addition to current price, purchase price, and associated paper gain or loss, participants were shown the tax consequences of selling the stock.

The only difference between the three conditions is the removal or addition of information during the trading screens when the stock was owned. The Control Group condition and the Tax Saliency Treatment closely resemble the experiment by Bazley, Moore, and Vosse (2022). The main difference between our Control Group and Purchase Price Saliency Treatment, compared to the design by Frydman and Rangel's (2014), is the inclusion of the tax consequences of selling.

### 3.5 Measuring the disposition effect

The calculation of the disposition effect in this study was conducted at the individual subject level, following the approach employed by Frydman and Rangel (2014) and Bazley, Moore, and Vosse (2022). When participants were presented with the opportunity to sell a stock, their decisions were classified into four mutually exclusive categories:

- **Realized gains:** The stock's current price was higher than the buying price, and the participant chose to sell.
- **Realized losses:** The stock's current price was lower than the buying price, and the participant chose to sell.
- **Paper gains:** The stock's price was higher than the buying price, and the participant decided to keep it.
- **Paper losses:** The stock's price was lower than the buying price, and the participant decided to keep it.

For each subject, the number of realized gains, realized losses, paper gains, and paper losses was counted throughout the trading sessions. These counts are then used to compute the Proportion of Gains Realized (PGR) and the Proportion of Losses Realized (PLR) using the following formulas:

$$(1) \text{PGR} = \frac{\# \text{ of Realized Gains}}{\# \text{ of Realized Gains} + \# \text{ of Paper Gains}}$$



$$(2) \textit{PLR} = \frac{\# \textit{ of Realized Losses}}{\# \textit{ of Realized Losses} + \# \textit{ of Paper Losses}}$$

The individual measure of the disposition effect is obtained by PGR–PLR. Specifically, when PGR is equal to PLR, there is no disposition effect observed. The magnitude of the disposition effect increases as PGR–PLR becomes larger, and when a subject exhibits  $\text{PGR} < \text{PLR}$ , it indicates the opposite of a disposition effect.

### **3.6 Additional variables**

Along with the primary experimental data and demographics, we collected additional factors during the experiment to capture other potentially relevant variables. The duration taken by each participant to complete the survey was recorded to account for potential variations in completion time.

Additionally, at the end of the trading sessions, participants were asked their perceived importance of the purchase price and tax implications on their trading decisions through two distinct 5-point Likert scale questions, ranging from "not impactful at all" to "extremely impactful".

To assess information retention of participants, in the middle of the trading sessions, they were asked to identify the correct percentage of tax implications of selling among three provided options.

## CHAPTER 4

### METHODS

The primary objective of this study is to investigate the influence of rational and intuitive decision-making styles on the effectiveness of nudges designed to reduce the disposition effect. As we aim to answer the central research question, we have the opportunity to examine the role that intuitive and rational decision styles may play in displaying the disposition effect by testing hypotheses 1a and 1b. Additionally, we attempt to reproduce the findings of the studies by Frydman and Rangel (2014) and Bazley et al. (2022) by replicating their experimental framework.

#### 4.1 Testing the impact of rational and intuitive decision styles on disposition effect

Hypotheses 1a and 1b posit that individuals with a markedly intuitive decision style are likely to exhibit a larger disposition effect, while those with a more pronounced rational decision style may display the opposite.

To test these hypotheses, we take into account exclusively the Control Group, therefore excluding all the observations related to individuals allocated to the Tax Saliency Treatment and the Purchase Price Saliency Treatment, and run the ordinary least squares (OLS) regression model as outlined below:

$$DE_j = \alpha_0 + \beta_1 \text{Rational}_j + \beta_2 \text{Intuitive}_j + \beta_9 X_j + \varepsilon \quad (4.1)$$

Where:

- “DE” is the disposition effect, measured as difference between proportion of gains realized and proportion of losses realized (PGR-PLR).
- “Rational” and “Intuitive” represent scores obtained from the Rational and Intuitive Decision Style Scales (RIDSS).
- “X” is a vector of covariates, including demographic variables, self-assessed financial literacy, and other controls already mentioned in the experimental design section.

All variables are comprehensively detailed in Appendix A.

This OLS regression is employed in a three-steps progressive analysis. Initially, only the decision styles variables are included as explanatory variables. Secondly, demographic variables are incorporated, followed by the inclusion of all remaining control variables to obtain the full OLS model. This approach

helps at understanding how the progressive inclusion of control variables impacts the explanatory power and the coefficients of the primary variables of interest.

## 4.2 Replicating findings of Frydman and Rangel (2014) and Bazley et al. (2022)

Before testing hypotheses 2 and 3, we have the chance to attempt at replicating the findings of the studies by Frydman and Rangel (2014) and Bazley et al. (2022). To do so, we first check whether the three treatment groups of the experiment are balanced. Then, in order to assess the effectiveness of the two nudge treatments, we perform for each one of them the following Mann-Whitney U test:

$$U = n_C \cdot n_T + \left( \frac{n_C \cdot (n_C + 1)}{2} \right) - R_C \quad (4.2)$$

Where:

- $n_C$  is the sample size of the control group.
- $n_T$  is the sample size of the treatment group.
- $R_C$  is the sum of the ranks in the control group.

## 4.3 Testing the impact of rational and intuitive decision styles on nudges effectiveness

Hypotheses 2a and 2b, and hypotheses 3a and 3b, suggest how the effectiveness of the nudges is moderated by decision styles: individuals scoring high on the intuitive decision style scale will, compared to those scoring low on the same scale, observe an enhanced effectiveness of both nudges. Conversely, the two nudges will have a diminished effect for individuals scoring high on the rational scale. To validate these hypotheses, we employed an ordinary least squares (OLS) regression model as outlined below:

$$\begin{aligned} DE_j = & \alpha_0 + \beta_1 \text{Rational}_j + \beta_2 \text{Intuitive}_j + \beta_3 \text{PP\_TREATMENT}_j + \beta_4 \text{PP\_TREATMENT} \\ & j * \text{Rational}_j + \beta_5 \text{PP\_TREATMENT}_j * \text{Intuitive}_j + \beta_6 \text{TS\_TREATMENT}_j + \beta_7 \\ & \text{TS\_TREATMENT}_j * \text{Rational}_j + \beta_8 \text{TS\_TREATMENT}_j * \text{Intuitive}_j + \beta_9 X_j + \varepsilon \end{aligned} \quad (4.3)$$

Where:

- “DE” is the disposition effect, measured as difference between proportion of gains realized and proportion of losses realized (PGR-PLR).
- “Rational” and “Intuitive” represent scores obtained from the Rational and Intuitive Decision Style Scales (RIDSS).

- “PP\_TREATMENT” and “TS\_TREATMENT” are dummy variables, indicating participants' assignment to the Purchase Price Saliency Treatment and Tax Saliency Treatment, respectively.
- “X” is a vector of covariates, including demographic variables, self-assessed financial literacy, and other controls already mentioned in the experimental design section.

Again, the OLS regression is employed in a three-steps progressive analysis. In the first step, only the decision styles variables, treatment dummies, and their interactions are included as explanatory variables. After that, demographic variables are added, and finally all remaining controls are included to achieve the full model.

## CHAPTER 5

### RESULTS

The objective of this study is to investigate the influence of rational and intuitive decision styles on the effectiveness of nudges designed to reduce the disposition effect. The subsequent sections detail the findings from the descriptive statistics, correlation, and regression analyses.

Table 1: Descriptive statistics of numeric variables

| Variable                    | Mean     | Median | SD       | Range         | Obs. (N) |
|-----------------------------|----------|--------|----------|---------------|----------|
| Disposition Effect          | 0.0845   | 0.125  | 0.2732   | [-0.82; 0.83] | 154      |
| Purchase Price Saliency Tr. | 0.3312   | -      | -        | [0; 1]        | 154      |
| Tax Saliency Tr.            | 0.3442   | -      | -        | [0; 1]        | 154      |
| Intuitive                   | 2.8727   | 2.8    | 0.8097   | [1; 4.8]      | 154      |
| Rational                    | 4.3      | 4.2    | 0.5446   | [2.8; 5]      | 154      |
| User Language: Italian      | 0.5714   | -      | -        | [0; 1]        | 154      |
| Age                         | 32.9415  | 26     | 14.2137  | [18; 67]      | 154      |
| Female                      | 0.5194   | -      | -        | [0; 1]        | 154      |
| Memory Check (TRUE)         | 0.8052   | -      | -        | [0; 1]        | 154      |
| Completion Time (Seconds)   | 590.4481 | 525    | 272.7379 | [156; 1566]   | 154      |
| Price Path Scenario A       | 0.3442   | -      | -        | [0; 1]        | 154      |
| Price Path Scenario B       | 0.3052   | -      | -        | [0; 1]        | 154      |

Table 1 presents summary statistics for various numeric variables, both continuous and binary. These variables include: (i) variables of interest, such as the disposition effect scores, intuitive and rational decision style scores, and participation in treatments; (ii) demographic data, encompassing age, gender, and the user's language; and (iii) experiment-specific metrics, like memory check, completion time, and price path scenarios. Statistics should be interpreted in light of the corresponding range of values for each variable. Detailed descriptions of each variable are provided in Appendix A.

Table 2: Descriptive statistics of categorical variables

| Variable  | Category              | Relative Frequency | Obs. (N) |
|-----------|-----------------------|--------------------|----------|
| Education | Less than high school | 6.49%              | 154      |
|           | High school graduate  | 30.52%             |          |
|           | Bachelor's degree     | 31.17%             |          |
|           | Master's degree       | 30.52%             |          |
|           | Doctorate             | 1.30%              |          |

|                                       |                      |        |     |
|---------------------------------------|----------------------|--------|-----|
| <b>Financial Knowledge</b>            |                      |        | 154 |
|                                       | Limited              | 42.21% |     |
|                                       | Basic                | 36.36% |     |
|                                       | Moderate             | 16.23% |     |
|                                       | Advanced             | 5.20%  |     |
| <b>Financial Experience</b>           |                      |        | 154 |
|                                       | None                 | 50.65% |     |
|                                       | Limited              | 35.06% |     |
|                                       | Moderate             | 11.69% |     |
|                                       | Extensive            | 2.60%  |     |
| <b>Importance of Purchase Price</b>   |                      |        | 154 |
|                                       | Not impactful at all | 5.19%  |     |
|                                       | Slightly impactful   | 16.23% |     |
|                                       | Moderately impactful | 31.17% |     |
|                                       | Very impactful       | 40.91% |     |
|                                       | Extremely impactful  | 6.44%  |     |
| <b>Importance of Tax Implications</b> |                      |        | 154 |
|                                       | Not impactful at all | 23.38% |     |
|                                       | Slightly impactful   | 24.03% |     |
|                                       | Moderately impactful | 28.57% |     |
|                                       | Very impactful       | 20.78% |     |
|                                       | Extremely impactful  | 3.24%  |     |

Table 2 presents the relative frequencies for each category within several categorical variables. These variables include educational attainment, self-assessed financial knowledge, self-assessed financial experience, the perceived importance of purchase price in trading decisions, and the perceived importance of the tax consequences of selling in trading decisions. Detailed descriptions of each variable are provided in Appendix A.

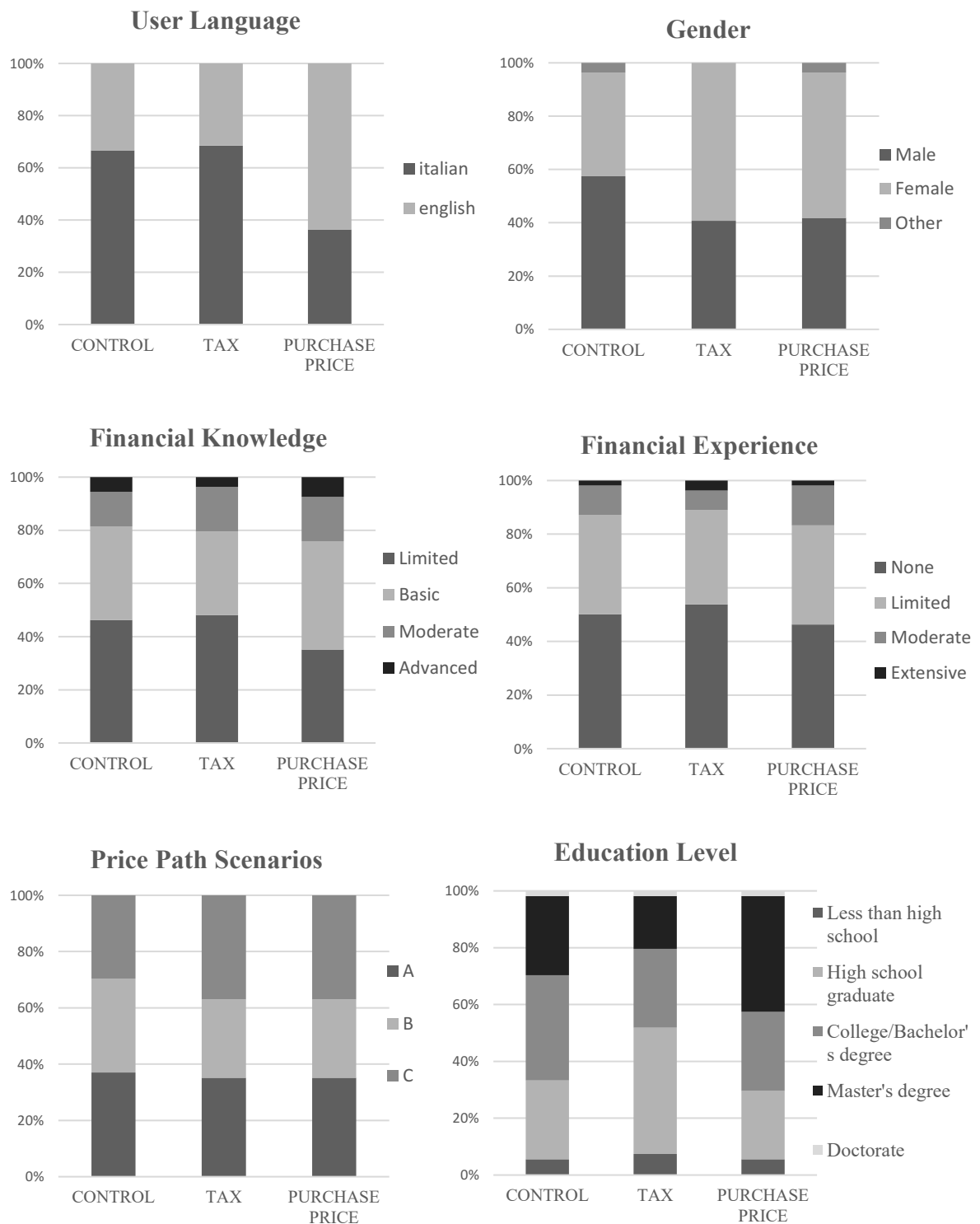
## 5.1 Data

### 5.1.1 Demographics

Respondents' ages varied from 18 (the minimum age required for participation) to 67, with a median age of 26, indicating a predominantly young group of participants. The gender distribution was relatively balanced: 46% male, 52% female, with the remaining 2% either identifying as non-binary or choosing not to specify their gender. Regarding the level of education, over 90% of participants were almost evenly split between those holding a high school diploma (30.5%), a bachelor's degree (31.2%), and a master's degree (30.5%). Additionally, 6.5% had not completed high school, and 1.3% had earned a doctorate.

In terms of financial knowledge, nearly 80% of participants claimed to possess only basic or limited understanding of financial markets and investment concepts. Just 5.2% believed they had a deep understanding on these topics. As for practical experience in financial market investing, the figures were even more pronounced: 85.7% reported limited to no experience, while a mere 2.6% indicated extensive expertise in the field.

Finally, 57% of the participants completed the survey in Italian, while 43% chose English, indicating they were international participants.



**Fig. 5.** Analysis of balance between treatment conditions, comparing the relative frequencies of variables such as user language, gender, self-assessed financial knowledge, self-assessed financial experience, educational attainment and randomly allocated price path pre-generated scenario.

### **5.1.2 Demographic distribution across treatment groups**

To assess the balance and comparability among the treatment groups, we now explore the demographic distribution across them. This is also crucial for determining the validity of the Mann-Whitney U tests employed in our attempt to replicate the findings of previous studies.

The median age remains 26 across the three treatment groups. Gender distribution is relatively balanced, although in the Control Group, a male majority of 57.4% is recorded, as opposed to the Tax Saliency Treatment and Purchase Price Saliency Treatment, where males represent 40.7% and 41.8% of the total, respectively. The distribution of the pre-generated price path scenarios is also evenly balanced across the three groups.

A notable difference is observed for the language used by participants during the experiment. In the Tax Saliency Treatment and Control Group, around two-thirds of the participants conducted the experiment in Italian (68.5% and 66.7%, respectively), while in the Purchase Price Saliency Treatment, 64% of subjects completed the experiment in English.

Given that Italy has education levels below the EU average [insert: European Commission. (2022). Educational attainment statistics. Eurostat: Statistics Explained. [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Educational\\_attainment\\_statistics](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Educational_attainment_statistics)], this disparity is reflected in the educational background observed across the three groups. Specifically, the Purchase Price Saliency Treatment group, mostly composed of international participants as suggested by the language statistics, display slightly higher education levels, with the most prevalent category being master's graduates (40% of the total). This contrasts with the Control Group, where the modal education level is a Bachelor's/College degree (37%), and the Tax Saliency Treatment, where 44% of the subjects have attained up to a High School diploma.

This trend seems to extend, even if weakly, to the self-assessed financial knowledge and experience. In the Purchase Price Saliency Treatment, 74.5% of participants reported having limited or basic financial knowledge, and 81.8% having limited to no financial experience. On the other hand, for the Control Group the corresponding figures are 81.4% and 87%, and for the Tax Saliency Treatment are 78.6% and 88.9%, respectively.

Although small differences exist across the three samples, which is common occurrence in small samples, these are not marked enough to expect a significant impact. We can therefore affirm that the three groups are relatively balanced, hence allowing to perform non-parametric tests such as the Mann-Whitney U test.

### **5.1.3. Decision styles**

The rational decision scale consisted in 5 items designed to capture the extent to which an individual employs a deliberate and analytical approach to decision-making. Specifically, this scale measures if individuals gather comprehensive information, evaluate all viable alternatives, and systematically take



various factors into account to make sure their decisions are informed, adhere to normative models, and are logically defensible (Hamilton, Shih, & Mohammed, 2016).

The responses on this scale had a mean score of 4.3 out of 5 (SD = 0.55), with a median value of 4.2, suggesting that the central tendency of the responses was towards the higher end of the scale. The internal consistency of the rational decision scale was found to be solid, with a Cronbach's alpha of 0.78.

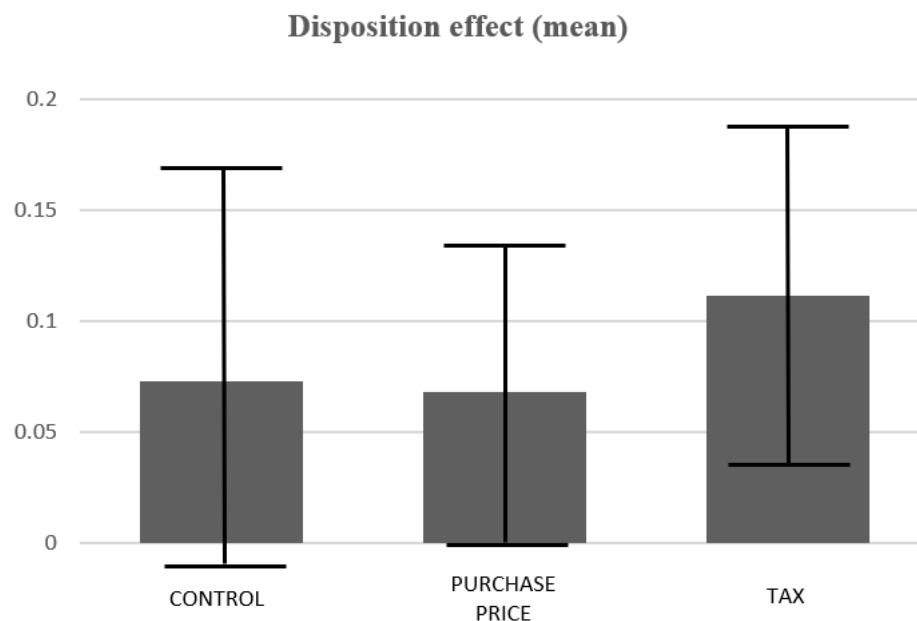
The intuitive decision scale consisted in 5 items that aimed to assess the degree to which individuals rely on instinctive, subconscious processes in their decision-making. In particular they measure the extent to which individuals rely on gut feelings, first impressions, and innate hunches, displaying an automatic, rapid, emotional, and experience-based approach to decision-making (Hamilton, Shih, & Mohammed, 2016).

Responses on the intuitive scale presented a mean of 2.87 (SD = 0.81). The median stood at 2.8, showing that the central tendency was towards the middle of the scale. The intuitive decision scale showed a robust internal consistency, reflected by a Cronbach's alpha of 0.81.

#### 5.1.4 Decision styles distribution across treatment groups

The distribution of rational and intuitive decision styles scores shows small differences and can be considered reasonably balanced.

In the Control Group, the average score for the rational scale was 4.26, with a median value of 4.4. In the Tax Saliency Treatment, these values stood at 4.26 and 4.2, respectively, while the Purchase Price Saliency Treatment presented an average score of 4.38 and a median value of 4.4 for the rational scale.



**Fig. 6.** Comparison of the mean disposition effect scores across the three treatment conditions. Bars represent the 95% confidence intervals.

Regarding the intuitive decision style scale, the average and median values were 3.09 and 2.9 in the Control Group, 2.77 and 2.8 in the Tax Saliency Treatment, and finally 2.81 and 3 in the Purchase Price Saliency Treatment.

## 5.2 Disposition Effect Analysis

Across the entire dataset, the mean disposition effect stands at 0.0845, which is significantly higher than zero ( $p < 0.001$ , based on a two-tailed t-test against zero). This suggests a minor inclination for participants to realize gains while retaining losses. However, a breakdown of the disposition effect by treatment group shows the following:

In the Control Group, the disposition effect averaged at 0.0729, with a median of 0.0917.

In the Tax Saliency Treatment, participants displayed a mean disposition effect of 0.1115, making it the highest among the groups, with a median disposition effect of even 0.2.

Finally, participants in the Purchase Price Saliency Treatment had an average disposition effect of 0.0678 and a median value of 0.0857.

By observing these values, we can already gain insights on the effectiveness of the two nudges before performing the Mann-Whitney U tests. It is in fact clear how neither the Purchase Price Saliency Treatment nor the Tax Saliency Treatment had a marked impact in reducing the disposition effect.

## 5.3 Correlation Analysis

A Spearman's rank correlation was computed to understand the relationship between the rational and intuitive decision scales. A significant, but moderately weak negative correlation was found ( $\rho = -0.23$ ,  $t = 2.95$ ,  $p < 0.005$ ). In line with established literature (Denes-Raj & Epstein, 1994; Nygren & White, 2002; Baldacchino, Ucbasaran, & Cabantous, 2022; Wang, Highhouse, Lake, Petersen, & Rada, 2017; Hodgkinson & Clarke, 2007; Hamilton, Shih, & Mohammed, 2016; Akinci & Sadler-Smith, 2013), this indicates how, although not independent, the two measures cannot be considered two ends of the same continuum. Instead, they rather represent two orthogonal constructs.

No substantial correlation is observed between the disposition effect and intuitive decision-making style. However, a mildly positive correlation exists between the disposition effect and rational decision-making style, although this is not statistically significant ( $r = 0.1163$ ,  $p = 0.1509$ ).

The time taken to complete the experiment is not significantly associated with decision styles. Interestingly, the duration was negatively related to the Purchase Price Saliency Treatment ( $r = -0.1708$ ,  $p = 0.0342$ ). This may be due to the fact that this treatment presented minimal information on the trading screen, leaving the participants with less visual information to process.

Additionally, a marginally significant negative correlation was found between completion time and the disposition effect ( $r = -0.1473$ ,  $p = 0.0682$ ). This supports the concept from existing literature that increased cognitive effort and time spent on tasks might help in reducing biases, including the disposition effect.

The ability of participants to retain information about the tax implications of selling was not significantly linked with any other variables, showing how simply being part of the Tax Saliency Treatment did not improve this ability.

An interesting, and to some extent counterintuitive, finding was the moderately negative and statistically significant correlation between the perceived importance of the purchase price and intuitive decision-making style ( $r = -0.2134$ ,  $p = 0.0079$ ).

## 5.4 Testing nudges effectiveness

Two separate Mann-Whitney U tests were performed to evaluate the effectiveness of the Tax Saliency Treatment and of the Purchase Price Saliency Treatment in reducing the disposition effect. Since this research closely follows the experimental designs of the studies by Frydman and Rangel (2014) and Bazley et al. (2022), this can be considered an attempt to replicate their findings.

The comparison between the Control Group and the Tax Saliency Treatment yielded a test statistic of 1277 ( $p = 0.7537$ ), suggesting no statistically significant difference between the distributions of the disposition effect in the control and treatment groups. Similarly, the comparison between the Control Group and the Purchase Price Saliency Treatment resulted in a test statistic of 1262 ( $p = 0.9367$ ), indicating that there is no statistically significant difference between the distributions of disposition effect across the two groups.

In both comparisons, the results suggest that the treatments did not affect disposition effect, failing to replicate the findings of the previous studies. The lack of significant effect from the two treatments severely constrains the ability of this study to explore the moderating role played by the decision styles. However, further insights can still be gained by the following regression analysis.

## 5.5 Regression Analysis

### 5.5.1 Assumptions and Validations

Several assumptions underlie the OLS regression approach. These include linearity in the parameters, homoscedasticity, and lack of perfect multicollinearity. To validate these assumptions, diagnostic tests were conducted on the full OLS model as described in Section 4.3.

#### **Linearity in Parameters:**

RESET (Regression Equation Specification Error Test) was employed to assess any potential specification

error due to omitted polynomial terms. The test produced a statistic of RESET = 0.90051, and a p-value of 0.4088, suggesting that the model does not suffer from omitted variable bias.

| Influence of intuitive and rational decision styles on disposition effect |                   |                    |                     |
|---|-------------------|--------------------|---------------------|
| Dependent variable: Disposition Effect                                    |                   |                    |                     |
|   | (1)               | (2)                | (3)                 |
| Rational  | 0.015<br>(0.016)  | 0.025<br>(0.017)   | 0.021<br>(0.018)    |
| Intuitive   | -0.006<br>(0.012) | 0.0001<br>(0.014)  | 0.003<br>(0.014)    |
| Age   |                   | -0.002<br>(0.004)  | -0.003<br>(0.004)   |
| Gender: male  |                   | -0.063<br>(0.113)  | -0.075<br>(0.121)   |
| Gender: non-binary  |                   | -0.226<br>(0.351)  | -0.334<br>(0.390)   |
| Gender: rather not say  |                   | 0.227<br>(0.337)   | 0.240<br>(0.386)    |
| Education: less than high school  |                   | -0.318<br>(0.214)  | -0.361<br>(0.233)   |
| Education: high school graduate   |                   | -0.233*<br>(0.120) | -0.191<br>(0.147)   |
| Education: master's degree  |                   | -0.155<br>(0.116)  | -0.096<br>(0.130)   |
| Financial literacy  |                   | 0.016<br>(0.039)   | 0.014<br>(0.045)    |
| User language: Italian  |                   | -0.183<br>(0.118)  | -0.157<br>(0.128)   |
| Duration (in seconds)   |                   |                    | -0.0002<br>(0.0002) |
| Purchase price importance   |                   |                    | -0.002<br>(0.050)   |
| Tax implications importance   |                   |                    | -0.002<br>(0.047)   |
| Memory check  |                   |                    | -0.151<br>(0.145)   |
| Price path A  |                   |                    | 0.097<br>(0.135)    |
| Price path B  |                   |                    | -0.045<br>(0.127)   |
| Constant  | -0.165<br>(0.391) | -0.163<br>(0.408)  | 0.109<br>(0.614)    |
| Observations  | 50                | 50                 | 50                  |
| Adjusted R <sup>2</sup>   | -0.016            | 0.001              | -0.068              |

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**Table 3.** Presents a progressive OLS regression conducted in three steps, testing the influence of rational and intuitive decision styles on disposition effect. In the first step (1), the OLS model includes only rational and intuitive decision styles as covariates. The second step (2) incorporates demographic variables, specifically gender, educational attainment, self-assessed financial literacy, and user language. The third step (3) integrates the remaining control variables: duration (measured in seconds), perceived importance of purchase price, perceived importance of tax implications, memory check, and price path scenarios.

#### **Homoscedasticity:**

The assumption of homoscedasticity was verified using the studentized Breusch-Pagan test. The test statistic was  $BP = 15.475$ , yielding a p-value of 0.948. This, combined with visual diagnostics where we plotted residuals against predicted values, confirmed that the assumption of homoscedasticity was not violated.

#### **Multicollinearity:**

To assess multicollinearity, variance inflation factors (VIF) were examined. As expected, we observed an evident multicollinearity between self-assessed financial knowledge and financial experience, with VIFs of 5.05 and 5.39 respectively. This showed a predictable positive correlation between the two ( $\rho = 0.599$ ,  $p < 0.0001$ ). To address this multicollinearity issue, the variables were combined by converting the ordered categorical variables into numeric ranks, then summing these ranks. The resulting summed rank was later employed as a singular ordinal measure, denominated *financial literacy*.

### **5.5.2 Influence of decision styles on disposition effect**

This research initially explores the impact of intuitive and rational decision styles on the likelihood of displaying the disposition effect. This led to our first hypotheses:

**Hypothesis 1a:** *Individuals high on intuitive decision-making scale exhibit a larger disposition effect.*

**Hypothesis 1b:** *Individuals high on rational decision-making scale exhibit a smaller disposition effect.*

As mentioned in the Methods section, these two hypotheses are tested using a progressive OLS regression analysis, taking into account exclusively the Control Group. In the first step, the OLS model features rational and intuitive decision styles as the only two covariates predicting the dependent variable “Disposition Effect”. Both rational and intuitive variables show minimal to no effect on disposition effect, and neither is statistically significant.

In the second step, demographics variables are added. The rational variable shows now a slightly higher positive effect on disposition effect (0.025) and a smaller, although still not significant, p-value ( $p = 0.1413$ ).

Interestingly, the coefficient for those with less than a high school diploma is negative and statistically significant at the 10% level (-0.233,  $p = 0.0599$ ). This unexpected finding suggests how these individuals, compared to those who achieved secondary and tertiary education, tend to display weaker disposition effect.

In the third step the remaining control variables are integrated. Now, none of the variables displays a statistically significant coefficient. The adjusted  $R^2$  being around 0 for all three models means that they do not significantly improve the prediction of disposition effect over simply predicting the mean for all observations, suggesting an unsatisfactory data fitting.

| Influence of intuitive and rational decision styles on treatments effectiveness against disposition effect |                   |                     |                       |
|--|-------------------|---------------------|-----------------------|
| Dependent variable: Disposition Effect   |                   |                     |                       |
|  | (1)               | (2)                 | (3)                   |
| Rational   | 0.075<br>(0.345)  | 0.104<br>(0.070)    | 0.103<br>(0.071)      |
| Intuitive  | -0.027<br>(0.052) | -0.035<br>(0.054)   | -0.051<br>(0.056)     |
| PP_TREATMENT   | 0.260<br>(0.538)  | 0.266<br>(0.556)    | 0.249<br>(0.561)      |
| TS_TREATMENT   | -0.306<br>(0.516) | -0.365<br>(0.520)   | -0.417<br>(0.534)     |
| Age  |                   | 0.002<br>(0.002)    | 0.002<br>(0.002)      |
| Gender: male   |                   | 0.050<br>(0.053)    | 0.039<br>(0.054)      |
| Gender: non-binary   |                   | 0.031<br>(0.200)    | 0.013<br>(0.205)      |
| Gender: rather not say   |                   | 0.239<br>(0.284)    | 0.248<br>(0.289)      |
| Education: Doctorate   |                   | -0.006<br>(0.202)   | -0.022<br>(0.204)     |
| Education: high school graduate  |                   | -0.022<br>(0.059)   | -0.023<br>(0.060)     |
| Education: less than high school   |                   | -0.257**<br>(0.101) | -0.259**<br>(0.102)   |
| Education: master's degree   |                   | -0.048<br>(0.059)   | -0.052<br>(0.060)     |
| Financial literacy   |                   | 0.0001<br>(0.017)   | -0.005<br>(0.018)     |
| User language: Italian   |                   | -0.045<br>(0.055)   | -0.052<br>(0.056)     |
| Duration (in seconds)  |                   |                     | -0.0002**<br>(0.0001) |
| Purchase price importance  |                   |                     | -0.022<br>(0.024)     |
| Tax implications importance  |                   |                     | -0.016<br>(0.021)     |
| Memory check   |                   |                     | -0.043<br>(0.060)     |
| Price path A   |                   |                     | -0.068<br>(0.057)     |
| Price path B   |                   |                     | -0.010<br>(0.055)     |

|                         |                   |                   |                   |
|-------------------------|-------------------|-------------------|-------------------|
| Rational*PP_TREATMENT   | -0.074<br>(0.106) | -0.074<br>(0.109) | -0.080<br>(0.110) |
| Intuitive*PP_TREATMENT  | 0.015<br>(0.071)  | 0.005<br>(0.074)  | 0.017<br>(0.075)  |
| Rational*TS_TREATMENT   | 0.035<br>(0.100)  | 0.045<br>(0.102)  | 0.049<br>(0.105)  |
| Intuitive*TS_TREATMENT  | 0.069<br>(0.072)  | 0.077<br>(0.073)  | 0.087<br>(0.074)  |
| Constant                | 0.050<br>(0.093)  | -0.166<br>(0.351) | 0.079<br>(0.377)  |
| Observations            | 154               | 154               | 154               |
| Adjusted R <sup>2</sup> | -0.032            | 0.004             | -0.004            |

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**Table 4.** Presents a progressive OLS regression conducted in three steps, testing the influence of decision styles on the effectiveness of treatments against disposition effect. In the first step (1), the OLS model includes only rational and intuitive decision styles as covariates. The second step (2) incorporates demographic variables, specifically gender, educational attainment, self-assessed financial literacy, and user language. The third step (3) integrates the remaining control variables: duration (measured in seconds), perceived importance of purchase price, perceived importance of tax implications, memory check, and price path scenarios

### 5.5.3 Influence of decision styles on nudges effectiveness

Building on our initial findings, we now investigate this study's primary research question: *How do intuitive and rational decision-making styles affect the effectiveness of nudges designed to mitigate the disposition effect?* Specifically, we evaluate the impact of two nudges, the Tax Saliency Treatment and the Purchase Price Saliency Treatment. To assess this, we employ a progressive OLS regression to test the following hypotheses:

**Hypothesis 2a:** *Individuals with high scores on the intuitive decision-making scale will experience a greater relative reduction in the disposition effect following the Tax Saliency Treatment compared to those with low scores on the intuitive scale.*

**Hypothesis 2b:** *Individuals with high scores on the rational decision-making scale will experience a smaller relative reduction in the disposition effect following the Tax Saliency Treatment compared to those with low scores on the rational scale.*

**Hypothesis 3a:** *Individuals with high scores on the intuitive decision-making scale will experience a greater relative reduction in the disposition effect following the Purchase Price Saliency Treatment compared to those with low scores on the intuitive scale.*

**Hypothesis 3b:** *Individuals with high scores on the rational decision-making scale will experience a*

*smaller relative reduction in the disposition effect following the Purchase Price Saliency Treatment compared to those with low scores on the rational scale.*

In the first step of the regression analysis, only the treatments dummies, intuitive and rational decision styles and their interaction enter the model. As already highlighted by the descriptive statistics, neither of the two treatments seemed to have impacted the levels of disposition effect, with the Purchase Price Saliency Treatment even having a largely positive coefficient (0.260), although not statistically significant ( $p = 0.6303$ ). The Tax Saliency Treatment dummy, on the other hand, has a largely negative coefficient of -0.306, implying a substantial reduction in disposition effect for those subjected to the nudge. However, the effect is not statistically significant ( $p = 0.5541$ ). Importantly, the interaction terms between the decision styles and treatments are not statistically significant, meaning that, at this stage, there is no evidence to confirm the moderating effect of decision styles on the effectiveness of the treatments.

In the second step, the demographic variables are integrated into the model. The key variables coefficients show negligible changes and remain statistically non-significant.

The coefficient for not having obtained a high school diploma is negative (-0.257) and statistically significant at a 5% confidence level ( $p = 0.0116$ ), reiterating our previous findings about the impact of not achieving secondary education on disposition effect.

The coefficient for completion time of the experiment, differently from the first progressive regression analysis, shows now a negative coefficient significant to the 5% confidence level (-0.0002,  $p = 0.0150$ ).

In the third and last step, all the remaining covariates are added, obtaining full the model as shown in section 4.3. The coefficient of the Tax Saliency Treatment becomes even more negative (-0.417), but still not statistically significant ( $p = 0.3156$ ). The coefficient of the Purchase Price Saliency Treatment remains positive (0.249) and statistically not significant ( $p = 0.7863$ ).

The coefficients of decision styles (rational and intuitive) and their interactions with treatments remain largely non-significant. Again, this goes against our main hypotheses and suggests that neither rational nor intuitive styles enhance or diminish the effectiveness of the tax implications or purchase price nudges in the context of disposition effect.

Among other covariates, coefficients for completion time and not obtaining a high school diploma are both significant at the 5% level. Their association with disposition effect is consistent with previous findings.

The Adjusted  $R^2$  value of the model is close to zero, indicating a poor fit to the data.



## CHAPTER 6

### DISCUSSION

The primary objective of this research was to investigate the influence of intuitive and rational decision-making styles on the effectiveness of nudges aimed at reducing the disposition effect. Our findings explored various dimensions of behavioural finance and behavioural economics, reinforcing some past understandings and challenging others. However, our results cannot be interpreted without considering the context of the methods implemented and the strong limitations faced. This section provides an in-depth interpretation of the key findings, a discussion of the broader implications of the results, and the potential limitations that are likely to affect the generalizability and reliability of our results.

#### 6.1 Interpretation of Key Findings

##### 6.1.1 Disposition Effect

Our data revealed a minor inclination among participants towards realizing gains while holding onto losses. Specifically, we observed a mean disposition effect across the whole dataset of 8.45%. This value aligns with results from Dhar and Zhu (2006), who explored actual trading decisions, and from Frydman and Rangel (2014), who implemented the trading experiment upon which ours is directly built. The latter study individuated -55% as the disposition effect value for the optimal Bayesian trader with linear utility, termed the “expected value trader”. We find how the disposition effect is not only well-above that value, but also significantly above zero ( $p < 0.001$ ).

This result confirms the robust and consistent nature of the disposition effect in trading settings.

##### 6.1.2 Influence of Decision Styles on disposition effect

Contrary to expectations, both intuitive and rational decision-making styles showed minimal direct influence on the disposition effect. Intuitive decision style seems to be completely unrelated to the disposition bias. This result can be considered in strong opposition with the findings of Richards et al. (2018), although the reliance on System 1 and System 2 they measured is only partially overlapping with the intuitive and rational decision styles explored in our study. The rational decision style, on the other hand, even if weakly, moved in a direction opposite to our hypothesis. It registered a coefficient of 0.017 with a p-value of 0.0547, suggesting that scoring higher on the rational scale of the RIDSS may correlate with slightly higher levels of disposition effect.

Our hypothesis about the effect of the rational decision style on the disposition effect was weaker than the one regarding the intuitive style. As a matter of fact, we identified contrasting forces within the rational

decision style that could impact the disposition bias. If emotional responses and the mental accounting heuristic are considered the primary drivers of the disposition effect, then a more rational decision style, given its intrinsic analytical and intentional attributes, should theoretically reduce the disposition effect. Conversely, if cognitive dissonance and loss aversion are the root causes of disposition effect, then rational decision-makers, who may be linked to higher levels of loss aversion and are shown to be prone to the escalation of commitment, might be more likely to display disposition effect.

Our findings may hint at the fact that cognitive dissonance could play a significant role in causing the disposition effect. Although the disposition effect has been extensively explored in past literature, very few studies have explored this possibility.

### **6.1.3 Effectiveness of Nudges**

This research aimed to investigate how relying predominantly on either a rational or intuitive decision-making style might affect the effectiveness of nudges designed to mitigate the disposition effect. Central to this goal was the fact that such interventions are usually implemented using a one-size-fits-all approach, leading to the so-called “problem of heterogeneity” (Mills, 2020, 2022). As individuals differ in how they process information, tackle challenges and make decisions, their susceptibility to interventions designed to guide their decision-making in a specific direction may also differ. Some, due to innate traits, might even respond in unexpected and counterproductive manners (Halpern, 2015; Sunstein, 2022).

In executing this research, the study replicated two treatments, built on an experimental trading setting, which had previously proved successful in reducing the disposition effect (Frydman & Rangel, 2014; Bazley, Moore, & Vosse, 2022). One treatment nudged participants to pay less attention to gains and losses by removing the purchase price of the stock from the trading screen (Frydman & Rangel, 2014). The other treatment nudged the subjects to consider more closely the tax implications of selling by explicitly displaying them on the trading screen (Bazley, Moore, & Vosse, 2022).

However, our results deviate significantly from the outcomes of the studies that originally designed these nudges. Neither the Tax Saliency Treatment nor the Purchase Price Saliency Treatment, surprisingly, had a discernible impact in reducing the disposition effect.

Given that our treatments closely mirrored those of the referenced studies, both in the experimental trading context and in their presentation, questions arise regarding the real effectiveness of these nudges and highlight the resiliency of the disposition effect.

Moreover, the lack of impact of these nudges completely hindered our ability to test the hypotheses related to how rational and intuitive decision-making styles might influence treatment effects, since no effect was observed in the first place.

### **6.1.4 Unexpected Findings**

An intriguing, and somewhat counterintuitive, finding is the observation that individuals with less than a high school diploma displayed a diminished disposition effect, as opposed to their more educated counterparts. One might instinctively assume that more advanced educational backgrounds would provide

individuals with the analytical and critical thinking skills necessary to overcome behavioural biases, including the ones commonly observed in financial markets. Yet, this finding seems to challenge this assumption.

It's possible that those with less formal education rely more on real-world experiences, which might equip them with practical insights or grounded decision-making strategies that better guard against the disposition effect. Alternatively, this group might perceive financial risks differently (Riley Jr & Chow, 1992). They might be more risk-averse due to potential financial constraints, or because they feel less confident when approaching complex matters such as trading decisions and stock evaluations, leading them to avoid holding onto losing stocks in the hope they might rebound. This unexpected result highlights the complexity underlining the factors that influence financial decision-making. It serves as a reminder that educational attainment, while undoubtedly valuable, is just one piece of the puzzle.

Another interesting finding was the negative correlation between intuitive decision style and the perceived importance of purchase price in trading decisions. It may seem counterintuitive, as we expect intuitive decision-makers to be more reliant on heuristics, instinct and feelings, and to be more sensitive to the saliency of information and to visual cues. Therefore, the purchase price of a stock should, in theory, influence heavily the trading decision of those scoring high on the intuitive scale. This is because it highlights whether they are at a loss or gain, evoking the associated emotional response.

However, being influenced by something doesn't necessarily mean being conscious of that influence. The system 1 on which intuitive decision-makers predominantly rely on, in fact, operates subconsciously, often bypassing conscious awareness in its processes (Kahneman, 2011). If such diminished attention to purchase price, and consequently to gains and losses, translated directly into actions, we would expect intuitive decision-makers to be less susceptible to disposition effect, a conjecture our results didn't confirm.

This unexpected result highlights the complexity underlining the factors that influence financial decision-making. It serves as a reminder that educational attainment, while undoubtedly valuable, is just one piece of the puzzle.

Another interesting finding was the negative correlation between intuitive decision style and the perceived importance of purchase price in trading decisions. It may seem counterintuitive, as we expect intuitive decision-makers to be more reliant on heuristics, instinct and feelings, and to be more sensitive to the saliency of information and to visual cues. Therefore, the purchase price of a stock should, in theory, influence heavily the trading decision of those scoring high on the intuitive scale. This is because it highlights whether they are at a loss or gain, evoking the associated emotional response.

However, being influenced by something doesn't necessarily mean being conscious of that influence. The system 1 on which intuitive decision-makers predominantly rely, in fact, operates subconsciously, often bypassing conscious awareness in its processes (Kahneman, 2011). If the lower importance given to purchase price, and consequently to gains and losses, translated directly into actions, we would expect intuitive decision-makers to be less susceptible to disposition effect, a conjecture our results didn't confirm.

## **6.2 Implications**

Despite the lack of significant results, the outcomes of this research still hold substantial implications for both academic and practical realms, concerning the importance of replications, the disposition effect, and nudging strategies.

### **6.2.1 Importance of Replication**

One of the fundamental principles of empirical research is the reproducibility of results. By attempting to replicate previous findings and observing different outcomes, this study highlights the variability and complexity of behavioural interventions. Our results show the need for a re-evaluation of earlier conclusions and methodologies, ensuring that our collective understanding of the field is grounded in robust, replicable findings. One of the main reasons why nudges trying to mitigate biases in the financial realm are hardly ever implemented is their lack of robustness and, overall, the limited research around them. This concern has been reinforced by the inconsistent results of our replication of the studies by Frydman and Rangel (2014) and by Bazley, Moore, and Vosse (2022).

### **6.2.2 Re-evaluating the root causes of disposition effect**

The observed potential role of the rational decision style as positive predictor of the disposition effect, contrary to our initial hypothesis, highlights the need to reexamine our understanding of this bias. Traditionally, disposition effect is considered to be rooted in emotional responses or mental accounting heuristics (Pleßner, 2017). Yet, our findings suggest a potentially deeper cognitive mechanism at work. Specifically, when stock performance contradicts an investor's belief in their investment decision, it can trigger cognitive dissonance (Chang, Solomon, & Westerfield, 2016). This dissonance might be especially pronounced in rational decision-makers, who more heavily rely on an analytical thinking and logical consistency, strengthening their commitment to their original choices. In an effort to rationalize their initial decision when confronted with contradictory evidence, they might double down in the hope of a turnaround. This behaviour of sticking with their decisions in spite of clear contradicting evidence can be understood as the “escalation of commitment” (Staw, 1997). This relationship between cognitive dissonance and the escalation of commitment emphasizes the need for a re-examination of the psychological drivers of the disposition effect, in the attempt to offer a richer understanding of investors behaviour.

This is especially true when we observe the resilience of the disposition effect, even in the presence of nudges aimed at reducing it. This suggests how our understanding of biases, even those as extensively explored in past literature as the disposition effect, might still be incomplete.

### **6.2.3 Broader Implications on nudges**

Beyond the realm of finance, this research contributes to the growing discussion on the true nature and effectiveness of behavioural interventions. Nudges are growing in popularity and gaining more and more traction. Yet, we need to understand if the enthusiasm around them is justified, as it appears that not only the evidence base supporting their effectiveness is limited, but also presents internal and external reliability

concerns (Lin, Osman, & Ashcroft, 2017). In addition to this, Maier et al. (2022) show that, after accounting for publication bias, there's a lack of evidence for the effectiveness of nudges. So, we must ask: do nudges truly have a lasting impact on deep-rooted behavioural biases like the disposition effect? Or do they only trigger temporary deviations, that are hard to reproduce and over the long term are not able to tackle the prevailing behavioural tendencies? It's a question that requires attention from both behavioural economists and psychologists.

In conclusion, while our research posed more questions than it answered, it underscores the ever-evolving nature of knowledge within behavioural finance and behavioural economics. It is clear how, even for extensively studied biases and patterns such as the disposition effect, our current understanding might just be the tip of the iceberg. In particular, the exploration of decision-making styles—a field still relatively untouched in behavioural finance—may be one of the most promising paths to follow in order to gain a deeper knowledge of all the psychological dynamics at play in investors behaviour.

## **6.3 Limitations**

While this research offers valuable insights into the realm of decision-making styles and the disposition effect, numerous limitations need to be taken into account when interpreting our results.

### **6.3.1 Sample size and representativeness**

The research did not meet the targeted sample size, collecting data from a total of only 154 participants instead of the intended 86 subjects per treatment. A sample size of this magnitude can significantly reduce the power of statistical tests, not only constraining our capability to identify authentic effects if present, but also raising serious concerns about the study's generalizability and the reliability of its findings.

The age distribution of our study's participants poses a significant limitation, too. With a median age of 26 years old, the sample predominantly consists of younger individuals. This demographic distribution may not be representative of the broader population, further limiting the generalizability of our findings.

### **6.3.2 Nudging Effectiveness**

A core limitation in this research regards the nudges, which did not yield the expected outcomes. This severely limited our ability to test primary hypotheses regarding the interplay between decision-making styles and the effectiveness of these nudges. The absence of the anticipated effects from nudges may also suggest that other unaccounted variables may be at play.

### **6.3.3 Decision Style Self-Assessment**

The Rational and Intuitive Decision Style Scales (RIDSS) developed by Hamilton, Shih, and Mohammed (2016) played a crucial role in our study. However, being a self-assessed measure, RIDSS inherently carries an element of subjectivity. This poses the risk that participants may not accurately assess their decision-

making styles, introducing measurement errors. As a matter of fact, the observed trend of participants scoring toward the higher end of the rational scale, likely due to its perceived social acceptability, hints at the possibility of social desirability bias affecting the reliability of our measurements.

#### **6.3.4 Experimental Environment**

While the experimental studies our research was built on were conducted in controlled lab settings (Frydman & Rangel, 2014; Bazley, Moore, & Vosse, 2022), where participants were immersed in their tasks, appropriately compensated, and equipped with all necessary tools for an unbiased experiment, our study faced the constraints typical of a master's thesis. We aimed to replicate the experiments to the best of our abilities, resorting to the Qualtrics Survey XM platform due to resource limitations. Despite the tremendous effort to render the trading experiment as close as possible to the original, this platform isn't primarily designed for economic experiments and brings with it its inherent constraints. Moreover, the absence of a controlled environment means participants could take the survey anytime, anywhere, using any device, which may have compromised their focus and attention to the task at hand.

The lack of an appropriate compensation for participants' effort of taking part in the experiment introduced also a significant time constraint. As a result, we were able to gather much fewer observations per participant compared to Frydman and Rangel (2014), who made participants engage in a total of 198 trading sessions. Our study, which could count on data from 15 trading sessions per subject, still did better than the nine trading sessions of the experiment by Bazley, Moore, and Vosse (2022).

## CHAPTER 7

### CONCLUSION

In this research we tried to gain a better understanding of the complexities linking the different approaches and processes behind human decision-making to the display of one of the most robust and well-known biases in the realm of behavioural finance: the disposition effect. This bias describes the tendency of investors to hold too long onto their losing stocks while quickly selling their winners. Despite struggling to find evidence to support its hypotheses, our study brought some valuable insights that contribute to our overall understanding of behavioural finance.

One of the key findings was the robustness and resilience of disposition effect, which is apparently deeply rooted in human behaviour and that seems harder to tackle than expected. Contrary to expectations, neither intuitive nor rational decision-making styles had a significant influence over it. This suggests that the factors at play in influencing financial decisions might be more and more complex than previously thought, and this area still needs further investigation.

In particular, this research sheds light on the potential role of cognitive dissonance, and the related escalation of commitment, in driving the disposition effect. We therefore hope that future research will better explore this avenue, building on the work by Chang, Solomon, and Westerfield (2016) .

The nudges we implemented, which were shown to be successful in the studies by Frydman and Rangel (2014) and by Bazley, Moore, and Vosse (2022), did not perform as anticipated in our study. Their inability to make difference not only highlights the resilience of the disposition effect, but also raises questions about the efficacy of such interventions in the financial realm. Most importantly, it brings up concerns about the broader concept of nudges, which sometimes risk to be oversimplistic solutions to extremely complex problems.

As we reflect on these findings, it is clear how the field of behavioural finance is still immature. While for sure there is a lot of room for further exploration, most importantly there is need to challenge and test their robustness of what we think we already know.

In essence, our research, despite its severe limitations, aimed to shed light on an underexplored area with the resources we could count on. Future research might delve deeper into personalized financial interventions, re-examine the role of intuitive and rational decision styles in finance, and perhaps even study of their impact on financial nudges.

Ultimately, the main finding of this master's thesis is perhaps the most obvious. The way in which we make decisions, and the factors playing a role in this process, create an incredibly complex web, and we are still very far from having a solid and comprehensive understanding of it.

## REFERENCES

- Ahmad, F. (2020). Personality traits as predictor of cognitive biases: moderating role of risk-attitude. *Qualitative Research in Financial Markets*, 12(4), 465-484.
- 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.
- Allahyani, M. H. (2012). The Relationship between Cognitive Dissonance and Decision-Making Styles in a Sample of Female Students at the University of Umm Al Qura. *Education*, 132(3).
- Baldacchino, L., Ucbasaran, D., & Cabantous, L. (2022). Linking Experience to Intuition and Cognitive Versatility in New Venture Ideation: A Dual-Process Perspective. *Journal of Management Studies*.
- Baldacchino, L., Ucbasaran, D., & Cabantous, L. (2022). Linking Experience to Intuition and Cognitive Versatility in New Venture Ideation: A Dual-Process Perspective. *Journal of Management Studies*.
- Barberis, N., & Thaler, R. (2003). A survey of behavioral finance. *Handbook of the Economics of Finance*, 1, 1053-1128.
- 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.
- Bavořár, J., & Mihál, Š. (2019). Decision-making styles and information search-the relationships with need for cognition and curiosity. *Psychology & Its Contexts/Psychologie a Její Kontexty*, 9(2).
- Bazley, W. J., Moore, J., & Vosse, M. M. (2022). Taxing the disposition effect: The impact of tax awareness on investor behavior. *Journal of Financial and Quantitative Analysis*, 57(7), 2724-2765.
- Bergman, O., Ellingsen, T., Johannesson, M., & Svensson, C. (2010). Anchoring and cognitive ability. *Economics Letters*, 107(1), 66-68.
- Boyce, C. J., Wood, A. M., & Ferguson, E. (2016). Individual differences in loss aversion: Conscientiousness predicts how life satisfaction responds to losses versus gains in income. *Personality and Social Psychology Bulletin*, 42(4), 471-484.
- Cacioppo, J. T., Petty, R. E., & Feng Kao, C. (1984). The Efficient Assessment of Need for Cognition. *Journal of Personality Assessment*, 48:3, 306-307, DOI: 10.1207/s15327752jpa4803\_13 .
- Cacioppo, J. T., Petty, R. E., & Morris, K. J. (1983). Effects of need for cognition on message evaluation, recall, and persuasion. *Journal of personality and social psychology*, 45(4), 805.
- Cecchini, M., Bajo, E., Russo, P. M., & Sobrero, M. (2019). Individual differences in the disposition effect. *Journal of Behavioral Finance*, 20(1), 107-126.
- Chang, T. Y., Solomon, D. H., & Westerfield, M. M. (2016). Looking for someone to blame: Delegation, cognitive dissonance, and the disposition effect. *The Journal of Finance*, 71(1), 267-302.



- Cheng, T. Y., Lee, C. I., & Lin, C. H. (2013). An examination of the relationship between the disposition effect and gender, age, the traded security, and bull–bear market conditions. *Journal of Empirical Finance*, 21, 195-213.
- Clarke, I., & Mackaness, W. (2001). Management ‘intuition’: An interpretative account of structure and content of decision schemas using cognitive maps. *Journal of management studies*, 38(2), 147-172.
- Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Academic press.
- Constantinides, G. M. (1983). Capital market equilibrium with personal tax. *Econometrica: Journal of the Econometric Society*, 611-636.
- Costa, P. T., & McCrae, R. R. (1992). Normal personality assessment in clinical practice: The NEO Personality Inventory. *Psychological assessment*, 4(1), 5.
- Da Costa Jr, N., Goulart, M., Cupertino, C., Jr, M., J., & Da Silva, S. (2013). The disposition effect and investor experience. *Journal of Banking & Finance*, 37(5), 1669-1675.
- Dalal, R. S., & Bonaccio, S. (2010). What types of advice do decision-makers prefer? *Organizational Behavior and Human Decision Processes, Volume 112, Issue 1*, 11-23.
- de Ridder, D., Kroese, F., & van Gestel, L. (2022). Nudgeability: Mapping conditions of susceptibility to nudge influence. *Perspectives on Psychological Science*, 17(2), 346-359.
- Del Missier, F., Mäntylä, T., Hansson, P., Bruine de Bruin, W., Parker, A. M., & Nilsson, L. G. (2013). The multifold relationship between memory and decision making: an individual-differences study. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 39(5), 1344.
- Denes-Raj, V., & Epstein, S. (1994). Conflict between intuitive and rational processing: when people behave against their better judgment. *Journal of personality and social psychology*, 66(5), 819.
- Denes-Raj, V., & Epstein, S. (1994). Conflict between intuitive and rational processing: when people behave against their better judgment. *Journal of personality and social psychology*, 66(5), 819.
- Dhar, R., & Zhu, N. (2006). Up close and personal: Investor sophistication and the disposition effect. *Management science*, 52(5), 726-740.
- Donnelly, G., Iyer, R., & Howell, R. T. (2012). The Big Five personality traits, material values, and financial well-being of self-described money managers. *Journal of economic psychology*, 33(6), 1129-1142.
- Driver, M. J., Brousseau, K. R., & Hunsaker, P. L. (1998). The dynamic decision maker: Five decision styles for executive and business success. *IUniverse*.
- Durand, R. B., Newby, R., L., P., & M., S. (2013a). Personality. *Journal of Behavioral Finance*, 14:2, 116-133, DOI: 10.1080/15427560.2013.791294.
- Durand, R., Fung, L., & Limkriangkrai, M. (2019). Myopic loss aversion, personality, and gender. *Journal of Behavioral Finance, Vol. 20 No. 3*, 1-15.
- Durand, R., Newby, R., & Sanghani, J. (2008). An intimate portrait of the individual investor. *Journal of Behavioral Finance, Vol. 9 No. 4*, 193-208.

- Durand, R., Newby, R., Tant, K., & Trepongkaruna, S. (2013b). Overconfidence, overreaction and personality. *Review of Behavioural Finance, Vol. 5 No. 2*, 104-133.
- Epstein, S. (1998). Cognitive-experiential self-theory. *Advanced personality*, 211, 238.
- Epstein, S. (2003). Cognitive-experiential self-theory of personality. *Comprehensive handbook of psychology*, 5, 159-184.
- Epstein, S. (2010). Demystifying intuition: What it is, what it does, and how it does it. *Psychological Inquiry*, 21(4), 295-312.
- Epstein, S., & Pacini, R. (2001). The influence of visualization on intuitive and analytical information processing. *Imagination, Cognition and Personality*, 20(3), 195-216.
- 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.
- Evans, J. S. (2014). Two minds rationality. *Thinking & Reasoning*, 20(2), 129-146.
- Festinger, L. (1962). Cognitive dissonance. *Scientific American*, 207(4), 93-106.
- Fischbacher, U., Hoffmann, G., & Schudy, S. (2017). The causal effect of stop-loss and take-gain orders on the disposition effect. *The Review of Financial Studies*, 30(6), 2110-2129.
- 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 & organization*, 107, 541-552.
- Frydman, C., Barberis, N., Camerer, C., Bossaerts, P., & Rangel, A. (2014). Using neural data to test a theory of investor behavior: An application to realization utility. *The Journal of finance*, 69(2), 907-946.
- Gaeth, G. J., & Shanteau, J. (1984). Reducing the influence of irrelevant information on experienced decision makers. *Organizational Behavior and Human Performance*, 33(2), 263-282.
- Gambetti, E., & Giusberti, F. (2019). Personality, decision-making styles and investments. *Journal of Behavioral and Experimental Economics*, 80, 14–24.
- Gambetti, E., Zucchelli, M., M., Nori, R., & Giusberti, F. (2022). Default rules in investment decision-making: trait anxiety and decision-making styles. *Financial Innovation*, 8(1), 23.
- Goldstein, D. G., & Gigerenzer, G. (2011). The beauty of simple models: Themes in recognition heuristic research. *Judgment and Decision Making*, 6(5), 392-395.
- Greco, A. A., & McClung, C. (1979). Interaction between attention directing and cognitive style. *ECTJ*, 27(2), 97-102.
- Halpern, D. (2015). *Inside the nudge unit: How small changes can make a big difference*. Random House.
- Hamilton, K., Shih, S. I., & Mohammed, S. (2016). The development and validation of the rational and intuitive decision styles scale. *Journal of personality assessment*, 98(5), 523-535.
- Harren, V. A. (1979). A model of career decision making for college students. *Journal of vocational behavior*, 14(2), 119-133.

- Hayes, J., & Allinson, C. W. (1994). Cognitive style and its relevance for management practice. *British journal of management*, 5(1), 53-71.
- Hirshleifer, D. (2015). Behavioral finance. *Annual Review of Financial Economics*, 7, 133-159.
- Hodgkinson, G. P., & Clarke, I. (2007). Conceptual note: Exploring the cognitive significance of organizational strategizing: A dual-process framework and research agenda. *Human Relations*, 60(1), 243-255.
- Ingendahl, M., Hummel, D., Maedche, A., & Vogel, T. (2021). Who can be nudged? Examining nudging effectiveness in the context of need for cognition and need for uniqueness. *Journal of Consumer Behaviour*, 20(2), 324-336.
- Jamal, A. A., Ramlan, W. K., Pazim, K. H., & Budin, D. S. (2014). Decision-making style and investment success of retail investors in Malaysia. *International Journal of Business and Social Science*, 5(9).
- Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. *The Journal of finance*, 48(1), 65-91.
- Jeong, Y., Oh, S., Kang, Y., & Kim, S. H. (2021). Impacts of Visualizations on Decoy Effects. *International Journal of Environmental Research and Public Health*, 18(23), 12674.
- Kahneman, D. (2003). A perspective on judgment and choice: mapping bounded rationality. *American psychologist*, 58(9), 697.
- Kahneman, D. (2011). *Thinking, fast and slow*. macmillan.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2), 263-292.
- Kaufmann, L., Wagner, C. M., & Carter, C. R. (2017). Individual modes and patterns of rational and intuitive decision-making by purchasing managers. *Journal of Purchasing and Supply Management*, 23(2), 82-93.
- Klein, G. (2008). Naturalistic decision making. *Human factors*, 50(3), 456-460.
- Knobloch-Westerwick, S., Mothes, C., & Polavin, N. (2020). Confirmation bias, ingroup bias, and negativity bias in selective exposure to political information. *Communication Research*, 47(1), 104-124.
- König, L. M., Sproesser, G., Schupp, H. T., & Renner, B. (2018). Describing the process of adopting nutrition and fitness apps: behavior stage model approach. *JMIR mHealth and uHealth*, 6(3), e8261.
- Kozhevnikov, M. (2007). Cognitive styles in the context of modern psychology: toward an integrated framework of cognitive style. *Psychological bulletin*, 133(3), 464.
- Kuo, J. C., Horng, D. J., Lin, C. L., & Lee, S. H. (2012). The causal relationship between need for cognition and advertising recall. *Social Behavior and Personality: an international journal*, 40(6), 1025-1032.

- Kuo, M. H., Chen, S. K., & Chen, S. S. (2013). How to lessen the disposition effect? It pays to study before investing. *Advances in Business and Management Forecasting (Vol. 9, pp. 77-90)*, Emerald Group Publishing Limited.
- Larrick, R. P. (2004). Debiasing. *Blackwell handbook of judgment and decision making*, 316-338.
- Lassiter, G. D., Briggs, M. A., & Slaw, R. D. (1991). Need for cognition, causal processing, and memory for behavior. *Personality and Social Psychology Bulletin*, 17(6), 694-700.
- Lin, C. H., Yen, H. R., & Chuang, S. C. (2006). The effects of emotion and need for cognition on consumer choice involving risk. *Marketing Letters*, 17, 47-60.
- Lin, H., & Lu, H. (2015). Elucidating the association of sports lottery bettors' socio-demographics, personality traits, risk tolerance and behavioural biases. *Personality and Individual Differences, Volume 73*, 118-126, ISSN 0191-8869.
- Lin, Y., Osman, M., & Ashcroft, R. (2017). Nudge: concept, effectiveness, and ethics. *Basic and Applied Social Psychology*, 39(6), 293-306.
- Louis, M. R., & Sutton, R. I. (1991). Switching cognitive gears: From habits of mind to active thinking. *Human relations*, 44(1), 55-76.
- Maier, M., Bartoš, F., Stanley, T. D., Shanks, D. R., Harris, A. J., & Wagenmakers, E. J. (2022). No evidence for nudging after adjusting for publication bias. *Proceedings of the National Academy of Sciences*, (pp. 119(31), e2200300119).
- Malkin, N., Mathur, A., Harbach, M., & Egelman, S. (2017, April). Personalized security messaging: Nudges for compliance with browser warnings. *2nd european workshop on usable security. internet society*.
- Mills, S. (2020). A Theory of Personalised Nudging: Integrating Heterogeneity and Behavioural Science into Political Decision-Making. *Doctoral dissertation, Manchester Metropolitan University*.
- Mills, S. (2022). Personalized nudging. *Behavioural Public Policy*, 6(1), 150-159.
- Morewedge, C. K., & Kahneman, D. (2010). Associative processes in intuitive judgment. *Trends in cognitive sciences*, 14(10), 435-440.
- Muhammad, N. M., & Abdullah, M. (2009). Investment decision-making style: Are Malaysian investors rational decision makers. *Interdisciplinary Journal of Contemporary Research in Business*, 1(3), 96-108.
- Nygren, T. E., & White, R. J. (2002). Assessing individual differences in decision making styles: Analytical vs. intuitive. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (pp. Vol. 46, No. 12, pp. 953-957). Sage CA: Los Angeles: CA: SAGE Publications.
- Odean, T. (1998). Are investors reluctant to realize their losses? *The Journal of finance*, 53(5), 1775-1798.
- Pacini, R., & Epstein, S. (1999). Rational-Experiential Inventory--Revised. *Journal of personality and social psychology*.

- Patterson, F. M., & Daigler, R. T. (2014). The abnormal psychology of investment performance. *Review of financial economics*, 23(2), 55-63.
- Peer, E., Egelman, S., Harbach, M., Malkin, N., Mathur, A., & Frik, A. (2020). Nudge me right: Personalizing online security nudges to people's decision-making styles. *Computers in Human Behavior*, 109, 106347.
- Peltier, J. W., & Schibrowsky, J. A. (1994). Need for cognition, advertisement viewing time and memory for advertising stimuli. *ACR North American Advances*.
- Pilli, L. E., & Mazzon, J. A. (2016). Information overload, choice deferral, and moderating role of need for cognition: Empirical evidence. *Revista de Administração (São Paulo)*, 51, 36-55.
- Pleßner, M. (2017). The disposition effect: a survey. *Management Review Quarterly*, 67(1), 1-30.
- Qu, L., Xiao, R., Shi, W., Huang, K., Qin, B., & Liang, B. (2022). Your Behaviors Reveal What You Need: A Practical Scheme Based on User Behaviors for Personalized Security Nudges. *Computers & Security*, 122, 102891.
- Rabinovitch, H., Bereby-Meyer, Y., & Budescu, D. V. (2022). To deliberate or not? The role of intuition and deliberation when controlling for irrelevant information in selection decisions. *Cognition*, 225, 105105.
- Rau, H. A. (2014). The disposition effect and loss aversion: Do gender differences matter? *Economics Letters*, 123(1), 33-36.
- Riaz, M. N., Riaz, M. A., & Batool, N. (2012). Personality Types as Predictors of Decision Making Styles. *Journal of Behavioural Sciences*, 22(2).
- Richards, D. W., Fenton-O'Creevy, M., Rutterford, J., & Kodwani, D. G. (2018). 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*, 66, 79-92.
- Riding, R. J., Grimley, M., Dahraei, H., & Banner, G. (2003). Cognitive style, working memory and learning behaviour and attainment in school subjects. *British Journal of Educational Psychology*, 73(2), 149-169.
- Riley Jr, W. B., & Chow, K. V. (1992). Asset allocation and individual risk aversion. *Financial analysts journal*, 48(6), 32-37.
- Rubaltelli, E., Rubichi, S., Savadori, L., Tedeschi, M., & Ferretti, R. (2005). Numerical information format and investment decisions: Implications for the disposition effect and the status quo bias. *The Journal of Behavioral Finance*, 6(1), 19-26.
- Salas, E., Rosen, M. A., & DiazGranados, D. (2010). Expertise-based intuition and decision making in organizations. *Journal of management*, 36(4), 941-973.
- Schöning, C., Matt, C., & Hess, T. (2019). Personalised nudging for more data disclosure? On the adaptation of data usage policies format to cognitive styles. *52nd Hawaii International Conference on System Sciences*.

- Scott, S. G., & Bruce, R. A. (1995). Decision-making style: The development and assessment of a new measure. *Educational and psychological measurement*, 55(5), 818-831.
- Scott, S. G., & Bruce, R. A. (1995). Decision-making style: The development and assessment of a new measure. *Educational and psychological measurement*, 55(5), 818-831.
- Shapira, Z., & Venezia, I. (2001). Patterns of behavior of professionally managed and independent investors. *Journal of Banking & Finance*, 25(8), 1573-1587.
- 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.
- Shiloh, S., Salton, E., & Sharabi, D. (2002). Individual differences in rational and intuitive thinking styles as predictors of heuristic responses and framing effects. *Personality and Individual Differences*, 32(3), 415-429.
- Shu, S. (2018). Debias human judgment with a common decision bias: an experimental study of the anchoring effect in hiring decision-making. *Doctoral dissertation, University of Minnesota*.
- Shumway, T., & Wu, G. (2005, March). Does disposition drive momentum? *In AFA 2006 Boston meetings paper*.
- Smith, S. M., & Levin, I. P. (1996). Need for cognition and choice framing effects. *Journal of Behavioral Decision Making*, 9(4), 283-290.
- Soll, J. B., Milkman, K. L., & Payne, J. W. (2015). Outsmart your own biases. *Harvard business review*, 93(5), 64-71.
- Staw, B. M. (1997). The escalation of commitment: An update and appraisal. *Organizational decision making*, 191, 215.
- Summers, B., & Duxbury, D. (2012). Decision-dependent emotions and behavioral anomalies. *Organizational Behavior and Human Decision Processes*, 118(2), 226-238.
- Sunstein, C. R. (2014). Nudging: a very short guide. *Journal of Consumer Policy*, 37, 583-588.
- Sunstein, C. R. (2022). The distributional effects of nudges. *Nature human behaviour*, 6(1), 9-10.
- Tang, S., Huang, S., Zhu, J., Huang, R., Tang, Z., & Hu, J. (2019). Financial self-efficacy and disposition effect in investors: The mediating role of versatile cognitive style. *Frontiers in Psychology*, 9, 2705.
- Taufik, D., Bouwman, E. P., Reinders, M. J., & Dagevos, H. (2022). A reversal of defaults: Implementing a menu-based default nudge to promote out-of-home consumer adoption of plant-based meat alternatives. *Appetite*, 175, 106049.
- Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. Yale University Press.
- Thompson, E. P., Chaiken, S., & Hazlewood, J. D. (1993). Need for cognition and desire for control as moderators of extrinsic reward effects: A person  $\times$  situation approach to the study of intrinsic motivation. *Journal of Personality and Social Psychology*, 64(6), 987.
- Thunholm, P. (2004). Decision-making style: habit, style or both? *Personality and individual differences*, 36(4), 931-944.

- van der Molen, A. E., Hoenink, J. C., Mackenbach, J. D., Waterlander, W., Lakerveld, J., & Beulens, J. W. (2021). Are nudging and pricing strategies on food purchasing behaviors equally effective for all? Secondary analyses from the Supreme Nudge virtual supermarket study. . *Appetite*, ., 167, 105655.
- Wang, Y., Highhouse, S., Lake, C. J., Petersen, N. L., & Rada, T. B. (2017). Meta-analytic investigations of the relation between intuition and analysis. *Journal of Behavioral Decision Making*, 30(1), 15-25.
- Warberg, L., Acquisti, A., & Sicker, D. (2019, November). Can Privacy Nudges be Tailored to Individuals' Decision Making and Personality Traits? *Proceedings of the 18th ACM Workshop on Privacy in the Electronic Society*, (pp. pp. 175-197).
- Weber, M., & Camerer, C. F. (1998). The disposition effect in securities trading: An experimental analysis. *Journal of Economic Behavior & Organization*, 33(2), 167-184.
- Weber, M., & Camerer, C. F. (1998). The disposition effect in securities trading: An experimental analysis. *Journal of Economic Behavior & Organization*, 33(2), 167-184.
- Welsh, M. B., Delfabbro, P. H., Burns, N. R., & Begg, S. H. (2014). Individual differences in anchoring: Traits and experience. *Learning and Individual Differences*, 29, 131-140.
- Wensing, J., Caputo, V., Carraresi, L., & Bröring, S. (2020). The effects of green nudges on consumer valuation of bio-based plastic packaging. *Ecological Economics*, 178, 106783.
- Wolfradt, U., Oubaid, V., Straube, E. R., Bischoff, N., & Mischo, J. (1999). Thinking styles, schizotypal traits and anomalous experiences. *Personality and Individual Differences*, 27(5), 821-830.
- Wong, K. F., Kwong, J. Y., & Ng, C. K. (2008). When thinking rationally increases biases: The role of rational thinking style in escalation of commitment. *Applied Psychology*, 57(2), 246-271.
- Young, L. (2015). Is experiential-intuitive cognitive style more inclined to conjunction fallacy than analytical-rational cognitive style. *Frontiers in Psychology*, 6, 1-8.

# APPENDIX

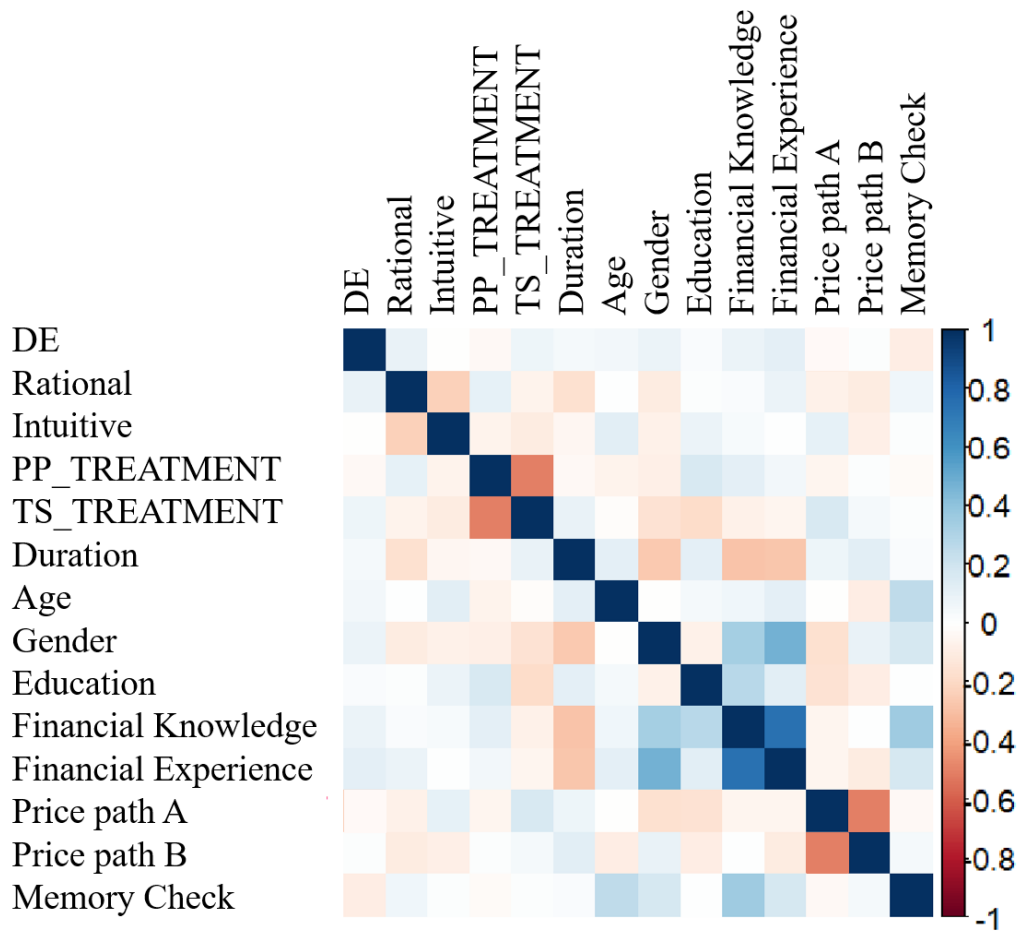
## A. Detailed description of experimental variables

| Variables definition   |   |
|------------------------|---|
| Key Variables          | Definition  |
| DE                     | Disposition effect, measured as difference between proportion of gains realized and proportion of losses realized (PGR-PLR). Has a range of values going from +1 (maximum disposition effect) to -1 (opposite of disposition effect).         |
| PP_TREATMENT           | Equal to 1 if subject was randomly selected into the Purchase Price Saliency Treatment, and 0 otherwise. Subjects randomly selected into this treatment will not be able see the purchase price of the stock and the gain or loss associated. |
| TS_TREATMENT           | Equal to 1 if subject was randomly selected into the Tax Saliency Treatment, and 0 otherwise. Subjects randomly selected into this treatment will be shown tax implications of selling on the trading screen.                                 |
| Intuitive              | The intuitive decision style score. It is a score obtained by computing the average of all the scores on the 5 intuitive items of the 5 point-Likert RIDSS scale. This score can range from 1 (minimum) to 5 (maximum).                       |
| Rational               | The rational decision style score. It is a score obtained by computing the average of all the scores on the 5 rational items of the 5 point-Likert RIDSS scale. This score can range from 1 (minimum) to 5 (maximum).                         |
| Explanatory variables  | Definition  |
| User language: Italian | Equal to 1 if subject conducted the experiment in Italian, and 0 if in English. These were the only two available languages for the experiment.   |
| Gender                 | Gender categorical value, divided in “male”, “female”, “non-binary” and “rather not say”.   |
| Education              | Highest educational qualifications, divided in, from lowest to highest, “Less than high school”, “High school graduate”, “College/Bachelor’s degree”, “Master’s degree”, “Doctorate”.   |
| Financial Knowledge    | Self-assessed financial knowledge, divided into, from lowest to highest, “Limited”, “Basic”, “Moderate”, “Advanced”.  |
| Financial Experience   | Self-assessed financial experience, divided into, from lowest to highest, “None”, “Limited”, “Moderate”, “Extensive”.   |
| Memory check           | Equal to 1 if the subject correctly identified the right percentage of tax implications of selling among three provided options, and 0 otherwise.   |
| Financial literacy     | Financial literacy measure, obtained by combining self-assessed financial knowledge and self-assessed financial experience into a single ordinal measure.   |

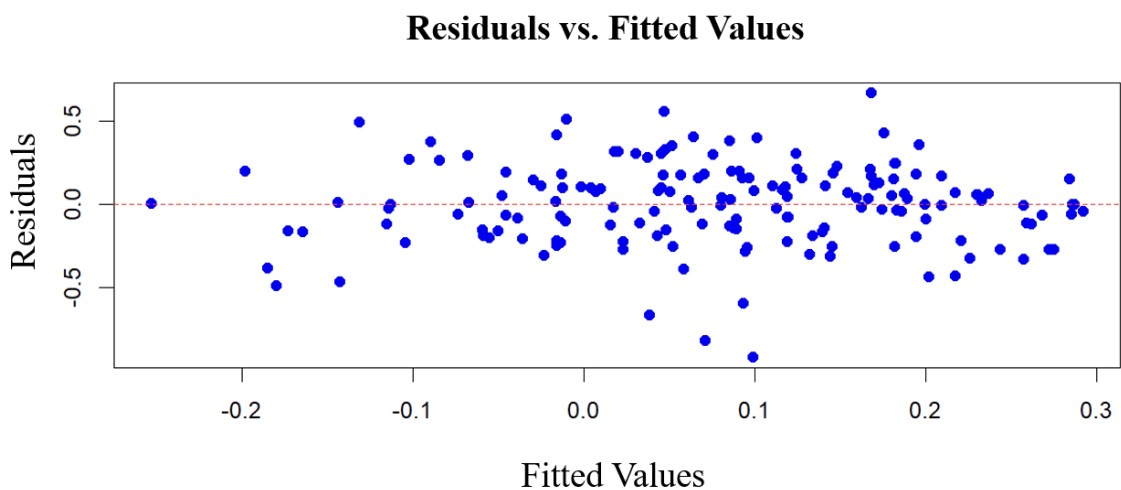


|                             |   |
|-----------------------------|---|
| Purchase price importance   | Self-assessed perceived importance of purchase price in trading decision, divided into 5 points scale, going from “not impactful at all” to “extremely impactful”.                    |
| Tax implications importance | Self-assessed perceived importance of tax implications in trading decision, divided into 5 points scale, going from “not impactful at all” to “extremely impactful”.                  |
| Duration (in seconds)       | Time (in seconds) spent by the subject to complete the survey.  |
| Price path A                | Equal to 1 if the subject was randomly assigned to the experimental trading setting with stock fluctuations based on pre-generated scenario A, and 0 if assigned to scenarios B or C. |
| Price path B                | Equal to 1 if the subject was randomly assigned to the experimental trading setting with stock fluctuations based on pre-generated scenario B, and 0 if assigned to scenarios A or C. |

---



**Fig. 7.** Heatmap displaying correlations between experimental variables. Shades of blue indicate positive correlations, while shades of red indicate negative correlations. Intensity of colour corresponds directly to the strength of the correlation. Variables names are labelled along the x and y axes for reference.



**Fig. 8.** Scatterplot of residuals against fitted values. Each point represents the difference between the observed value and its predicted value for every observation. The random distribution of points around the dotted line confirms that the homoscedasticity assumption was not violated.

## B. Items from the Rational and Intuitive Decision Styles Scale (RIDSS)

### Rational items

1. I prefer to gather all the necessary information before committing to a decision.
2. I thoroughly evaluate decision alternatives before making a final choice.
3. In decision making, I take time to contemplate the pros/cons or risks/benefits of a situation.
4. Investigating the facts is an important part of my decision-making process.
5. I weigh a number of different factors when making decisions.

### Intuitive items

1. When making decisions, I rely mainly on my gut feelings.
2. My initial hunch about decisions is generally what I follow.
3. I make decisions based on intuition.
4. I rely on my first impressions when making decisions.
5. I weigh feelings more than analysis in making decisions.

The figure displays two side-by-side screenshots of a questionnaire interface. The left screenshot is a desktop view, and the right is a mobile view. Both screens show a Likert scale for the item: "I thoroughly evaluate decision alternatives before making a final choice." The desktop version shows five response options: "Strongly agree" (selected), "Strongly disagree", "Somewhat disagree", "Neither agree nor disagree", and "Strongly agree". The mobile version shows the same item and options, with "Somewhat agree" selected. The mobile screen also shows a time of 12:29 and signal strength indicators at the top.

**Fig. 9.** Example screens of questionnaire administering RIDSS on desktop (left) and on mobile (right)

### C. Instructions for the experimental trading game

Welcome to the experimental trading game!

In this game, you will have 350 experimental dollars to invest in three different stocks. Your objective is to maximize your after-tax earnings by choosing the best times to buy and sell each stock. Here are the rules for the game:

- 1) *Initial Portfolio*: **You will start with 1 share each** of Stock A, Stock B, and Stock C. Each share has an initial value of **\$100**. Additionally, you will have **\$50 in cash**.
- 2) *Trading Restrictions*: Throughout the experiment, **you can only hold either 1 share or 0 shares of each stock**. The remaining portion of your portfolio will be held in cash.
- 3) *Tax Implications*: When you sell a stock, the cash you receive will be adjusted for tax implications. If you sell a stock that has increased in value, a **capital gains tax of 15%** will be charged **on the profit**. If you sell a stock that has declined in value, the **cash loss** will be **reduced by 15%**.
- 4) *Price History Session*: Firstly, you will be shown the price history for Stock A, Stock B, and Stock C over the **past nine periods**. During this session, you will only be shown a **price update** for a randomly selected stock, but won't be able to trade it.
- 5) *Trading Sessions*: Following the price history presentation, you will have **fifteen trading sessions**. Now, **after receiving the price update**, you will have the opportunity to **trade the stock**.
- 6) *Trading Decisions*: Based on the information provided, you can decide whether to **buy** or **sell** shares of the selected stock. Remember, **you can only hold 1 share or 0 shares of each stock**, and don't forget about the **tax implications** of selling!
- 7) *How the stock prices change*: Each stock is either in a **good state** or in a **bad state**. In the good state, the stock goes up with 70% chance, and it goes down with 30% chance. In the bad state, the stock goes down with 70% chance and it goes up with 30% chance. The **size of the change is always random**, and will either be \$5, \$10, or \$15. For example, in the bad state, the stock will go down with 70% chance, and the amount it goes down by is \$5, \$10, or \$15 with equal chance.  
The stocks will all randomly start in either the good state or bad state, and after each price update, there is a **20% chance the stock switches state**. Therefore, it is highly likely (80%) for the stock to remain in the same state for the next price update.

Your goal is to strategically buy and sell stocks to maximize the total value of your portfolio by the end of the experiment. Good luck, and have fun trading!

English ▾

Before we proceed, please answer the following question:  
 When you sell a stock that has increased in value, what percentage of capital gains tax is charged on the profit?

15%

25%

35%

→

**Fig. 10.** Example screen of the memory check, which asks participants to select the correct percentage to which the tax consequences of selling amount from among the three provided options. This question was asked midway through the trading sessions.

Great job! You have successfully completed your final trading session. Before we proceed to review your results, we kindly request that you answer a couple of final questions:

How much did the purchase price of a stock, and whether you were at a loss or profit, influence your decision to sell it during the trading game?

Not impactful at all

Slightly impactful

Moderately impactful

Very impactful

Extremely impactful

How much did the tax implications of selling at a profit or at a loss influence your decision to sell a stock during the trading game?

Not impactful at all

Slightly impactful

Moderately impactful

Very impactful

Extremely impactful

How much did the tax implications of selling at a profit or at a loss influence your decision to sell a stock during the trading game?

→

**Fig. 11.** Example screens of the two questions that assess the perceived importance of the purchase price (left) and the tax implications of selling (right) on trading decisions.