Social Investing, Ethical Mind-sets, and Nudges: A Neuro-economic Investigation

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Abstract

With the advent of social and impact investing in the financial markets, investment choices have become increasingly complex. Investors often consider a wide range of social factors, in addition to financial return, when making their financial decisions. Pilaj (2017) has called for increased focus on testing these mixed financial and social motives of investors, and whether nudges can be effective in nudging investors towards social investments. Motivated by this call, we draw upon lessons from behavioural economics (and in particular, social preference theory) in order to develop neuro-economic tests of investors’ social and financial mind-sets. We focus on two main research questions: a) How heterogeneous are (social-) investors, in terms of the unconscious weightings that they place upon financial and social returns? Can investors’ mind-sets be placed upon a continuum from focussing on social returns, through mixed motivations/weightings, through to focussing on financial returns? b) Can investors be nudged along this financial-social continuum?

Our neuro-experiments provide affirmative answers to these two questions. We thus provide policy implications regarding nudges towards social investment. Practically, we suggest the development of a phone application that integrates real-time stock-tracking with nudges in order to inspire socially responsible investing; banks would play a key role in encouraging its download. Nudges can help to overcome the conflict between social and financial returns.

1. Introduction

Investing into financial markets, and into entrepreneurship, has become increasingly complex in recent years. There are many investment vehicles, and a mixture of investment motives. Furthermore, with the rapidly growing areas of social and impact investing, social enterprise/social entrepreneurship, and social innovation in finance, scholars and practitioners recognise that
investors and entrepreneurs often consider a wide range of social factors, in addition to financial return, when making their financial decisions.

In considering their investments, “social investors”, such as social banks, social venture capitalists, philanthropists, and charities, consider both the financial return and the “social impact” of their investments (for example, impact on the local community, job-creation, environmental and ethical effects). There is much evidence that social investors are prepared to pay a price premium, and hence accept a lower financial return, to invest into enterprises or companies that can demonstrate positive social impact.

Since investment into (social-) entrepreneurial ventures can drive economic growth, and create social, sustainable and ethical impact, it is important to understand the complex economic and behavioural/psychological factors affecting social investors’ decision-making. We can draw upon studies in behavioural economics (and particularly the study of social preferences, such as altruism, fairness, trust, empathy, ‘warm-glow’ emotions), combined with lessons from neuro-economics, which examines brain- and physiological activity when people are making decisions, in order to consider the relative importance of rational deliberation, cognition and emotion in decision-making: in short, to attempt to understand social investors’ mind-sets. In this paper, we are particularly interested in two main research questions: a) How heterogeneous are (social-) investors, in terms of the unconscious weightings they place upon financial and social returns? Can investors’ mindsets be placed upon a continuum, ranging from almost entirely focussing on financial returns, through mixed motivations/weightings on financial and social returns of an investment, to almost entirely focussing on social returns? b.) If we can place investors on this financial/social returns continuum, is this then fixed by each investor’s nature, or can they be nudged along the continuum towards more social or more financial investments?

In this paper, we approach these two research questions using neuro-economic experimental methods. Particularly, we develop and run two separate but related neuro-economic experiments, the first of which focuses on the first research question regarding the nature of investors’ mind-sets along the social-financial continuum. We test for participants’ levels of focus on social versus financial goals. All of our participants are from the social investing arena, and yet we find a great deal of variation in their levels of social versus financial motivations.

Our second neuro-economic experiment develops the first experiment, in order to focus on the second research question, by considering whether we can nudge individuals along the financial-social continuum to influence their investment behaviour. This second experiment has the features
of the first experiment, but with the addition of the nudges. In contrast to the first experiment, the second experiment is conducted with students as the subjects. Our intention is to roll the nudge experiment out to real-world social investors.

**Lessons from Behavioural and Neuro-economics**

Our work is motivated by the seminal paper of Pilaj (2017). He considers investors’ complex motives (financial/social/ethical), and applies insights from behavioural economics in order to consider whether nudges may be effective in pushing investors towards social investing. Pilaj focuses on behavioural barriers to social investing. Thus, he draws on the work of Thaler (2000), who considers the gap between human intentions and actual human behaviour: humans do not always act as they intend to do. This is due to bounded rationality, cognitive biases, limited attention, complexity, myopia, impulsive behaviour, procrastination.

Thus, Pilaj (2017) argues that behavioural economics demonstrates that humans often make errors in their decision-making. Drawing on this insight, he argues that investors may face behavioural barriers to social investing: they may have latent intentions to make social/ethical investments. However, due to these barriers, their intentions are not translated into actions.

Hence, Pilaj suggests that nudges towards social investing should be designed to overcome these barriers. He develops a 5A framework based around cognitive limitations (activation, awareness, attitude, action, adjustment). He argues that investors are subject to limited attention and information overload: in making their investment decisions, they are often faced with great complexity. In the spirit of Thaler, Pilaj states, “If you want to encourage investors to engage in SRI, make it easy for them.” Hence, his analysis of behavioural economics leads Pilaj to argue for simplification in the investment advice process. He suggests that the inclusion of the following single SRI question in the ‘investment advisory protocol’ may be sufficient: “In addition to financial success, are you also concerned about the social and environmental performance of your investments?” He notes that this ties in with the current MiFID EU-directive that requires financial intermediaries to align investors’ portfolios with their level of risk tolerance. He asks whether it should also become standard
procedure to align portfolios with investors’ non-financial (such as social and ethical) objectives too.

To emphasise, Pilaj uses the behavioural economics analysis of psychological and cognitive barriers to social investing and analyses nudges that overcome these barriers: thus, he assumes that the intention to invest socially exists within the investor, but just needs encouraging. However, he does note that “given the wide range of behavioural biases, there is clearly more than one way to improve the choice architecture of SRI.”

In contrast to Pilaj, we focus on the social preference approach within behavioural economics. Rather than considering the intention-action gap and behavioural errors, we focus on the ‘social-preference architecture’ of the investor’s mind-set itself. We focus on two main research questions: a) How heterogeneous are (social-) investors, in terms of the unconscious weightings that they place upon financial and social returns? Can investors’ mind-sets be placed upon a continuum from focussing on social returns, through mixed motivations/weightings, through to focussing on financial returns? b) Can investors be nudged along this continuum? Thus, our approach is subtly different to Pilaj: Pilaj’s nudge (the financial advisor’s question about social investing) is designed to overcome the investor’s cognitive barriers and errors, and bridge the intention-action gap. Our approach is about nudging to ‘shift’ the investors’ fundamental preferences towards social/ethical investments.

Social Mindsets: fixed or context-driven?

In this section, we draw upon lessons from behavioural economics/social preference theory relating to our first research question: whether humans are naturally diverse in their financial/social considerations, thus existing along a financial/social ‘continuum’. That is, we consider the social preference literature that investigates the complex and heterogeneous mix of financial and non-financial/ behavioural/ emotional/ psychological motives in human decision-making.

The standard economics approach focuses on homo economicus: a perfect agent who is a fully rational, self-interested, emotionless, maximiser of expected utility, with stable preferences. In contrast, behavioural economics/finance examines the activities of homo sapiens: a real-world human being, who is boundedly rational, suffering from psychological biases and heuristics, not fully self-interested, emotional, with unstable and inconsistent
preferences. In contrast to Pliaj (2017), who considers social-investment nudges in the light of the first ‘ingredients’ (bounded rationality, psychological biases and heuristics), we focus on the non self-interested and emotional nature of humans. Benabou and Tirole (BT 2009) consider the motivations for individual and corporate social responsibility. They find that there may be a mix of motivations. As they note: “Many people give to charities, invest in socially responsible funds, supply their blood, or give their time and sometimes even their lives for good causes. Such prosocial behaviours obey a complex mix of interdependent motivations.”

BT note the following motives:

a) **Genuine intrinsic (pure) altruism**: “to varying degrees, we all aspire to do good and help.”

b) **Material Incentives**: “We are more likely to give to charities if contributions are tax-deductible.”

c) **Social and self-esteem concerns**: “Our conduct defines what kind of person we are, in the eyes of others, and, no less importantly, in our own eyes.”

In contrast to genuine (pure) altruism, scholars have developed ‘Warm Glow’ theories (Andreoni 1989; 1990), whereby humans gain emotionally warm feelings from performing helpful and charitable acts for their fellows.

BT differentiate between two types of motivation for prosocial behaviour: **intrinsic** and **extrinsic** incentives. The former relates to non-financial, social feelings and emotions, such as genuine altruism, warm-glow, conscience, and ethicality. The latter relates to financial, economic and self-interested incentives. Thus, in our neuro-experiment, when considering investors along the continuum from financial to social mind-sets, we may consider this as extrinsic versus intrinsic motivation.

In a series of papers, Fehr and Schmidt (FS: XXX, YYY, ZZZ) developed a seminal theoretical and experimental approach to fairness: inequity-aversion. This approach incorporates both narrow self-interest, and ‘other-regarding’ preferences. FS model this as follows: the individual’s utility function equals her personal financial payoff plus a weighting that she places on interpersonal comparisons of wealth between her and her fellows (the fairness
component). In FS’s approach, people have fairness types (that is, fairness is a characteristic, like colour of eyes, height etc). The fairness type is reflected in the weighting that the individual places on fairness/interpersonal comparisons. Indeed, Fehr and Schmidt provide evidence that approximately 40% of a society’s population may be fair-minded, while the remaining 60% are self-interested. Thus, this approach may be considered as supporting our first hypothesis; that individuals have intrinsic and heterogeneous socially-minded characteristics.

In contrast to the work that assumes that people have intrinsic fairness or self-interested types, in recent research, it is argued that pro-social behaviour may be context- and culture-specific. Further research in this direction examines the effect of social norms of fairness and trust.

In a further departure from Fehr and Schmidt’s view that people have social preference-types, David Sally (2001; 2002) develops a game-theoretic model in which players’ empathy towards each other is context-specific. This approach suggests that the social preferences of individuals are not fixed. Humans can be very self-interested in some situations, and very charitable, altruistic, fair-minded in others, and, indeed, the context and frame may affect these preferences. Indeed, Kirman and Teschl (2010) consider the debate on whether social preferences are inherent to, and fixed within, individual-types, and thus heterogeneous across the population, or whether social preferences/empathy levels are context specific: their public goods experiments support the latter. This opens the way for our second experiment, analysing whether people’s mind-sets can be nudged along the social-financial continuum, affecting their investment behaviour.

**Social Preferences and Social Investing**

It is important to consider both the mind-set of (social)-investors, and the efficacy of nudges towards social investing. This is an important and growing area of financial market activity, and has the capability of driving economic, sustainable, ethical growth, and providing great social impact. Several actors exist in the social investing arena. Investment into (social-) entrepreneurship may come from social banks, social/impact investors (both at the institutional and individual retail investor level)/social venture capitalists and others.
To highlight the complex mix of motivations (thus providing a justification for our neuro-experiments), we focus on the role of social banks in this literature review. We gain some in-depth understanding of this role by focusing on the papers of Cornee (2014), Cornee and Szafarz (2012; 2014), and Cornee et al (2012; 2015).

Cornee et al (2012), and Cornee and Szafarz (2014), compare social banks’ and standard banks’ loans to entrepreneurs and enterprises, in terms of loan structure (loan rate, size of loan), performance of loan (levels of default versus repayment), and loan forgiveness by the banks. They further examine the type of enterprises and entrepreneurs that the two types of banks lend to. Generally, they find that social banks tend to lend to social and ethical businesses. Furthermore, they find that “social bankers exhibit a higher probability of granting a loan and make fairer credit offers to borrowers.” (2012). Further, these authors examine a French social bank (2013), and find that a) “the bank charges below market interest rates for social projects,” and b) “motivated borrowers respond to advantageous credit terms by significantly lowering their probability of default.” Cornee et al interpret this outcome as ‘evidence of reciprocity in the credit market.’ They appeal to social preference theory, and social identity theory (Akerlof and Kranton 2000). Their empirical research supports the game-theoretic model of Barigozzi and Tedeschi (2011), in which the credit market is segregated, with social (standard) banks lending to social/ethical (standard) entrepreneurs (Barigozzi and Tedeschi employ the terms motivated and unmotivated borrowers respectively).1

At the individual level, we have already noted that Pilaj (2017) argues that there may be behavioural barriers impeding individuals’ social investing. Furthermore, Hoffmann et al (2008) argue that the increasing demand for socially responsible investment suggests that investment decisions are influenced by both financial and moral considerations. These authors compare several models (multiple attribute utility theory, theory of planned behavior, and an issue-contingent model of ethical decision-making) that may explain this phenomenon. Nilsson (2008) examines the impact of a number of pro-social, financial performance, and socio-demographic variables on the amount of SRI investments within investors’ portfolios. Glac (2008) analyses the importance of decision-frames in nudging

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social investment. Girerd-Potin et al (2014) analyse the dimensions of social responsibility which are of concern to financial investors. Finally, Doskeland and Pedersen (2018) analyse a field experiment where the frame of the responsible investment affects investors’ decision-making (fittingly, the authors consider “Investing with Brain or Heart?”).

In summary, investors, such as standard versus social banks, as well as individual retail investors, exhibit a complex mix of economic and social motivations in their decision-making. It may, therefore, be important for behavioural finance scholars to develop psychological and neuro-economics experiments and approaches to understanding investors’ complex financial and social motives. This motivates our experiments in this paper.

**Neuro-economics, nudges and social investing**

Economics has long considered that people make financial decisions based on rationality and calculation, seeking to maximise self-interest (Renneboog, Ter Horst & Zhang, 2008a). This reflects the Expected Utility Model (EUM), which posits that choices are weighted by their objective value and probability of the best outcome (Von Neumann & Morgenstern, 1947). According to this account, prices in financial markets reveal all the available information needed for optimal investment decisions (Fama, 1991).

However, neuroeconomics, a field that integrates economics and psychology, has demonstrated that decisions are influenced by emotional and cognitive biases. As Kuhnen and Knutson (2011) illustrate, the valence (positive or negative value) of emotions felt whilst investing have a predictive influence on decisions: positive emotions (e.g. pride) stimulated more risk-taking and confidence in choice evaluations, whereas negative emotions (e.g. guilt) induced the opposite reactions. Rubaltelli, Agnoli and Franchin (2016) argue that investors exploit these emotional reactions to ascribe meaning to stocks and reduce anxiety about how their money is invested, basing choices on what stimulates the most positive feelings. Consequently, suboptimal decisions are frequently made by investors, as Fairchild, Hinvest and Alsharman (2016) show. Using galvanic skin response data, they discovered that high levels of emotion are detrimental to performance in a game-simulated bear
market, where share prices fall and selling stocks are encouraged. Combined with high risk-aversion (measured through bespoke questionnaires), it does so by leading to paralysis and holding onto depleting shares. This interconnection was observed when comparing the non-linear relationships of performance with either measure; emotion and risk-aversion effected performance similarly, with optimal levels existing for both.

These findings are true within conventional financial markets where investment decisions are usually led by the goal of increasing financial capital. However, recently there has been a rising pressure for companies to adopt corporate social responsibility, in that they foster social, ethical and environmental issues beyond their legal requirements (Barnea & Rubin, 2010). This has led to a shift in the market, where investors have been adopting more socially responsible investment strategies. Socially responsible investing is an investment process that assesses corporate responsiveness to social issues (Kinder, 2005). Kroll and Egan (2004) demonstrated that people display a formidable emotional sensitivity towards moral deeds, such that actions like CSR could induce emotions that motivate investors to carry out prosocial actions and evade those considered negative. However, investors are met with a conflict between personal values and risk-reward optimization when making investment decisions, as maximizing financial capital for oneself is not always compatible with increasing social capital for others (Renneboog, Ter Horst & Zhang, 2008b). Folbre (2001) speculates that emotions derived from interpersonal relationships, such as empathy (perspective-taking) and sympathy (concerns for others’ misfortunes), are the driving force of this conflict. This is made prominent by the tendency of stock markets to undervalue CSR (Orlitzky, Schmidt & Rynes, 2003). This brings to question whether investors truly forego immediate financial rewards for the welfare of others. Little research has looked explicitly at decision-making processes involved in investments characterised by this conflict.
To alleviate this issue, the use of psychological nudges can help to ensure more socially responsible investments. Nudges, a concept introduced by Thaler and Sunstein (2008), are “choice architecture that alters people’s behaviour in a predictable way without forbidding any options or significantly changing their economic incentives” (p.6). This is achieved through indirect suggestions and presenting information in diverse ways. There have been many successful examples of nudges in the finance domain, including Thaler and Benartzi’s (2004) Save More Tomorrow (SMarT) Program. Over the course of the program, they increased employee savings rates by 10% through default choice adjustments (increasing rates yearly and automatically transferring money into their savings account). This occurred because the cause of the problem was used as the solution; employee inertia caused postponed saving but this inclination also resulted in few opting out of the program even as default rates increased. Moreover, in the social domain, Burt and Strongman (2005) varied the emotional intensity in images of people for charity donation advertising. They found that negative emotions in images nudged individuals to make larger monetary donations than positive emotions due to stronger intensities of empathy and sympathy felt. However, both studies only examined when individuals were guided by one goal, either financial or social, but no research has examined when these goals conflict. Furthermore, the use of nudges for socially responsible investments has not been investigated before. This may have emanated from the argument that collectively beneficial nudges are unethical because they incur personal cost and eliminate freedom of choice (Raihani, 2013). Yet, Pilaj (2015) asserts that socially responsible investment enhancement is an area in which nudges can vastly improve both individual and social welfare, whilst conserving choice. Hence, he suggests that rigorous empirical testing is needed to examine whether nudges are efficacious and applicable to this real-world condition.

**Theoretical Model**

In this section, we develop a simple behavioural economics social-preference model in order to examine a) the continuum of investor mind-sets across the financial-social spectrum, b) the efficacy of nudging. This approach thus motivates our experiments.
We begin by considering investor attitudes and behaviour in the absence of nudges (the ‘pre-nudge’ condition). We note that we begin by developing appendix theory diagram 1: ‘pre-nudge’ (below, we will then develop appendix theory diagram 2 ‘post-nudge’). The reader is invited to compare these diagrams with our diagram 1 in the main text.

We consider a population of investors: each investor chooses to invest in one of two possible investments: \( j \in \{F,S\} \), where \( F \) represents a purely financial investment, and \( S \) represents a social investment. The representative investor \( i \) has the following utility function from investing in investment \( j \):

\[
U_i = \Pi_j + \omega_j e S_j - \beta e^2. \tag{1}
\]

where \( \Pi_j \) represents investor \( i \)’s expected return from her investment in \( j \). \( S_j \) is the social impact from this investment. \( e \) represents the psychological effort that the investor exerts into ‘enjoying’ the social impact from the investment. The final term of the payoff is the investor’s cost of psychological effort.

An important parameter in this payoff is \( \omega_i \), which is the weighting that investor \( i \) places on social impact. First, we consider a pre-nudge situation (analogous to our experiment 1). We assume that the investors in the population are heterogeneous in their social feelings, and are differentiated according to personal social impact weights. We assume that this weighting is uniformly-distributed across the population as follows: \( \omega_i \sim U[0, W_{\text{max}}] \). Thus, investors naturally range uniformly along a financial-social continuum, from \( \omega = 0 \) (purely financial investor) to \( \omega = W_{\text{max}} \) (the investor in the population with maximum social feelings).

Appendix Theory Figure 1 here

Now, in the absence of nudges, we solve \( \frac{\partial U_i}{\partial e} = 0 \) in (1), in order to obtain each investor’s optimal psychological effort, which is:

\[
e^* = \frac{\omega_j S_j^2}{2\beta}. \tag{2}
\]
This represents the effort that the investor exerts into psychologically enjoying the social impact of the investment. We substitute (2) into (1) to obtain:

$$U_i = \Pi_i + \frac{w_i^2 S_i^2}{4\beta}. \quad (3)$$

Thus, this is the investor’s payoff incorporating the optimal psychological effort level, and the cost of effort.

Now, we consider the case that each investor is choosing between to invest in one of two possible investments: a) a purely-financial investment \( f \), with an expected financial return of \( \Pi = X_H > 0 \), and no social return \( S = 0 \), or b) a social investment \( j \) with an expected financial return of \( \Pi = X_L \), where \( X_H > X_L > 0 \), and with a social return of \( S > 0 \). Thus, the social investment has lower financial return than the financial investment, but has a positive social return compared with the financial investment that has zero social return. Each investor trades-off these two factors in making their investment decision.

Substituting all of this into equation (3), investor \( i \)'s utility from investing in the purely-financial versus social investment is respectively:

$$U_i(f) = X_H. \quad (3a)$$

$$U_i(s) = X_L + \frac{w_i^2 S^2}{4\beta}. \quad (3b)$$

Thus, investor \( i \) chooses the social investment \( s \) if (3b) > (3a). We note that the financial returns \( X_H \) and \( X_L \) are independent of investor identity. Investors in our framework are differentiated by the weighting that they place on social impact. We noted above that we
assumed that this weighting is uniformly distributed across the population of investors, as 
\[ \omega_i \sim U[0, \omega_{\text{max}}]. \]
follows.

Note that, since \( X_H > X_L \), then, the investor with zero weighting on social impact, \( \omega_i = 0 \), strictly prefers to invest in the financial asset to obtain \( X_H \) (3a > 3b). As the weighting on social impact, \( w_i \), increases, \( 3b \) increases. Under the assumption that 
\[ U_i(s) = X_L + \frac{W_{\text{max}}^2 S^2}{4\beta} > X_H, \]
it is the case that a critical weighting \( \hat{\omega} \), with 
\( 0 < \hat{\omega} < \omega_{\text{max}} \), exists at which (3b) rises to equal (3a). Equating 3a) and 3b), we obtain the critical value:
\[ \hat{\omega} = \sqrt{\frac{(X_H - X_L)^2}{2 S^2} \frac{4\beta}{\omega_{\text{max}}}}. \] (4)

We position \( \hat{\omega} \) on the line in diagram 1. Due to the assumption of the uniformity of social-impact weights in the population, we note that the proportion \( Y \) investing in the social investment (lying to the right of \( \hat{\omega} \) on the line) is
\[ Y = \frac{\omega_{\text{max}} - \hat{\omega}}{\omega_{\text{max}}}, \] (5)

With the remaining proportion (to the left of \( \hat{\omega} \) on the line),
\[ 1 - Y = \frac{\hat{\omega}}{\omega_{\text{max}}}. \] (6)

Investing in the financial investment.

From (4), we note that the position of the critical weight \( \hat{\omega} \) is affected by the relative financial returns \( X_H - X_L \), the absolute level of social impact \( S \), and the effort-cost parameter \( \beta \). From (5) and (6), this position affects the proportions investing in financial and social investments. If, for example, \( \hat{\omega} = 0.5\omega_{\text{max}} \), 50% of investors invest financially, and 50% invest socially.
Next, we fix \( \hat{\omega} \) exogenously on the line, and we consider the impact of nudging (thus, we turn our attention to Appendix Theory Figure 2). We assume that nudging affects each investor's weighting as follows. The post-nudge weight becomes \( \omega_i^A, \quad A \geq 1 \) measuring the effectiveness of the nudge. Note that, by assuming this effect of nudging, effectively we are assuming that nudging 'stretches' the line 'elastically': those with lower weights on social investment are little affected by the nudge (for example, the investor at \( \omega = 0 \)) is totally unaffected by the nudge. As we move to the right of the line, nudging increasingly affect the weighting. In diagram 1, we demonstrate the case where nudging doubles each investor’s weighting.

Thus, the proportion now investing in the social investment increases to

\[
Y(\text{post-nudge}) = \frac{A\omega_{\text{Max}} - \hat{\omega}}{A\omega_{\text{Max}}}.
\]

**Appendix Theory Figure 2 here**

**Numerical example:** In order to clarify, we consider the following numerical example. Consider the following parameter values:

\[
X_H = 100; \quad X_L = 50; \quad S = 10; \quad \beta = 0.125. \quad \omega_{\text{Max}} = 1.
\]

Substituting these values into equation (4), we obtain the critical weighting which partitions the investor into financial investors (on the left) and social investors (on the right). We obtain:

\[
\hat{\omega} = 0.5 = 0.5\omega_{\text{Max}}.
\]
Thus, given these values, 50 per cent of the population are financial investors, with the remaining being social investors.

Now, we consider nudging by the authorities, and we assume that $A$ equals 2. The critical value remains at $\hat{\omega} = 0.5$, but the maximum weighting in the population increases to $\omega_{\text{Max}} = 2$. Thus, now 25 percent of the population now lie to the left of the critical value, and 75 per cent lie to the right. Thus, following the nudge, the proportions investing in financial/social products shifts from 50/50 pre-nudge to 25/75 post-nudge.

At this point, we note that this numerical example is artificial, and not intended to represent values observable in the real-world. The model is intended to be indicative and illustrative. It provides the following interesting policy implications.

An interesting aspect of this analysis is that nudging shifts mind-sets such that 'marginal' investors who were investing financially pre-nudge are converted to social investing by the nudge (geometrically, they were to the left of the critical weighting pre-nudge, but shifted to the right of this critical value post-nudge). Meanwhile, there will be those investors who had such a low weighting on social investing (to the extreme left of the line) that nudging has no effect on them: they remain to the left of the line, and continue to invest in the financial product. Similarly, those to the right of the line pre-nudge invest socially pre-nudge and post nudge.

Now, imagine that nudging has a cost per investor-nudged for the authorities. In our model, the authorities nudge every investor: however, our model suggests that this is inefficient, since nudging only converts the marginal investors around the critical weighting. Our model suggests therefore that the authorities may wish to attempt to place the pre-nudged investors on the financial-social continuum (as in our first experiment) and then use that to target those pre-nudge financial investors that are 'marginal' and that can be converted to social investors post-nudge.

2. Measuring Social Preferences using a Neuroeconomic Approach

We have demonstrated that human’s social preferences (altruism, warm-glow, fairness, trust, empathy) are important in creating social value and social impact. We have also considered the mixed and multifarious motivations for such preferences. We considered
such issues as heterogeneity of social preferences, whether it is intrinsic or extrinsic; whether it is context-specific; and the role of empathy and group-processes. It is thus important to have a deeper understanding of the real-world psychological foundations underlying social preferences. For this, we turn to the new and growing powerful field of neuroeconomics. Neuroeconomics provides a bridge between economics, psychology and neuroscience. It explores the hidden processes underlying all forms of economic behaviour. A neuroeconomics approach provides a powerful tool as it not only measures conscious representations of behaviour, i.e. the individual’s introspection about their own behaviour, but also measures unconscious representations, i.e. motivators of our own behaviour of which we are not aware. Investigation of unconscious processes is critical to understanding human behaviour as there are so many emotional effects and biases that creep into our moment-to-moment behaviour of which we have no conscious awareness. This does not imply a duality between conscious and unconscious, rather that consciousness is bounded in its reserves, so much of the aspects of our personality and mind that are automatic are deemed not to be useful to intrude into consciousness. However, if we wish to understand individual differences in behaviour then into the unconscious and conscious we must delve.

Neuroeconomics uses a variety of traditional and new tools. For example, Functional Magnetic Resonance Imaging (fMRI) provides high spatial resolution scans of location of brain activity locked to particular environmental event. Electroencephalography (EEG) (static and wireless) provides high temporal resolution of brain activity in the order of milliseconds. Further precision can be gained via Event Related Potentials (ERPs), EEG waveforms aligned to a discrete stimulus which provides us with an understanding of the numerous cognitive processes that occurs, for example, in the one second window after being presented with a stimulus. Recording of various psychophysical signals, such as heart rate and skin conductance, provide us with a quantifiable value of the level of arousal experienced by an individual following a stimulus. This approach also uses standard methods such as questionnaires and computer-based tasks. All these methods provide a window into the unconscious (and conscious) processes that occur before an action (e.g. a decision) is taken by an individual. We can then explore how the person responds to the stimulus on an unconscious and conscious level and the reasons why different individuals may react differently to the same stimulus. In terms of economics decisions-making, the use
of the neuroeconomic approach provides us with the opportunity to really get to grips with how people truly react and what the psychological processes that are actually going on inside of us.

3. Our First Neuro-experiment

When making a decision between particular alternatives, the amount of attention an individual deploys towards each particular alternative is highly correlated with the magnitude of salience that alternative has within the individual’s decision-making framework (in which the various alternatives are represented and compared in terms of value). Eye-tracking can be readily used to provide an accurate estimate of how much covert visual attention is deployed to particular alternatives and thus how salient they are to an individual.

Using the above known effect, this experiment was designed to simulate real-life decision scenarios in which the decision to increase wealth and/or improve social welfare were integrated, using eye-tracking to identify the salience of key visual stimuli embedded within the alternatives. In our simulations these alternatives sometimes moved in harmony and, sometimes, diverged, providing scope for exploration of the behavioural actions that individuals took in such decision scenarios. Thus, this experiment would elucidate what information (and how much of it) individuals truly took into account when faced with decisions between wealth and social impact.

The simulations presented an investment scenario (presented on a PC) in which they chose how many shares of a company to purchase and witnessed the evolution of the price trend over time, being able to adapt the magnitude of their investment at several junctures during this. Critically, participants were also presented with an index of the “social impact” associated with that share. The pathways were presented visually as graph lines that evolved over time. Participants were free to use whatever investment style they liked, being explicitly instructed that there was no right or wrong answer. There were four simulations each presenting different share and social impact pathways. The pathways from the four task are shown in Figure 1.

**Figure 1.** Pathways from the four simulations

Simulation 1
Eye-tracking was used to assess how much attention was covertly deployed to each pathway (share price or social impact metric). A greater amount of attentional deployment is highly suggestive of increased salience of that particular stimuli in decision-making strategies. Using eye-tracking we hypothesised that we could place individuals on a continuum from “socially-minded” to “financially-minded”. This hypothesis was novel, innovative and challenging.

There were nine participants. All participants were trustees of charitable boards. This specific group of individuals was targeted as they would each have a significant amount of experience with decisions in which there would feature a trade-off between the maximisation of social impact and the increase in monetary income. Although the sample size could be considered low, due to the measurement of a very specific group, the number of appropriate group members within the general population is relatively low, thus recruitment is an issue. To compensate and increase the validity of findings, the experimenters are currently undertaking the exact same procedure in a larger body of students and members of the general population. The task is easily understandable and thus is appropriate for testing in other adult groups.

The data from the trustee group are presented below. Due to the cutting-edge methodology regarding calculation of an individual’s social-financial status via eye-tracking the data are currently being refined. The data here represent the approaches taken so far.

To calculate an individual’s point on the social-financial continuum (henceforth termed as the SOCFIN), the total fixation duration (sum of all fixation times on each graph line in seconds, known henceforth at TVT) were compared. These two values produced a ratio used to determine the position of each individual on the SOCFIN. The equation for calculating position on the SOCFIN is \[ \frac{TF_{share}}{TF_{share} + TF_{social}} \], the resulting value of which is converted to a percentage so as to more easily convey the distribution of an individual’s levels of salience attached to each alternative.
To assess the individual’s investment strategy the number of shares invested in in each period was correlated with the price of the share (henceforth known as their INVEST score). Using these two scores in conjunction we can identify the decision strategy being employed by the individual. For example, if a person sells shares when the social impact decreases but the share process decreases we can identify whether an individual is behaving in a socially-motivated manner in which social impact is given greater salience than increased financial status or whether the individual is behaving in a financially-motivated manner but in a contrarian fashion. Individual SOCFIN and INVEST scores are shown in table 3 overleaf. A graphical representation of the distribution of scores is shown in Figure 2.
Table 3: Individual eye-tracking scores, SOCFIN scores and INVEST scores.

<table>
<thead>
<tr>
<th>PARTICIPANT</th>
<th>GAME</th>
<th>TFTSHARE</th>
<th>TFTSOCIAL</th>
<th>SOCFIN PER TASK (%)</th>
<th>MEAN SOCFIN (%)</th>
<th>INVEST SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>47.5</td>
<td>21.68</td>
<td>68.66%</td>
<td>70.96%</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>40.82</td>
<td>17.3</td>
<td>70.23%</td>
<td>-0.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>26.58</td>
<td>13.44</td>
<td>66.42%</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>23.13</td>
<td>6.33</td>
<td>78.51%</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3.02</td>
<td>5.41</td>
<td>35.82%</td>
<td>61.09%</td>
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</tr>
<tr>
<td></td>
<td>2</td>
<td>2.84</td>
<td>2.7</td>
<td>51.26%</td>
<td>-0.30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>6.25</td>
<td>2.17</td>
<td>74.23%</td>
<td>-0.42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>2.84</td>
<td>0.58</td>
<td>83.04%</td>
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</tr>
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<td>3</td>
<td>2</td>
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<td>4.61</td>
<td>76.66%</td>
<td>67.52%</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>19.31</td>
<td>19.75</td>
<td>49.44%</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>15.13</td>
<td>4.66</td>
<td>76.45%</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>9.28</td>
<td>4.11</td>
<td>69.31%</td>
<td>64.64%</td>
<td>-0.34</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5.44</td>
<td>3.63</td>
<td>59.98%</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>20.23</td>
<td>9.27</td>
<td>68.58%</td>
<td>-0.37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>12.32</td>
<td>7.98</td>
<td>60.69%</td>
<td>-0.57</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>28.99</td>
<td>15.09</td>
<td>65.77%</td>
<td>63.36%</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5.81</td>
<td>4.17</td>
<td>58.22%</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>12.75</td>
<td>4.34</td>
<td>74.61%</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
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<td>7.56</td>
<td>54.87%</td>
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</tr>
<tr>
<td>6</td>
<td>1</td>
<td>16.76</td>
<td>5.75</td>
<td>74.46%</td>
<td>62.00%</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>12.37</td>
<td>10.07</td>
<td>55.12%</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>8.33</td>
<td>6.32</td>
<td>56.86%</td>
<td>-0.65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>24.44</td>
<td>15.25</td>
<td>61.58%</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>13.06</td>
<td>3.79</td>
<td>77.51%</td>
<td>66.65%</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>-------</td>
<td>--------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAME 2</td>
<td>13.21</td>
<td>5.36</td>
<td>71.14%</td>
<td>0.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAME 3</td>
<td>13.06</td>
<td>10.58</td>
<td>55.25%</td>
<td>-0.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAME 4</td>
<td>20.28</td>
<td>12.05</td>
<td>62.73%</td>
<td>0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARTICIPANT 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAME 1</td>
<td>0.38</td>
<td>0.17</td>
<td>69.09%</td>
<td>61.52%</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>GAME 2</td>
<td>21.28</td>
<td>13.18</td>
<td>61.75%</td>
<td>-0.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAME 3</td>
<td>32.59</td>
<td>30.07</td>
<td>52.01%</td>
<td>-0.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAME 4</td>
<td>23.85</td>
<td>13.88</td>
<td>63.21%</td>
<td>0.32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
These scores can be used to place each individual along a continuum from 100% “financially-minded” to 100% “socially-minded”. Although it is highly doubtable that one person could be placed at extreme ends the utilisation of such a continuum can be readily used to compare inter-individual differences in the social-financial “mindset”. For example, as can be seen in Table 3, participant 2 is almost 10% more “socially-minded” than participant 1, a finding that can then be used to compare other behaviours within the same spectrum (i.e. finance-social). Taking another example, participant 1, in game 2, had a highly negative INVEST score (-.8) which may suggest, on the face of it, that they were behaving in a manner designed to maximise social impact. However, given their SOCFIN score which is heavily biased in favour of the share pathway, we can validly state that that the participant was financially-motivated as opposed to socially motivated in this game.

3.1 Result of First Experiment

Using these simulations, we have shown that we can identify the position of an individual on a “social-financial continuum”. Using eye-tracking significantly augments the behavioural testing. If only behavioural testing were to be used it would not be possible to accurately identify whether someone on the task were truly performing in a social manner. Using the eye-tracking and what we know from eye-tracking studies, our simulations can identify how salient the financial and social information is for their decision frameworks. Our ongoing work is expanding our sample size which will lead to the identification of a wider variance of scores on the SOCFIN. In terms of our trustee sample we can now move forward and test the participants in more ecologically valid settings, using the SOCFIN to inform our understanding of how the motivation to engage in social vs. financial choice outcomes may affect real-world decisions.
In our first neuro-experiment, we analysed whether investors could be placed on a financial-social mindset continuum. We now turn to our second experiment. The aim of this experiment is to investigate the question: Are nudges effective in guiding investor decisions when there is conflict between social and financial capital gain? The eye-tracking paradigm will be used during a real-time trading game, which was confirmed to be robust for inferring information processing during investment decisions (Fairchild et al., 2016; Rubaltelli et al., 2016). As images evoke strong emotional responses, the nudges will be presented as social or financial images to assess for opposing effects (Lang, 1995). Furthermore, social images will be positively- or negatively-valenced due to their differing effects on the intensity of empathy felt and subsequent charitable behaviour (Burt & Strongman, 2005).

It is hypothesised that nudges will significantly impact investment decision-making processes and subsequent behaviours based on the stock: social nudges will cause more socially-oriented decisions, whereas financial nudges will cause more financially-oriented decisions. It is also hypothesized that social nudge valence will impact its effectiveness: negatively-valenced nudges will elicit stronger responses than positively-valenced nudges.

**Method**

**Design**

A between-participants design was used with four conditions: a financial nudge (FN) condition (money-related images), socially-positive nudge (SPN) condition (positively-valenced images of people), socially-negative nudge (SNN) condition (negatively-valenced images of people), and control neutral nudge (NN) condition (unrelated images). Participants were randomly assigned to one
condition. The independent variable was condition (based on nudge stimuli) and the dependent variable was investment behaviour (based on money earnt in a behavioural trading game and fixations during this task).

Participants

There were sixty participants, divided into fifteen for each condition; two were excluded from NN due to undetected eye-tracking. This comprised of twenty-two males and thirty-six females, with a mean age of 20.52 (SD=1.30). The majority identified as ‘White European’ (43.1%) and ‘Arab Middle Eastern’ (27.6%). Participants were undergraduates recruited by opportunity at the University of Bath via response to posters or the Research Participation Scheme. They received course credit and snacks for participating, and a chance to win £40 for the highest earner. Ethical approval was received by the University of Bath Psychology Ethics Committee (see Appendix 2).

Materials

Two questionnaires were used. The first was the Positive and Negative Affective Scale (PANAS), a twenty-item mood scale by Watson, Clark and Tellegen (1988) (Appendix 3). Ten of these items reflect Positive Affect (extent of activeness, alertness and enthusiasm) whereas the other ten reflect Negative Affect (extent of unpleasurable engagement and distress). Based on the summation of ratings for each affect, participants received two scores to establish emotional effects on performance. Secondly, a demographics questionnaire was used to obtain information pertaining to age, sex, ethnicity and investment experience (Appendix 4).
Tobii Studios and its eye-tracker device (Tobii X2-60 Compact) were used for eye-tracking, which measured attentional direction towards the task by capturing pupil movement. The device was attached to the computer monitor, allowing for free mobility.

E-Prime 2.0 was used to run the task. This comprised of four short simulations of a real-time trading game. Game One, Two, Three and Four represented different price paths that together signified a bear market (Figure 1). A chart was presented demonstrating the performance of a company’s share over yearly periods. If the line of the share was green it denoted an increase, whilst red denoted a decrease of share price during that year (also given in text below the line). A social index of the company was also provided, presented as a blue line, adjusting relative to the share. Ten years of decisions were required to be made per simulation and the history of these decisions was given below the task. Finally, a nudge stimuli was displayed at points where decision conflict was most salient.

The nudge stimuli consisted of 48 images: three images were assigned to each simulation according to condition (examples in Appendix 5). These were piloted via survey, where people rated their valence and the extent to which they related to money and people (results in Appendix 6). Accordingly, optimal images were selected to ensure nudge effectiveness.

![Graph showing stock price and social index over years](image-url)
Figure 1. Reproductions of the computer-based game simulations. Image (a) depicts Game One representing a n-shaped stock projection. Image (b) depicts Game Two as a u-shaped trend. Image (c) depicts Game Three representing an upward trend. Image (d) depicts Game Four representing a downward trend. Note that the social line (blue) moves in opposition to the financial line (black) to create conflict. The circles indicate the times at which nudges were presented and the rectangles indicate where the image appears.

Procedure

Participants were sat down in front of the computer monitor. They then received a verbal explanation of the task and were presented with a practice on the screen to which they could
accustom. Once understood, participants signed the informed consent form and proceeded to complete the PANAS and demographics questionnaire on paper. Subsequently, the eye-tracker was calibrated and the experiment commenced. This was repeated between simulations. During the task, participants were given a hypothetical amount of money (£20,000) which they could decide to invest in the stock of a fictitious company or kept as assets in the bank. Using a mouse, they would press up or down on arrows indicated next to the number of units. If units were increased (decreased), assets decreased (increased). Their goal was to maximise earnings. When decisions were made, participants pressed on a button to review the next year’s performance. Once all four simulations were completed, participants were verbally debriefed and the experiment was concluded.

**Results**

To assess whether nudges impacted investment decisions, attention (fixation duration) and performance (total earnings) were examined. Particularly, three fixation areas were chosen: social line fixation, financial line fixation and nudge fixation. The data was analysed based on a nudge-attention-performance triangle (shown in Figure 2). Nudges were expected to influence attentional direction and performance, whilst attention should mediate performance. All four games were combined to analyse for overall effects of the bear market and separately to test for outcome differences in varied investment settings.

![Figure 2. The Nudge-Attention-Performance Triangle.](image-url)
Initially, normality of the data was tested. Some data was not normally distributed; e.g. FN’s Game 4 social line fixation had a skewness of 2.44 (SE=.58) and kurtosis of 6.86 (SE=1.12). These z-scores were above the threshold for normality (Howitt & Cramer, 2005).

Correspondingly, two tests were chosen. To analyse condition differences on fixation and total earnings, one-way Analysis of Variances (ANOVAs) were chosen. Although the data was not normally distributed, ANOVAs are robust against all violations (Khan & Rayner, 2003). To test the fixation and total earnings relationship, a non-parametric Spearman’s Rank Order correlation was chosen because of the violation of normal distribution (Pallant, 2013).

Two potential confounds were analysed to ensure that they did not impact the data: incidental emotional state (PANAS scores) and culture (ethnicity/nationality). There were no effects on results from either measure; e.g. a Mann-Whitney U Test revealed no significant difference in social line fixation between collectivistic (Mdn=.12, IQR=.25) and individualistic cultures (Mdn=.13, IQR=.18), U(30,28)=346.5, Z=-1.14, p=.25 (Appendix 7 for full analysis).

**Overall Game**

Differences between conditions for overall mean fixations and total earnings are displayed in Table 1.

Table 1.

*Comparison between FN (N=15), SNN (N=15), SPN (N=15) and NN (N=13) in mean and standard deviation (SD) of fixations and total earnings*
In an overall bear market, there were significant differences in mean social line fixation between conditions: \( F(3,54)=4.31, p=.008, \eta^2=.19 \) (large effect size; Cohen, 1988). Using a post-hoc Tukey HSD test, the significant differences were found between FN (\( M=.10, SD=.03 \)) and SNN (\( M=.16, SD=.07 \)) and between FN and SPN (\( M=.16, SD=.06 \)). There were no significant differences between conditions for financial line fixation and nudge fixation (\( p>.05 \)).

For total earnings, there were significant differences in means between conditions: \( F(3,54)=3.63, p=.018, \eta^2=.17 \) (large effect size). The Tukey HSD test indicated that mean total earnings for FN (\( M=31705.59, SD=8519.73 \)) was significantly different from SNN (\( M=25261.78, SD=4401.33 \)). Evidently, FN and SPN (\( M=26414.04, SD=4246.43 \)) had the potential to be significantly different (\( p=.07 \)) had it not been for modest sample sizes (\( N=15 \)). A G*Power post-hoc power analysis (Erdfelder, Faul, & Buchner, 1996) confirmed this: based on the mean, approximately twenty-eight participants per condition would be needed to reach the optimal statistical power of .80 from the current .77 (Cohen, 1988). No differences were found between other conditions.

No significant correlations were found for fixations and total earnings (\( p>.05 \)). With a larger sample, there was potential for a significant correlation between financial line fixation and total earnings (\( r_s=.24, n=58, p=.07 \)).

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Social Line Fixation</th>
<th>Financial Line Fixation</th>
<th>Nudge Fixation</th>
<th>Total Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Duration (seconds)</td>
<td>SD</td>
<td>Mean Duration (seconds)</td>
<td>SD</td>
</tr>
<tr>
<td>FN</td>
<td>.10</td>
<td>.03</td>
<td>.20</td>
<td>.03</td>
</tr>
<tr>
<td>SNN</td>
<td>.16</td>
<td>.07</td>
<td>.19</td>
<td>.04</td>
</tr>
<tr>
<td>SPN</td>
<td>.16</td>
<td>.06</td>
<td>.19</td>
<td>.06</td>
</tr>
<tr>
<td>NN</td>
<td>.12</td>
<td>.04</td>
<td>.20</td>
<td>.03</td>
</tr>
</tbody>
</table>
Game One

Differences between conditions for fixations and total earnings for Game One are displayed in Table 2.

Table 2.

Comparison between conditions in mean and SD of fixations and total earnings in Game One

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Social Line Fixation</th>
<th>Financial Line Fixation</th>
<th>Nudge Fixation</th>
<th>Total Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Duration (seconds)</td>
<td>Mean Duration (seconds)</td>
<td>Mean Duration (seconds)</td>
<td>Mean (£)</td>
</tr>
<tr>
<td>FN</td>
<td>.13 .07</td>
<td>.22 .04</td>
<td>.25 .07</td>
<td>28333.51</td>
</tr>
<tr>
<td>SNN</td>
<td>.17 .07</td>
<td>.20 .04</td>
<td>.23 .08</td>
<td>18314.23</td>
</tr>
<tr>
<td>SPN</td>
<td>.18 .06</td>
<td>.20 .06</td>
<td>.24 .10</td>
<td>22924.36</td>
</tr>
<tr>
<td>NN</td>
<td>.11 .06</td>
<td>.20 .05</td>
<td>.19 .05</td>
<td>25739.53</td>
</tr>
</tbody>
</table>

For the n-shaped stock, there were significant differences in mean social line fixation between conditions: $F(3,54)=3.18$, $p=.03$, eta-squared=.15 (large effect size). The significant difference was between the SPN ($M=.18$, $SD=.06$) and NN ($M=.11$, $SD=.06$) conditions. There were no significant differences for financial line and nudge fixation ($p>.05$).

For total earnings, significant differences were found for means between conditions: $F(3,54)=2.82$, $p≤.05$, eta-squared=.14 (large effect size). The mean total earnings for FN ($M=28333.51$, $SD=11810.86$) was significantly different from SNN ($M=18314.23$, $SD=8931.05$).

No significant correlations were found for fixations and total earning ($p>.05$).
Game Two

Differences between conditions for fixations and total earnings for Game Two are displayed in Table 3.

Table 3.

Comparison between conditions in mean and SD of fixations and total earnings in Game Two

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Social Line Fixation</th>
<th>Financial Line Fixation</th>
<th>Nudge Fixation</th>
<th>Total Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Duration (seconds)</td>
<td>SD</td>
<td>Mean Duration (seconds)</td>
<td>SD</td>
</tr>
<tr>
<td>FN</td>
<td>.09</td>
<td>.04</td>
<td>.20</td>
<td>.06</td>
</tr>
<tr>
<td>SNN</td>
<td>.15</td>
<td>.09</td>
<td>.17</td>
<td>.07</td>
</tr>
<tr>
<td>SPN</td>
<td>.15</td>
<td>.09</td>
<td>.18</td>
<td>.07</td>
</tr>
<tr>
<td>NN</td>
<td>.11</td>
<td>.06</td>
<td>.19</td>
<td>.05</td>
</tr>
</tbody>
</table>

For the U-shaped stock, there were no significant differences in mean fixations between conditions. However, the $p$ value for the social line fixation was close to significance; $F(3,54)=2.60, p=.06$. Specifically, FN ($M=.09, SD=.04$) and SNN ($M=.15, SD=.09$) had the potential to be significant ($p=.09$) with a larger sample.

For total earnings, there were significant differences in means between conditions: $F(3,54)=3.43, p=.02$, eta squared=.16 (large effect size). Specifically, FN ($M=45063.54, SD=22322.61$) was significantly different from SPN ($M=26570.83, SD=6822.29$). With a larger sample, the difference between FN and SNN ($M=30966.91, SD=19298.74$) could have obtained significance ($p=.09$).
No significant correlations were found for fixations and total earning \( (p>.05) \).

**Game Three**

Differences between conditions for fixations and total earnings for Game Three are displayed in Table 4.

Table 4.

*Comparison between conditions in mean and SD of fixations and total earnings in Game Three*

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Social Line Fixation</th>
<th>Financial Line Fixation</th>
<th>Nudge Fixation</th>
<th>Total Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Duration (seconds)</td>
<td>SD</td>
<td>Mean Duration (seconds)</td>
<td>SD</td>
</tr>
<tr>
<td>FN</td>
<td>.12</td>
<td>.05</td>
<td>.19</td>
<td>.05</td>
</tr>
<tr>
<td>SNN</td>
<td>.17</td>
<td>.07</td>
<td>.20</td>
<td>.05</td>
</tr>
<tr>
<td>SPN</td>
<td>.18</td>
<td>.06</td>
<td>.21</td>
<td>.07</td>
</tr>
<tr>
<td>NN</td>
<td>.15</td>
<td>.03</td>
<td>.20</td>
<td>.05</td>
</tr>
</tbody>
</table>

For the upward stock, there were significant differences in mean social line fixation between conditions: \( F(3,54)=2.78, p\leq.05 \), eta-squared=.14 (large effect size). This significant difference was between FN \( (M=.12, SD=.05) \) and SPN \( (M=.18, SD=.06) \). There were no significant differences for financial line and nudge fixation \( (p>.05) \).

No significant differences were found for total earnings between conditions \( (p>.05) \).

No significant correlations were found for fixations and total earnings \( (p>.05) \).
Game Four

Differences between conditions for fixations and total earnings for Game Four are displayed in Table 5.

Table 5.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Social Line Fixation</th>
<th>Financial Line Fixation</th>
<th>Nudge Fixation</th>
<th>Total Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Duration (seconds)</td>
<td>SD</td>
<td>Mean Duration (seconds)</td>
<td>SD</td>
</tr>
<tr>
<td>FN</td>
<td>.07</td>
<td>.05</td>
<td>.20</td>
<td>.05</td>
</tr>
<tr>
<td>SNN</td>
<td>.15</td>
<td>.08</td>
<td>.17</td>
<td>.06</td>
</tr>
<tr>
<td>SPN</td>
<td>.14</td>
<td>.08</td>
<td>.18</td>
<td>.07</td>
</tr>
<tr>
<td>NN</td>
<td>.11</td>
<td>.07</td>
<td>.21</td>
<td>.06</td>
</tr>
</tbody>
</table>

For the downward stock, there were significant differences in mean social line fixation between conditions: $F(3,54)=3.71$, $p=.02$, eta-squared=.17 (large effect size). The significant differences were between FN ($M=.07$, $SD=.05$) and SPN ($M=.14$, $SD=.08$), and FN and SNN ($M=.15$, $SD=.08$). There were no significant differences for financial line and nudge fixation ($p>.05$).

For total earnings, there was a significant difference in means between conditions: $F(3,54)=1.59$, $p=.03$, eta-squared=.15 (large effect size). Specifically, SPN ($M=18373.79$, $SD=3042.21$) was significantly different from SNN ($M=14584.80$, $SD=4503.15$). However, the difference between FN ($M=17750.18$, $SD=3313.41$) and SNN could obtain significance with a bigger sample ($p=.09$).

The contradictory outcome of SPN earning more than FN warranted further analyses. A two-way mixed ANOVA was conducted to compare conditions on stock units bought over 10 years in Game
Differences in means are presented in Figure 3. Due to violated assumptions, the Greenhouse-Geisser adjustment to degrees of freedom was used (Geisser & Greenhouse, 1958). There was a significant interaction between conditions and units bought, $F(8.55,153.94)=4.03$, $p<.001$, partial eta-squared=$.18$, $\epsilon=.36$, suggesting that year of investment had a different effect on the units bought in each condition. Further, there was a main effect for units bought, $F(2.85,153.94)=17.54$, $p<.001$, partial eta-squared=$.25$, suggesting all four conditions had different patterns of buying over ten years. However, no significant effect was found for conditions, $F(3,54)=1.66$, $p=.19$, partial eta-squared=$.09$, signifying no differences between conditions.

![Figure 3](image-url)

*Figure 3.* Difference between FN (N=15), SNN (N=15), SPN (N=15) and NN (N=13) in mean number of stock units bought per year in Game Four.

Finally, no significant correlations were found for fixations and total earnings ($p>.05$).
Discussion and Conclusion

The overall results indicated that social nudges influenced investors to fixate on the stock’s social projection significantly longer than financial nudges, but no differences were found for financial projection fixations. While all conditions experienced financial gain, nudges also impacted performance: socially-nudged individuals earned significantly less than financially-nudged individuals. Controls averaged between these conditions on both measures. Also, there was no mediating effect of attention on performance. The first hypothesis was thus accepted, as nudges guided investment decisions in a financial or social direction. Additionally, negatively-valenced social nudges produced stronger responses than positively-valenced social nudges on attention and earnings; the second hypothesis was accepted. These results were echoed throughout most individual games.

Based on previous literature, it can be inferred that fixation and earning differences stemmed from information processing differences (Rubaltelli, Dickert, & Slovic, 2012). For socially-nudged individuals, longer fixations on the social projection indicates that nudges incited more careful deliberation over the strengths and weaknesses of the stock’s social value (Rubaltelli et al., 2012). This caused more conservative investments and less earnings than financially-nudged individuals, as the social ramifications outweighed financial gain. This is supported by Fiske and Taylor (2013) who assert that the more time spent on detailed and conscious information processing reflects a higher pragmatic concern, translating itself in behavioural actions. Nonetheless, socially-nudged individuals still placed some importance on financial gain, indicated by similarities in financial projection fixations across conditions and overall financial profits. For financially-nudged individuals, the nudges guided them to selectively process financial information, leading to higher earnings and a disregard for social factors. The cognitive miser model can account for this, which posits that people’s inability to process all information impartially propagates conservation and prioritization of cognitive resources for the fulfilment of important goals (Fiske & Taylor, 2013); i.e. maximizing
financial capital over social capital. Ultimately, all participants pursued financial gain but the magnitude of this goal was adjusted to social evaluations. This can illuminate on why attention to the financial projection did not mediate performance. Financial considerations were confounded by social ones, which have an inverse effect on earnings; longer social fixations beget less financial reward-seeking.

As emotions drive both attention and investment behaviour, it is hypothesised that social nudges elicited emotional responses that engendered the disparity of behavioural outcomes (Ackert, Church & Deaves, 2003). Stock projections are inherently impersonal, thus, seeing the consequences of decisions through images of others may have incited empathetic and sympathetic responses that initiated more socially responsible investments (Folbre, 2001); this evocation would not have occurred from financial nudges. Regarding Rubaltelli et al.’s (2016) explanation, investors conceivably drew on these emotions and added social meanings to the stock, acting in ways that induced the most positive feelings, i.e. prosocially. According to Batson, Fultz and Schoenrade (1987), this can be interpreted by tension-reduction. This refers to an individual’s need to reduce their empathetic distress by eradicating the source that causes it. This could have proliferated monitoring, assessment and adjustment to the social projection. Conceptually, when it declines, participants extract money from the stocks despite any financial rewards as this incites guilt and contradicts personal values (helping those in the images). Whereas if it rises, participants invest more money even if that incurs a financial loss because this produces feelings of benevolence. However, they did not entirely forgo financial rewards; participants were charitable only to an extent.

Moreover, the behavioural discrepancies between social nudge valences can be explained by the negativity bias (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Upon review of the literature,
Baumeister et al. (2001) concluded that people have an attentional priority and exert more cognitive effort towards negative information. This bias conjures stronger behavioural reactions, as was found with negatively-valenced social nudges. Their adverse nature caused longer deliberations over the social projection and more conservative investments than positively-valenced nudges.

Furthermore, it is hypothesised that negatively-valenced images elicited more empathetic and sympathetic responses than positive ones, as seen in Burt and Strongman’s (2005) study. This may explain differences in behavioural outcomes. Referring to Kuhnen and Knutson’s (2011) study, perhaps both social nudges generated a level of guilt due to empathy, which increased risk aversion; however, positively-valenced nudges simultaneously generated pride, which stimulated some risk seeking and confidence in choices. It can thus be reasoned that negatively-valenced nudges caused more empathetic distress due to higher levels of guilt. This may have reached a point of emotional paralysis and high risk aversion, characterised by investing in depleting shares (charitable giving) for tension-reduction (Fairchild et al., 2016). Contrarily, positively-valenced images allowed investors to feel proud of their donations, reducing empathetic distress and the degree of charitable giving. This has implications for events such as Red Nose Day by the Comic Relief Foundation, which uses comedy and positive images in the media to inspire charitable donations for African children. Although they do generate numerous donations, they may be hindering the extent of contributions towards their charity and others’ by stimulating too much complacency; the public might believe that they have helped enough on this momentous day. Borowski (2011) refers to this as the “hidden cost of a red nose” (p.18). Future research should examine donation differences between two publicised fundraising campaigns, a positively- and negatively-valenced one, to corroborate assumptions relating to emotions and socially responsible investments; this can be assessed through galvanic skin conductance data, as done by Fairchild et al. (2016).
Although both hypotheses were accepted, limitations must be acknowledged. Due to time constraints, the number of participants recruited was minimal. It is possible that with a larger sample, differences and correlations may have been stronger. This was confirmed with post-hoc power analyses which indicated that twenty-eight participants in each condition is required to optimally test all measures across the four games.

Additionally, the sample comprised of students rather than real investors. Based on heartrate variability, Fenton-O’Creevy et al. (2012) found differences in how they handle financial markets: experienced investors regulate their emotions more efficiently than naïve investors due to expertise. Accordingly, they may not be as prone to the nudge because of an ability to cope with negative emotions and maintain objectivity. Contrarily, distinctions can be made between investors in financial markets, e.g. individual (manage private wealth) and professional (manage client wealth) investors. The former group are less likely to be experienced and would mirror the reaction of the current sample (Rubaltelli et al., 2015). Nevertheless, future research should examine whether the findings extend to a range of investors who are active in financial markets using a large sample. It is expected that nudges will have a weaker effect on experienced compared to inexperienced investors.

Finally, the use of a bear market was advantageous because this market instigates more active trading than other markets, as passive traders experience high losses (Fairchild et al., 2016); decision processes could be inferred as a result. However, it is unknown whether nudges only influence decisions when arousal from the stock is high (due to losses). Future research should examine whether findings are generalisable to a range of markets, e.g. moderately stable trends. Especially as De Bondt (1993) argues that the variability and trend of the market also influences how decisions are made. Nevertheless, it is expected that the responses evoked from nudges is enough to
influence decisions across all markets. Despite the need for future research, the current study contributes greatly to an emerging field in which little research has been conducted.

Ultimately, to maximise social-welfare outcomes in society, companies need to be motivated to adopt corporate social responsibility. If future research supports current findings, an informed intervention can be constructed to encourage socially responsible investments, which propels corporate social responsibility (Pilaj, 2015). By targeting investors rather than companies, socially non-responsive companies will be pressured to change from their own shareholders rather than policymakers. This would be more effective as it directly impacts corporate revenue. With an increasingly digitized world, a phone application integrating the concept of nudges can be built for this purpose (Appendix 8 for design). This application would be a real-time stocks tracker, presenting charts with companies’ stock performance and social index. Based on whether the social index rises or falls, differently-valenced nudges can be presented from an image database to elicit appropriate responses from investors. However, bankers will play a significant role in the success of this intervention, as many investors are not aware of socially responsible investing and will need to be advised (Pilaj & Reisinger, 2015). This nudge intervention preserves the freedom of choice, as it is the investor who chooses to download and use the application. This counters claims that nudge interventions are unethical (Raihani, 2013). Also, not only does it have collective benefits in improving society, but it also has monetary, emotional and expressive (pursuant to personal beliefs) benefits for investors (Sachs, 2015). Future research will have to develop and determine the efficacy of this application.

Conclusively, introducing nudges to financial markets can alleviate financial and social capital gain conflict. This is attributable to guiding information processing and, possibly, emotions during
financial decision-making. Social nudges stimulate social awareness, emotions and responsibility in investment decisions, whereas financial nudges incite financial reward-seeking. Nonetheless, both investors and society stand to benefit from socially responsible investments. Therefore, creating a social responsibility investment application has been proposed, and all it takes is a little nudge.

References


Appendix 1: Positive and Negative Affective Scale

POSITIVE AND NEGATIVE AFFECT SCHEDULE

<table>
<thead>
<tr>
<th>Name:</th>
<th>Date:</th>
<th>Record Number:</th>
</tr>
</thead>
</table>

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent:

Use the following scale to record your answers.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>very slightly</td>
<td>a little</td>
<td>moderately</td>
<td>quite a bit</td>
<td>extremely</td>
</tr>
<tr>
<td>or not at all</td>
<td>interested</td>
<td>distressed</td>
<td>excited</td>
<td>upset</td>
<td>strong</td>
</tr>
<tr>
<td></td>
<td>guilty</td>
<td>scared</td>
<td>hostile</td>
<td>enthusiastic</td>
<td>proud</td>
</tr>
<tr>
<td></td>
<td>irritable</td>
<td>alert</td>
<td>ashamed</td>
<td>inspired</td>
<td>nervous</td>
</tr>
<tr>
<td></td>
<td>determined</td>
<td>attentive</td>
<td>jittery</td>
<td>active</td>
<td>afraid</td>
</tr>
</tbody>
</table>

*Insert appropriate time instructions above from page 27*


This measure is part of Measures in Health Psychology: A User’s Portfolio, written and compiled by Professor Marie Johnston, Dr Stephen Wright and Professor John Weinman. Once the invoice has been paid, it may be photocopied for use within the purchasing institution only. Published by nferNelson Publishing Company Ltd, The Chiswick Centre, 414 Chiswick High Road, London W4 5TF, UK. Code 0690005989
Appendix 2: Demographics Questionnaire

Please complete this questionnaire (both sides) as honestly as possible. If there are any questions you do not feel comfortable answering, please leave them blank.

Your age: ___________ years

Your sex: Male / Female

How would you describe the region of your nationality (please circle one)?

European North American Central/ South American

Asian African Australasian Arab Other

How would you describe your ethnicity (please circle one)?

White Afro-Caribbean Indian Pakistani Bangladeshi

Chinese Japanese South East Asian Other Asian

Native American Hispanic American Polynesian Middle Eastern

Other: Please state: _________________________________
Are you attending (or have you attended) College/ University?  Yes / No

If yes, what is your major? ________________________________

Have you “played” the stock market before?   Yes / No

If yes, how many years have you been playing the stock market? _______ years

And how often do you play the stock market (tick the appropriate box)?

<table>
<thead>
<tr>
<th>Daily</th>
<th>Not daily, but several times a week</th>
<th>Not weekly, but several times per month</th>
<th>Not monthly, but several times per year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 3: Nudge Stimuli Examples

Figure 4. Examples of nudge stimuli. Image (a) depicts a social positive nudge, image (b) a social negative nudge, image (c) a financial nudge and image (d) a neutral nudge.
Appendix 4: Summary of Pilot Survey Results for Nudge Stimuli

Table 6.

Mean Ratings Given for Valence, Monetary and Social Nature of the Nudge Stimuli Based on Allocated Condition (N=10)

<table>
<thead>
<tr>
<th>Type of Nudge</th>
<th>Mean Negative-Positive Rating</th>
<th>SD</th>
<th>Mean Money Rating</th>
<th>SD</th>
<th>Mean People Rating</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0- Negative, 5-Neutral, 10-Positive)</td>
<td></td>
<td>(0-Extremely Unrelated, 10-Extremely Related)</td>
<td></td>
<td>(0-Extremely Unrelated, 10-Extremely Related)</td>
<td></td>
</tr>
<tr>
<td>FN</td>
<td>6.07</td>
<td>1.35</td>
<td>8.86</td>
<td>1.41</td>
<td>5.05</td>
<td>3.46</td>
</tr>
<tr>
<td>SNN</td>
<td>0.93</td>
<td>1.04</td>
<td>6.12</td>
<td>3.33</td>
<td>8.61</td>
<td>1.41</td>
</tr>
<tr>
<td>SPN</td>
<td>7.69</td>
<td>1.61</td>
<td>4.54</td>
<td>3.92</td>
<td>8.67</td>
<td>1.29</td>
</tr>
<tr>
<td>NN</td>
<td>5.84</td>
<td>1.48</td>
<td>1.31</td>
<td>1.51</td>
<td>2.46</td>
<td>2.37</td>
</tr>
</tbody>
</table>
Appendix 5: Analysis of Potential Confounds

Culture: Collectivistic vs. Individualistic

The differences in fixations and total earnings between collectivistic and individualistic cultures are displayed in Table 6. These groups were divided by definitions of collectivistic and individualistic cultures. Collectivistic cultures include the East, Middle East and South Americas, which emphasize the importance of family and community goals, whereas individualistic cultures include the United States and Western Europe, which emphasize personal achievement (Noordin, Williams & Zimmer, 2002).

Table 7.

Comparison between collectivistic (N=30) and individualistic (N=28) cultures in median and interquartile range (IQR) of fixations and total earnings

<table>
<thead>
<tr>
<th>Upbringing</th>
<th>Social Line Fixation</th>
<th>Financial Line Fixation</th>
<th>Nudge Fixation</th>
<th>Total Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median Duration (s)</td>
<td>IQR</td>
<td>Median Duration (s)</td>
<td>IQR</td>
</tr>
<tr>
<td>Collectivistic</td>
<td>.12</td>
<td>.25</td>
<td>.19</td>
<td>.21</td>
</tr>
<tr>
<td>Individualistic</td>
<td>.13</td>
<td>.18</td>
<td>.21</td>
<td>.15</td>
</tr>
</tbody>
</table>

Fixations and total earnings were analysed using non-parametric Mann-Whitney U tests because the data did not meet the assumptions of a parametric test: it was not normally distributed as z-scores of skewness and kurtosis indicated measures above the -1.96 and 1.96 threshold. The tests revealed that there were no significant differences between collectivistic and individualistic groups for fixations or for total earnings as all four $p$ values were above .05. This indicates that culture did not impact the results of the experiment.

Incidental Emotional State: PANAS Scores

The differences in PANAS scores between conditions are displayed in Table 7.

Table 8.
Comparison between conditions in positive affect and negative affect scores as measured on the PANAS

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Positive Affect Score</th>
<th>Negative Affect Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Score (Max. 50)</td>
<td>SD</td>
</tr>
<tr>
<td>FN</td>
<td>31.40</td>
<td>6.12</td>
</tr>
<tr>
<td>SNN</td>
<td>32.87</td>
<td>6.21</td>
</tr>
<tr>
<td>SPN</td>
<td>32.87</td>
<td>5.32</td>
</tr>
<tr>
<td>NN</td>
<td>31.15</td>
<td>3.58</td>
</tr>
</tbody>
</table>

The data in Table 8 was analysed using two one-way ANOVAs as assumptions of normality and homogeneity of variances were met. The ANOVAs did not reveal significant differences between the four conditions on either positive affect or negative affect as both p values were above .05, indicating that incidental emotions did not impact the results of the experiment.

Appendix 6: Design of Social Responsibility Investment Application

![Diagram explaining the design of the social responsibility phone application](image-url)
Theory Figure 1: Pre-Nudge

\[ \omega_i = 0 \quad \omega_i = \hat{\omega} \quad \omega_i = \omega_{\text{Max}} \]

Theory Figure 2: Post-Nudge

\[ \omega_i = 0 \quad \omega_i = \hat{\omega} \quad \omega_i = \hat{\omega} \]