Choosing and Changing Financial Advisors: An *f*MRI Study of Associated Brain Activations

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Changing financial advisors during an advisor-intermediated stock-market game was more likely during periods of relative underperformance. Immediately prior to changing advisors, brain activation was greater in areas associated with error detection (dorsal anterior cingulate cortex) and number comparisons (inferior parietal and middle frontal gyri). This combination of activations was analogous to those associated with choosing to stop chasing losses in a gambling task. Advisors may consider using heuristics from gambling research and investment practice that re-characterize loss experiences as something other than errors. During non-switching "quiet" periods, subjects were more likely to be focusing on the images of advisors, reflected by activation in face-specific visual regions. These results may support client-retention strategies emphasizing personal connections rather than pure numerical performance.

Key Words: financial planning, fMRI, neuroeconomics

Introduction

Understanding investor behavior is important for the overall economy and especially for those who work in the financial services industry. With the growth of professional financial planning, it has become common for individuals to make investment choices not through the direct buying and selling of individual stocks and bonds, but by hiring a professional who manages investments on their behalf. Although some research has investigated the behavior of individuals when directly investing in markets (e.g., Barber & Odean, 2000; Grinblatt & Keloharju, 2000), relatively little has been done to explore how individuals select financial professionals to manage funds on their behalf.

The current study presents results from the first neuroimaging study investigating the subject of investment advisor selection. Gaining a greater understanding of neural activations associated with this process may provide insight at the individual level for practicing financial advisors, and potentially at the macroeconomic level for modeling longer term investment behavior.

Literature Review

The following study examined the neural correlates of advisor switching in an advisor-intermediated stock market game. As there appears to be no previous research that specifically addresses this particular question, this review examined four related areas: non-neuroscience research in the areas of financial advisor selection and stock market games, neuroscience research in the potentially related task of observing the error of another person (in this case the advisor), and neuroscience research on related gambling behavior (particularly examining the phenomenon of "loss chasing").

Financial Advisor Selection

A variety of popular press books and articles have addressed the topic of financial advisor selection (e.g., Davis, 2007; Drozdeck & Fisher, 2007; Waymire, 2003), although the topic has not been extensively explored in the academic literature. As Brown and Brown (2008) confirmed, "there is little research devoted to the relationship between advisor and investor" (p. 232). However, some facets of the relationship have been researched. Christiansen and DeVaney (1998) explored the importance of communication in the financial planner-client relationship. More narrowly, Joiner, Leveson, and Langfield-Smith (2002) demonstrated the importance of using less technical language to establish trust in the financial planning relationship. Taking a psychological approach, Brown and Brown (2008) explored the relationship between investor attachment style and financial advisor loyalty. Bae and Sand-

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ager (1997) explored the characteristics that consumers preferred in a financial planner while others have explored the characteristics of people who use financial planners (Chang, 2005; Elmerick, Montalto, & Fox, 2002).

Although not extensively studied, the process of selecting and switching financial advisors is particularly relevant given that, as Brown and Brown (2008) explained, “Clients frequently change advisors, split assets among several different advisors, or fail to develop a complete investment plan and instead shift from one investment theme to another” (p. 232). Indeed, one survey found that investors with $1 to $5 million portfolios averaged three different advisors, and that this number continued to grow at higher levels of wealth (Brown & Brown, 2008).

Stock Market Games

The current study involves participants playing an advisor-intermediated stock market game. Stock market games are used widely in economic education (Mandell & Klein, 2009; Wood, O’Hare, & Andrews, 1992) and in a variety of research, although none appeared to have involved selecting advisor intermediaries. Simple stock market-type games are common where player choices are limited. For example, player choices may only include choosing to stay or leave the market (Tykocinski, Israel, & Pittman, 2006), or predicting if the market will go up or down in the next period (Mattox, Valle-Inclan, & Hackley, 2006). Others have created highly sophisticated games such as Oehler, Heilmann, Läger, and Oberländer (2003) who created a series of sophisticated stock market games allowing complex trading including short selling and borrowing.

Neuroimaging: Chasing Losses

One would naturally expect underperformance in comparison with the market to be a significant determinant of advisor switching. To the extent that continuing to stay with an underperforming market strategy or financial advisor is analogous to continuing to gamble after experiencing losses, the neural activations may be related. Campbell-Meiklejohn, Woolrich, Passingham, and Rogers (2007) explored the neural correlates of both continuing to chase losses and ceasing chasing losses in an fMRI study. In that experiment subjects, after experiencing losses, were given the opportunity to “chase” the loss with a “double or nothing” bet. Subjects could continue to chase losses until they chose to stop, their loss limit was reached, or the game ended. The point at which subjects choose to stop chasing losses may be particularly relevant for advisor switching. Advisor switching is potentially more likely to take place after a series of negative outcomes. One’s faith in the advisor or the advisor’s strategy may gradually erode until the point at which optimism evaporates and the advisor is abandoned. This point of abandonment may be similar to the point at which a gambler ceases to chase losses by refusing to take additional gambles.

In the Campbell-Meiklejohn et al. (2007) study, decisions to stop chasing losses were associated with activity in a variety of areas. The regions of greatest activation when contrasting decisions to stop chasing losses with decisions to continue gambling were located in the dorsal ACC, the anterior insula, and left and right inferior parietal gyri. Additional activations above a Z-score of 4 were located in the middle frontal gyrus, cuneus, and precuneus. When contrasting decisions to stop chasing losses with a control task, the clusters with a Z-score of 4 or greater were located in dorsal ACC, the thalamus, and the inferior parietal gyrus. The two regions activating with a Z-score greater than 4 in both contrasts were in the dorsal ACC and the inferior parietal gyrus.

Neuroimaging: Error Detection

Although no previous studies have been conducted on the neural correlates of changing financial advisors, significant research has been conducted on potentially related behaviors. For example, studies involving identifying the errors of another person may be relevant. From a technical perspective underperforming the market at times may be an inevitable consequence resulting from the variance inherent in the market and in any particular market strategy. Nevertheless, investors may view returns that underperform the market as a failure on the part of the advisor. In simple terms, when the market index outperforms the advisor, a client may perceive this as an advisor failure or an advisor “error” in stock selection. Thus, to the extent that dropping a financial advisor may be precipitated by a perceived lack of performance, studies involving identifying the errors of another person may engage related processes. In general, the anterior cingulate cortex (ACC) and nearby areas of the medial frontal cortex (MFC) have been implicated in monitoring behavior and detecting errors (Rushworth, Buckley, Behrens, Walton, & Bannerman, 2007). Kang, Hirsh, and Chasteen (2010) found ACC activation when subjects watched another person make errors in the Stroop task, noting that the activation grew stronger when observing friends make errors, rather than strangers. Similarly, Newman-Norlund, Ganesh, van Schie, De Bruijn, and Bekkering (2009) found MFC and ACC activation increased in response to observing others make errors in shooting penalty shot goals in soccer. In a separate study, MFC activity increased when subjects observed the errors of others in a computer shooting task (De Bruijn, de Lange, von Cramon, & Ullsperger, 2009).

Hypothesis

The present study investigated the neural correlates of switching financial advisors in an advisor-intermediated stock-market game. As this study was the first of its kind and thus exploratory in nature, the initial hypotheses were broad. Consequently, no "region of interest" analysis or small-volume corrections were used for neural activations, as this would be justified only by strong prior neural hypotheses. Behaviorally, advisor switching was anticipated to occur more frequently when advisors were performing poorly relative to the overall market. It was anticipated that decisions to drop one's advisor in favor of another could also be associated with activation in the ACC, given its previous associations with choosing to stop chasing losses in a gambling task as well as associations with observing errors committed by others.

Methods

Participants

Nineteen healthy adult female volunteers (age range 20-31) participated in this study. All subjects had normal or corrected to normal vision. Subjects provided written informed consent after the details of the study were explained to them. The Institutional Review Board of Texas Tech University approved the experimental processes.

Task

Subjects in the scanner could observe a screen and respond with four buttons (two left hand and two right hand). After completing tasks that familiarized subjects with the button functions they received the following instructions, across several screens, with the slides advancing on their command:

> Next you will play a stock market game. The participant who accumulates the most money in this game will be paid $250.00. Instead of picking stocks, you will select among four financial planning firms. These advisors will invest in stocks for you based on one of four strategies. You may change firms at any time, as many times as you like. There is no cost to change firms. The four financial planning firms are (A) The Able Firm, (B) The Baker Firm, (C) The Clark Firm, and (D) The Davis Firm. The Able Firm follows a TRENDS strategy immediately selling stocks that are falling and buying stocks that are rising. The Baker Firm follows a GROWTH strategy buying stocks in companies that are growing. The Clark Firm follows a VALUE strategy buying "cheap" stocks in companies with a lot of assets but low stock price. All advisors in the Clark firm are Certified Financial Planners. A CFP® must have years of experience, a college degree with investment coursework, must pass a series of rigorous exams and continually complete ongoing education in investing. The Davis Firm follows an INCOME strategy buying stocks in companies that pay high dividends (income). All advisors in the Davis firm are Certified Financial Planners. After each round you will see your percentage return (gain or loss) for that round and the overall market return for that round. You may change advisors at any point by clicking on the relevant button: left button/left hand for Able; right button/left hand for Baker; left button/right hand for Clark; right button/right hand for Davis.

After choosing their initial advisor, subjects experienced six segments of market conditions reporting increases/decreases of the overall market and increases/decreases of their investments with each segment lasting four seconds. The top half of each screen read:

> This round the market was up [down] x.x%
> Your investments were up [down] x.x%

After each set of segments, subjects were given an 11 second break during which time the screen read "you may change your advisor at any point by clicking the relevant button. The market will begin again in a moment." Subjects played six sets of segments, at which point they were introduced to a new set of financial planning firms, made their initial selection and played six more sets of segments. In total, subjects experienced 72 segments of reported returns.

During instructions, breaks, and market periods the four advisors were pictured at the bottom of screen as shown in Figure 1 (The rights to use and publish the photographs were purchased from istockphoto.com). Two groups were created (10 in group A, 9 in group B) in order to reverse more formal and more casual appearances of advisors without any subject seeing any advisor more than once.

Unknown to the subjects, all subjects experienced the same sequence of market and own returns regardless of advisor choices. The winning player was determined by degree of adherence to pre-designated "preferable" market strategies during rising, flat, and falling market periods.

Figure 1. Images Appearing at the Bottom of the Screen During Instructions, Advisor Selection, and Active Market Periods

Note. Original images were in color but have been converted to black and white here to match with journal publication guidelines.

During each set of six segments, own returns would either significantly outperform or significantly underperform the market during the entire set. During outperforming sets, the advisor selected by the participant would do better than the market by 1 to 5 percentage points. During underperforming sets, the advisor selected by the participant would do worse than the market by 1 to 5 percentage points. During each set, market returns were consistently flat (0.5% to 3%), high (10% to 20%), or low (-10% to -20%).

fMRI

The purpose of the fMRI analysis is to identify those regions of the brain that are more active during a "switching" period than during a "quiet" period, and vice-versa. Here, a switching period was defined as the one second prior to the button press triggering a change of an advisor. A "quiet" or non-switching period was defined as any period that was more than five seconds prior to a switch and more than one second after a switch. Non-switching periods did not include any periods of time when switching advisors was not allowed, such as during preliminary instructions. The remainder of this section describes the technical parameters of the neuroimaging analysis process.

The functional imaging was conducted using a Siemens 3.0 Tesla Skyra to acquire gradient echo T2*-weighted echoplaner images (EPI) with blood oxygenation level-dependent (BOLD) contrast. Functional data were collected in a single 7.55 minute session consisting of 151 whole brain images. Each volume comprised 45 axial slices collected in an ascending manner. The imaging parameters were as follows, echo time: 21 ms; field of view: 282 mm; flip angle: 80˚; in-plane resolution and slice thickness: 3 mm; repetition time: 3000 ms. Whole brain high-resolution structural scans (1 X 1 X 1 mm) were acquired from all subjects and co-registered with their mean EPI images.

Image analysis was conducted using SPM8 (Wellcome Department of Imaging Neuroscience, Institute of Neurology, London, UK). Images were motion corrected with realignment to the first volume, adjusted for beta-zero magnetic field inhomogeneities, spatially normalized to standard Montreal Neurological Institute (MNI) EPI template, and spatially smoothed using a Guassian kernel with a full-width-at-half-maximum of 8 mm. High pass temporal filtering using a filter width of 128 seconds was also applied to the data.

The contrasts presented results from application of a general linear model (GLM) in three steps. First, a GLM was estimated for each individual with first order autoregression using the two regressors of switching period and non-switching period. Second, first-level single-subject contrasts were calculated for switching periods minus non-switching periods and the converse. Third, second-level group contrasts were calculated using a one-sample t-test on the single-subject contrasts.

Anatomical localizations were identified by overlaying the t-maps on a normalized structural image averaged across subjects. Activation areas were identified relative to the most probable gray matter location for coordinates corresponding to the highest peak level within the cluster. MNI coordinates were converted to Talairach coordinates using the Nonlinear Yale MNI to Talairach Conversion Algorithm (Lacadie, Fulbright, Rajeevan, Constable, & Papademetris, 2008), and locations identified using the Talairach Daemon (Lancaster et al., 2000; Lancaster et al., 1997).

Results

Behavioral Results

To introduce a minimal level of choice variation similar to what one might experience in the market for financial advisors, the market strategies and characteristics of the advisors were varied. The most predictive factor in financial planner selection was the presence of the Certified Financial Planner™ (CFP®) distinction, with 73% of initial selections going to CFP® holders (see Table 1). Given the proximity of the detailed explanation of this credentialing the result was not surprising. It is notable, however, that the tendency to choose CFP® planners was greatest prior to the opening of the market. The experience of underperformance may have reduced the significance of this designation, explaining the difference between the 73% initial selection of CFP® planners and the 62.5% of total time in the market with CFP® planners.

The most popular strategy selected was the growth strategy, with the income strategy being the least popular. As before, these differences were greater in the initial selection than in the total share of time in the market using a particular strategy, likely reflecting an experimental strategy in the face of weak returns. There was no apparent systematic difference in advisor selection related to advisors being dressed more casually or more formally (Figure 1 displays the different styles of dress). Older advisors were more likely to be selected initially but had little advantage in the share of time in the market once the return reports began.

As expected, underperformance was a key factor in determining switching behavior with three-fourths of all switching behavior occurring when advisors were underperforming the market (see Table 2). The overall market was important in that switching behavior was approximately half as likely during a rising market as compared with a flat or falling market.

fMRI Results

Regions where the blood oxygenation level dependent (BOLD) signal was significantly greater during switching periods (the one second prior to changing one's financial advisor) as contrasted with quite periods (more than five seconds before and more than one second after switching) as shown in Table 3. Clusters significant at $p < .05$ after correction for family wise error were located in the right and left inferior parietal gyrus, left middle frontal gyrus and dorsal ACC/MFC. The precentral gyrus activation likely relates to the button pushing requirement of the task and thus will not be discussed further. The final cluster to

Table 1. Advisor Characteristics and Duration of Selection

	Share of time in market with advisor %	Share of initial advisor selections (before market opened) %
Credentialing		
Certified financial planner	62.5	73.0
Non-certified financial planner	37.5	27.0
Strategy		
Trends	17.2	13.5
Growth	36.6	40.5
Value	30.2	37.8
Income	16.0	8.1
Dress		
More casual	54.6	59.5
More formal	45.4	40.5
Age		
Older	53.3	62.2
Younger	46.7	37.8

Note. Each advisor characteristic occurred with equal frequency in the experiment.

include activations significant at $p < .001$ uncorrected was the middle frontal gyrus again, this time on the right side.

Figure 2 visually displays regions of activations using a threshold of $p < .0001$ uncorrected. The top half of the figure displays those areas of activation associated with switching periods. From the axial view (view from above) on the far right, one can most easily distinguish the regions of activation. The middle frontal gyri activations in both hemispheres are the most anterior (closest to the front), with relatively weak activation in the right middle frontal gyrus. Located slightly more posterior and centered roughly between the two hemispheres is activation in the ACC/MFC. Finally, activation in the inferior parietal gyri of both hemispheres can be seen as the most posterior regions of activation.

As previously noted, the ACC and nearby areas of the MFC have been associated with tasks involving monitoring the behavior of others and detecting errors. The combination of the increased propensity to switch during periods of underperformance and ACC/MFC activation during switching periods suggests that the underperformance may be reflected in error detection regions and subsequent switching. Additional activations took place in the inferior parietal gyri in both hemispheres. Previous research has implicated the inferior parietal gyri in number processing tasks (Chochon, Cohen, van de Moortele, & Dehaene, 1999). Damage to these areas can cause highly specific impairments in number manipulation (Dehaene & Cohen, 1997). Sandrini, Rossini, and Miniussi (2004) demonstrated that interference with the left inferior parietal gyrus by transcranial magnetic stimuli significantly slowed a number comparison task. The middle frontal gyri of the prefrontal cortex have been associated with a variety of potentially relevant tasks including predicting immediate contingent outcomes (Carter, O'Doherty, Seymour, Koch, & Dolan, 2006), recall of numbers (Knops, Nuerk, Fimm, Vohn, & Willmes, 2006), and mathematical calculations (Davis et al., 2009).

While reviewing tasks associated with each individual region is relevant, a more powerful approach is to find tasks that simultaneously activate all of the regions activated in our task (excluding the precentral gyrus activation from button pushing). The decision to stop chasing gambling losses is such a task. As noted above, the dorsal ACC, middle frontal gyrus, and inferior parietal gyri were all

Table 2. Frequency of Advisor Switching During Varying Returns

Returns	Total switches %
Rising market	19.5
Flat market	42.0
Falling market	38.5
Outperforming market	25.2
Underperforming market	74.8

activated more strongly during decisions to stop chasing gambling losses as contrasted with decisions to continue chasing losses (Campbell-Meiklejohn et al., 2007). In that study, the only two regions activating with a Z-score greater than 4, both in contrasts with a control task and in contrasts with decisions to continue chasing losses, were in the dorsal ACC and the inferior parietal gyrus (Campbell-Meiklejohn et al., 2007), both of which also activated in the current study. The strongest activations for decisions to stop chasing losses in both contrasts in that study peaked in the dorsal ACC at (-2, 26, 36) and (-4, 22, 38), roughly similar to the peak dorsal ACC activation in our task of (0, 24, 40). Although the match of activations between advisor switching and ceasing to chase gambling losses was not perfect, the neural similarities did appear substantial, especially given the substantially different task frameworks.

In distinction to the mathematical and error-detection related activations immediately preceding advisor switching, "quiet" periods substantially removed from switching behavior reflect greater activity in visualization areas (see Table 4). This can be seen in the bottom half of Figure 2 as the activations occurred in the occipital region located in the posterior area of the brain. More specifically, this activation appeared to occur especially in face-specific regions of the brain. Grill-Spector, Knouf, and Kanwisher (2004) identified specific brain regions responding strongly to faces but not to houses, cars, or other novel objects. In their study this face-specific region, labeled the fusiform face area, was identified as located (using Talairach coordinates) at right, 39±3, -40±7, -16±5; left -37±4, -42±7, -16±5. Converting our peak MNI coordinates in Table 4 to Talairach coordinates shows that our activation coordinates for the second and fourth most significant clusters (or second and third if we once again exclude the precentral gyrus activations from consideration) fall within these regions both in the right (36, -41, -16) and left (-34, -37, -15) hemispheres. Aside from these face specific regions, the most significant activation cluster was centered in the right lingual gyrus and extending into the left cuneus. These areas of the occipital lobe are part of the visual system (Dupont, Orban, De Bruyn, Verbruggen, & Mortelmans, 1994; Vanni, Tanskanen, Seppä, Uutela, & Hari, 2001). The lingual gyrus has also been shown to respond differentially to the presentation of faces (Puce, Allison, Asgari, Gore, & McCarthy, 1996), especially emotional faces (Batty & Taylor, 2003).

The images of advisors remained at the bottom of the screen throughout the task, suggesting that the differences in activation were not due to changes in the presentation of faces on the screen, but were likely due to differences in attention. Specifically, when subjects were far removed from making a choice to change advisors, they appeared more likely to be looking at the advisors themselves, rather than focusing on the financial returns and the mathematical meaning of those returns.

Implications and Limitations

Limitations

This is the first study to directly examine financial advisor selection and switching using fMRI techniques. The actual significance of the related activations will not be well understood until several variations and replications of this type of study are completed. Many brain regions, including the ones differentially activated in this study, are involved in a wide range of cognitive activities. As such, the activations may relate not only to the proposed function, but also to some other processes which may drive the relevant decision-making circuit. Consequently, although the activation differences are clear, explanations of the causes behind these neurological correlates should be considered only preliminary working concepts. In order to reduce subject variance in brain characteristics, it is common practice in neuroimaging to use as homogenous of a group as possible. In keeping with this, the sample used here was of only one gender (female), and relatively young. Although this may improve the ability to identify relevant activations, it may also limit the implications of the findings. Results may be systematically different for those of a different gender, age, or level of financial sophistication.

Error Detection and Reframing

Decisions to change one's financial advisor were predicated by activation in regions of the brain associated with error detection, including detecting errors made by others.

Table 3. BOLD Signal Greater During Switching Periods than During Non-Switching Periods

		Peak-level		Cluster-level	
Cluster	**Peak location title**	**Peak MNI coordinates**	**Z-score**	***p* (FWE-corr)**	k_e
1	R. Parietal Cortex, Inferior Parietal Gyrus (BA 40)	56, -44, 44	4.68	0.000	885
	R. Parietal Cortex, Inferior Parietal Gyrus (BA 40)	50, -50, 42	4.17		
	R. Parietal Cortex, Inferior Parietal Gyrus (BA 40)	48, -46, 54	4.14		
2	L. Prefrontal Cortex, Middle Frontal Gyrus (BA 10)	-36, 48, 8	4.68	0.001	518
	L. Prefrontal Cortex, Middle Frontal Gyrus (BA 10)	-36, 56, 6	4.05		
	L. Prefrontal Cortex, Middle Frontal Gyrus (BA 10)	-38, 44, 26	3.86		
3	L. Parietal Cortex, Inferior Parietal Gyrus (BA 40)	-54, -44, 46	4.63	0.004	403
	L. Parietal Cortex, Inferior Parietal Gyrus (BA 40)	-58, -38, 42	4.02		
	L. Parietal Cortex, Inferior Parietal Gyrus (BA 40)	-40, -56, 58	3.46		
4	Medial Frontal Cortex (BA 8)	2, 32, 42	4.53	0.004	405
	Dorsal Anterior Cingulate Cortex, Cingulate Gyrus (BA 32)	0, 24, 40	4.44		
5	R. Precentral Gyrus	52, 18, 2	4.13	0.489	77
6	R. Prefrontal Cortex, Middle Frontal Gyrus (BA 10)	38, 44, 26	3.87	0.374	94
	R. Prefrontal Cortex, Middle Frontal Gyrus (BA 10)	38, 52, 20	3.47		

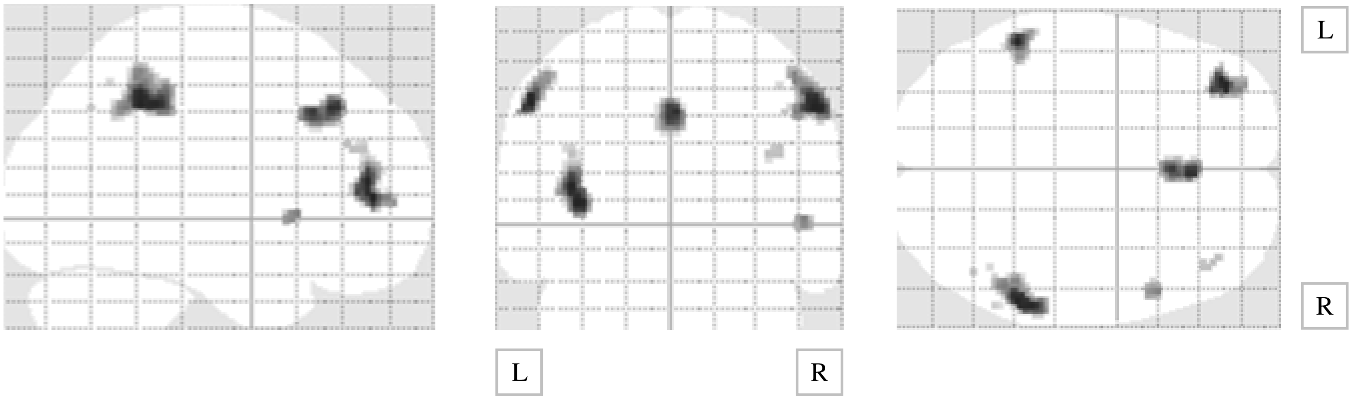
Note. Height threshold $t = 3.61$ ($p = 0.001$) Extent threshold (k = 0 voxels) Voxel size 2x2x2 mm Volume 182552 voxels Expected voxels per cluster, k = 25.199 FWHM (in mm) = 14.7x14.5x12.2.

It is plausible that underperforming the market, which was also associated with increased likelihood of advisor switching, was perceived as an advisor error. This perception of advisor error then led to an increased propensity to drop one's advisor in favor of another. Periods of underperforming the overall market, however, are an unavoidable part of any investment strategy. Even a strategy that produces superior returns over the long term will underperform the market on certain days, weeks, months, quarters, or even years. Given that advisors cannot avoid periods of underperformance, what client communication strategy might this suggest? It is possible that periods of underperformance can be reframed, not as errors, but as expected fluctuations. To the extent that periods of underperformance are not viewed as errors, the propensity to switch advisors during such periods might be reduced.

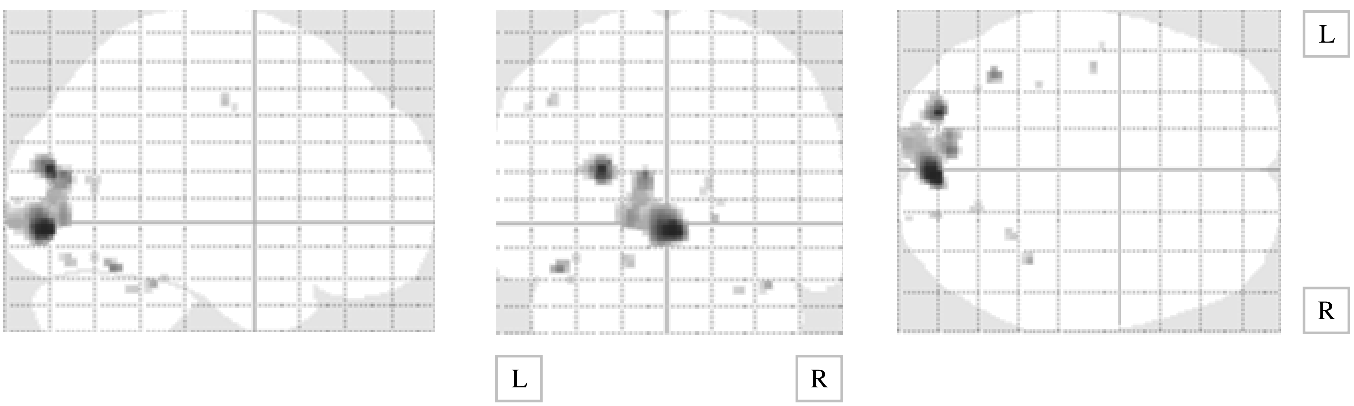
Some research suggests that such reframing may be successful at changing physiological responses to losses. Sokol-Hessner et al. (2009) demonstrated that reframing losses not only resulted in greater risk taking, but also reduced the physiological responses to losses as measured by

Figure 2. Glass Brain Images of BOLD Signal Contrasts

Switching > Non-Switching "Quiet" Period at $p < .0001$ uncorrected



Non-Switching "Quiet" Period > Switching at $p < .0001$ uncorrected



skin conductance response. In that study, when participants were instructed to think of each potential gamble separately, as if it was the only one, they demonstrated greater aversion to gambles and greater physiological responses to experienced losses. However, both the aversion to gambles as well as physiological responses to experienced losses dropped when subjects were told to consider all potential gambles together, as if creating a portfolio, including the guidance, "All that matters is that you come out on top in the end—a loss here or there will not matter in terms of your overall portfolio. In other words, you win some and you lose some" (Sokol-Hessner et al., 2009, p. 3).

Certainly, the effect of "bracketing" on loss aversion has been seen in a variety of behavioral results (James, 2012). Simply not checking the market as frequently has been shown to decrease loss averse behavior and consequently overall returns (Andreassen, 1990; Thaler, Tversky, Kahneman, & Schwartz, 1997). However, the result from the Sokol-Hessner et al. (2009) study suggests that such bracketing actually changes physiological processes. This was confirmed by Sokol-Hessner et al. (2012), who ran essentially the same study using fMRI. Reframing decisions in terms of an overall portfolio not only changed behavioral outcomes as before, but also specifically reduced activation in the amygdala region of the brain. As the amygdala is known to mediate arousal responses, this shows that the difference in arousal demonstrated through skin conductance response in Sokol-Hessner et al. (2009), resulted specifically from a change in activation of the amygdala.

Such a result lends credence to the possibility that intentionally reframing periods of underperformance in advance may successfully change the neural activations associated

Table 4. BOLD Signal Greater During Non-Switching Periods than During Switching Periods

		Peak level		Cluster-level	
Cluster	Peak location title	Peak MNI coordinates	Z-score	*p* (FWE-corr)	k_e
1	R. Lingual Gyrus (BA 18)	2, -84, -4	4.73	0.000	3406
	L. Cuneus (BA 18)	-24, -82, 20	4.54		
	L. Cuneus (BA 18)	-8, -76, 18	4.21		
2	R. Fusiform Gyrus (BA 20)	38, -40, -24	3.96	0.362	96
	R. Anterior Lobe, Culmen	28, -48, -26	3.81		
3	L. Precentral Gyrus (BA 4)	-44, -12, 46	3.84	0.453	82
	L. Precentral Gyrus (BA 4)	-52, -8, 44	3.74		
	L. Precentral Gyrus (BA 4)	-36, -14, 46	3.34		
4	L. Fusiform Gyrus (BA 20)	-36, -36, -22	3.77	0.976	14
5	L. Parahippocampal Gyrus (BA 36)	-36, -22, -18	3.65	0.983	12
6	R. Superior Temporal Gyrus (BA 41)	42, -32, 6	3.53	0.996	5
7	L. Anterior Lobe, Culmen	-22, -46, -18	3.50	0.960	18
8	L. Cingulate Gyrus (BA 31)	-18, -54, 20	3.50	0.965	17
9	L. Posterior Cingulate (BA 29)	-10, -50, 18	3.47	0.076	14

Note. Height threshold $t = 3.61$ ($p = 0.001$) Extent threshold (k = 0 voxels) Voxel size 2x2x2 mm Volume 182552 voxels Expected voxels per cluster, k = 25.199 FWHM (in mm) = 14.7x14.5x12.2.

with subsequent advisor underperformance, and potentially, change the likelihood of changing advisors. Future research may be able to establish the effectiveness, and neural mechanisms, of these types of prophylactic reframing strategies in the context of advisor selection. However, some evidence suggests the special relevance of such loss aversion research. As mentioned previously, activation in the ACC as seen in the present study has been associated with error detection. Magno, Foxe, Molholm, Robertson, and Garavan (2006) advanced a hypothesis that "the functional role of the cingulate is not particular to errors but instead is related to an evaluative function concerned with on-line behavioral adjustment in the service of avoiding losses" (p. 4769). This would suggest even more strongly that reframing losses is of central importance in influencing the neural activations that result in the choice to switch advisors.

Lessons from Loss Chasing

The broad similarity of neural activations associated with switching financial advisors in the present study with choosing to stop chasing losses in a gambling study suggests the possibility that some research on gambling behavior may be usefully applied to investment choices and advisor selection. Conceptually, the decision to stop chasing losses in a gambling context and the decision to stop using a particular financial advisor appear similar, especially given the association of advisor switching with underperforming the market. In both cases, the person experiences negative outcomes. If optimism is maintained regarding future outcomes, then the gambling behavior continues (or the advisor is retained). However, at the point that optimism regarding future results evaporates, further gambling or further use of the financial advisor stops.

Loss chasing is a behavior of central importance in the study of gambling and gambling problems. It is the essential characteristic that uniquely defines pathological gambling in contrast with other forms of addiction. Lesieur and Rosenthal (1991), in a review of the literature prepared for the American Psychiatric Association task force on DSM-

IV explain, "These criteria (for "Pathological Gambling") were specifically modeled after those for psychoactive substance dependence in the DSM-III revision. All the criteria, with the exception of criterion five (chasing losses), have their counterpart in the diagnosis of alcohol, heroin, cocaine and other forms of drug dependence" (pp. 7-8). Similarly, Schellinck and Schrans (1998) suggested the loss chasing behavior "will be highly effective in discriminating between problem players and those in the other (diagnostic) segments" (Section: 3-56). A variety of other research in gambling has demonstrated that loss chasing is a core phenomenon in problem gambling (Dickerson & Adcock, 1987; Lesieur, 1984; O'Conner & Dickerson, 2003; Orford, Morison, & Somers, 1996).

Clearly, in the gambling context, loss chasing can become a problematic behavior. However, in the investment context, continued investment in the face of down markets, or temporary underperformance, is often critical to long term investor success. As the popular saying goes, investor returns are more about "time in" the market than "timing" the market. Such behavior also has important macroeconomic consequences. Excessive reactions to negative market events dramatically exacerbate recessionary trends by contracting available capital. From both an individual-level and macro-level perspective, encouraging continuation of sound investment strategies in the face of losses should produce relatively positive outcomes. Thus, understanding predictors of neurally similar behaviors in gambling may generate insight into strategies that may also be effective in an investment context.

Lambos and Delfabbro (2007) established that problem gambling was not associated with reduced numerical ability or with any misunderstanding of gambling odds. Instead, "pathological gamblers are particularly prone to various cognitive biases that may explain why they continue to gamble despite having incurred substantial losses" (p. 157). A variety of studies have confirmed a relationship between measurements of problem gambling and susceptibility to cognitive biases related to gambling (e.g., Jefferson & Nicki, 2003; Joukhador, Blaszczynski, & MacCallum, 2004; Toneatto, Blitz-Miller, Calderwood, Dragonetti, & Tsannos, 1997).

A shared characteristic of many such biases is a reinterpretation of gambling losses. For example, loss experiences may be interpreted as "near misses." Griffiths (1999) explained that the problem gambler "is not constantly losing but constantly nearly winning" (p. 442). Near misses are inevitable in many games. For example, slot machine players interpret "their" machine later paying out to another player as a near miss (O'Connor & Dickerson, 1997). Poker players are unlikely to play for an extended period without experiencing a near-miss, and such near misses are a major reason for chasing losses (Browne, 1989). Given the wide variety of potentially winning combinations in some electronic gaming machines, Delfabbro and Winefield (1999) suggested, "As a result, it is possible to see almost every outcome as a near-miss" (p. 448).

A related heuristic is to interpret losses as providing information that will improve future outcomes. For example, interpreting a loss as a near miss can relate to a cognitive distortion of probability, leading to the belief that one is about to be lucky (Griffiths, 1990). Reid (1986) also noted this inclination to believe that success was approaching due to near-miss experiences explaining, "there was a noticeable tendency to think of gaining information from a near-miss even when the outcome could only be a matter of chance" (pp. 32-33). A common example of reinterpreting losses as providing information of improving future outcomes is the gambler's fallacy (a.k.a., representation bias). This heuristic suggests that an event is more probable if it has not occurred for some time (Lambos & Delfabbro, 2007). For example, the fact that a coin flip has produced "tails" for five consecutive flips might suggest an increased likelihood that it will subsequently be "heads."

A variety of other cognitive biases are associated with problem gambling. Summarizing these findings Lambos and Delfabbro (2007) explained, "Dysfunctional gambling of this type is thought to arise because pathological gamblers frequently fall victim to a variety of well-documented decision-making errors, heuristics or biases …all of which either encourage gamblers to continue playing, or make them overly confident about the potential profitability of gambling" (p. 158).

Some heuristics used in investment advice may serve similar roles by reinterpreting losses or market downturns. For example, dollar cost averaging is a strategy of investing fixed sums of money at regular intervals regardless of market circumstances. It is often explained as a way to purchase more shares of a company when they are "cheap," in that the fixed dollar amount purchases more shares following a price decline. A variety of research suggests that such a strategy is not optimal (e.g., Knight & Mandell, 1993; Leggio & Lien, 2003). Similar to the gambler's fallacy, the strategy implies that recent losses in price predict an increased probability of future gains (i.e., shares following a drop are “cheap”). And indeed, were this true, that is, if security prices exhibited mean reversion behavior, then such a strategy would be statistically valid (Brennan, Li, & Torous, 2005). However, even if the strategy is not statistically valid, it may produce better investor behavior by reinterpreting losses as buying opportunities. Conversely, disabusing clients of the gambler’s fallacy (i.e., securities are not more likely to increase following a price decline) may result in less time in the market and consequently lower long-term returns.

To the extent that volatility is associated with greater returns over extended periods of time, a rational long-term strategy may be to keep investors in more volatile investments for longer periods of time. Given that the risk of exiting is pronounced following periods of underperformance or relative loss, heuristics that reinterpret such losses may be critical to sustaining market participation. Gambling research suggests that these heuristics, rather than increasing investors’ general financial and mathematical abilities, may be the key to sustaining market participation. The neurological similarity between switching advisors and ceasing to chase losses in gambling suggests these loss-reinterpretation heuristics may also be critical to avoiding advisor switching during inevitable periods of relative underperformance. Such strategies may also be employed by individual investors who wish to overcome the emotional difficulty of staying with a volatile strategy for a long period of time.

People Versus Performance

As discussed previously, immediately preceding advisor switching, subjects appear to have engaged in mathematical comparison and error-detection related activities. Conversely, during “quiet” periods substantially removed from switching behavior, subjects were more likely to be concentrating on the images of the advisors themselves, specifically reflected by relatively greater activation in face-specific regions of the occipital cortex. Although this may simply be an artifact of this particular study design, it is also possible that this shifting of attention relates to financial advisor switching in the real world. Clients who are intently focused on the financial aspects of advisor performance, for example frequent comparison of returns against various benchmarks, may be more likely to engage in advisor switching. Conversely, clients who are focused on the person of the advisor, (i.e., the relationship with the human being, may be less likely to engage in advisor switching).

Such an emphasis towards people and away from performance, at least short-term performance, is common in popular practice-building strategies for financial advisors. The emphasis is frequently on building relationships and sharing values, rather than beating the market (e.g., Bachrach, 1996; Mullen, 2009). In a popular guide for building financial planning practices, Katz (1999) suggests completely removing short-term performance benchmarks from reports to clients. Although planners should have the information available to clients who are interested, bringing up constant comparisons was not deemed beneficial. Similarly, trying to “beat clients over the head with education on Modern Portfolio Theory,” was deemed unhelpful given that, “Clients only want to know two things: 1) are you competent and 2) do you put their interests first?” (Katz, 1999, p. 205).

Conclusion

In the real world, selecting and changing advisors is a complex, multifaceted and often highly social process. However, neuroimaging results from this simplified experimental example suggests two possible implications. First, following related findings from gambling research, advisors may do well to use loss-reinterpreting heuristics in an effort to keep clients in sound long-term investment strategies during times of negative volatility. Second, emphasizing personal qualities and relationships may be more effective in retaining clients than consistently drawing attention to return-related numerical comparisons.

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