Why Controllers Compromise on their Fiduciary Duties:

EEG Evidence on the Role of the Human Mirror Neuron System

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ABSTRACT

Business Unit (BU) controllers have a fiduciary role to ensure the integrity of their unit's financial reporting. They often face, however, social pressure from unit managers to violate this integrity. Drawing on the literature on the human mirror neuron system (hMNS), we use electroencephalographic (EEG) evidence from 29 professional controllers to predict their ability to withstand such social pressure. Event-related desynchronization (ERD) of mu waves during observation of emotional facial expressions served as predictor of controllers' susceptibility to emotional influence. Violations of fiduciary duty were measured using vignettes of controllers being pressed by their unit manager to adapt their financial reports. For each of six vignettes subjects were asked to state the likelihood they would comply with a dubious reporting approach suggested by the manager. We find a positive relationship between controllers' mu waves ERD and their inclination to comply. This relationship was strongest when controllers were pressed to serve the unit manager's personal interests. These findings suggest that social pressure is an antecedent of financial reporting integrity violations, and that controllers' compliance with such pressure is predicted by activation of the mirror neuron system by emotional stimuli. We conclude that considering BU controllers' neurobiological characteristics adds to the explanation of financial reporting integrity and possible violations thereof.

Keywords: controllers; fiduciary role; ethics; social pressure; mirror neuron system

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I. INTRODUCTION

Over the last decades a number of accounting scandals have increased awareness in society, capital markets and business firms of financial reporting integrity violations (Cohen, Dey, and Lys 2008). Traditionally, accounting research has studied financial reporting quality at the firm level, as evidenced by the large literatures on earnings management (e.g. Zang 2012) and on audit failures (e.g. Kanagaretnam, Krishnan, & Lobo 2010). However, since accounting reports are prepared by accounting professionals inside firms, some recent studies seek to understand the integrity-related roles of these individuals. One relevant such role is that of the BU controller, who plays an important fiduciary part in safeguarding financial reporting integrity (e.g. Sathe 1983). It is commonly accepted that BU controllers may violate their fiduciary role, and engage in financial misreporting, because of the social pressure they encounter from their unit managers (Davis, DeZoort, and Kopp 2006; Sathe 1983; Hartmann and Maas 2010). Unit line managers have incentives to misrepresent the performance of their unit, and to influence the BU controller's reporting behavior (Indjejikian and Matejka 2006). As BU controllers are often involved in managerial decision making processes themselves and typically work in close cooperation with BU management, the incidence of social pressure is hard to avoid (Maas and Matejka 2009). This makes the individual controller's ability to withstand social pressure, fulfill fiduciary obligations, and ensure reporting integrity, a crucial personal competence (Davis, DeZoort, and Kopp 2006; Sathe 1983).

In this paper we explore whether BU controllers' personal ability to withstand social pressure can be explained by their individual neurobiological responses to emotional stimuli. Our analysis builds on the literature that investigates the role and function of the human mirror neuron system (Rizzolatti & Craighero 2004). This system has been demonstrated to play a fundamental role in social processes and to be crucial in understanding feelings and emotions of others. For example, the human mirror neuron system (hMNS) is associated with theory of mind (Gallese & Goldman, 1998), perspective taking (Yang et al. 2009), and empathy (Carr et al. 2003).

Humans differ in the extent of activation in the hMNS when confronted with emotional stimuli, which explains their behaviors in emotionally laden situations (Kaplan and Iacoboni 2006; Leslie, Johnson-Frey, and Grafton 2004). In clinical psychology, hMNS dysfunction has been associated with autism spectrum disorders (Frenkel-Toledo et al. 2014; Oberman et al. 2005). In the marketing literature, individual differences in hMNS activation explained the degree of customer orientation of sales people (Bagozzi et al. 2011). For BU controllers, we expect that hMNS activation predicts controllers' sensitivity to social pressure by unit managers. As social pressure by definition relies on implicit and emotional cues rather than explicit and rational orders (DeZoort & Lord, 1997; Lord & DeZoort, 2001), we expect a positive relationship between hMNS activation and controllers' inclination to give in to the financial reporting changes that the manager suggests.

For a sample of 29 experienced unit controllers, we conducted a vignette-based survey on a validated set of six scenarios describing situations in which BU managers try to influence their BU controllers' financial reporting behaviors. We then examined hMNS activation by electroencephalogram (EEG) recordings during a dynamic emotional facial expressions task

(Bastiaansen et al. 2011; Jabbi & Keysers 2008; Jabbi, Swart, & Keysers 2007; Schraa-Tam et al. 2012). We used event-related desynchronization (ERD) of mu waves in the motor cortex in response to the emotional facial expressions to obtain a measure of hMNS activation (Oberman et al. 2005; Oberman, McCleery, Ramachandran, & Pineda 2007; Ulloa & Pineda 2007). Our findings indicate a strong association between hMNS activation during the emotional facial expressions tasks and controllers' inclination to compromise on fiduciary duties when BU managers socially press them to do so.

This paper contributes to the literature in at least three ways. First, this paper extends the literature on the intra-firm origins of financial reporting integrity problems. In particular, it confirms the important role of controllers as guards of reporting quality, and the potential impact of social pressure (Indjejikian and Matejka 2006; Maas and Matejka 2009; Hartmann and Maas 2010). Second, the paper provides a theoretical foundation of social pressure, by emphasizing its emotional basis and considering that individuals differ in their susceptibility to emotional influence (DeZoort and Lord 1997; Lord and Dezoort 2001). Third and final, the paper uses a neural predictor of controllers' social behaviors, which provides the study with a neuroscientific methodological basis. This does not merely enhance measurement validity, but rather enables extending the debate on the desired fundamental qualities of accountants and controllers beyond its current focus on behavioral norms. In doing so, we contribute to the emerging field of neuroaccounting (Dickhaut 2009; Dickhaut, Basu, McCabe, & Waymire 2010).

The remainder of the paper is structured as follows. Section II gives the theoretical background of our study and develops hypotheses. Section III presents the research design and implementation. Section IV offers an analysis of the empirical results. Section V reviews the findings, presents conclusions, and discusses theoretical and practical implications and limitations of the study.

II. LITERATURE REVIEW AND HYPOTHESES

Responsibilities of the BU controller

An important role characteristic of BU controllers is the combination of local and functional responsibilities (e.g. Hopper 1980; Indjejikian & Matejka 2006). The latter type of responsibilities pertains to the fiduciary duty controllers have in enabling corporate control. BU controllers should ensure that corporate management receives objective and reliable reports on the performance of the BU, which requires sufficient independence in opinion, judgment, and reporting from BU managers, who have incentives for misreporting (San Miguel and Govindarajan 1984). This independence, however, is affected by a controller's local responsibilities to support their BU managers in operational and strategic decision making. Although the quality of local support is believed to benefit from close involvement with BU management (Sathe 1983), a number of studies show that such involvement may pose a threat to controllers' fiduciary responsibilities. Lord & DeZoort (2001) and Davis et al. (2006) show that obedience pressure from immediate superiors causes controllers to violate explicit corporate policies. Indjejikian & Matejka (2006) and Maas & Matejka (2009) demonstrate a positive relationship between emphasis on the controllers' local responsibilities and organizational slack. Hartmann and Maas (2010) find that under such conditions, controllers high in Machiavellianism are likely to create slack when pressed by their BU manager.

The tension between the two responsibilities cannot easily be removed, since exercising effective fiduciary control requires at least some involvement with local management (Sathe 1983). Moreover, controllers who are more closely involved in local decision making typically also have better and more timely access to the information needed to exercise such control (Maas and Matejka 2009). This necessary coherence between fiduciary and local tasks is personified in the ideal type of the ‘strong controller’ (Sathe 1982, 1983)[1]. Such a controller possesses a skill set that enable providing support for local decision making while safeguarding reporting and other fiduciary duties. This type of controllership has seen a steady rise over the last decades (Maas and Matejka 2009), representing an evolution of the BU controller’s role from ‘bean counter’ to ‘business partner’ (e.g. Burns & Baldvinsdottir 2005; Granlund & Lukka 1998; Zoni & Merchant 2007). The inherent source of role conflict of the contemporary controller thus necessitates organizations to find and cultivate professionals that are able to withstand inappropriate social pressures to misreport from their BU managers (Davis et al. 2006; Hartmann & Maas 2010; Lord & DeZoort 2001).

Establishing the (in)appropriateness of reporting actions suggested by BU management often requires controllers’ personal judgments, as not all reporting choices are monitored or observed by higher management (Maas and Matejka 2009). This means that controllers have a considerable discretion to, for example, accept budgetary slack creation as a part of the normal ‘game’ of budgeting (Hofstede 1967; Collins, Munter, & Finn 1987), or denounce it as a violation of corporate control (Davis et al. 2006; Indjejikian & Matejka 2006). During such judgment calls, controllers need to balance their fiduciary responsibility with practical demands.

[1] According to Sathe’s typology, organizations may choose to emphasize local responsibilities (the ‘involved’ controller); to emphasize functional responsibilities (the ‘independent’ controller); to divide the two sets of responsibilities over two people (the ‘split’ controller); or to emphasize the importance of both (the ‘strong’ controller).

BU managers may try to influence this balance explicitly through obedience pressure or social conformance pressure (Davis et al. 2006; Lord & DeZoort 2001). They may also exert implicit social pressure when making emotional appeals to controllers to consider personal or corporate consequences of a reporting decision (DeZoort & Lord 1997; Lord & DeZoort 2001). Appeals with affective or emotional loadings create compliance through emotional contagion (Weiss and Cropanzano 1996; Johnson 2008). Whether or not such appeals have judgmental and behavioral effects depends on the emotional susceptibility of the receiver (Bakker and Schaufeli 2000; Totterdell 2000; Johnson 2008). We thus expect that individual controllers' reactions to such forms of social pressure reflect a generic receptivity to such social and emotional cues. Research in neuroscience suggests that such receptivity is predicted by mirror neuron system activation.

Mirror neurons

Over the last decades, studies in neuroscience have documented the role of neurobiological factors in determining humans' affective, cognitive and behavioral responses to social cues. The identification of the hMNS in particular has greatly advanced our understanding of humans' receptivity to social and emotional cues (Fabbri-Destro and Rizzolatti 2008). The hMNS denotes those parts of the human cortex that have the property to be active both during the execution of an action and the observation of the execution of that action by others. This mirroring property was initially found through single-cell recordings of neuronal firing in the premotor cortex of macaque monkeys (Di Pellegrino et al. 1992)[2]. Later studies established the existence of a

[2] It was found that certain cells fired both when monkeys made and observed a grasping movement. Over the last two decades, these findings have been developed extensively. Macaque mirror neurons are also involved in mouth actions (Ferrari et al. 2003) and posited to be involved in communication (Rizzolatti, Fadiga, Gallese, & Fogassi 1996); they represent actions based not just on the motorics but on the goal of the action (Umiltà et al. 2001; Rochat et al. 2010); and they respond to auditory as well as visual stimuli (Kohler et al. 2002; see also Keysers et al. 2003). In addition to area F5, mirror neurons were also found in the inferior parietal lobule or area PFG (Fogassi et al. 2005).

homologue in the human brain (e.g. Fadiga, Fogassi, Pavesi, & Rizzolatti 1995)[3]. Initially, studies on humans focused on the specific counterparts of the macaque areas (e.g., Decety et al. 1997). Later studies identified various further cortical regions involved in the hMNS (Fabbri-Destro & Rizzolatti 2008; Iacoboni & Dapretto 2006; Keysers, Kaas, & Gazzola 2010).[4]

The mirroring properties of the hMNS are considered to play a crucial role in social cognition (Carr et al. 2003), which confirms the essential role of social imitation in human social behavior (Lieberman 2007) and in building social relationships (Chartrand and Bargh 1999). Chartrand and Bargh (1999) found a higher inclination to mimic somebody else's behaviors and postures for experimental subjects who scored higher on self-reported empathy. Studies on hMNS activation demonstrate similarity of cortical activation during deliberate execution and imitation of actions (see e.g. Iacoboni et al. 1999; Koski et al. 2002; Leslie, Johnson-Frey, & Grafton 2004; for a review see e.g. Rizzolatti & Craighero 2004). Leslie et al. (2004) established the involvement of the hMNS in imitative motor actions for facial expressions. Iacoboni (2009) shows similar neuronal action for humans observing and executing emotional facial expressions. However, these studies also show that hMNS activation is not restricted to deliberate imitation (Yang et al. 2009). Schulte-Rüther, Markowitsch, Fink, and Piefke (2007) and Van der Gaag, Minderaa, and Keysers (2007) show hMNS activation even when emotional facial expressions are merely observed, without active imitation. This suggests a major role of the hMNS in the shared understanding of action, feelings and intentions, required for higher forms of social functioning (Sinigaglia 2013). The hMNS is thus considered to play an important role in theory

[3] An exception is the work of Mukamel, Ekstrom, Kaplan, Iacoboni, & Fried (2010), who provide single-cell evidence in support of the claim that individual mirror neurons exist in the human brain.

[4] It was initially proposed that the ventral premotor cortex and the pars opercularis of the posterior inferior frontal gyrus are the human counterparts of the macaque mirror area F5, and that the rostral inferior parietal lobule corresponds to the macaque mirror area PFG (Decety et al. 1997; Iacoboni et al. 1999; Koski et al. 2002; Rizzolatti et al. 1996; Rizzolatti & Craighero 2004; Rizzolatti, Fogassi, & Gallese 2001).

of mind (Gallese and Goldman 1998), and empathy (Carr et al. 2003; Leslie, Johnson-Frey, and Grafton 2004).

The studies on the hMNS suggest that the underlying mechanism enabling such experiences is mirroring (Decety et al. 1997; Carr et al. 2003). When emotions are expressed through motor actions of facial muscles, the automatic mirroring of emotional facial expressions of others enables us to experience their emotional content (Bargh, Chen, and Burrows 1996; Iacoboni et al. 1999; Iacoboni et al. 2001). Individuals differ in the extent to which they display mirroring activities, which explains their social functioning. Studies on hMNS responses to emotional cues (Oberman et al.;2005) and Dapretto et al.; 2006) demonstrate reduced hMNS activity in children with autism spectrum disorders (ASD). Zaki, Weber, Bolger, & Ochsner (2009) find that hMNS activation corresponds with the accuracy of judgments about others' emotional states. Bastiaansen et al. (2011) show a relationship between age-related decreases of ASD and age-related increases of hMNS activation. In particular, a strong relationship exists between social imitation, hMNS activation, and empathy (see Kaplan & Iacoboni 2006; Pfeifer, Iacoboni, Mazziotta, & Dapretto 2008). A recent meta-analysis of 21 fMRI studies (Molenberghs, Cunnington, & Mattingley 2012) confirms similarity of activation of the posterior IFG and the adjacent ventral premotor cortex, the amygdala, insula, and cingulate gyrus both in executing and in observing emotional facial expressions. Overall, the literature points to hMNS activation as a valid predictor of an individual's susceptibility to emotional influences.

Hypothesis development

We investigate situations in which a BU manager exerts social pressure on a controller, which potentially threatens the controller's fiduciary obligations. Based on the neuroscientific evidence on the hMNS as the driver of emotional receptivity, we expect that the extent to which controllers are influenced by such pressure is predicted by their hMNS activation. Individual differences in hMNS activation when confronted with emotional cues reflect individual differences in the level of susceptibility to emotional contagion. We therefore expect that the propensity to cooperate with the local BU manager is associated with hMNS activation. This is summarized in the first hypothesis.

H1. BU controllers who show greater hMNS activation while confronted with emotional stimuli are more likely to comply with their BU manager's demands to misreport.

Importantly, BU managers may exercise pressure from different motives. One motive is the BU manager's personal interest. This reflects a situation in which a BU manager may profit from misreporting. Another motive is the BU manager's corporate interest. The latter refers to cases in which corporate reporting policies conflict with the BU manager's best judgment. In these cases BU managers' pressure to deviate from corporate policies could even serve shareholder interests. In the former type of situation, where self-interest is central, direct consequences for the BU manager are at stake, and the emotional and social pressure is more personal. Here, the BU manager would typically provide self-interested grounds in hopes of gaining a 'personal' favor from BU controllers. Both types of situations may fall within the discretionary space of the controller. However, we expect that those involving managerial self-interest will be influenced more directly by the emotional appeal to BU controllers. We explore the effect of motives by detailing our expectations about the impact of hMNS activation on controllers' behaviors, as formulated in the second hypothesis as follows.

H2. The positive relationship between BU controllers' hMNS activation and their likelihood to comply with their BU manager's demands to misreport is stronger when BU managers are driven by self-interest than when driven by corporate interest.

III. METHOD

Sample

We recruited professional controllers from the Executive Master of Finance and Control programs of two universities in the Netherlands. These programs are designed for professional controllers and lead to the qualification of Registered Controller. A number of sessions were hosted at which participants were invited to complete a paper-based survey containing vignettes (see below) and to sign up for an EEG measurement in the lab at Erasmus University Rotterdam. Participants first completed the survey, and visited the EEG lab within one to five weeks after the survey. Participation was voluntary and rewarded with an amount of EUR 50 (approx. USD 65). A total of 29 people completed the survey and EEG measurement procedure (5 females; mean age 34.7 years (SD = 7.8)).

Vignettes

To measure the propensity of controllers to cooperate with local managers against fiduciary duties, participants responded to a set of situations contained in six vignettes, which were included in the paper-based survey. Each vignette describes a BU controller who is requested by a BU manager to engage in an action that is not in accordance with fiduciary requirements.

Participants indicated on a scale from 1 (= Very unlikely) to 7 (= Very likely) whether they would engage in the action proposed by the BU manager. The vignettes were built up in structured fashion, each using the same types of components presented in the same order. The vignettes were validated in a number of interviews with professional controllers. We held a total of seven interviews, each lasting between sixty and ninety minutes. In these interviews a preliminary set of vignettes was reviewed. Each situation was separately discussed in detail. Out of the preliminary set we selected six vignettes for further use, based on intelligibility, clarity, recognizability, realism, and relevance. The six vignettes were submitted to a pretest—to validate the distinction between the SELF and CORP vignettes—and used in the final survey.

Exhibit 1 provides the structure and an example of a vignette. The full set of vignettes is reproduced in Appendix A. Each vignette portrays the occurrence of an event beyond the control of the BU manager. This prompts the BU manager to give an emotional response and to propose some action to the BU controller that would ameliorate the situation. This proposition goes against the fiduciary responsibilities of the BU controller. In order to be able to test Hypothesis 2 we developed two types of vignettes. Three vignettes describe a situation in which the BU manager aims to promote self-interest (SELF). The other three situations portray BU managers who press the controller to promote the corporation's interest (CORP). Two paper-based versions with different pseudo-random order were used to control for vignette order effects.

--- INSERT EXHIBIT 1 ABOUT HERE ---

EEG recording

Participants visited the Erasmus Behavioral Lab on individual appointment for the EEG measurement session. Upon arrival, they were brought to the soundproof and electromagnetically shielded EEG recording chamber, and seated in a comfortable chair[5]. Activation of participants' hMNS was assessed using electroencephalographic (EEG) recording of mu waves, while participants were watching movie clips that contained visual emotional stimuli, as further explained below. In resting state, sensorimotor neurons tend to fire synchronously, leading to large amplitude EEG oscillations in the mu frequency band (8-13 Hz). Mu suppression, which is the dampening or even disappearance of these oscillations as observable through EEG, signifies the activation of sensorimotor neurons. Such activation involves the asynchronous firing of neurons, which occurs in parallel with one's own motor actions (e.g. Pfurtscheller, Neuper, Andrew, & Edlinger, 1997), but also with the observation of the motor actions of others (e.g. Pineda, Allison, & Vankov, 2000). The mu suppression associated with the observation of dynamic emotional expressions of others is therefore indicative of hMNS activation (Oberman et al. 2005; Oberman et al. 2007; Ulloa and Pineda 2007; Frenkel-Toledo et al. 2014). The visual emotional stimuli, which were originally developed for this purpose by Van der Gaag et al. (2007), consisted of full-color video clips of dynamic facial expressions by actors. Four different types of clips were used, each representing a within-subject experimental condition: facial expressions of positive emotions; facial expressions of negative emotions; neutral, non-moving facial expressions; and moving abstract shapes[6]. Illustrative still images of the clips are provided

[5] Data were recorded using a BioSemi ActiveTwo amplifier system (www.biosemi.com). Measurement was taken from 32 scalp sites using Ag/AgCl electrodes mounted in an elastic cap according to the International 10-20 method of electrode placement. Two additional electrodes were placed at the mastoids behind the ears; these were computationally linked and used as reference electrodes. To monitor eye movements and blinks the electrooculogram (EOG) was recorded using four electrodes, attached to the outer canthi of both eyes and to the infraorbital and supraorbital regions of the right eye. The online EEG and EOG signals were recorded with a low-pass filter of 134 Hz. All signals were digitized with a sample rate of 512 Hz and 24-bit A/D conversion.

[6] The clips lasted three seconds each and were separated by one-second intervals of black screens. For the three conditions containing facial expressions, actors were displayed from the shoulders up, with the face in the center of the image. They all started with a neutral expression, with movement commencing after 0.5 s. The condition of abstract shapes was used as a baseline condition to correct for individual differences in absolute mu power. It

in Exhibit 2. There were 72 clips per experimental condition, presented in pseudo-randomly ordered blocks of three clips of the same condition. The full task lasted 19:12 minutes. This experimental task has previously been employed in measuring mirror neuron activation in various studies (e.g. Bastiaansen et al. 2011; Jabbi & Keysers 2008; Jabbi, Swart, & Keysers 2007; Schraa-Tam et al. 2012). The use of dynamic stimuli is in line with recommendations from recent research showing processing differences between dynamic and static representations of facial expressions (Biele and Grabowska 2006).

--- INSERT EXHIBIT 2 ABOUT HERE ---

IV. RESULTS

The distinction between the SELF and CORP vignettes was validated as follows. A separate sample of 51 accounting professionals[7] rated each vignette on two dimensions: the extent to which the BU manager is following his/her self-interest and the extent to which the BU manager is following the interest of the corporation. We aggregated the ratings of the three SELF vignettes and those of the three CORP vignettes. On the dimension self-interest, scores were 6.27 for SELF vignettes and 4.20 for CORP vignettes (t = 10.471, p < .001). On the dimension corporate interest, average scores were 2.67 for SELF vignettes and 4.41 for CORP vignettes (t =

consisted of oval figures with striped patterns initially presented statically, then starting to move around the screen after 0.5 s.

[7] This sample (14 females) had a mean age (41.3 years) and mean level of work experience (17.4 years) significantly higher ($t = 3.787$, $p < .001$ and $t = 5.166$, $p < .001$, respectively) than those of the EEG sample (34.7 years and 8.9 years, respectively); however, no evidence of differences between the two samples in mean scores per vignette was revealed when conducting a MANOVA ($F = .092$, $p = .997$) nor when conducting individual t-tests per vignette (all t-statistics < .5, all $p > .5$).

9.798, $p < .001$). These scores suggest that the motives of the BU managers are different between the SELF and the CORP vignettes, in line with our intended focus.

We computed the independent variable mu suppression (MU) as the ratio of mu power in the emotional and abstract shapes condition[8]. This employment of a baseline condition allows us to filter out individual differences in mu power unrelated to mirror neuron activity, for example resulting from differences in scalp thickness or electrode impedances (Pineda & Oberman 2006). To correct for the inherent non-normality of the ratio variable, we then applied a logarithmic transformation (Oberman et al. 2005). This procedure yielded a measure of mu suppression in which a value of zero indicates no difference in mu power between the emotional and baseline condition, and *lower* values indicate more 'mirroring' (Ulloa and Pineda 2007), associated with *higher* levels of trait empathy (see Yang et al. 2009).

Through the survey we obtained six scores per participant reflecting their self-reported likelihood of engaging in certain actions in cooperation with BU managers. We refer to this variable as COOP. The mean score overall was 3.33 (SD = .87) with means per vignette across participants ranging from 2.89 to 4.11. Descriptive statistics for COOP per vignette are reported in Table 1.

--- INSERT TABLE 1 ABOUT HERE ---

[8] The data were first processed using BrainVision Analyzer 2.0 software (www.brainproducts.com). EEG and EOG data were filtered off-line with a band- pass of 0.1 to 30 Hz (24 dB/octave slope) and were re-referenced off-line to the digital average of the mastoids. Prior to analyzing the EEG data, we corrected for eye blinks and movements as reflected in the EOG (Gratton, Coles, and Donchin 1983). We analyzed the data for electrodes C3, C4, and Cz (Oberman et al. 2005). Data were segmented into epochs of 3,000 ms based on the start and end point of the stimulus clips. Then for each segment the integrated power in the mu range (8–13 Hz) was computed. A Hamming window was used to control for artifacts which may result from data splicing. The resulting segments were averaged per experimental condition.

To test the main hypothesis that mirror neuron activation is positively associated with cooperation, we computed an aggregate score over the six vignettes and regressed this measure on MU. This yielded a standardized regression coefficient of –.445, which was significantly different from zero (t = -2.485, p = .020). Higher mu power while observing emotional stimuli, which indicates a weaker response, is thus generally associated with lower willingness to cooperate[9]. This result supports Hypothesis 1.

Our second test aims to establish this result holds indiscriminately across the six vignettes or whether, as predicted in Hypothesis 2, MU is more strongly associated with COOP for the three SELF vignettes than the three CORP vignettes. We refer to this distinction with the moderating variable vignette type (TYPE). By averaging participants' three scores per vignette type we obtained two measures per participant, which we submitted to a repeated-measures ANCOVA using TYPE as within-subject factor and MU as covariate. This revealed a statistically significant cross-level interaction between MU and TYPE (Wilks' Lambda = .836, F = 5.290, p = .029) as well as a main effect of TYPE (F = 4.567, p = .042) and a main between-subjects effect of MU (F = 5.533, p = .026). MU was more predictive of COOP for the SELF vignettes than for the CORP vignettes, in accordance with Hypothesis 2.

We further investigated the strength of the effect using Hierarchical Linear Modeling (HLM). Our research design resulted in a dataset with two levels. The independent variable MU is measured at the level of the participant; the dependent variable COOP is measured at the vignette level and therefore was observed six times per individual; and the moderating variable

[9] After responding to the vignettes, participants completed a questionnaire containing two subscales of the Interpersonal Reactivity Index (IRI) developed by Davis (1980): empathic concern (EC) and perspective taking (PT). The IRI has been associated with hMNS activation (Kaplan and Iacoboni 2006; Pfeifer et al. 2008). Our data reveal correlations with MU of -.119 for PT and -.161 for EC; furthermore, correlations with COOP were .016 for PT and .138 for EC. All effects are in the expected direction, although given the sample size for this analysis (n = 29) none of these correlations reached statistical significance (all p > .05).

TYPE is a dummy variable at the vignette level. To test Hypothesis 2 we were interested in a cross-level interaction effect between MU and TYPE in predicting COOP. HLM enables us to model and test this relation in a linear model represented by a single equation with a complex error structure (see Bryk & Raudenbush, 1992), avoiding the loss of information from aggregating vignette scores into two values per participant. We present the results of two models here, both estimated using a Generalized Least Squares algorithm. Model 1 addresses the main effect of mu suppression on cooperation. In Model 2, we introduce TYPE as a first-level explanatory variable with a cross-level interaction with MU[10]. In order to get more meaningful coefficients, the second-level independent variable MU was centered around its mean (Algina and Swaminathan 2011), and furthermore the dependent variable COOP was centered around vignette mean, so that scores indicated the participants' deviation from the average score across participants on a particular vignette.

The main results of parameter estimations for both models can be found in Table 2. Model 1 revealed that MU is a statistically significant predictor of COOP (γ_{01} = -1.321; t = -2.338; p = .027). This supports the notion that there is a negative main effect of mu power on cooperation, as predicted in Hypothesis 1. Model 2 allowed us to further qualify this relation. There was a significant interaction between MU and TYPE (γ_{11} = -1.551; t = -2.088; p = .039), such that MU was more strongly related to COOP when TYPE was one rather than zero. The main effect of MU in Model 2, which can be interpreted as the coefficient of MU when TYPE is zero, was now no longer statistically significant (γ_{01} = -.546; t = -.807; p = .427). Jointly, these findings provide support for the moderating effect of TYPE as formulated in Hypothesis 2: MU

[10] We tested a number of additional models to control for the effects of gender, age, and work experience. Note that all three control variables are measured at the personal level (i.e. Level 2). Each control variable was tested separately for a main effect on COOP and furthermore for a cross-level interaction effect with SELF. No evidence was found for the existence of such effects; in the remainder of the analysis presented here, control variables are not part of the models.

predicts COOP when the manager has self-interest in mind, but not when he/she has corporate interest in mind.

--- INSERT TABLE 2 ABOUT HERE ---

V. DISCUSSION AND CONCLUSIONS

The goal of this paper is to explain BU controllers' propensity to engage in financial reporting behaviors which constitute a violation of their fiduciary obligations. Based on the mirror neuron system literature on the neurobiological drivers of social behavior, we expected a positive relationship between mirror neuron activation during a dynamic facial expression task and controllers' inclinations to give in to social pressure from their BU managers. This pressure has been considered an important cause of misreporting in previous studies. The results from our study suggest that controllers differ in their receptivity to such pressure, which predicts their subsequent reporting behavior. In particular, our results indicate a strong positive relationship between hMNS activation, as measured by desynchronization of mu waves during the emotion observation task, and their propensity to give in to the social pressure by their BU managers. This finding provides a first indication that the personal neurobiological characteristics of accounting professionals play an important role in compromising fiduciary obligations. Controllers who are relatively sensitive to emotional cues are likely to bias their decisions towards the interests of their managers, and especially so when these interests were personal rather than corporate. This suggests a higher inclination to compromise on their fiduciary role in financial reporting.

These findings have a number of implications for our theoretical understanding of the intra-organizational causes of financial misreporting. First, our results confirm the role of social pressure as an important antecedent of financial reporting problems at the level of accounting professionals inside the firm. This is in line with previous findings on the sources and effects of social pressure in the work place (DeZoort & Lord, 1997). Second, our results contribute to the growing debate on the roles of BU controllers (Hartmann and Maas 2010; Maas and Matejka 2009). In addition to job design, structure and the absence or presence of professional behavioral norms, it appears that the controller's neurobiological characteristics explain a large part of the variance in reporting behaviors. This has direct implications for our understanding of what it takes to be a 'good' accounting professional. The well-known accountant who stays calm and controlled amidst an ocean of emotional pressures may be a desirable characterization, rather than a mere archetype (Miley and Read 2012). Third, our findings confirm available neuropsychological evidence on the role of the hMNS, but extend those findings to the field of accounting. In this sense, our study provides a basis for explaining accounting systems and behaviors by neurobiological mechanisms as was suggested in Dickhaut (2009) and Dickhaut et al. (2010).

Our findings have practical implications as well. While emotional commitment is generally seen as a desirable social characteristic, and has even been proposed as a cure for unethical accounting behaviors (McPhail 2001), our study suggests that emotional receptivity may cause excessive alignment between the interests of the BU manager and those served by the reporting behaviors of the BU controller. When line managers have personal incentives to misreport their financial results, their inclinations may be best countered by controllers low on automatic compliance responses to emotional pressure. Thus, practice could consider adopting selection and placement procedures for controllers that consider the neurobiological drivers of controller behavior.

When interpreting the theoretical and empirical implications of our study, however, a number of limitations should be considered. First, our study focused on a limited set of the competences, skills and inclinations that controllers typically bring to the work place. Since the activation of the mirror neuron system is predictive of a wider set of social behaviors (Iacoboni 2009), a further analysis of the impact of emotional contagion should include its potential positive effects. Indeed, if emotional responsiveness is an indication of BU controllers' empathic ability, it may be predictive of controllers' ability to support their unit managers' other needs, which may not relate to financial reporting, such as the preparation of business decisions. In our design we explicitly excluded such potential positive effects. Second, our use of an EEG-based analysis to test a neurobiological theory limits the ease of understanding the implications of our findings. Neuroscience is a rapidly developing field, which continues to discuss the nature, consequences and measurement of fundamental neurobiological processes, including the hMNS. While our theory and method are fully in line with state-of-the-art investigations in this field of neuroscience, this requires some care in interpreting our findings. It also opens up a promising avenue for cross-disciplinary research.

Concerning such and other future studies, we would like to specifically point to three potentially fruitful avenues. First, while our study focuses on dysfunctional fiduciary behavior of controllers and disregards the role of accountants as support providers to BU management, we propose that future research should address this question. Using additional vignettes with situations crucial to such a support role may be a first step in that direction. Vignettes which present situations in which controllers face a trade-off between their fiduciary and support roles may be a further step to explore the role of emotional and implicit social cues on controllers' behaviors. Second, the findings presented here are based on self-reported behaviors in hypothetical vignettes. While these situations were carefully designed, selected, and validated, there is an opportunity for future research to confirm the relationship between emotional contagion an controller behavior using field and observational approaches. Third, studies could observe the role of emotional pressure on decision making during the actual decision making process. This would require extending the neuroscientific measurement during the vignette task. Taking the findings, limitations and directions for future research together, we finally conclude that this study demonstrates the potential synergy of further using the theoretical developments in neuroscience in the ongoing quest in the (behavioral) accounting literature to understand the actual and desired behaviors of accounting professionals.

APPENDIX A

Below we provide the full text of the six vignettes. Vignettes 1 to 3 present situations in which the BU manager is pursuing his/her self-interest, while in Vignettes 4 to 6 the BU manager has a corporate interest in mind.

Vignette 1

Jim is BU manager and direct supervisor of BU controller Carl. For most of the current year, the BU's performance was quite good. In large part this is due to Jim's excellent management skills. However, a major production problem in December threatens the BU to face a loss this year. This would cost Jim his full bonus for the year. He was counting on the bonus, so this prospect seriously distresses him, as his family situation is problematic. Jim proposes to release part of an existing provision to improve the BU's bottom line. The provision is in a grey area, so that accounting rules allow interpretation both ways.

Vignette 2

Victor is BU manager and direct supervisor of BU controller Bob. The BU has shown three years of solid performance. Victor has been working very hard in this period and turned the BU into a successful business. However, this year the BU is about to end below the sales target. This would strongly decrease Victor's chances of getting the promotion he was hoping for. Victor is very excited about a possible step up the hierarchy in the company, and is very keen on making the target. Victor asks Bob to authorize a sharp price discount for a sales promotion in December, which would ensure the BU to meet its target, even though sales in early next year would suffer.

Vignette 3

Ben is BU manager and direct supervisor of BU controller Claire. Their company is starting the budget rounds for the coming year. As BU manager, Ben is responsible for meeting the target, which the BU will fail to meet this year due to unforeseen market circumstances. Ben fears the risk that the BU will miss its target again next year. This could cost him his job as BU manager. Ben tells Claire he is very afraid of losing his job, which would put him in serious personal trouble. He therefore wants to include a safety margin in next year’s budget proposal by submitting a lower sales budget than the best estimate. HQ do not have sufficient market insight to detect this.

Vignette 4

Mark is BU manager and direct supervisor of BU controller Helen. Mark is planning to hire a consultancy for a project next year, which is dependent on having sufficient budget. Mark has shown enormous enthusiasm and passion for the project. This year's consulting budget has not been used, due to a delay in one of the other projects. HQ might therefore cut next year's budget, in which case the project would have to be cancelled. Mark is very motivated to do everything he can to save it. He proposes to Helen to pay a substantial part of the fee from the current year's budget, even though the real work won't start until next year.

Vignette 5

David is BU manager and direct supervisor of BU controller Henry. Henry is preparing the innovation budget for next year, using best estimates of costs. David describes several of the innovation projects with great enthusiasm and belief. However, it is likely that HQ will make budget cuts across all BU's. This would render it impossible to carry out some of the projects in the BU's pipeline. David shows real passion to make the projects happen. He therefore proposes to increase the cost estimations somewhat. David says that in order to end up with fair amounts, the controller needs to submit overestimated numbers, in spite of the corporate policy to use best estimates.

Vignette 6

George is BU manager and direct supervisor of BU controller James. The BU is considering a small acquisition which George strongly supports. James is required by HQ to use the standard 25% discount rate. HQ do not allow deviations from the standard discount rate. This yields a slightly negative NPV, leaving the target undervalued: the company has a solid, proven track record, and a 15% rate would be more appropriate. George is absolutely furious about the standard rate of 25%. George proposes to increase projected sales growth beyond Year 3 in order to get a realistic NPV with a reasonable chance of approval by HQ. This sales growth prediction would most likely not be met.

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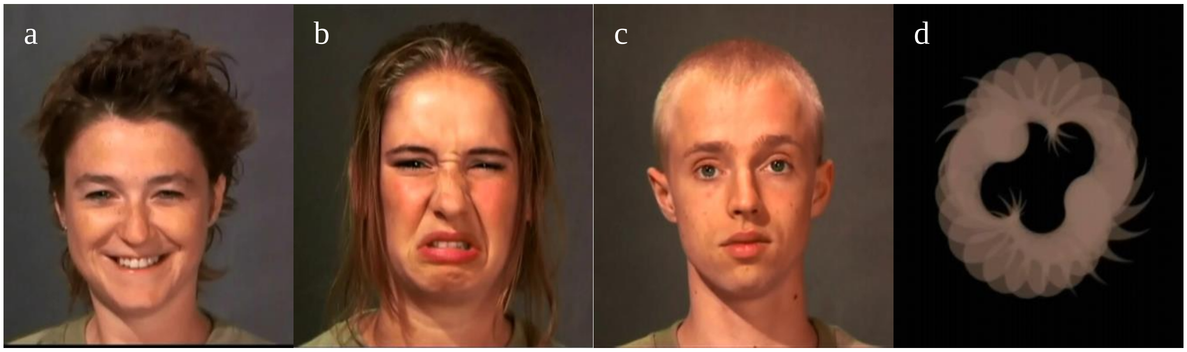
Exhibit 1: Example vignette

People involved	Ben is BU manager and direct supervisor of BU controller Claire.
Factual situation	Their company is starting the budget rounds for the coming year.
BU manager's commitment	As BU manager, Ben is responsible for meeting the target,
Uncontrollable circumstance	which the BU will fail to meet this year due to unforeseen market circumstances.
Factual consequence for BU manager	Ben fears the risk that the BU will miss its target again next year. This could cost him his job as BU manager.
BU manager's emotional response	Ben tells Claire he is very afraid of losing his job, which would put him in serious personal trouble.
Action proposed by BU manager	He therefore wants to include a safety margin in next year's budget proposal by submitting a lower sales budget than the best estimate.
Trade-off	HQ do not have sufficient market insight to detect this.
Question	Would you include the safety margin in the budget proposal?

Note. This table provides a single vignette by way of example. The full set of vignettes can be found in Appendix A. All vignettes follow the structure and sequence indicated in the left column.

Exhibit 2: Experimental stimuli



Note. Example stills of the dynamic stimuli of each condition: (a) positive emotional facial expressions; (b) negative emotional facial expressions; (c) emotionally neutral facial expressions; (d) abstract shapes.

Table 1: Descriptive statistics for COOP

	mean	st. dev.	min.	max.	corr. MU
SELF					
Vignette 1	4.11	1.76	1	7	-.413*
Vignette 2	3.00	1.47	1	6	-.299
Vignette 3	3.89	1.42	1	6	-.406*
CORP					
Vignette 4	2.89	1.45	1	6	-.142
Vignette 5	3.52	1.53	1	6	.164
Vignette 6	2.78	1.45	1	7	-.337

Note. This table provides descriptive statistics for COOP, as well as the Pearson correlation coefficient per scenario to MU. Asterisks denote statistical significance at an alpha level of five percent; these vignette-specific correlations should be interpreted with care as they are based on a small number of observations.

Table 2: Parameter estimations for HLM

		coefficient	st. error	t-ratio	p-value
Model 1					
INCPT	γ_{00}	0.000	.15	0.000	1.000
MU	γ_{01}	-1.321	.57	-2.338	.027
Model 2					
INCPT	γ_{00}	0.000	.18	0.000	1.000
MU	γ_{01}	-.546	.68	-.807	.427
TYPE	γ_{10}	0.000	.20	0.000	1.000
MU*TYPE	γ_{11}	-1.551	.74	-2.088	.039

Note. The models specified below were estimated using the HLM for Windows 7 software package (Scientific Software International, Inc, USA).

Model 1: $COOP_{ij} = \gamma_{00} + \gamma_{01}*MU_j + u_{0j} + r_{ij}$

Model 2: $COOP_{ij} = \gamma_{00} + \gamma_{01}*MU_j + \gamma_{10}*TYPE_{ij} + \gamma_{11}*MU_j*TYPE_{ij} + u_{0j} + r_{ij}$