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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 play a fiduciary role to ensure the integrity of financial reporting. However, they often face social pressure from their BU managers to misreport. Drawing on the literature on the human mirror neuron system, this paper investigates whether controllers' ability to withstand such pressure has a neurobiological basis. We expect that mirror neuron system functionality determines controllers' inclination to succumb to social pressure exerted by self-interested managers to engage in misreporting. We measure mirror neuron system functionality using electroencephalographic (EEG) data from 29 professional controllers during an emotional expressions observation task. The controllers' inclination to misreport was measured using scenarios in which controllers were being pressed by their manager to misreport. We find a positive association between controllers' mirror neuron system functionality and their inclination to yield to managerial pressure. In line with our expectation, we find that this association existed specifically for scenarios in which managers pressed their controllers out of personal rather than organizational interests. We conclude that BU controllers' neurobiological characteristics are involved in financial misreporting behavior and discuss the implications for accounting research and practice.

1. Introduction

The accounting scandals that have occurred in recent decades have increased awareness of financial reporting integrity threats in society, capital markets, and business firms (Cohen, Dey, & Lys, 2008). Recently, accounting researchers have started to explore the role of business unit (BU) controllers in these integrity violations. Whereas professional norms dictate that controllers should safeguard reporting integrity as part of their fiduciary duty (e.g. Indjejikian & Matějka, 2009; Maas & Matějka, 2009; Sathe, 1983), studies show that BU controllers may be inclined to engage in financial misreporting as a result of pressure from their BU managers (Davis, DeZoort, & Kopp, 2006; Hartmann & Maas, 2010; Sathe, 1983). Because BU managers often have incentives to misrepresent the performance of their unit (Indjejikian & Matějka, 2006) and BU controllers are often closely involved in local managerial decision-making processes, the incidence of social pressure is difficult to evade (Maas & Matějka, 2009). As a consequence, individual controllers' ability to withstand managerial social pressure to misreport is considered a crucial professional competence (CIMA, 2010; IMA, 2011), and discovering the determinants of this ability is an important aim of research (Davis et al., 2006; Hartmann & Maas, 2010).

In this paper, we investigate whether this ability has a biological basis. The alleged existence of such a basis is reflected in the

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stereotypical view of accounting professionals as "cold, aloof and impersonal" (DeCoster & Rhode, 1971, p. 651), which suggests they possess an innate immunity against social pressure. However, no systematic evidence of the actual presence of such immunity among accounting professionals, or of any underlying personal characteristics, exists. Our research responds to recent calls in the accounting literature to explore neuroscientific drivers of human social behavior (Waymire, 2014).

Our analysis specifically builds on the recent discovery of the human mirror neuron system (hMNS) in the neuroscience literature (Rizzolatti & Craighero, 2004). The hMNS designates a set of related regions in the human brain that have "mirroring" properties, which means they are active not only when someone performs a movement but also when observing someone else who is making the same movement (Iacoboni, 2009). These mirroring properties enable us to understand other people's emotions through an automatic mimicking of emotional facial expressions (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003). Studies in neuroscience show that people differ in the extent to which their brain has this mirroring function (Iacoboni & Dapretto, 2006). This hMNS functionality is a stable personal trait (Bastiaansen et al., 2011; Leslie, Johnson-Frey, & Grafton, 2004), which explains why some people are consistently more receptive and responsive to other people's feelings and emotions than others (Kaplan & Iacoboni, 2006; Yang, Decety, Lee, Chen, & Cheng, 2009). For BU controllers, we expected that hMNS functionality predicts controllers' vulnerability to the social pressure to misreport exerted by BU managers.

For a sample of 29 experienced unit controllers, we conducted a scenario-based survey on a validated set of six scenarios describing situations in which BU managers try to influence their BU controllers' financial reporting behaviors. The scenarios included a context effect: BU managers were either driven by personal interests (e.g. obtaining a bonus) or organizational interests (e.g. saving a valuable project). We separately examined these controllers' hMNS functionality using electroencephalographic (EEG) recordings during a dynamic emotional facial expressions task (Bastiaansen et al., 2011; Jabbi, Swart, & Keysers, 2007; Jabbi & Keysers, 2008; Schraa-Tam et al., 2012). Our findings indicate a strong association between hMNS functionality and controllers' inclination to yield to BU managers' pressure to misreport when this pressure stems from BU managers' personal interests rather than from managers' concerns with organizational interests.

This paper contributes to the accounting literature on the advantages and disadvantages of current developments in controller roles (Hartmann & Maas, 2010; Indjejikian & Matějka, 2006; Maas & Matějka, 2009). We show that controllers' inclination to misreport under social pressure has a neurobiological antecedent. Given recent calls in theory (Sathe, 1982, 1983) and practice (Granlund & Lukka, 1998; Maas & Matějka, 2009) for more socially able and socially active controllers, our findings identify a potential cost: such a controller may be less equipped to withstand social pressure to misreport. In establishing the role of the hMNS, our paper also contributes to the emergent field of neuroaccounting by further exploring the neuroscientific drivers of human social behavior (Birnberg & Ganguly, 2012; Dickhaut, 2009; Dickhaut, Basu, McCabe, & Waymire, 2010, 2014). Because responses to emotional pressures typically occur non-consciously, eluding traditional personality psychology constructs and instruments (Becker, Cropanzano, & Sanfey, 2011), our introduction of the EEG method to analyze an accounting phenomenon also constitutes a methodological advancement of the field.

The remainder of the paper is structured as follows. In the next section, we present the theoretical background of our study and develop the hypothesis. We then present the research design and implementation, followed by an analysis of the empirical results. The final section reviews the findings, presents conclusions, and discusses the theoretical and practical implications and limitations of the study.

2. Literature review and hypotheses

2.1. Responsibilities of a BU controller

An important characteristic of the role of BU controllers is the combination of local and functional responsibilities (see, e.g., Hopper, 1980; Indjejikian & Matějka, 2006). The latter type of responsibility pertains to the fiduciary duty controllers have in enabling corporate control. BU controllers must ensure corporate management receives objective and reliable reports on the performance of the BU. This task requires sufficient independence in opinion, judgment, and reporting from BU managers, who have incentives for misreporting (San Miguel & Govindarajan, 1984). This independence, however, is affected by controllers' 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 and DeZoort (2001) and Davis et al. (2006) show that obedience pressure from immediate superiors causes controllers to violate explicit corporate policies. Indjejikian and Matějka (2006) and Maas and Matějka (2009) show a positive association between emphasis on controllers' local responsibilities and levels of organizational slack creation. Hartmann and Maas (2010) find that when local responsibilities are emphasized, controllers high in Machiavellianism are likely to create slack when pressed by their BU manager.

The tension between the two sets of responsibilities cannot easily be removed, because 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 & Matějka, 2009). This necessary coherence between fiduciary and local tasks is personified in the ideal type of the "strong controller" (Sathe, 1982, 1983).[1] A strong controller possesses a skill set that enables providing support for local decision making while safeguarding reporting and other fiduciary duties. This type of controllership has witnessed a steady rise over the last decades, 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). Modern BU controllers work in close proximity to BU managers and form strong personal relationships with them (Maas & Matějka, 2009).

Extant studies consistently document that controllers are regularly influenced by inappropriate social pressure from management (Davis et al., 2006; Hartmann & Maas, 2010). The inherent conflict in the role of the controller thus poses a challenge to organizations to find and cultivate professionals who are able to withstand social pressure to misreport (Lord & DeZoort, 2001). However, little is known about the individual characteristics that determine the controller's response to such pressure. In this paper, we build on findings from social neuroscience to shed light on this

[1] Sathe's typology further specifies three less desirable ways to design controllers' roles: prioritizing local over functional responsibilities (the "involved" controller); prioritizing functional over local responsibilities (the "independent" controller); or dividing the two sets of responsibilities over two people (the "split" controller).

topic. Specifically, we expect that mirror neuron functionality is a crucial source of vulnerability when BU controllers are pressed to misreport by their BU managers.

2.2. Mirror neurons

It has been long established that primates and humans are experts in the unconscious and automatic mimicking of each other's postures, facial expressions, and other behaviors (Preston & De Waal, 2002). Although the mechanisms underlying this spontaneous and uncontrollable mimicking long remained unknown, research established that the act of mimicry itself plays an important role in understanding the meaning of the mimicked behavior (Allport, 1987; Prinz, 1987). For example, when observing somebody smile, an unconscious imitation takes place that is essential in understanding that the smiling person is happy (Wild, Erb, Eyb, Bartels, & Grodd, 2003).

Research on this so-called *chameleon effect* suggests a close connection between motoric actions and the understanding of their intention (Lieberman, 2007). Recent studies on the working of the primate brain and human brain have established that this close relation can already be observed at the neuronal level in the brain (Lamm, Decety, & Singer, 2011). Several brain regions show similarity in neuronal activity when a person has a certain experience and when someone else is observed having a similar experience (Jackson, Meltzoff, & Decety, 2005). This automatic and unconscious mirroring of neuronal activity plays a role in the intuitive understanding of another person's sensation of pain when, for example, touching a hot stove or cutting a finger and explains the associated motoric reaction of pulling oneself back (Jackson et al., 2005; Lamm et al., 2011).

The automatic neuronal correspondence between one's own sensations and experiences and those of others is now attributed to the existence of mirror neurons. Mirror neurons are defined as specific neurons in the brain that are active when executing a specific action as well as when observing someone else executing a similar action (Rizzolatti & Craighero, 2004). The mirroring property of neurons was first identified in macaques (di Pellegrino, Fadiga, Fogassi, Gallese, & Rizzolatti, 1992), who displayed similar neuronal activity in brain areas responsible for motoric actions when making a grasping movement as when observing others making the same movement. Later studies identified regions in the human brain with similar mirroring properties (Rizzolatti & Craighero, 2004). These regions are now commonly referred to as the human mirror neuron system (hMNS).

Research on the role and function of the hMNS has established the crucial involvement of this mechanism in the perception, recognition, and interpretation of the emotional states of others (Leslie et al., 2004). Moreover, mirror neurons show the existence of a close connection between observing motoric actions and understanding the experiences associated with those actions (Ferrari & Rizzolatti, 2014). For example, when observing emotional facial expressions, the hMNS supports the automatic and mechanical simulation of the motoric actions of the facial muscles and thus facilitates the understanding of these expressions (Leslie et al., 2004; Iacoboni, 2009). Research on the mirroring of emotional expressions shows that the hMNS is active when people actively imitate facial expressions as well as when they passively observe such expressions (Van der Gaag, Minderaa, & Keysers, 2007; Leslie et al., 2004; Schulte-Rüther, Markowitsch, Fink, & Piefke, 2007).[2] In both cases, the activation of the hMNS is considered crucial for understanding the emotional content of a facial expression and is the central mechanism for transferring the underlying emotion associated with the observed expression to the observer (Lieberman, 2007).

Research has established that hMNS functionality varies across people, and is a stable personal trait explaining cross-sectional variation in a wide range of human social behaviors (Iacoboni & Dapretto, 2006; DeYoung & Gray, 2009; Fabbri-Destro, Gizzonio, & Avanzini, 2013; Lepage, Lortie, Deal, & Théoret, 2014). Studies on empathy, for example, show that hMNS functionality is positively related to people's ability to recognize and care for other people's feelings, both in adults (Kaplan & Iacoboni, 2006) and in children (Pfeifer, Iacoboni, Mazziotta, & Dapretto, 2008). Differences in hMNS functionality predict people's different responses to other people's emotions, but also differences in the accuracy of the attributions people make about others' internal emotional state (Zaki, Weber, Bolger, & Ochsner, 2009). In psychiatry, low hMNS functionality is found in patients diagnosed with sociopathy, which is a social pathology characterized by low regard for other people's feelings (Fecteau, Pascual-Leone, & Théoret, 2008; Meffert, Gazzola, Den Boer, Bartels & Keysers, 2013). In clinical psychology, hMNS functionality is shown to correlate with autism spectrum disorder (ASD) diagnoses of social functioning (Gillespie, McCleery, & Oberman, 2014; Oberman et al., 2005). ASD is reflected in people suffering from various deficits in social functioning, most clearly in verbal and nonverbal communication (DSM-V). ASD symptoms fall on a continuum and correspond to levels of hMNS functionality (Rizzolatti & Fabbri-Destro, 2010). Overall, these studies attest to hMNS functionality as a robust predictor of cross-sectional variation in a large set of social behaviors (Fox et al. 2015).

To date, only one empirical study in the management literature has investigated the role of cross-sectional differences in hMNS functionality, despite an apparent wider interest in the potential role of this functionality in improving leadership (Goleman & Boyatzis, 2008) and business ethics (Pavlovich & Krahnke, 2012). Bagozzi et al. (2011) studied the hMNS in a marketing management context and showed that variation in hMNS functionality across sales people predicted their relative success in understanding their customers' needs and desires, resulting in higher sales. Overall, the literature on the hMNS indicates that the system plays an essential role in our interactions with others and that its functionality is an important predictor of one's sensitivity to other people's emotional states and the reasons underlying those states.[3]

2.3. Hypothesis development

We expect that hMNS functionality plays a crucial role in controllers' ability to resist social pressure exerted by their managers to engage in misreporting. When serious personal consequences are at stake, BU managers have strong incentives to misrepresent their unit's performance (Indjejikian & Matějka, 2006). In such situations, one possible strategy is for managers to call upon their BU controller to misreport (Hartmann & Maas, 2010). We expect that in such cases controllers' hMNS functionality will predict their inclination to either comply or resist the social pressure from their

[2] A meta-analysis of 21 fMRI studies by Molenberghs, Cunnington, and Mattingley (2012) revealed that both in executing and in observing emotional facial expressions activity in the posterior IFG and adjacent ventral premotor cortex, the amygdala, insula, and cingulate gyrus is observed.

[3] Based on these findings, some researchers are inclined to attribute mirror neurons a central role in human evolution, addressing them as a “missing link” in the current explanation of the development of uniquely human faculties (Rizzolatti, Fadiga, Gallese, & Fogassi, 1996). While such claims have been critiqued by Hickok (2009; 2014) as being too optimistic, they have recently been defended by Kemmerer (2014). The existence of mirror neurons itself is undisputed (Hickok, 2014, p. 27).

managers. The hMNS facilitates the influence of others' emotions and well-being on one's behavior. Controllers with high hMNS functionality are therefore more likely to emotionally engage in social contexts involving personal consequences for BU managers. These controllers will be better able to perceive, recognize and interpret associated emotional signals, as well as the reasons for sending those signals. The hMNS facilitates the transfer of managers' concerns to the BU controller, who as a result is more willing to compromise on fiduciary duties and engage in misreporting.

BU managers may also try to press their controllers into misreporting without being driven by immediate self-concerns, but rather to benefit the organization in general. In such situations, we expect that hMNS functionality does not play a role in determining controllers' willingness to misreport. When organizational concerns drive unit managers to press their controllers into misreporting, there is no social sensitivity that requires involvement of the hMNS as in the case of pressure out of self-concern. This leads us to formulate the following interaction hypothesis:

H1. BU controllers' hMNS functionality influences their inclination to comply with BU managers' social pressure to misreport, but only when such pressure stems from BU managers' self-interest and not from organizational interest.

3. Method

3.1. Sample

A total of 29 people participated in the study (mean age 34.7 years; SD age 7.8 years; 5 females). 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 both a Master of Science degree and the professional qualification of Certified Controller. All participants in our sample had several years of relevant working experience in a controller role, ranging from 2 to 25 years and averaging 8.9 years (S.D. = 7.1). We considered the use of professional controllers, rather than undergraduate students, vital for our study, given the complex and contextual nature of the fiduciary aspect of controllership that is our focus. Using professional controllers satisfies the need that participants recognize the cases described in the scenarios, but comes at some cost of participant availability. Throughout a number of teaching sessions, we invited participants to complete a paper-based survey containing scenarios (see below) and to sign up for an EEG measurement in a university laboratory in the Netherlands. Those who participated first completed the survey and then visited the EEG lab on individual appointment within one to five weeks after completing the survey. Participation in both stages was voluntary, with EEG participation rewarded with EUR 50 (approx. USD 65). Overall, we recruited participants over one full academic year of the controlling program.[4]

3.2. Scenario instrument

To measure the propensity of controllers to cooperate with BU managers against fiduciary duties, participants responded to a set of situations contained in six scenarios, which were included in the paper-based survey. Each scenario describes a BU controller who is pressed 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. Fig. 1 provides the structure and an example of the scenarios. The full set of scenarios is reproduced in the appendix. Each scenario portrays the occurrence of an event beyond the control of the BU manager, prompting the BU manager to give an emotional response and to propose some action to the BU controller that would ameliorate the situation but goes against the fiduciary responsibilities of the BU controller.

We developed two types of scenarios. Three scenarios describe a situation in which the BU manager aims to promote self-interest (SELF), e.g. to obtain a bonus or avoid losing his/her job. The other three situations portray BU managers who press the controller out of organizational concern (ORG), e.g. to save an important project or get approval for a valuable acquisition. Two paper-based versions with different pseudo-random order were used to control for scenario order effects. The scenarios were developed in structured fashion, each using the same types of components presented in the same order. Before inclusion in the survey, draft versions of the scenarios were pre-tested in a number of interviews with professional controllers, who did not participate in the final study. In seven interviews, each lasting between sixty and ninety minutes, each of the draft scenarios was separately discussed in detail, assessing intelligibility, clarity, recognizability, realism, and relevance. The six scenarios thus validated were submitted to a further pretest to validate the distinction between SELF and ORG, as explained later, and then included in the final survey.

3.3. EEG

We measured hMNS functionality in separate sessions that took place between one and five weeks after measuring responses to the survey scenarios. This order was chosen to avoid the validity threat associated with hypothesis guessing while participants responded to the scenarios. hMNS functionality is a mechanical disposition of the brain, exhibited automatically without conscious control (DeYoung & Gray, 2009; Fabbri-Destro et al., 2013), and therefore not sensitive to hypothesis guessing.

Individual levels of hMNS functionality can be observed in electroencephalogram (EEG) recordings of brain activity (Lepage et al., 2014). EEG recordings capture the synchronous firing of neurons in the brain. Sensorimotor neurons, which are found in brain areas responsible for bodily movements, tend to fire synchronously when in resting state, which causes EEG signals in the mu frequency band (8–13 Hz). Both when motoric actions are performed (e.g. Pfurtscheller, Neuper, Andrew, & Edlinger, 1997) and when motoric actions of others are observed (e.g. Pineda, Allison, & Vankov, 2000) these neurons begin to fire asynchronously. The associated weakening of the EEG signal is called mu suppression. Mu suppression has been shown to be a robust and valid indicator of hMNS functionality, across a multitude of research settings and contexts (see Fox et al., 2015 for a meta-analysis). We use mu suppression resulting from the observation of emotional facial expressions of others as a measure of hMNS functionality (Frenkel-Toledo, Bentin, Perry, Liebermann, & Soroker, 2014; Oberman et al., 2005; Oberman, McCleery, Ramachandran, & Pineda, 2007; Ulloa & Pineda, 2007).

Participants visited the EEG 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. The researcher then explained the measurement procedure to the participant, prepared

[4] Approval to conduct this study was granted by the board of the university laboratory.

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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?

Fig. 1. Example scenario. The full set of scenarios can be found in Appendix 1. All scenarios follow the structure and sequence indicated in the left column.

the EEG equipment, and started the recording.[5] During the EEG recording, participants watched movie clips of emotional facial expressions. These visual stimuli, originally developed to measure hMNS functionality 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 in Fig. 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 min. 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 et al., 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 & Grabowska, 2006).

We computed the independent variable mu suppression (MU) as the decrease in power of mu waves in the emotional expressions condition relative to the abstract shapes condition.[7] This employment of a baseline condition allowed us to filter out individual differences in mu power unrelated to mirror neuron activity resulting, for example, 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 & Pineda, 2007), associated with *higher* levels of sensitivity

[5] Data were recorded using a BioSemi ActiveTwo amplifier system (www.biosemi.com). Measurements were 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 electro-oculogram (EOG) was recorded using four electrodes, which were 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] Clips lasted three seconds each and were separated by one-second intervals of black screens. For the 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 .5 s. The condition involving abstract shapes was used as a baseline condition to correct for individual differences in absolute mu power. It consisted of oval figures with striped patterns; the figures were initially static and then started to move around the screen after .5 s.

[7] The data were first processed using the BrainVision Analyzer 2.0 software program (www.brainproducts.com). EEG and EOG data were filtered off-line with a band-pass of .1–30 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, & Donchin, 1983). We analyzed the data for electrodes C3, C4, and Cz (Oberman et al., 2005). Data were segmented into epochs of 3000 ms based on the start and end points of the stimulus clips. For each segment, the integrated power in the mu range (8–13 Hz) was then computed. A Hamming window was used to control for artifacts that may have resulted from data splicing. The resulting segments were averaged per experimental condition. We included both positive and negative emotions in the "emotional" condition. The suitable baseline for EEG experiments was the abstract shapes condition. This condition required processing of moving visual stimuli, like the emotional conditions, but without the need for processing emotions. The condition of neutral facial expressions did not include movement and is therefore not suitable for use in EEG experiments; this condition was originally included in the task by Van der Gaag et al. (2007) for use in fMRI experiments and retained by us to preserve the validated structure of the task.

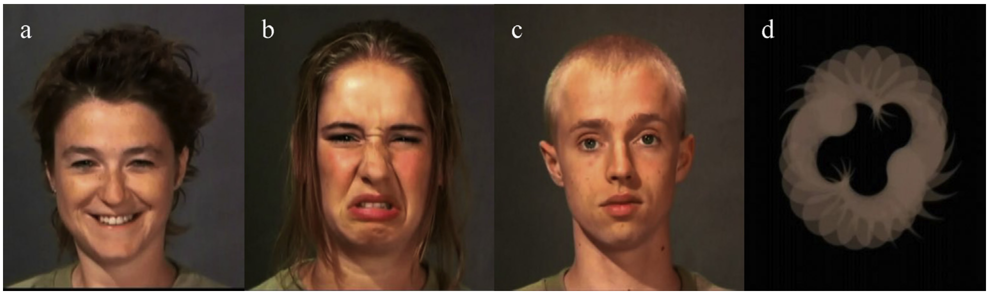

Fig. 2. Example stills of the dynamic stimuli of each condition: (a) positive emotional facial expressions; (b) negative emotional facial expressions; (c) emotionally neutral facial expressions; (d) abstract shapes.

to others' emotions (see Yang et al., 2009).[8]

4. Results

We validated the distinction between the SELF and ORG scenarios as follows. An independent and separate sample of 52 management accounting professionals rated each scenario on two seven-point scales (1 = Do not agree at all; 7 = Completely agree): 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 organization. Table 1 presents the mean difference score per scenario between these two dimensions. We aggregated the difference scores of the three SELF scenarios ($M = 3.615$, $SD = 1.426$) and those of the three ORG scenarios ($M = -.180$, $SD = 2.130$). A paired-samples t-test revealed a statistically significant difference between the two types of scenarios ($t = 11.893$, $p < .001$) such that the perceived level of self-interest driving the BU manager was higher for the SELF scenarios than for the ORG scenarios, in line with our intended focus.

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 scenario across participants ranging from 2.89 to 4.11. Descriptive statistics for COOP per scenario are reported in Table 2.

We use Hierarchical Linear Modeling (HLM) to test the main hypothesis. Our research design resulted in a dataset with two levels. The independent variable mu suppression (MU) is measured at the level of the participant; the dependent variable COOP is measured at the scenario level and therefore was observed six times per individual; and a dummy variable (TYPE) at the scenario level denotes whether the BU manager is following self-interest (1) or an organizational interest (0), each of which occurs three times per individual. Our multilevel dataset contains 174 observations at Level 1 and 29 observations at Level 2. To test H1, we were interested in a cross-level interaction effect between MU and TYPE in predicting COOP. HLM enables us to model and test this association in a linear model represented by a single equation with a complex error structure (see Bryk & Raudenbush, 1992).[9]

We present the results of two models, 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] To obtain more meaningful coefficients, the second-level independent variable MU was centered around its

Table 1
Scenario validation scores.

	Type	Mean (standard deviation)
Scenario 1	SELF	3.769 (1.628)
Scenario 2	SELF	3.173 (2.102)
Scenario 3	SELF	3.904 (1.729)
Scenario 4	ORG	−.173 (2.691)
Scenario 5	ORG	.135 (2.575)
Scenario 6	ORG	−.500 (2.429)

Validation scores reflect the difference between BU managers' self-interest and organizational interest as perceived by participants. A higher score indicates that the participant perceived the BU manager described in the scenario as relatively more driven by self-interest and less driven by corporate interest.

Table 2
Descriptive statistics for dependent variable.

	Type	Minimum	Maximum	Mean (standard deviation)
Scenario 1	SELF	1	7	4.11 (1.76)
Scenario 2	SELF	1	6	3.00 (1.47)
Scenario 3	SELF	1	6	3.89 (1.42)
Scenario 4	ORG	1	6	2.89 (1.45)
Scenario 5	ORG	1	6	3.52 (1.53)
Scenario 6	ORG	1	7	2.78 (1.45)

The dependent variable represents controllers' likelihood of cooperation with the request of the BU manager in the scenario (COOP). This variable was measured on a scale from 1 (= Very unlikely) to 7 (= Very likely).

[8] We included two subscales of the Interpersonal Reactivity Index (IRI) questionnaire developed by Davis (1980) to explore whether hMNS functionality is correlated with the psychometric constructs empathic concern (EC) and perspective taking (PT). EC has been associated with hMNS functionality in an fMRI study by Kaplan and Iacoboni (2006) and Pfeifer et al. (2008). PT served an exploratory function. Our data reveal correlations with MU of −.161 for EC and −.119 for PT. While these effects do not reach conventional levels of statistical significance ($p < .05$) for our sample size ($n = 29$), they suggest some correspondence between empathy and mu suppression.

[9] An alternative approach would be an analysis of covariance (ANCOVA). We carried out this analysis as a robustness check. By averaging participants' three scores per scenario 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 scenarios than for the ORG scenarios, in accordance with Hypothesis 1. Note that HLM avoids the loss of information from aggregating scenario scores into two values per participant, and therefore offers the most powerful hypothesis test.

[10] Even though Model 1 does not provide any hypothesis test, it is presented as a preliminary to the cross-level interaction relation in Model 2, as is standard practice in HLM analysis. We tested additional models to control for the effects of gender, age, and work experience, which were measured at the personal level (i.e. Level 2). Each control variable was tested separately for a main effect on COOP and a cross-level interaction effect with TYPE. No evidence was found for the existence of such effects in any of the additional models. Therefore, the models presented here do not include these control variables.

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mean (Algina & Swaminathan, 2011) and the dependent variable COOP was centered around the scenario mean, so that scores indicated the participants' deviation from the average score across participants on a particular scenario.

The main results of parameter estimations for both models are presented in Table 3. Model 1 revealed that MU is a statistically significant predictor of COOP ($\gamma_{01} = -1.321$; $t = -2.338$; $p = .027$). This finding supports the notion that mu power negatively affects cooperation. Model 2 allowed us to further qualify this association. There was a significant interaction between MU and TYPE ($\gamma_{11} = -1.551$; $t = -2.088$; $p = .039$) 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 then no longer statistically significant ($\gamma_{01} = -.546$; $t = -.807$; $p = .427$). Jointly, these findings provide support for the conditional effect of TYPE as formulated in H1: MU is more predictive of COOP for the SELF scenarios than for the ORG scenarios.

5. Discussion and conclusions

The goal of this paper is to explain the propensity of BU controllers to engage in misreporting behavior that runs counter to their fiduciary duties. Based on the growing literature on hMNS functionality as a crucial determinant of human social behavior, we expected a positive association between controllers' hMNS functionality and their inclination to give in to misreporting pressure from BU managers, and we expected this relation to be limited to situations where BU managers act from self-interest. Our findings support this expectation and suggest that the sensitivity to social pressure, which is an antecedent of misreporting behavior (Davis et al., 2006; Hartmann & Maas, 2010), has a biological origin. Although previous studies have shown that fiduciary duty threats are inherent to the role of BU controllers (Maas & Matějka, 2009; Hartmann & Maas, 2010), we show that hMNS functionality is a central personal characteristic.

Our findings contribute to the accounting literature in a number of related ways. They add to the current debate on the business support role of BU controllers. Our results suggest that the associated plea for more socially competent controllers may come at the cost of an increased fiduciary duty threat. Our findings show the involvement of an important personal characteristic: hMNS functionality. The identification of the role of hMNS functionality in misreporting aligns with calls to identify neuroscientific drivers of accounting behaviors (Waymire, 2014). Our findings both support existing neuropsychological evidence on the role of the hMNS (Becker et al., 2011) and extend those findings to the field of accounting. In particular, our study adds to the novel basis for explaining accounting systems and accounting behaviors by neurobiological mechanisms as suggested by Dickhaut (2009) and Dickhaut et al. (2010). Overall, our identification of the role of the hMNS in resisting pressure to misreport suggests that the stereotypical accountant, who stays “cold, aloof and impersonal” (DeCoster & Rhode, 1971, p. 651) when confronted with emotional pressure, may reflect a desirable characterization rather than a disagreeable caricature (Miley & Read, 2012; Richardson, Dellaportas, Perera, & Richardson, 2015). Finally, our use of EEG to analyze controllers' behaviors constitutes a methodological advancement of the accounting literature, enabling the observation of emotional influences that typically elude traditional personality psychology constructs and instruments (Becker et al., 2011).

Our findings have several practical implications as well. While sensitivity to the emotions and well-being of others is generally viewed as a desirable social characteristic, and has even been proposed as a cure for unethical accounting behavior (McPhail, 2001), our study suggests that emotional influence may cause excessive alignment between the interests pursued by the BU manager and those served by the reporting behaviors of the BU controller. In designing internal control structures, organizations need to be aware of the reporting risks associated with the expansion of “business partner” controllers (Maas & Matějka, 2009). Our approach can yield direct implications for our understanding of what it takes to be a “good” accounting professional. For example, our results support the use of human resources procedures of selection and placement informed by the neurobiological drivers of controller behavior, rather than with the normative view that “strong controllership” is always desirable (Sathe, 1982, 1983). These procedures could complement the codes of conduct published by professional controller bodies (CIMA, 2010; IMA, 2011). Such codes acknowledge the importance of personal integrity, yet are not likely to be effective against someone's neurobiologically determined inclinations that elude conscious control.

When interpreting these implications of our study, a number of limitations should be considered. First, 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 that continues to discuss the nature, consequences and measurement of fundamental neurobiological processes, including the hMNS. Although our theory and method are fully in line with state-of-the-art investigations in this field of neuroscience, some care is required in interpreting our findings.

Second, our study focused on misreporting by controllers. Because the activity of the hMNS is predictive of a wider set of social behaviors (Iacoboni, 2009), a further analysis of its impact

Table 3
Parameter estimations for HLM.

		Coefficient	Std. error	t-ratio	*p*-value
Model 1					
INCPT	γ_{00}	.000	.15	.000	1.000
MU	γ_{01}	−1.321	.57	−2.338	.027
Model 2					
INCPT	γ_{00}	.000	.18	.000	1.000
MU	γ_{01}	−.546	.68	−.807	.427
TYPE	γ_{10}	.000	.20	.000	1.000
MU*TYPE	γ_{11}	−1.551	.74	−2.088	.039

Model 1: $COOP_{ij} = \gamma_{00} + \gamma_{01}{*}MU_j + u_{0j} + r_{ij}$.
Model 2: $COOP_{ij} = \gamma_{00} + \gamma_{01}{*}MU_j + \gamma_{10}{*}TYPE_{ij} + \gamma_{11}{*}MU_j{*}TYPE_{ij} + u_{0j} + r_{ij}$.
The models were estimated using the HLM for Windows 7 software package (Scientific Software International, Inc, USA). In both models the dependent variable is the participant's likelihood of cooperation with the BU manager, centered around scenario mean. INCPT denotes the intercept, which is equal to zero as a result of mean centering. MU is the participant's index of mu suppression. TYPE is a dummy variable, with a value of 1 for the scenarios where the BU manager pursued a self-interest. The *p*-values are based on two-tailed testing.

should include its potential positive effects. The hMNS may be predictive of controllers' ability to support their BU managers' needs beyond financial reporting, such as the preparation of business decisions.

Regarding this latter point, we believe that our study can be fruitfully extended by exploring hMNS functionality for controllers' roles as support providers to BU management. Using additional scenarios with situations crucial to such a support role, or involving a trade-off between fiduciary and support roles, could be a promising step in this direction. Moreover, future research could confirm the association between hMNS activity and controller behavior using field and observational approaches in addition to the self-reported behaviors examined in our study. Finally, studies could observe the role of emotional pressure within actual decision-making processes. This is a challenging route, however, requiring neuroscientific measurement during the actual performance of a scenario task.

Overall, our study and the directions for future research together suggest that developments in neuroscience may support the ongoing quest of accounting scholars to understand the actual and desired behaviors of accounting professionals in their social contexts.

Appendix. Scenario instrument

Below we provide the full text of the six scenarios. Scenarios 1 to 3 present situations in which the BU manager is pursuing a clear self-interest, whereas in Scenarios 4 to 6 the BU manager pursues organizational interests. The Pearson correlations of responses per scenario with the respondents' mu suppression score (MU) are included.

Scenario 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 gray area, so that accounting rules allow interpretation both ways.

Correlation with MU: $r = -.413$, $p = .026$

Scenario 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.

Correlation with MU: $r = -.299$, $p = .115$

Scenario 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.

Correlation with MU: $r = -.406$, $p = .029$

Scenario 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 canceled. 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.

Correlation with MU: $r = -.142$, $p = .464$

Scenario 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.

Correlation with MU: $r = .164$, $p = .395$

Scenario 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.

Correlation with MU: $r = -.337$, $p = .074$

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