ROELAND DIETVORST

Neural Mechanisms Underlying Social Intelligence and Their Relationship with the Performance of Sales Managers

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Neurale mechanismen van sociale intelligentie in relatie tot de prestaties van verkoopmanagers

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CHAPTER 1
INTRODUCTION

1.1 Prelude

The performance and strategies of salespeople have been under the scrutiny of marketing scholars for many years (Behrman etal., 1983; Comer and Drollinger, 1999; Saxe and Weitz, 1982). Identifying the drivers of salespeople's performance, strategies and moral behavior has been the primary focus of this research. The functioning of the drivers of salespeople's behaviors during selling interactions rests on assumptions about and processes going on in the minds of salespeople. However, research to date has used methods based only on verbal self-reports. Advances in techniques from neuroscience such as fMRI have inspired recent research in related areas, such as consumer behavior (Shiv et al. 2005; Yoon et al. 2006) and economics (Camerer, Loewenstein, and Prelec 2005), and suggest that despite their complexity and relative inaccessibility, mental processes can be measured more directly.

Throughout the three main chapters of this dissertation, the hypotheses that individual differences in neuropsychological processes might shed light on why some salespeople structurally outperform others or use manipulative tactics, are tested by scanning the brains of sales professionals. Because functional MRI is a relatively new phenomena in the field of economics, this prelude is dedicated to explaining some aspects about fMRI based research. The following very basic primer on fMRI should help readers that are not familiar with fMRI develop a better understanding of the data described in this dissertation, and more appreciation for how the fMRI experiments are designed. A more detailed description in which we also describe the preprocessing and statistical methods underlying fMRI analysis can be found in the webappendix of our October 2009 Journal of Marketing Research publication (Appendix D).

Since functional MRI was introduced as a research tool, the number of papers using this technique has been growing exponentially. The scanning procedures do not involve any radiation or injection of contrast materials, and they are generally thought of as completely harmless to the human body. For the first time in history scientists have a tool that will allow them to analyse what regions in the brain become active when we perform certain experimental tasks.

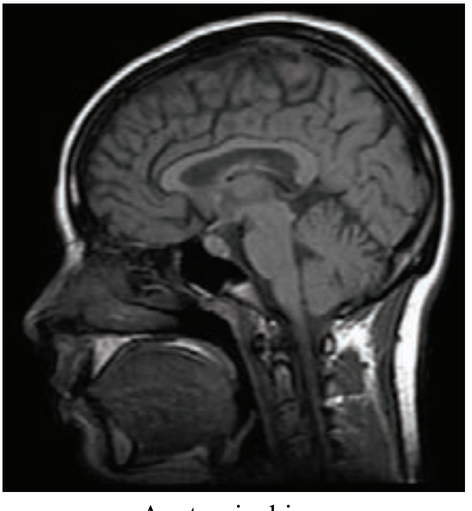
In a nutshell, the MRI scanner (without the ‘f’ which stands for functional) works by generating a magnetic field about 80.000 times stronger than we experience outside of the scanner environment. When a body is placed in this magnetic field the protons in the molecules that make up the body align with one another. Next, a radiofrequency pulse is added that excites the protons in a higher energy state. When these protons relax in their lower energy state they emit a signal or echo that is detected by the MRI machine. Depending on the type of tissue (e.g. bones, fat, muscle), some molecules recover faster than other molecules from this excited state. By measuring the difference in time it takes for molecules to recover from the radio pulse for each location in the body, it becomes possible to generate highly detailed 3D images of the body’s anatomy. It takes an MRI scanner approximately 5 minutes to generate an anatomical image of the brain.

The technique to create these highly detailed anatomical images had been evolving for a few decades before the next step was invented/discovered around 1996, when the first functional MRI scans were produced. Functional MRI works with the same basic principles as regular MRI, but by lowering the resolution, it becomes possible to scan the entire brain every two or three seconds, instead of the five minutes it takes for an anatomical image.

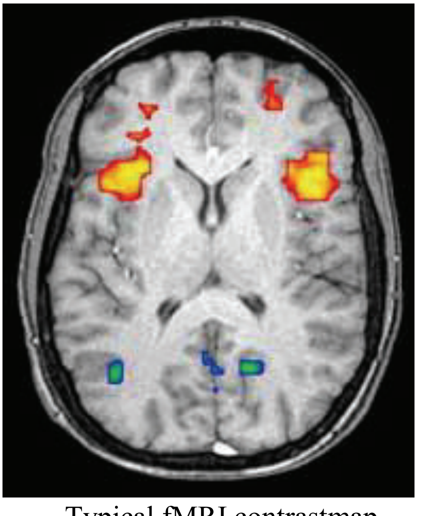
When a subject performs a certain task, the blood vessels in the brain respond by sending more blood to those regions in the brain that become active and use more glucose and oxygen. When haemoglobin (the transporters of oxygen in blood) lets go of its oxygen, the magnetic properties of the molecule change. Because the proportion of haemoglobin with oxygen and haemoglobin without oxygen changes in areas in the brain that become active, they also start to display different magnetic properties. This effect is referred to as the BOLD signal, or Blood Oxygenation Level Dependent signal. Because the BOLD signal is an indirect measure for neural activity through blood flow, the effects occur a few seconds after the actual neural activity and also remain longer than the actual neural activity lasting up to 16 seconds. This is why fMRI scans have a relatively low temporal resolution in comparison to EEG for example (EEG measures brain activity directly), but the spatial resolution of an fMRI scan is unparalleled by other techniques.

For the analyses, analysis software such as Statistical Parametric Mapping is used in order to analyse whether certain brain regions become active or inactive when stimuli are presented to a subject in the scanner. The software works by using template haemodynamic responses in order to plot an expected haemodynamic response (the haemodynamic response function) based on the experiment design. Next the software searches in each voxel with regressions, to what extent the measured signal strength resembles the expected haemodynamic response.

Voxels in MRI images are the three-dimensional equivalent of pixels on a computer screen. The brain image is divided into thousands of voxels, and the size of the voxels determines the resolution of the image. The voxel size in anatomical scans is usually around 1x1x1mm, while the voxel size in functional scans is usually increased to 3x3x3mm. The hypothesis is tested in each voxel, resulting in a t-map. The t-map holds information on which voxels became active during critical moments in the experiment. The final step is to combine the anatomical scans with the functional scans. This is done by superimposing the t-map on the anatomical scan, and by translating only the significant statistical values of the t-map into colours. The most prominent results of our research appear in this style in Appendix H.



Anatomical image



Typical fMRI contrastmap superimposed on an anatomical image

There are some important drawbacks with fMRI experiments: the environment in which the experiment is performed is unnatural; lying in a MRI scanner makes people feel awkward because it is a new experience, and in addition the scanner generates a lot of noise. So how it is possible to infer that certain neural activations are the results of your experiment and not the results of lying in the scanner? In order to answer this question it is important to understand something about how fMRI experiments are designed. An fMRI experiment exists out of two or more conditions, and the analysis of the neural activity is based on comparing the activity between different experimental conditions.

For example, imagine we want to learn something about what parts of the brain become involved during story comprehension, and we compare brain activity during the listening to stories with brain activity during a rest condition. If the brain activity during the listening to stories is compared with the brain activity during rest the resulting activity is associated with computing sound, voices, language, memory, comprehension, etc…, making it very difficult to pinpoint exactly what neural activity is specifically dealing with the content of the stories. In order to isolate the neural activity that is specifically dedicated to unravelling the content of the stories, it is necessary to compare the critical experimental condition in which the stories are presented, with a condition that is as similar as possible but without actual story comprehension. Such a condition could exist of listening to sentences that are unlinked and do not form a coherent story. So when the brain activity during the listening to stories is compared to the brain activity during the listening to unlinked sentences (instead of rest), less activations will be revealed, and these neural activations are more likely specifically associated with computing the content of the stories. In every fMRI experiment a similar strategy is used in which the critical experimental condition is matched as closely as possible. Such a comparison between conditions is referred to as a ‘contrast’.

1.2 Motivation

One of the fields that has embraced fMRI as a research tool is social neuroscience, only in the past ten years four new major journals have been introduced that are solely dedicated to publishing research about the neurobiology of social interactions. The picture emerging from this field is that as much as 20 or 25% of the brains structures have specifically evolved in order for people to be able to cope with the social aspects of their environment (Frith and Frith, 2001).

Especially research on Autistic Spectrum Disorders has generated a lot of understanding about what parts of the brain and what processes play a role during the attribution of mental states such as intentions, beliefs and desires, or attributing emotions to interaction partners (Ramachandran and Oberman, 2006; Iacoboni and

Dapretto, 2006). Autism is a developmental disorder that is characterized by a severe impairment in social intelligence, a mild form of autism usually referred to as high functioning autism, is a disorder in which the ability to reason is intact, and only social intelligence is impaired. What is important here, is the realization that apparently normal or even high abilities to reason, or having a high Intelligence Quotient (I.Q.) does not automatically make a person socially competent.

When researchers started comparing the brain activity between normal subjects and subjects with Autistic spectrum disorders while they performed different social intelligence tasks during fMRI scanning (Frith and Frith, 2003; Ramachandran and Oberman, 2006; Iacoboni and Dapretto, 2006;), two important psychological processes were revealed that underlie our ability to understand other people; Theory of Mind (ToM), and Mirror Neurons. Theory of Mind refers to the process of attributing mental states such as beliefs, intentions, and desires. This is an automatic or reflexive process that is associated with activity in a highly distinct and vast symmetrical neural network in the brain. Mirror Neurons are those neurons that fire both when we act, and when we observe that same action performed by another person, hence the name mirror neuron. The importance of the discovery of mirror neurons for social neuroscience, is according to Ramachandran comparable with the importance of the discovery of DNA for evolution. The mirror neuron system is what makes people resonate with each other's emotions, it allows us to literally feel what other people are feeling.

These new insights from neuroscience lead to a generation of new hypotheses around the roles that these neural networks play in how successful people are, or how people behave in organisations. One example is the paper by Tania Singer and Ernst Fehr (2005) titled "The Neuroeconomics of Mind Reading and Empathy". The paper is a call for research on understanding whether there are individual differences in Theory of Mind processing and mirror neuron activity, and what the behavioral correlates are of these individual differences.

1.3 Outline of the thesis

In order to understand the role that Theory of Mind and mirror neurons play in everyday functioning, a specific population is targeted for which one can expect that if there exist individual differences in the functioning of Theory of Mind and mirror neurons, their behavioral correlates will be particularly prominent in a population of salespeople. The buyer-seller interaction allows us to explore how individual differences in ToM processing and mirror neuron functioning relate to job performance, strategy and behavior in the organisation.

In CHAPTER 2 we use insights from neuroscientific research on autistic spectrum disorders to show how individual differences in ToM processing relate to the job performance of salespeople. In order to do this we needed to develop the Salesperson Theory of Mind (SToM) scale which gauges a salespersons ability to interpersonally mentalize. The psychometric properties of the scale are tested by multitrait-mulitmethod matrix, structural equation models and confirmatory factor analysis, and finally the validity of the scale is tested with functional MRI. The results show that salespeople exhibit different degrees of interpersonal mentalizing that can be represented in four distinct but related dimensions that are related to performance.

In CHAPTER 3 we show how individual differences in mirror neuron functioning relate to whether salespeople use a strategy in which they display a customer orientation versus a selling orientation. A customer orientation is characterized by the tendency of a salesperson to mainly focus on solving a customer's problem. In contrast, a salesperson with a selling orientation is characterized by the tendency to try and sell a customer as much as possible regardless of what a customer actually needs, which is also referred to as hard selling. Based on our results, we argue that having a highly responsive mirror neuron system, dispositions a salesperson to display a customer orientation.

In CHAPTER 4 we investigate how Machiavellian Intelligence (a strategy of social conduct) in salespeople relates to mirror neuron functioning and Theory of Mind processing. People scoring high on the trait Machiavellianism are characterized by a willingness and enhanced ability to manipulate other people for their personal gain. Researchers have focused on what mechanisms allow Machiavellians to be skilled manipulators. ToM processing was hypothesized to be a likely candidate explaining their abilities. In our research we expected and found the opposite; Machiavellianism is negatively correlated with the ability to interpersonally mentalize and positively correlated with the amount of activity in key structures in the mirror neuron system. We argue that this specific configuration in social intelligence mechanisms, reflects the rigid mind sets and emotional shallowness with which Machiavellians approach others. With additional field studies, we further elaborate on the relationship between Machiavellianism, organizational citizenship behaviours and performance.

In CHAPTER 5 we conclude with a short overview of our findings and their implications.

CHAPTER 2
A SALESFORCE SPECIFIC THEORY OF MIND SCALE: TESTS OF ITS VALIDITY BY CLASSICAL METHODS, AND FUNCTIONAL MAGNETIC RESONANCE IMAGING

The goal of this chapter is to develop a new theory driven scale for measuring salesperson's interpersonal mentalizing skills: which is the ability of salespeople to "read the minds" of customers in the sense of recognizing customer intentionality and processing subtle interpersonal cues, as well as adjusting one's volitions accordingly. Based upon research on autism and neuroscience, the authors develop a model of brain functioning that differentiates better, from less, skilled interpersonal mentalizers. The convergent, discriminant, concurrent, predictive, and nomological validities of measures of the scale were established by use of four methods in four separate studies: confirmatory factor analysis, structural equation models, multitrait-multimethod matrix procedures, and functional magnetic resonance imaging. The study is one of the first to test the validity of measures of a scale not only in traditional ways but also by adopting procedures from neuroscience.

2.1 Conceptual background

2.1.1 Interpersonal mentalizing

In his classic article, Bonoma (1982) cautions that salespeople should realize that "companies don't buy, people do," implying that it is important for salespeople to be attuned to the minds of buyers, minds that sometimes change rapidly as a consequence of group dynamics within buying centers (e.g., Dawes, Lee, and Dowling 1998). The imperative for salespeople is to immerse themselves into the nuances of the customer's organization and pay special attention to the subtle cues that customers communicate. In this way, salespeople can put themselves in the shoes of the members of the buying center and mentally simulate what customers indicate they want and why they want to buy. Following recent developments in neuroscience, we refer to such processes as "interpersonal mentalizing" (Singer and Fehr 2005). More formally, interpersonal mentalizing refers to the activity of inferring another person's beliefs, desires, risk preferences, intentions, and other mental states or events, as well as the ability to process subtle cues and adjust volitions accordingly (e.g., Frith and Frith 2003, p. 80). Interpersonal mentalizing is an automatic or reflexive process that encompasses specialized regions of the brain. The ability to engage in interpersonal mentalizing and read the minds of the customer can be linked to the adaptive-selling concept, which is a deliberative phenomenon (whereas interpersonal mentalizing is largely an automatic process) and is defined as "the altering of sales behaviors during a customer interaction or across customer interactions based upon perceived information about the nature of the selling situation which enables salespeople to tailor messages to fit individual needs and preferences" (Franke and Park 2006, p. 693; see also Spiro and Weitz 1990; Szymanski 1988). In a similar vein, Sujan, Weitz, and Kumar (1994) propose that adaptive selling is analogous to working smarter, which involves planning so as to better determine the suitability of sales behaviors and activities that will be undertaken in upcoming selling encounters.

However, Sujan (1999, pp. 18–19) proposes that "we need improved measures of salespeople's ability to 'read' their customers" and suggests that promising avenues for developing constructs that pertain to the perceptiveness of salespeople's observations are the ability to identify clients' needs or desires at the underlying, rather than a superficial, motive level, as well as the ability to pick up on nonverbal cues. Several drivers have been proposed to explain why salespeople interact in adaptive ways or work smarter. One example is salespeople's incremental learning, which results in the accrual of contextual knowledge of selling contexts; that is, adaptation depends in part on knowledge of how a person's behavior shapes and is shaped by his or her interactions, which requires mental preparation and planning and a certain degree of self-efficacy with the ability to alter behavior in sales situations (Sujan, Weitz, and Kumar 1994). Individual differences in personality traits are another driver; a key individual difference in this regard is self-monitoring, which reflects the degree to which people regulate their self-presentation by altering their actions in accordance with the situational cues present in an interaction (Spiro and Weitz 1990). The functioning of the drivers of adaptation in selling interactions rests on assumptions about and processes going on in the minds of salespeople.

However, research to date has used methods based only on verbal self-reports. Advances in neuroscience have inspired recent research in related areas, such as consumer behavior (Shiv et al. 2005; Yoon et al. 2006) and economics (Camerer, Loewenstein, and Prelec 2005), and suggest that despite their complexity and relative inaccessibility, mental processes can be studied more directly. The goal of this chapter is to develop a domain-specific theory-of-mind (ToM) scale (hereinafter, we call this a Salesperson Theory-of-Mind [SToM] scale) that gauges salespeople's ability to engage in interactions with customers based on how well they take into account the intentions and other mental states and events of customers.

From the scores of salespeople on the SToM scale (we describe this in greater detail subsequently), we categorize salespeople according to their theory of mind. Then, people scoring relatively high or low on the scale were asked to participate in a laboratory experiment in which their brain activity was monitored during a task that involved listening to stories designed to evoke different opportunities for taking the perspective of both customer and salesperson. Our aim is to pinpoint specific brain areas that distinguish high versus low interpersonal mentalizers and to provide a paper-and-pencil scale and managerial implications.

To our knowledge, this study is the first in marketing to test the validity of a new scale using insights from neuroscience, along with traditional methods. To accomplish this goal, we develop several ideas from neuroscience because these insights provide a different view on what might make salespeople successful during selling encounters. Then, we describe four studies that investigate the role of mentalizing in personal selling.

In Study 1, our objective is to identify real situations and tasks that require interpersonal mentalizing by actual salespeople. Here, we do not study interpersonal mentalizing, per se, but rather uncover expressed skills believed to be related to interpersonal mentalizing. In other words, we investigate how interpersonal mentalizing is embodied or enacted within specific selling situations (for a similar perspective, see Zaltman 1997). Thus, we develop a paper-and-pencil measure that indirectly operationalizes interpersonal-mentalizing concepts in a selling context. We call this the SToM scale to stress the context-specific aspects of our measures and to differentiate them from a generalized ToM scale, which we develop and use to test criterion-related validity.

In Study 2, we replicate the findings of Study 1 and further relate the SToM scale to performance and other variables related to interpersonal mentalizing. In both Studies 1 and 2, we investigate convergent, discriminant, and criterion-related validity. Study 2 also examines nomological validity of the measures of the SToM scale with structural equation models. Study 3 then collects data using a multitrait–multimethod matrix and uses confirmatory factor analysis (CFA) to test for the convergent and discriminant validity of measures of interpersonal mentalizing. Then, in Study 4, to identify the brain areas involved in interpersonal mentalizing and validate measures of the scale at the neural level, we use functional magnetic resonance imaging (fMRI) and experimental treatments to compare salespeople identified as high versus low in interpersonal-mentalizing skills, as measured by our scale, and to pinpoint specific differences in neural processing. Appendix D provides a brief primer on fMRI methodology, as well as technical details specific to Study 4.

2.1.2 Essentials from neuroscience

Salespeople interact with customers for the purpose of understanding customer needs and designing and offering a product or service to meet those needs. The goal is to forge an understanding and a contract that potentially meets the interests of both seller and buyer. From the point of view of the firm, this requires that the salesperson understands the customer’s perspective and skillfully navigates negotiations to achieve a signed contract. To be effective, salespeople need to comprehend and interpret the customer’s mental states and processes. Scholars characterize the aspect of mentalizing that is critical for salesperson effectiveness as follows: “the ability to generate a ‘decoupled’ representation of the beliefs of the customer about the world, ‘decoupled’ in the sense that they are decoupled from the actual state of the world and that they may or may not correspond to reality” (Singer and Fehr 2005, p. 341). We suggest that the salesperson interprets the interpersonal situation, in general, and then mentalizes about the customer, in particular, through a process of making inferences and conjectures as to the beliefs, desires, intentions, and so forth, of the customer. Interpersonal mentalizing is especially needed in such self-interested exchanges as agency contract negotiations (e.g., Bergen, Dutta, and Walker 1992) and the forming of alliances to compete more effectively in certain markets (e.g., Morgan and Hunt 1994).

Neuroscience research reveals that interpersonal mentalizing is an automatic, unconscious, and effortless process that involves the activations of a network of hard-wired brain areas or modules (which we describe subsequently) as a function of social cues emerging from interactions between people in an encounter. To introduce the processes underlying interpersonal mentalizing for further discussion, we consider the following admonishment by a participant in a recent experiment in which the participant had his $10 ultimatum rejected by a player in a game:

> *I did not earn any money because all the other players are STUPID! How can you reject a positive amount of money and prefer to get zero? They just did not understand the game! You should have stopped the experiment and explained it to them." (Camerer, Loewenstein, and Prelec 2005, p. 47)*

Camerer, Loewenstein, and Prelec (2005) note that this particular respondent failed to mentalize effectively about the other party. That is, he failed to realize that many people react to what they perceive as unfair offers by rejecting them, even if by doing so they forgo any gain. Such one-sided allocations of attention to cues and formation of dysfunctional categorizations are analogous to reactions to others by people high on autistic spectrum disorders (ASD) (Camerer, Loewenstein, and Prelec 2005). People high on ASD tend to respond to social cues during interactions according to rote rules (e.g., by categorizing signals and remembering their meaning according to stereotypes or in literal senses), and as a result they frequently make mistakes in judgment in their interactions (e.g., Eckel and Wilson 2003). In other words, in an attempt to read the minds of their interlocutor, they use coarse-grained categories (akin to the categories described by Sujan, Sujan, and Bettman 1988). The coarse-grained categories might work for routine situations, but they come up short within more complex interpersonal contexts that require detailed attention to interaction partners, such that flexible, quick, and appropriate reactions can be generated to shape the conversation eventually to a person's advantage. This seems to be at the heart of Bonoma's (1982) analysis of the dynamics in buying centers and is consistent with the analysis of Singer and Fehr (2005, p. 343), who argue that "mind reading" involves the ability to understand the actual motivational state of the interaction partner, motivations that can change rapidly over time and thus require constant reinterpretation.

The way the human brain functions might help explain why coarse-grained categories dominate judgments by salespeople who seem relatively poor at interpersonal mentalizing (e.g., Camerer, Loewenstein, and Prelec 2005). Three functions are of note.

First, there are specialist functions. People possess specialized brain areas or modules that have evolved to process different kinds of informational cues, such as emotions, intentions, and content related to a specific topic and goals of people with whom they interact (Pinker 1997). When a specialized brain system is triggered by particular cues, processing is rapid, and the task is relatively effortless to the person engaged. In general, people are unaware of the power and sophistication of the processes that enable them to interact with others effectively (Camerer, Loewenstein, and Prelec 2005).

Second, there are parallel modules that operate in (un)coordinated ways. Different regions of the brain operate largely in parallel and, at times, act in a concerted way, while at other times, they work at odds with each other. The functioning of these brain regions can be viewed as networks of brain activities. Ramachandran (2004) refers to this as "cross-wiring" and provides a wide range of examples of such networks. During interpersonal mentalizing, specific brain modules interact in a coordinated way to form a network. (We discuss this in greater detail subsequently.)

Third, there is the "winner-takes-all" principle. The brain does not invariably integrate all the signals activated by individual groups of neurons or networks. When two distinct neural groups convey different information about the external world, the resulting perceptual judgment often adopts the information from one dominant activated neural group and suppresses or ignores the information carried by the other weakly activated neural group (Camerer, Loewenstein, and Prelec 2005).

Consistent with research in neuroscience, we suggest that salespeople low in interpersonal-mentalizing skills experience weak activation of certain specialized areas in their interpersonal-mentalizing brain network (Frith 2003). This involves low integration of the activated information in the brain and utilization of coarse-grained categories when making inferences during social interactions. Thus, for those low in interpersonal-mentalizing skills, abstract and coarse-grained categories become the key drivers for engaging in conversations (indicative of the winner-takes all principle). Interpersonal mentalizing is a hardwired brain process that occurs spontaneously and largely unconsciously in social encounters and is centralized in a distinct network of brain regions. Research by neuroscientists shows that the most consistently activated regions with mentalizing tasks are the medial prefrontal cortex (mPFC), located in the middle of the front of the brain; the left and right temporo-parietal junctions (TPJ), located on both sides just above the ears; and the left and right temporal poles (TP), located at the bottom of the temporal lobes (e.g., Frith 2003). In the ideal case, these three areas interact with one another and cooperate as a network to form an overall interpretation of the mental states or events of another person in an interaction (Frith 2003). Table 1 presents a summary of recent findings for studies of mentalizing that implicate these three brain regions.

Drawing on a growing body of social cognitive neuroscience research, we propose that people who are high (versus low) in interpersonal-mentalizing skills will display greater coordinated activation of all three areas implicated in the interpersonal-mentalizing network during a mentalizing task. The functioning of this distinct network in the brain provides an explanation for why some salespeople are better than others at taking a bird's-eye view of an interaction and integrating the different pieces of information to their advantage.

Table 1 Location and function of brain regions associated with interpersonal mentalizing

Regions	Summary of Findings	Studies
MPFC	The MPFC is involved when people reflect on ostensive cues that might signal faking by another person; the MPFC is especially active during interpersonal-mentalizing tasks.	Grèzes, Frith, and Passingham (2004a, b), as reviewed in Amodio and Frith (2006); Fletcher et al. (1995)
	People in game theory settings take an intentional stand and interpret and predict their opponent's behavior; this involves MPFC activation.	Gallagher et al. (2002)
TPJ	The TPJ is the most consistently activated area with mentalizing tasks. The right TPJ especially displays selective sensitivity for the onsets of cues about mental states of others and is a key driver in constructing a coherent model of the protagonist's mind.	Saxe and Wexler (2005)
TP	Left and right TP converge for all sensory modalities. Lesion studies show that this region is particularly associated with social knowledge in the form of scripts.	Frith and Frith (2003)

2.2 Study 1: The development of the SToM-scale

2.2.1 Rationale

To develop the SToM scale, we performed a literature search and did a content analysis of research in neuroscience and sales force behavior to find items that could be used in the scale. We then isolated different social situations and interactions in which people low in interpersonal mentalizing ability would presumably encounter difficulties (Frith and Frith 2000). The literature suggests that people low in interpersonal-mentalizing skills exhibit several characteristics.

First, they have difficulty strategically taking the initiative in conversations, which is needed to address needs, cajole, and gauge responses from customers. Second, they lack the ability to process indirect information and hints because they tend to focus on bare utterances or literal meaning and are less able to grasp and act on the ostensive meanings in communications (Soldow and Thomas 1984). A third variable differentiating high from low mentalizers is the ability to engage in mutually rewarding interactions. People with low mentalizing skills have difficulties engaging in tasks that require joint attention and reciprocity; from a salesperson's perspective, the establishment of joint attention implies that a conversational context has been created such that the salesperson and the customer cognitively elaborate on the same conversational topics to each other's advantage (see Grice's [1975] cooperative principle). Finally, people with low mentalizing skills have difficulties shaping or providing direction in conversations (Sujan, Weitz, and Kumar 1994).

2.2.2 Respondents and procedures

Sales managers participating in an executive education program were asked to send questionnaires to their salespeople. One hundred seventy questionnaires were distributed. Respondents were asked to provide a unique code anonymously instead of their name and then to return the completed questionnaire using a self-addressed envelope. As compensation for completing the questionnaire, participants received a gift valued at approximately $12. For further motivation, respondents were also informed that their scores would be available to them on the Web site of the Institute for Sales and Account Management at the university that was sponsoring the project. In addition, respondents were told that following a random selection, they might be invited to participate in an fMRI study of salespeople at the university hospital. Scores on the interpersonal-mentalizing scale were not published on the Web site before the fMRI study to keep the participants unaware of their categorization of being a high or low mentalizer.

We received 132 completed questionnaires (a response rate of 78%). The sample consisted of 90% men and 10% women, their average age was 38.2 years (SD = 7.4), and their average sales experience was 9.2 years (SD = 6.2). The distribution of gender was representative of the sales force in the country in which the study was conducted.

2.2.3 Results

Our content analysis identified 33 items. We administered these items to the respondents, along with other measures used to investigate validity (we describe these subsequently). After pruning items due to redundancy and low intercorrelations to arrive at a manageable scale, we identified 14 potential items. An exploratory factor analysis using Promax rotation and maximum likelihood estimation yielded four factors (explained variance of 48%, Kaiser–Meyer–Olkin = .86). After eliminating one item due to cross-loadings, we ended up with 13 items (see Table 2). The four factors are as follows: (1) ability to take initiative in sales and build rapport in conversations (α = .69), (2) ability to notice subtle cues during sales encounters (α = .76), (3) ability to take a bird's-eye view and supply missing information (i.e., achieve closure) during sales encounters (α = .66), and (4) ability to shape/influence interactions with customers in a positive way (α = .79).

Table 2 The Sales Theory of Mind (SToM) Scale

Factor 1: Rapport building

1. When I am with a customer (e.g., in the elevator before a sales meeting) I can easily kindle a small conversation.
2. I find it difficult to talk to a customer about topics that are not business-related. (*R*)
3. When at a business meeting or a reception, I can easily start off a conversation on a general topic such as the weather.

Factor 2: Detecting nonverbal cues

4. I find it difficult to discern the nonverbal cues of customers during a conversation. (*R*)
5. At times I realize that I do not pick up the hints in sales conversations; after the meeting colleagues explain to me what happened during the conversations. Only then do I realize what happened during the conversation. (*R*)
6. During a sales conversation, if customers hint of something, I do take that into consideration as we are speaking together.

Factor 3: Taking a bird's eye view

7. When I realize that someone does not possess the right amount of knowledge in or during a sales conversation, I can easily add some information to bring focus to the conversation, thus making it easier for people to understand what I want to say.
8. When I realize that people do not understand what I'm saying, I put what I want to say in a broader perspective in order to explain what I mean.
9. I always try to understand the industry context in which a customer operates; and by using examples from that context, I add any missing information.
10. Sometimes I summarize for customers what has been said up to that point in the meeting, this make for a smoother conversation!

Factor 4: Shaping the interaction

11. I make sure that I positively influence the atmosphere in a sales conversation.
12. I can easily act in ways that gives a sales conversation a positive twist.
13. I can easily make people feel more comfortable during a sales conversation.

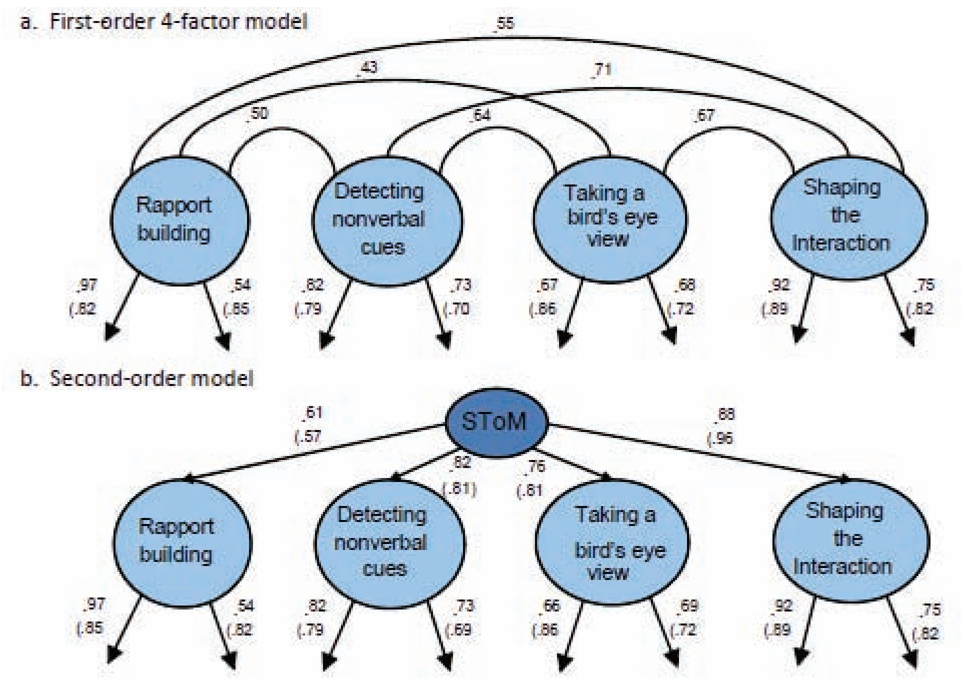
R = reverse coded

We correlated the four factors of the SToM scale with age and sales experience. The findings show that the four factors do not correlate significantly with age (r = –.087 to .001) or experience (r = .016 to .183). This implies that the dimensions of the SToM scale reflect more personal dispositions than learned behavior, per se. Next, we scrutinized the validity of the measures of SToM using CFA and the partial disaggregate model (Bagozzi and Edwards 1998; Bagozzi and Heatherton 1994). We performed four analyses: (1) a four-factor CFA to establish convergent validity of the items for each factor and discriminant validity of items across factors, (2) a second-order CFA to ascertain whether the four factors load satisfactorily on one higher-order factor and thus constitute more concrete dimensions of an overall abstract construct, (3) a seven-factor CFA to examine criterion-related validity of the measures of the four-factor SToM scale with measures of a three-factor general ToM scale, and (4) an eight-factor CFA to investigate the discriminant validity of measures of the four-factor SToM scale from measures of four factors representing important variables studied by contemporary sales force management researchers (i.e., two dimensions of sales call anxiety, perspective taking ability, empathy, and adaptiveness).

2.2.4 Convergent and discriminant validity

Figure 1, Panel A, shows the results for the factor loadings for the CFA model. These loadings are high (.54 to .97) and, in conjunction with the satisfactory goodness-of-fit indexes, establish that convergent validity was achieved: Goodness-of-fit measures for Study 1 are $\chi 2(14) = 17.51$, $p = .23$; root mean square error of approximation (RMSEA) = .05; nonnormed fit index (NNFI) = .99; comparative fit index (CFI) = .99; and standardized root mean square residual (SRMR) = .04 (for definitions of these indexes, see Appendix E. Discriminant validity of the measures is apparent from the values of correlations among factors (.43 to .71). These correlations reflect corrections for attenuation due to any unreliability of measures; the raw Pearson product-moment correlations are significantly lower than these correlations. Each correlation is significantly less than 1.00 (as indicated by both confidence intervals and chi-square difference tests) and thus supports the achievement of discriminant validity for the items across the four factors. (Subsequently, we examine discriminant validity of the measures of SToM from measures of other scales.)

Figure 1. Confirmatory factor analysis models and results for Sales Theory of Mind (SToM) scale. (Study 1 findings not in parentheses, Study 2 findings in parentheses)



2.2.5 Second-order CFA model

Figure 1, Panel B, presents the findings for the second-order CFA of the model. The model fits well according to all the goodness-of-fit indexes: $\chi 2(16)$ = 17.85, p = .33; RMSEA = .03; NNFI = .99; CFI = 1.00; and SRMR = .04. The second-order and first-order factor loadings are high: Second-order loadings range from .61 to .88, and first-order loadings range from .54 to .97. These results suggest that the four dimensions of the SToM scale can be organized as distinct, concrete representations of a single, abstract concept of sales theory-of-mind thinking (i.e., interpersonal mentalizing). Subsequently, we show that a certain substructure can be differentiated.

2.2.6 Criterion-related validity

To examine the criterion-related validity of the measures of the SToM scale, we performed a seven-factor CFA of the measures of the SToM scale and the measures of a ToM scale consisting of three factors. The measures of ToM comprised ten items according to the criteria proposed by Frith and Frith (2000) and pertaining to generalized interpersonal mentalizing ability (Appendix A). For the data in Study 1, we administered these items to the sample of salespeople, factor analyzed them, and found three factors corresponding to three of the four factors for our sales specific scale. The three ToM factors capture, respectively, (1) the ability to take initiative in interactions and build rapport (corresponding to our SToM1, rapport building), (2) the ability to process indirect information and hints in conversations (corresponding to our SToM2 subscale, detecting nonverbal cues), and (3) the ability to cooperate in and coordinate interactions to achieve closure (corresponding to our SToM3, taking a bird's-eye view). The literature on interpersonal mentalizing does not address our fourth scale factor (shaping the interaction), but we expect all three ToM dimensions to be correlated with SToM4 because such an ability is likely to be dependent on the skills summarized by the three ToM dimensions.

Overall, the CFA model fits well in Study 1, according to the goodness-of-fit indexes: $\chi 2(56) = 60.91$, $p = .30$; RMSEA = .02; NNFI = .99; CFI = 1.00; and SRMR = .05. The relevant correlations appear in Table 3 in the entries below the main diagonal and are highlighted in boldface type. As hypothesized, ToM1 and SToM1 are highly correlated (.90), ToM2 and SToM2 are highly correlated (.90), and ToM3 correlates moderately highly with SToM3 (.45). Positive correlations between SToM4 and ToM1–ToM3 also occur, as we expected (.39, .63, and .18). In summary, the measures of the sales-specific SToM scale factors achieve criterion-related validity with the measures of the generalized ToM scale factors.

Table 3 Summary of findings for studies 1 and 2: criterion-related validity, Theory of Mind processing (ToM) and Sales Theory of Mind (SToM)

	Parameter estimates for factor inter-correlation matrix (Study 1 below, Study 2 above diagonal)						
	1	2	3	4	5	6	7
1. ToM_1: Rapport building	1.00	.41	.35	**.97**	**.**52	.57	**.61**
2. ToM_2: Detecting non-verbal cues	.37	1.00	.68	**.**16	**.87**	.68	**.61**
3. ToM_3: Taking a bird's eye view	.13	.45	1.00	.22	.62	**.48**	**.42**
4. $SToM_1$: Rapport building	**.90**	**.**52	.08	1.00	.33	.44	.57
5. $SToM_2$:Detecting non-verbal uses	.40	**.90**	.24	.54	1.00	.66	.73
6. $SToM_3$:Taking a bird's eye view	.33	.43	**.45**	.44	.61	1.00	.75
7. $SToM_4$: Shaping the interaction	**.39**	**.63**	**.18**	.56	.69	.63	1.00

2.2.7 Discriminant validity

We investigated the discriminant validity between measures of the four dimensions of the SToM scale and measures of three other scales that should be related to the SToM scale, but in theory measure different constructs.

One of the other scales is a social anxiety scale, which was developed by Watson and Friend (1969) and is composed of 12 items. We chose social anxiety because it is a common emotion felt by salespeople and should be negatively related to the four dimensions of the SToM scale. A study by Ramachandran and Oberman (2006) investigating people high on ASD supports our conjecture. Verbeke and Bagozzi (2000) show the effects of social anxiety in a sales force but do not examine interpersonal mentalizing as we do here. The social anxiety scale we use has two dimensions that were highly correlated ($r = .68$).

The second scale we used measured perspective taking (i.e., a person's ability to put him- or herself in the place of another), which is one aspect of empathy. We used Davis's (1983) six-item scale and expected that the dimensions of the SToM scale would be positively correlated with perspective taking.

Third, we used Spiro and Weitz's (1990) 16-item adaptive selling scale and predicted that adaptiveness would be positively correlated with the dimensions of the SToM scale. Spiro and Weitz propose theoretically that adaptiveness consists of six facets, but the CFA they run on their data shows that the scale was not unidimensional. Nevertheless, they treat their scale as a unidimensional scale, which obscures differences among facets and violates psychometric principles of measurement, making any predictions based on the scale ambiguous. Moreover, their 16-item scale contains 7 items for Facet 6 and only between 0 and 3 items each for Facets 1–5. As a consequence, we operationalized adaptiveness with 6 of the 7 items for Facet 6, which Spiro and Weitz (1990, p. 62) define as "actual use of different approaches in different situations" and measure globally with general statements, such as "I am very flexible in the selling approach I use" (we dropped 1 item from their Facet 6 measures because it was too transparently redundant with one or more of the others). The six adaptiveness measures we used achieved unidimensionality. Table 4 presents the findings. The model fits well according to the goodness-of-fit indexes: $\chi 2(76) = 95.26$, $p = .07$; RMSEA = .04; NNFI = .98; CFI = .99; and SRMR = .05. The four dimensions of SToM correlate negatively with social anxiety (range: –.22 to –.53) and positively with perspective taking (range: .27 to .40) and adaptiveness (range: .46 to .61), as we hypothesized. Yet the correlations are significantly less than 1.00 and therefore demonstrate that the measures of SToM are distinct from the measures of social anxiety, perspective taking, and adaptiveness.

Table 4. Summary of findings for studies 1 and 2: discriminant validity for Sales Theory of Mind (SToM), anxiety perspective taking, and adaptiveness (Study 1 below, Study 2 above diagonal)

	Parameter estimates for factor inter-correlation matrix								
	1	2	3	4	5	6	7	8	9
1. Social anxiety1[a]	1.00	–	-.19	-.37	**-.38**	**-.23**	**-.24**	**-.29**	-.35
2. Social anxiety2	.68	1.00	–	–	**–**	**–**	**–**	**–**	-
3. Perspective taking	-.40	-.13	1.00	.38	**.28**	**.33**	**.32**	**.33**	.25
4. Adaptiveness	-.33	-.34	.23	1.00	**.46**	**.78**	**.75**	**.70**	.49
5. $SToM_1$: Rapport building	**-.32**	**-.22**	**.28**	**.46**	1.00	.34	.44	.58	.31
6. $SToM_2$: Detecting non-verbal cues	**-.43**	**-.26**	**.40**	**.61**	.53	1.00	.72	.75	.56
7. $SToM_3$: Taking a bird's eye view	**-.53**	**-.29**	**.39**	**.49**	.45	.64	1.00	.75	.31
8. $SToM_4$: Shaping the interaction	**-.31**	**-.22**	**.27**	**.49**	.58	.71	.66	1.00	.48
9. Performance	**--**	**--**	**--**	**--**	--	--	--	--	1.80

In Study 2, all anxiety items loaded on one factor.

2.2.8 Discussion Study 1

We show that the domain-specific SToM scale consists of four distinct factors, in which measures achieve convergent validity within factors and discriminant validity between factors. Furthermore, as our second-order CFA shows, the four SToM factors can be considered reflective of a single, higher-order abstract representation of SToM with four dimensions. Next, we show that the four SToM dimensions achieve criterion-related validity in the sense of systematically correlating with measures of generalized theory-of-mind skills. Finally, we show that the measures of the four SToM dimensions are distinct from measures of social anxiety, perspective taking, and adaptiveness. In Study 2, we attempt to replicate these findings in a new sample of salespeople and, at the same time, demonstrate that the dimensions of SToM are related to performance.

2.3 Study 2: Replication and test of predictive validity of the SToM-scale

2.3.1 Respondents and Procedures

We administered the measures of SToM, ToM, social anxiety, perspective taking, and adaptiveness to a new sample of salespeople. In addition, we obtained measures of performance. Finally, using an additional sample of sales managers and their salespeople, we validated the performance measures. We investigated convergent, discriminant, criterion-related, and predictive validity of the measures of SToM.

We surveyed 126 salespeople who were students and coworkers of the students at an executive education program at a cooperating university. The sample consisted of 91% men and 9% women, the average age was 40.0 years (SD = 9.0), and the average experience in sales was 12.3 years (SD = 7.8). In Study 2, we administered the same items used in Study 1. In addition, we used six items from Behrman and Perrault's (1982) performance scale. The six items focus on sales volume, sales quota, selling new products, sales by key accounts, building and maintaining long-term relation-ships with customers, and profit contributions. Each item asked salespeople to rank themselves on a ten-point scale, where 1 = "bottom 10%" and 10 = "top 10%" in sales compared with all salespeople in their company.

2.3.2 Convergent and discriminant validity

Figure 1, Panel A, shows the factor loadings for the four SToM factors. All loadings are high (.70 to .89). The high loadings and satisfactory fit of the CFA model support convergent validity: $\chi2(14) = 17.66$, $p = .22$; RMSEA = .04; NNFI = .99; CFI = .99; and SRMR = .02. We also achieved discriminant validity; the correlations among the factors range from .33 to .77 and are all significantly less than 1.00. Subsequently, we examine the discriminant validity of the measures of SToM from measures of other scales.

2.3.3 Second-order CFA model

Figure 1, Panel B, presents the findings for the second-order CFA model. This model fits well according to all the goodness-of-fit indexes, and the second-order and first-order factor loadings are high: Second-order loadings range from .57 to .96, and first-order loadings range from .69 to .89: $\chi2(16) = 22.68$, $p = .12$; RMSEA = .056; NNFI = .99; CFI = .99; and SRMR = .04. These results suggest that the four dimensions of the SToM scale can be organized as distinct, concrete representations of a single, abstract concept of sales theory-of-mind thinking (i.e., interpersonal mentalizing). Subsequently, we examine a particular substructure.

2.3.4 Criterion-related validity

The findings for the seven-factor CFA of the measures of the SToM scale and the measures of the ToM scale appear in Table 3. The model fits well overall: $\chi2(56) = 99.54$, $p = .00$; RMSEA = .066; NNFI = .96; CFI = .98; and SRMR = .05. The entries in the correlations matrix above the diagonal address criterion-related validity. As we hypothesized, ToM1 and SToM1 are highly correlated (.97), ToM2 and SToM2 are highly correlated (.87), and ToM3 is moderately correlated with SToM3 (.48). Positive correlations between SToM4 and ToM1–ToM3 also occur, as we predicted (.61, .61, and .42). In summary, the measures of the sales specific SToM scale factors achieve criterion-related validity with the measures of the generalized ToM scale factors.

2.3.5 Discriminant validity of measures of dimensions of the SToM scale from measures of other scales

Table 4 presents the results for this test of discriminant validity. The overall fit of the model is good: $\chi2(56) = 75.18$, $p = .05$; RMSEA = .04; NNFI = .98; CFI = .99; and SRMR = .04. The four dimensions of SToM correlate negatively with social anxiety (range: –.23 to –.38) and positively with perspective taking (range: .28 to .33) and adaptiveness (range: .46 to .78), as we forecasted. Yet the correlations are significantly less than 1.00, thus demonstrating that the measures of SToM are distinct from the measures of social anxiety, perspective taking, and adaptiveness.

2.3.6 Predictive validity

Table 4 also presents the correlations between the four SToM factors and anxiety, perspective taking, adaptiveness, and performance factors (see the final column). Performance correlated .31, .56, .31, and .48 with the four respective SToM factors; –.35 with anxiety; .25 with perspective taking; and .49 with adaptiveness. This establishes the bivariate predictive validity of the measures of the SToM scale.

2.3.7 Validation of performance measures

We asked 40 managers at a sales conference to distribute questionnaires to their top and bottom performers. We asked them to give at least two questionnaires each to top and bottom performers and up to ten if possible. A total of 200 questionnaires were distributed, with 100 to top performers and 100 to bottom performers. We defined top and bottom performers in terms of their ability to achieve high sales, meet quotas, build and maintain relationships with customers, and acquire profitable accounts. The questionnaires contained the same six performance items used in the replication and predictive validity study discussed previously, and they were embedded with many other questions, which helped disguise the purpose of our study. A total of 102 questionnaires were returned: 57 top performers (57% response rate) and 45 bottom performers (45% response rate). A t-test on the equality of mean performance across top and bottom performers showed that the six performance items indeed differentiate between high and low performers: MHigh = 7.70 versus MLow = 6.95, t = 4.19. Thus, evidence suggests that the scale items we used from Behrman and Perreault (1982) are related to actual performance.

2.3.8 Discussion

The SToM measures, which consisted of four distinct dimensions and loaded on one second-order factor, achieved convergent and discriminant validity in a new sample of salespeople and achieved criterion-related validity as well. Moreover the measures of the four dimensions of SToM were distinct from the measures of social anxiety, perspective taking, and adaptiveness.

2.4 Study 3: Construct validity by the multitrait-multimethod matrix approach and nomological validity

Studies 1 and 2 examined aspects of validity for the SToM scale but did so using only a single method. In Study 3, we perform a true construct validity assessment using CFA applied to data gathered by two methods: a "does not describe me/describes me completely" scale and a "disagree/ agree" scale, both measured with seven-point items. We obtained the sample, which included 132 salespeople, using methods similar to that employed in Study 2: average age was 38.3 years (SD = 8.9 years), and 80% were men and 20% were women.

The resulting multitrait–multimethod matrix that we formed consists of two indicators by each method for each SToM factor ("traits"). This yields a 16 × 16 matrix of correlations. Application of a six-factor CFA model (four SToM traits and two method factors) showed that the two method factors were highly correlated, after correction for attenuation ($\varphi = .96$, SE = .04). Therefore, we ran a five-factor CFA model (four SToM traits and one method factor). This model showed a good fit to the data: $\chi 2(82) = 169.55$, $p = .00$; RMSEA = .08; NNFI = .97; CFI = .98; and SRMR = .04. Trait variance ranged from .46 to .85 (average = .66), and of the 16 measures, only 1 (SToM3a) yielded less than 50% trait variance, and even then only slightly below the .50 standard. Random error variance ranged from .00 to .49 (average = .25), which is low. Method variance ranged from .00 to .44 (average = .09), which is also low; indeed, only 1 of 16 method factor loadings was significant.

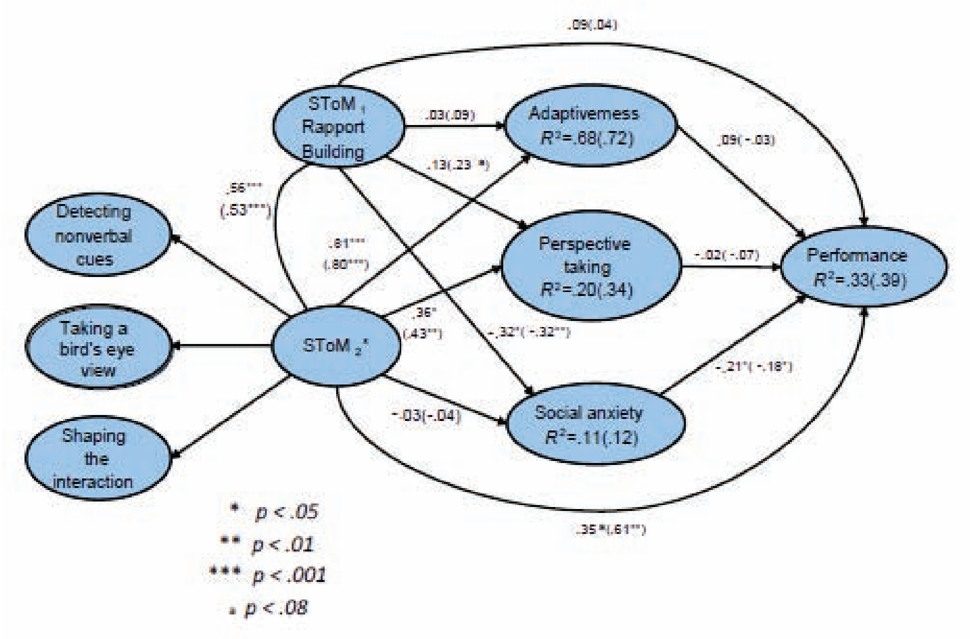
Overall, the construct validity of the measures of the SToM scale, in terms of convergent validity, is excellent. We also achieved discriminant validity for the measures of the SToM scale. The respective correlations of SToM1 with SToM2–SToM4 were .40 (SE = .08), .49 (SE = .08), and .55 (SE = .07). Furthermore, SToM2 correlated .79 (SE = .04) and .76 (SE = .04) with SToM3 and SToM4, respectively, and SToM3 and SToM4 correlated .78 (SE = .78). These correlations, which we corrected for attenuation and therefore are higher than the raw Pearson productmoment correlations, fall far and significantly below 1.00, thus demonstrating discriminant validity for the measures of SToM.

We also investigated predictive validity in a multivariate sense (sometimes also called "nomological validity") by examining a structural equation model in which two SToM factors (a first-order factor for rapport building and a second-order factor for detecting nonverbal cues, taking a bird's-eye view, and shaping the interaction) predicted adaptiveness, perspective taking, social anxiety, and performance, and in turn, adaptiveness, perspective taking, and social anxiety also predicted performance (see Figure 2). The two SToM factors represent intangible relational and instrumental aspects of sales theory of mind, respectively. Tables 3 and 4 show, that the correlations among the four SToM factors are consistent with such an interpretation, in that SToM2–SToM4 correlated highly and uniformly with each other, while SToM1 correlated moderately with SToM2–SToM4. Because we used two methods to measure SToM, adaptiveness, perspective taking, and social anxiety, we ran the structural equation model shown in Figure 2 twice, once for each method.

For Method 1, the overall model fit well: $\chi2(86) = 142.20$, $p = .00$; RMSEA = .07; NNFI = .97; CFI = .98; and SRMR = .05. Figure 2 shows that rapport building influences performance through social anxiety; specifically, the greater the rapport building, the lower is the social anxiety, and the greater is the performance. The only other effect on performance is a direct effect from SToM2* (the second-order factor with first order SToM2– SToM4 factors loading on it), in which the greater the SToM2*, the greater is the performance (here, the effect only approaches significance: $\beta = .35$, $t = 1.76$). The other notable results include the dependence of adaptiveness and perspective taking on SToM2* and the dependence of social anxiety on SToM1.

For Method 2, the overall model also fit well: $\chi2(86) = 135.66$, $p = .00$; RMSEA = .06; NNFI = .98; CFI = .98; and SRMR = .04. As Figure 2 shows, rapport building again influences performance indirectly through social anxiety. Here, SToM2* has a strong direct effect on performance ($\beta = .61$, $t = 2.97$). Similar to Method 1 findings, we again observe that adaptiveness and perspective taking are dependent on SToM2*, and social anxiety is dependent on rapport building.

Figure 2. Findings for predictive validity model in study 2 (method 1 results not in parentheses method 2 results in parentheses)



Note: $SToM_2$* refers to a second-order sales theory of mind factor for which the three first-order factors shown load on this factor. All ellipses designate first-order factors, except for $SToM_2$*, which is a second-order factor. All measures, factor loadings, and error variances are omitted form figure for simplicity. Coefficients in figure are standardized regression parameters.

In summary, SToM processes are the primary drivers of performance, such that SToM1 (i.e., rapport building) indirectly (through social anxiety) and SToM2* (the second order factor on which SToM2–SToM4 load) directly influence performance. Greater rapport building apparently reduces social anxiety, and the less the social anxiety, the greater is the performance. The instrumentality of SToM2* functions to affect performance straightforwardly. Adaptiveness (which we measured with overall or summary measures) and perspective taking are dependent on SToM processes but have no effects on performance beyond the more basic SToM processes. To validate the SToM scale and better understand the bases for interpersonal mentalizing, we turn now to our study of salespeople's brain processes.

2.5 Study 4: Do different patterns of brain activity occur between high and low interpersonal mentalizing salespeople during interpersonal mentalizing tasks?

2.5.1 Hypothesis

To the extent that the SToM scale measures salespeople's ability to interpersonally mentalize, we would expect to observe different patterns of brain activity between salespeople scoring high and those scoring low on interpersonal-mentalizing tasks. More specifically, in line with the recent research of neuroscientists with autistic and normal people, we would expect that high (versus low) scorers on the SToM scale would display greater activation in the MPFC, TPJ, and TP regions (e.g., Amodio and Frith 2006; Castelli et al. 2002; Frith and Frith 2003). Thus, we propose the following: Hypothesis: A comparison of the brain activity between salespeople who are high and those who are low on interpersonal-mentalizing ability during the performance of a mentalizing task (relative to performance on a nonmentalizing task) will show greater activations of the MPFC, TPJ, and TP.

2.5.2 Participants

From the sample of 132 salespeople in Study 1, 20 right-handed salespeople were recruited for the fMRI study. Table 5 presents the means, standard deviations, and t-tests for comparison of high versus low scorers on the

SToM scale across various criteria. High- versus low-scoring participants differed on all four dimensions of SToM. High and low scorers on the SToM scale did not differ in age or experience, but they differed, as expected, on the other scales. The high-interpersonal-mentalizing (high-IM) group scored higher on adaptive selling and perspective taking and lower on social anxiety than the low-IM group.

Table 5. Descriptive statistics for Study 4 participants, by SToM scale scores

	High SToM scorers *n* =10 Mean (SD)	Low SToM scorers *n* = 10 Mean (SD)	*t*-statistic
Age (years)	34.20 (7.52)	40.10 (10.05)	-1.49
Experience in sales (years)	8.30 (4.55)	9.90 (7.50)	.22
SToM	6.45 (.33)	5.18 (.40)	7.79***
$SToM_1$: Rapport building	6.53 (.57)	4.67 (.85)	5.78***
$SToM_2$: Detecting nonverbal cues	6.43 (.39)	5.37 (.82)	3.71**
$SToM_3$: Taking a bird's eye view	6.45 (.40)	5.47 (.70)	3.81**
$SToM_4$: Shaping the interaction	6.37 (.40)	5.10 (.86)	4.22**
Adaptive selling	6.32 (.44)	5.14 (.64)	4.85***
Social anxiety	2.08 (.66)	3.63 (.71)	-5.07***
Perspective taking	5.43 (.66)	4.45 (.85)	2.99*

Note: All subjects are right-handed males. *p<.05, **p<.005, ***p<.00

2.5.3 Method and Materials

The purpose and design protocol for the experiment were approved by the appropriate institutional review board, and all participants gave written informed consent. The stories serving as stimuli were presented auditorily, consistent with the method used by Nieminen-Von Wendt and colleagues (2003). The fMRI protocol consisted of three experimental conditions: interpersonal mentalizing, process, and unlinked sentences. Participants listened to five stories of each type presented in one of two counterbalanced orders. Interpersonal mentalizing is the critical condition, in which the cognitive task involves the use of theory of mind to understand why and how the characters in the story interact. The process condition serves as a closely matching control condition, in which the cognitive task involves nearly the same cognitive processes as in the interpersonal-mentalizing condition, with the exception that the stories do not explicitly require the use of Theory of Mind to understand why and how the characters operate or interact. Finally, in the unlinked-sentences condition, participants listened to a series of sentences that did not form a coherent story. The unlinked-sentences condition serves as a baseline control condition, in which the cognitive task involves the use of language and memory. Under each experimental condition, every story was followed by a question that the respondent was asked to answer silently to him- or herself. The number of words and types of words in the stories were distributed as evenly as possible over the different conditions. The stimuli were presented in the participant's mother tongue; an English translation appears in Appendix F. Every 42 seconds a new story was presented, durations of the stories, including the questions, were between 33 and 36 seconds and, on average, were equivalent in terms of time length across the three experimental conditions. Each participant was then given approximately 6 seconds to think about an answer for each question following the presentation of a story.

A separate group of 25 respondents who were informed about the purpose of the study were asked to evaluate the 15 scenarios. After being given definitions of the stimuli, the respondents identified each of the 15 scenarios as being either interpersonal-mentalizing, process, or unlinked sentence scenarios. They were also asked to describe the scenarios and were recorded as having given a correct response if their descriptions were sensible and could be interpreted. Finally, they rated on ten-point scales their own confidence in the classification and how clear they believed the scenarios were. The three respective scenarios were correctly classified with 96.8%, 99.2%, and 99.2% accuracy. Answers to the stories were correct for 92.0%, 95.6%, and 100% of interpretations, respectively. The respective average confidence ratings were 8.26 (SD = .94), 8.22 (SD = 1.16), and 9.54 (SD = .72). The average clarity ratings were 8.16 (SD = 1.12) for the interpersonal mentalizing and 7.86 (SD = 1.15) for the process scenarios. Clarity ratings for unlinked sentence scenario were not meaningful given their nature.

2.5.4 Functional Image Analysis

Imaging was conducted using a full-body 3.0 T General Electric scanner fitted with an eight-channel receive-only head coil. For the structural imaging, a high-resolution image of the brain was acquired with a three-dimensional T1-weighted inversion recovery fast spoiled gradient recalled echo sequence (echo time [TE]/repetition time [TR]/inversion time = 2.1/10.4/300 milliseconds, flip angle = 18°, matrix = 416 × 256, field of view [FOV] = 25 centimeters, slice thickness 1.6 millimeters with 50% overlap). For the functional imaging, we obtained a time series of 210 volumes with 39 slices in the transverse plane using single-shot gradient echo planar imaging (TR = 3000 milliseconds, TE = 30 milliseconds, flip angle = 75°, resolution = 3.5 millimeters × 3.44 millimeters × 2.3 millimeters, and FOV = 22 centimeters).

During the functional run, a new story was presented every 42 seconds, and volume acquisitions were made during the entire 42-second periods. This resulted in 14 wholebrain fMRI volume acquisitions per story, of which the first 13 were used for analysis (we excluded the last volume from analyses because during this period, participants heard three beeps, which signaled an interstimulus interval). We preprocessed and analyzed functional image data using statistical parametric mapping (SPM2). Linear image realignment, coregistration, nonlinear normalization to stereotactic anatomical space (MNI), and spatial smoothing three-dimensional Gaussian kernel 8-millimeter full-width at half maximum (FWHM) were performed for each participant using standard statistical parametric mapping methods. A high-pass (cutoff period, 250 seconds) frequency filter was applied to the time series.

In line with our hypothesis, we predicted greater activations for high- versus low-IM people in the regions implicated in mentalizing—specifically, the MPFC, TPJ, and TP. We first tested the hypothesis conservatively with a random-effects group analysis at coordinates defined by previous studies and then in an explorative way by searching for groups of voxels in which the activity across participants correlates with the individual SToM measures. Because the predictions were limited to specific anatomical regions, we adopted a region-of-interest approach. Such an approach tests the contrasts only in those specific regions rather than across the entire brain and, by reducing the degree of correction needed for multiple comparisons, allows greater sensitivity in detecting effects. Thus, small volume corrections (SVC; Worsley et al. 1996) were applied to the three a priori regions of interest. The MPFC region was defined using MARINA software (Walter et al. 2003), which has predefined anatomical regions that can be used as masks. The MPFC mask consisted of the MARINA "left and right superior frontal gyrus, medial" regions. For the TPJ and TP regions, we used a sphere with a ten millimetre radius in line with the coordinates of previous studies. We used the coordinates from the results of Saxe and Wexler's (2005) study for TPJ (centered at x = 54, y = –54, z = 14 and x = –48, y = –60, z = 21 for right and left, respectively) and those from Fletcher and colleagues' (1995) study for TP (centered at x = 44, y = 18, z = –16 and x = –44, y = 20, z = –16 for right and left, respectively). Before using SVC, we transformed coordinates given in these studies from Talairach space to MNI space (www.mrc-cbu.cam.ac.uk). We then tested the contrasts of interest in these regions in a second-level random-effects group analysis. For the correlational analysis, we extracted the mean percentage signal change associated with interpersonal mentalizing compared with the process condition and compared with the unlinked-sentences condition, and then we examined their correlations with participants' SToM scores. The sizes of the regions of interest are larger for the correlational analysis and were created with WFU Pickatlas software toolbox by selecting the left and right temporal lobes and the MPFC. Unless otherwise specified, all results were threshold at p = .005 (uncorrected) with a cluster size greater than k = 10. We chose this cluster size to ensure that all activations were at least two contiguous voxels in acquired space.

2.5.5 Results

In line with our hypothesis, we expected that the areas implicated in mentalizing (i.e., MPFC, TPJ, and TP) would be more strongly activated in high-IM participants than in low-IM participants. As a test of our hypothesis, we conducted a comparison between high-IM and low-IM groups for the interpersonal-mentalizing versus process condition and the interpersonal-mentalizing versus unlinked-sentences condition. As predicted, the test of the interpersonal-mentalizing versus process condition revealed more activation of the MPFC and the TPJ bilaterally (for significant interaction effects, see Table 6, Panel A). However, we obtained no difference for the TP. For the contrast of interpersonal-mentalizing versus process condition, three clusters in the mPFC were significantly more activated in the high-IM group than in the low-IM group.

Compared with the low-IM group, the high-IM group also displayed greater levels of activation in the mPFC when performing the interpersonal-mentalizing versus unlinked-sentences task (see Table 6, Panel B). In addition, the high-IM group showed greater activation in the right TPJ than the low-IM group in the interpersonal-mentalizing versus process contrast (see Table 6, Panel A) and in the interpersonal-mentalizing versus unlinked-sentences contrast (see Table 6, Panel B). Comparison between high-IM and low-IM groups for the contrast of both interpersonal-mentalizing versus process and interpersonal-mentalizing versus unlinked-sentences did not yield significant effects in the TP region. Furthermore, in a comparison of the low-IM group and the high- IM group, none of the areas associated with mentalizing were more active in the low-IM group.

Table 6 Foci of increased activation

Anatomical Region	L/R	MNI coordinates x	y	z	Z-value	(k)	Statistical effects IM	T	IM x T
a) Activations for Interpersonal Mentalizing versus Process task									
MPFC	R	10	58	20	3.86	64	n.s.	F(2,36) = 19.10 $p < .001$	F(2,36) = 3.95 $p < .05$
MPFC	R	2	48	42	3.60	30	n.s.	F(2,36) = 13.86 $p < .001$	F(2,36) = 2.00 $p < .10$
MPFC	L	-14	48	36	3.71	60	n.s.	F(2,36) = 11.57 $p < .001$	F(2,36) = 5.37 $p < .01$
TPJ	R	62	-46	4	3.35	18	F(1,18) = 5.39 $p < .05$	F(2,36) = 14.95 $p < .001$	F(2,36) = 3.92 $p < .05$
b) Activations for Interpersonal Mentalizing versus Unlinked Sentences task									
MPFC	L	-14	52	34	3.77	51	n.s.	F(2,36) = 14.09 $p < .001$	F(2,36) = 5.47 $p < .01$
TPJ/STS	R	64	-44	6	4.20	46	F(1,18) = 5.29 $p < .05$	F(2,36) = 18.62 $p < .001$	F(2,36) = 4.73 $p < .05$

IM = interpersonal mentalizing group (high vs. low)
T = task
L = left, R = right
(k) = Cluster size

As a further test of our hypothesis, we performed a correlational analysis between the individual SToM scores and the activity in the interpersonal-mentalizing versus process condition and the interpersonal-mentalizing versus unlinked-sentences condition. The results revealed three areas in which the activity showed significant, positive correlations with SToM scores for the interpersonal mentalizing versus process condition: right MPFC ([8 58 20], r = .69, p < .005), right TPJ ([54 –68 –2], r = .69, p < .005), and left TPJ ([–66 –28 –4], r = .61, p < .005) (see Figure 3, Figure 3 are coloured brain scans and appear in Appendix H). Two clusters in the left and right TP show a similar but nonsignificant trend in terms of correlations with SToM scores for the interpersonal mentalizing versus process condition: left TP ([–38, 10, –30], r = .52, p < .05) and right TP ([48, 2, –8], r = .45, p < .05).

Significant, positive correlations were also found with SToM scores for the interpersonal mentalizing versus unlinked-sentences condition in the following regions: left TPJ ([–64 –28 –4], r = .67, p < .005), left TPJ/superior temporal sulcus ([–60 –12 4], r = .63, p < .005), and right TPJ ([64 –42 6], r = .60, p < .01). Two small clusters in the MPFC showed a similar trend in terms of correlations with SToM scores for the interpersonal mentalizing versus unlinked-sentences condition, but the cluster sizes were smaller than ten voxels. Furthermore, for both contrasts (i.e., interpersonal-mentalizing versus process and interpersonal-mentalizing versus unlinked-sentences), none of the regions showed a significant negative correlation with SToM measures.

To summarize, in general, we find support for our hypothesis; that is, when we compared the neural responses in the interpersonal-mentalizing condition with those in the process and unlinked-sentences conditions, the mPFC and right TPJ regions were differentially activated in the high- and the low-IM groups. In addition to the mPFC and right TPJ, a correlational analysis revealed that the left TPJ was also significantly correlated with SToM measures. However, this effect was weaker in the TP region for the contrast of interpersonal-mentalizing versus process, and the TP was equally activated in high- and low-IM groups for the contrast of interpersonal-mentalizing versus unlinked-sentences.

Finally, the contrast of interpersonal-mentalizing versus process and interpersonal-mentalizing versus unlinked-sentences contrast yielded somewhat different results. This is mainly due to the noisy nature of the experiment and the different cognitive tasks involved in the process task and unlinked-sentences task.

2.6 General discussion

2.6.1 Discussion

In this study, we present a new theory-based SToM scale inspired from recent ideas on neuroscientific research on autism. We used both psychometric methods and fMRI based research to validate the scale. Our research responds to Sujan's (1999) call for improved measures of salespeople's ability to "read" their customers. Such scales should tap into salespeople's ability to identify their clients' needs or desires at the underlying, rather than superficial, motive level.

A core conclusion from neuroscience is that the brain consists of modules that are activated by different cues in the environment and, depending on individual differences, become activated in different intensities. Because salespeople both evoke and process these cues during sales encounters, such activations are coordinated in the brain to form a coherent interpretation ("sensemaking") of what occurs during a sales conversation (for an overview, see Camerer, Loewenstein, and Prelec 2005). Therefore, we developed a brain model that explains salespeople's ability to engage in interpersonal mentalizing.

The research consisted of four studies. In Study 1, we developed a paper-and-pencil measure (the SToM scale) to assess verbal expressions of the degree of interpersonal mentalizing that salespeople exhibit. The results showed that salespeople exhibit different degrees of interpersonal mentalizing that can be represented in four distinct but related dimensions, and furthermore the measures of SToM achieve convergent, discriminant, and criterion-related validity. Moreover, high versus low scorers on the SToM scale are relatively more adaptive in selling situations, are better able to take the perspective of customers, and show less fear of being evaluated negatively in selling situations.

Study 2 replicated the findings of Study 1 and showed that the four dimensions of SToM are significantly related to performance. The performance measures were then validated on a new sample of high and low performers.

Study 3 examined the construct validity of measures of SToM using the multitrait–multimethod matrix and CFA and also tested nomological validity. The measures showed high trait variance, low error variance, and very low method variance. Performance was driven largely by SToM: Rapport building influenced performance indirectly through social anxiety, and the other three dimensions of SToM influenced performance directly.

We conducted Study 4 to discover whether different functioning of brain regions provides evidence for individual differences in the ability to mentalize interpersonally and to provide evidence that the four dimensions of SToM discriminate between high- and low- IM people. We hypothesized that the high-IM group would display relatively greater activations of specific regions of the brain (i.e., MPFC, TPJ, and TP) that have been consistently reported in the literature in association with mentalizing tasks. This hypothesis was largely confirmed: The high-IM group showed more activity than the low-IM group during the mentalizing task in the MPFC and TPJ regions of the brain, but this effect was much weaker in the TP regions and was nonexistent when we compared the interpersonal-mentalizing task with the unlinked-sentences task.

A closer inspection of the data shows that the TP regions were indeed activated in both high- and low-IM groups (for evidence, see Appendix G). To the extent that such activation is related to the formation and use of mental scripts (e.g., Frith and Frith 2003), we speculate that both high- and low-IM salespeople equally use script-based thinking but differ in the ways described previously. Thus, it appears that only for high-IM salespeople is the entire network consisting of the MPFC, TPJ, and TP fully activated, whereas for low-IM salespeople, only part of the network, the TP, is activated. This interpretation is consistent with our previous conjectures that low-IM people rely too heavily on script-based (categorical) thinking, whereas high-IM people integrate such thinking with the use of ostensive cues and interpersonal sensitivity (see Table 1). However, it is also possible that the high-IM group paid more attention to the task, but this could also imply that they are more intrigued by the content of the interpersonal stories, as manifest in more thoroughly activated brain processing.

As Camerer, Loewenstein, and Prelec (2005) note, the more researchers know about functional specialization in the brain and how these regions collaborate in performing different tasks, the more these come to substitute for time-honoured distinctions between categories used to study human behavior; such implications are likely to occur as well for how sales forces are studied in the future. In our research, the findings suggest that the capability to interpersonally mentalize reflects the ability to grasp subtle cues intuitively and effortlessly and to go beyond information given in an interaction to take a holistic point of view (a bird's-eye view). This latter ability involves generating coherent but conjectural stories about an interaction, which are revised as the conversation continues. Another important implication is that people differ in their utilization of their mentalizing networks, and these differences have several behavioral correlates. A possible explanation of the differences in the pattern of brain activity between the high- and the low-IM groups could be that this reflects a difference in cognitive strategy in computing information about mental states of others. The high-IM group displayed an activity pattern in which the MPFC and TPJ play a major role during interpersonal mentalizing, and this might reflect salespeople's abilities to be more dynamic, flexible, and adaptive interaction partners. The pattern of brain activity during interpersonal mentalizing suggests that the mPFC and TPJ regions are significantly less activated in low- than in high-IM salespeople. Because only the TP is fully activated for low-IM people, whereas the MPFC, TPJ, and TP are activated for high-IM people, it appears that the pattern of responses for the low-IM people is consistent with the winner-takes-all metaphor we discussed previously. Here, we suggest that low-IM people act primarily in rigid ways and/or according to previously learned scripts. Either the low IM person fails to process social stimuli fully in interpersonal interactions (because the MPFC and TPJ are less active) or the TP dominates the person's responses in the sense of overwhelming whatever activity exists in the mPFC and TPJ. The latter is consistent with a winner-takes-all perspective.

2.6.2 Managerial implications

Interpersonal mentalizing also seems to be related to research on mindfulness in the organization science literature. However, to date, researchers in this tradition have limited their inquiry to the analysis of verbal reports by qualitative methods (e.g., Weick and Sutcliffe 2006). Whereas the information-processing perspective emphasizes a two-step process consisting of the categorization of customers followed by implementation of canned policies contingent on the categorization, mindfulness research has focused on disciplined observation of communication in a holistic sense and interpretation (sensemaking) of communication in light of the situation–person interface. Weick and Putnam (2006, p. 283) perceptively point out the limitations of the contingency approach as follows: "When people engage in distinction-making, they begin to realize just how quickly we put our experiences into tidy and unexamined conceptual boxes, how reluctantly we are to examine those conceptual boxes, and how much is discovered when we examine these boxes (Kabat-Zinn 2002, p. 69)." Low-IM people seem to be especially prone to categorical thinking in the rigid way that Weick and colleagues characterize it, and at the same time, low-IM people appear to be relatively insensitive to ostensive cues and nuances in everyday human interaction. In contrast, high-IM people actively engage in ongoing sensemaking as an interaction ebbs and flows. This occurs apparently in their interpersonal-mentalizing network, which becomes highly activated. Sense making is manifest in a dynamic, back-and-forth interpretation between (1) the content of what is said and what is not said, including nonverbal communication and inference making of the desires and intentions of the interaction partner, and (2) a decoupled bird's-eye view of how the ongoing interaction is related to motivations and expectations of the institutions and people connected to the interaction. Needless to say, high-IM people have an advantage that low-IM people lack. Our study suggests that the difference occurs in specific brain regions that vary across high- and low-IM people, and a paper-and-pencil scale can capture aspects of interpersonal mentalizing in this sense.

Can interactive mindfulness be learned? This is a difficult question to answer at this stage of what is known about mentalizing and what is required to cultivate mindfulness. However, we believe that through observational learning, role-playing, and practice, salespeople can be trained to become better in the practice of mindfulness and perhaps even enhance their mentalizing abilities to a certain extent. The first step in such training is to make people aware that the anxiety they experience during sales conversations may be a consequence of undeveloped skills in interpersonal mentalizing (see Ramachandran and Oberman 2006) and that anxiety can be reduced to the extent that they develop the discipline to occasionally assume a posture of a detached, abstract observer of their own interactions as they occur, which provides the opportunity to interpret the flow of ostensive cues at multiple, specific occasions across an ongoing interaction. For example, this might involve the subvocal posing of questions at different points in time (e.g., "Did the customer's hint to the effect that she wished we could bundle our offerings mean that her company would order more in the long run to achieve this short term benefit?") (Richardsen and Piper 1986). Moreover, role-playing may stimulate interpersonal mindfulness. Brief simulated interactions could be videotaped, and a skilled, sensitive trainer could analyze the tapes with the salesperson, pointing out what to watch for in ostensive cues and how to respond effectively (e.g., Soldow and Thomas 1984). For example, a customer might show signs of discomfort that could be traced to a mechanical or overly assertive style by the salesperson. Such role playing could take place, if appropriate, in the presence of other salespeople of the firm because salespeople will differ in their styles and abilities to mentalize, and shared learning could be facilitated. Considerable development and trial and error may be needed to institute effective role playing exercises of this sort. Note also that the diagnosis, training, and coaching of mindfulness may be best conducted by people identified as particularly skilled in interpersonal mentalizing and practiced in mindfulness. To the extent that mindfulness can be trained, this will have neurological implications as well. In this regard, many researchers (e.g., Hariri and Forbes 2007) have proposed that through life experiences, circuits in the brain get wired and rewired, a process that is called “neuroplasticity.” This speculation points to areas for further research.

CHAPTER 3
THE ROLE OF MIRROR NEURONS IN CUSTOMER ORIENTATION WITH IMPLICATIONS FOR CUSTOMER ALLIANCE BUILDING

In CHAPTER 3 brain processes of salespersons are studied uncovering the bases of taking a customer orientation. In addition, the implications of assuming a customer orientation for three customer alliance building strategies are investigated: discerning capabilities and practices in customer buying centers, acquiring knowledge from customers and forming contextual knowledge in the buying and selling environment.

"When we see a stroke aimed, and just ready to fall upon the leg
or arm of another person, we naturally shrink and drawback
on our leg or our own arm… The mob, when they are gazing
at a dancer on the slack rope, naturally writhe and
twist and balance their own bodies, as they see him do."

Adam Smith, The theory of Moral Sentiments.

3.1 Conceptual Background

The above quotations point to a fundamental process underlying human empathy in social interaction: imitating and resonating emotionally with another person. Building on the research of Camerer et al. (2005) and research by neuroscientists on simulation processes in the human social mind (e.g., Oberman and Ramachandran 2007), we investigate the neural processes behind empathy of salespersons and relate these to aspects of alliance building with customers.

Salespeople often approach customers with one of two fundamentally different orientations in mind. On the one hand, some sales people appear driven by such questions as, "How can I convince the customer to buy our product?" where the motivation, or at least the starting point, is to meet one's own short term interests and not necessarily the customer's. On the other hand, other salespeople seem guided initially by such questions as "How can I help a customer meet his/her needs by matching our product/service offerings to those needs?" Note that the first orientation – a selling orientation (SO) -- involves persuasion and is mainly one-sided, from salesperson to customer, and frequently leads to short-run relationships, whereas the latter – a customer orientation (CO) -- involves mutual problem solving and is primarily two-sided with the goal of building long-term relationships.

Saxe and Weitz (1982) were the first to systematically consider CO, which they conceived as helping customers assess their needs, bringing a customer problem together with a product, and avoiding the use of high pressure selling. Saxe and Weitz (1982, p. 347) developed a 12-item scale for CO and summarized the key concept underlying the scale as follows: "a high concern for others, low pressure selling and problem solution selling." Yet, how salespeople approach and realize a CO is little understood. Saxe and Weitz (1982) called for more research into the psychological mechanisms behind CO, but little in this regard has been done to date. We take this call and explore whether insights in a recently discovered group of neurons called mirror neurons might shed light in understanding what psychological or neurological processes play a role in how and why salespeople develop a customer orientation.

The paper is organized as follows. First we introduce the basic neurological principles of the mirror neuron system. Second we develop our specific hypotheses where two studies are described. The first is an fMRI investigation, an experiment with real salespersons, the second a field study of the nature of salesperson-customer relationships with regard to building alliances. Then we turn to our empirical studies, presenting the methods and findings. Last, we discuss the implications for research and practice.

3.1.1 Mirror Neuron System

The Mirror Neuron System (MNS) was discovered about ten years ago in the macaque's brain, when scientists used single cell recordings from multiple neurons in the premotor cortex of the macaque (Gallese et al., 1996). The scientists were studying the firing of neurons when a monkey grabbed a peanut; each time the monkey grabbed a peanut the neural activity in the monkey's brain was recorded. Researchers accidentally discovered that when they themselves grabbed the peanut in front of the monkey that the measurements of the single cell recordings showed very similar results to those measured when the monkey grabbed the peanut himself. The researchers concluded that many sensori-motor neurons fire both when a monkey executes certain kinds of actions and when the monkey perceives these same actions being performed by another, and named this class of neurons 'mirror neurons'. In their important paper they suggested that the monkey uses its own brain as a biological model in which actions performed by others are simulated, and that this simulation process forms the basis of an action recognition system. The discovery of the MNS has lead to a generation of new hypotheses testing around the role that the MNS plays in human social intelligence, empathy and in the development of Autistic spectrum disorders.

One study by Dapretto and Iacoboni (2006) compared the imitating of facial expressions with the viewing of these same facial expressions passively during brain scanning. The results revealed that many of the same neural structures are involved when people execute facial expressions, and passively view these expressions performed by others. When children diagnosed with autism were scanned during this task, they found that the activity in the frontal MNS located in the parse opercularis was highly correlated with the severity of the autistic disorder, such that the higher the severity of the disorder, the lower the activity in the frontal mirror neuron system in response to viewing pictures of emotional expressions.

The human MNS is located in the premotor and parietal areas of the brain (Iacoboni and Dapretto, 2006; Gaag van der et al., 2007). Several studies have shown that people with autistic spectrum disorders have a dysfunctional MNS, and this is believed to be the core deficit underlying this socially isolating developmental disorder (e.g., Oberman and Ramachandran, 2007). Mirror neurons are thought to play important roles in understanding and reacting (mimicking) the emotions of others, as well as their intentions.

The way mirror neurons function may be described as follows (Gallese, 2003): when we observe or hear another person performing an action, premotor sectors of the brain which are identical to those that would become active had we performed the action our self, become active. These premotor activations are in addition to visual system activations and show that motor circuits in common to observer and observed are simultaneously shared so to speak. Such processes are characteristic of non-conscious mimicry of facial expressions, posture, gestures and mannerisms observed in self and others when we interact with them. At the same time, in addition to action recognition, mirror neurons code and interpret the intentions of others under observation. This processing occurs in the posterior part of the inferior frontal gyrus and the adjacent sector of the ventral premotor cortex (Iacoboni et al., 2005). The actual emotional reactions happen in the limbic system, which is linked to the mirror neuron system through the pars opercularis (Iacoboni and Dapretto, 2006) and insula (Carr et al., 2003; Lamm, Batson, and Decety, 2007). Within the limbic system the amygdala plays a key role in emotional responding (Lamm et al., 2007).

3.1.2 The Present Studies

Our aim in Study 1 is to show that salespeople who score high versus low in CO, as measured with items from the SOCO scale, will exhibit brain activation suggestive of greater engagement of the mirror neuron system. The idea is that salespeople that have relatively more active or responsive mirror neurons will build more elaborate or richer representations of the mental states of customers. This difference in building representations of the mental states of customers in its turn creates an information bias, where those salespeople with richer representation of the needs and problems of customers are more likely to orientate themselves towards complying with these needs and solving these problems.

Our goal in Study 2 is to explore the associations between CO and alliance building. For example, as salespeople interact with customers, we expect that salespeople will more easily immerse or embed themselves in buying centers and create a psychological comfort zone allowing customers to share and express their needs and also permitting them to acquire contextual knowledge formation about factors needed for solutions of customer's problems. We examine the relationship of CO with each of these aspects of what we will call "alliance building". We turn now, to the scale we use and the specific hypotheses for Studies 1 and 2.

3.1.3 The SOCO Scale

Saxe and Weitz (1982) factor analyzed the responses of 95 salespeople to the 24 item SOCO scale (see Appendix C for the original 24 item SOCO scale). Their findings (Table 1 in Saxe and Weitz, 1982) show that 14 of 24 items failed to satisfy contemporary standards for acceptance (DeVellis, 1991). That is, 12 items loaded too highly on both of two derived factors (items 1, 2, 3, 6, 8, 9, 12, 14, 20, 21, 22, 24), and two items failed to load high enough on either factor (items 18 and 23). Moreover, although Saxe and Weitz (1982) treated the SOCO scale as a unidimensional scale and numerous studies have followed since (see meta-analysis by Franke and Park, 2006), the findings in the original study clearly do not support an unidimensional scale. Further, Periatt, LeMay, and Chakraarty (2004) present evidence showing that the SOCO scale also fails to satisfactorily represent the two dimensions of SO and CO, in accordance with current psychometric standards.

Thomas, Soutar, and Ryan (2001) developed a 10-item short form based on the SOCO scale, where 5 items were employed for measuring SO and 5 items CO. By use of confirmatory factor analysis, Periatt et al. (2004) showed that a two-factor, SO-CO model fit their data well.

We began our investigation with an attempt to replicate the 10-item version validated by Periatt et al. (2004). We found that 7 of 10 of the original items proposed by Thomas et al. (2001) worked well but that three new items performed better than the three in the original short form scale. Table 1 presents our new 10-item short form. We eliminated item 13 from the SOCO scale because it does not express a CO action as do the other CO items (item 13 measures a state of mind, not an action). In addition, item 13 loaded unacceptably low (.40) on the CO factor in the study by Periatt et al. (2003), which used confirmatory factor analysis. We also eliminated item 16 form the SOCO scale because it is nearly identical with items 14 and 23 that are included, and it had the second lowest loading on the CO factor in the study by Periatt et al. (2004). In our exploratory factor analysis, items 13 and 16 loaded on different factors than the other short form items. In place of items 13 and 16, we used items 1 and 2 from the SOCO scale because they capture aspects of CO that were not well represented on the original short form; namely, the new items measure attempts by the salesperson to give accurate expectations of what the product will do for customers and to get the customer to talk about their needs. Items 1 and 2 loaded .40 and .71, respectively, on our exploratory factor analysis. On the SO short form, 4 of 5 items from the original scale worked well, but we eliminated item 22 and replaced it with item 3. Item 22 in our exploratory factor analysis failed to load satisfactorily on any factor, whereas item 3 loaded .49.

Table 1. Items from Sales Orientation-Customer Orientation Scale Used in Study 1

Customer Orientation	
1.	I try to get customers to discuss their needs with me. (2)
2.	I try to find out what kind of product would be most helpful to a customer. (23)
3.	I try to bring a customer with a problem together with a product that helps him solve the problem. (14)
4.	I try to give customers an accurate expectation of what the product will do for them. (1)
5.	I try to figure out what a customer's needs are. (12)
Selling Orientation	
1.	I try to sell a customer all I can convince him to buy, even if I think it is more than a wise customer would buy. (19)
2.	I try to sell as much as I can rather than to satisfy a customer. (6)
3.	If I am not sure a product is right for a customer, I will still apply pressure to get him to buy. (3)
4.	I paint too rosy a picture of my products, to make them sound as good as possible. (20)
5.	It is necessary to stretch the truth in describing a product to a customer. (17)

Note: Numbers in parentheses are the item numbers in the original study by Saxe and Weitz (1982).

We then performed a confirmatory factor analysis on the new short form scale and found that the two factor model fit very well: $\chi^2(1) = 2.28$, $p = .13$, NNFI = .97, CFI = .99, and SRMR = .01. The factor loadings for the CO factor ranged form .82 to .93, and for the sales orientation factor from .82 to .87. The two factors correlated -.57 with a s.e. = .08. Thus the items for the new short form of SOCO measure the two factors well and achieve discriminant validity.

One point we wish to make about the items of the original SOCO scale is that many of the measures of SO, unlike the measures of CO, are double barrelled. That is, many measures express a SO but contrast it with a CO in such a way as to imply that the salesperson takes a SO despite believing that in doing so it works against the interests of the customer. For example, item 19 on the SOCO reads, "I try to sell a customer all I can convince him to buy, even if I think it is more than a wise customer would buy”. In effect, some items for SO present a contingency, while others do not. This introduces ambiguity into the meaning of items and could introduce systematic error in the data and analyses. The items measuring CO do not have this problem and more clearly correspond to the concept that they are intended to measure, namely, CO in the sense discussed above.

3.2 Hypothesis

3.2.1 Hypothesis Study 1

Mirror neuron system. Mirror neurons are neurons that fire both when we act and observe that same action performed by others. For the present hypothesis an extended interpretation of the mirror neuron system is implied, in which all regions that are involved in imitating and resonating with the emotional expressions are considered as part of the mirror neuron system, while in a classical interpretation of the mirror neuron system only those neurons that are part of the motor circuitry are involved. Recent research identifies several key brain regions in this regard (e.g., Carr et al., 2003; Gaag van der et al., 2007; Gallese, 2003; Iacoboni and Dapretto, 2006; Koski et al., 2002; Lamm et al., 2007). Hence we hypothesize,

> Hypothesis 1, (the mirror neuron system): Salesperson scoring high versus low in customer orientation will display greater activation of regions associated with the mirror neuron system.

Spontaneous, reflexive processing. To investigate at what levels of processing individual differences between high and low SOCO occur, subjects will participate in a second experiment, the imitation task. During the imitation task activity at a deliberate or executive level of processing will be evoked in many of the same neural structures as during the MNS experiment.

Hypothesis 2, (spontaneous, reflexive processing): During an imitation task salespeople scoring high versus low in customer orientation will display no significant differences in the amount of neural activity.

3.2.2 Hypothesis Study 2

Salesperson implement or fulfil their customer orientation by creating a shared intersubjective reality with customers. At the level of the interactions between buyer and seller firms, salespeople seek to increase their customer orientating capabilities by building, integrating, and reconfiguring internal and external competencies to address rapid changes in the environment (e.g,. Teece, Pisano, and Shuen, 1997). These capabilities are manifest in interactional, functional, and environmental knowledge stores (Johnson, Sohi, and Grewal, 2004). At the level of interpersonal interactions, a kind of co-creation occurs, where salespersons and customers jointly create alliances so as to meet the needs of both parties (Wotruba, 1992). Mutual knowledge, fostered by a shared manifold of intersubjectivety, leads salesperson and customer to cooperate in a confederation of joint problem solving, initiated by the CO of the salesperson as it resonates with the revealed needs of the customer. Knowledge sharing and the dynamic social construction of the customer-seller relationship are shaped (1) at the level of shared emotions and mutual understanding of intentionality through the operation of mirror neurons and closely allied theory of mind, empathetic, and perspective taking processes and (2) at the level of organization adjustments, which lead to embedded knowledge and embodied knowledge in the joint solution that salesperson and customer fashion (Madhavan and Grover, 1998), as well as enhanced knowledge diffusion between and within firms through what has been termed cognitive spiraling (Salomon, 1993; Johnson et al., 2004) and spillover effects (Uzzi and Lancaster, 2003). More specifically, when people mimic one another, it is not the case that the MNSs are completely shared; only one third of mirror neurons fire for the same executed and observed action and they are known to function as broadly congruent mirror neurons (Iacoboni, 2009, p. 660). Hence through experience, people acquire broader motor programs allowing them to empathize with actions or intentions across domains.

From the point of view of the salesperson, we hypothesize that interpersonal and interorganizational knowledge coupling is initiated through three actions taken by salespersons. These three actions provide the bases for our hypotheses below and are proposed to be dependent on a CO.

Discerning capabilities and practices. Bonoma’s (2006) aphorism that “companies don’t buy, people do” is particularly applicable for large organizations where buying centers comprised of multiple decision makers, each with their own perspective, stake, and need, are involved in deal making. For a CO to be fulfilled, a salesperson must understand the nature and dynamics of the buying center. This means identifying the key members and their characteristics (e.g., training, responsibilities, professional norms), as well as the network of relationships and the distribution of influence among decision makers (e.g., Dawes, Lee, and Dowling, 1998). It is also likely to entail discerning how the buying center and its members perceive and regard the seller, the company, and the product he or she represents. As Bonoma (2006) puts it, salespeople must immerse themselves into the life of the buying center and adjust to the formal and informal social system, as well as the everyday verbal and nonverbal cues in interpersonal interaction. Mirror neuron systems, empathic capabilities and perspective taking associated with a CO should especially be functional as the salesperson apprehends and interprets the buying center. Therefore we hypothesize,

> Hypothesis 3, (discerning capabilities and practices in the buying center). Salespeople scoring high versus low in customer orientation will seek more to distinguish competencies and practices in the buying center.

Knowledge acquisition from customers. A customer orientation entails openness and readiness to uncover customer needs and figure out how to better meet those needs through the resources of one's own company. Implicitly to the extent that customers feel that their needs are understood by the salesperson, they will feel psychological comfort (Edmonson and Woolley, 2003; Tanner et al., 2008) and more readily voice implicit needs and structure them better. Similarly, they should feel motivated to seek to validate knowledge they gain from the market (Cross and Sproull 2004). Such salespeople attain a trusted advisory position in customer-seller relationships. The ability of the salesperson to learn from customers and acquire knowledge in this regard are central elements in the full realization of a CO. Thus we hypothesize,

> Hypothesis 4, (knowledge acquisition from customers). Salespeople scoring high versus low in customer orientation will learn and benefit more from customers.

Contextual knowledge formation. It is not enough to understand the buying center and to learn from customers, in order to fulfil the promise of a CO. The environment and network within which both seller and buyer operate, and which constrain and facilitate the selling and buying transaction, must also be taken into consideration. From the point of view of the salesperson, this means gaining knowledge about the industry and competition and from such other sources as trade fairs and conferences. Rodan and Galunic (2004) showed that knowledge heterogeneity (i.e., the variety of knowledge, know-how, and expertise derived from one's network) is positively related to performance and innovativeness. A CO should foster contextual knowledge formation. Such reactions relate to customer imagination, because salespeople, as they come to form cognitive schemas of and feel customer needs, congruent mirror neuron simulations and motor representations can better help generate solutions to customer problems when salespersons absorb different sources of knowledge (Zaltman, 2003). Such customer imagination is akin to analogical or metaphorical thinking (Hargadon, 1998; Johnson and Lakoff, 2003; Niedenthal et al., 2005). In this regard, Oberman and Ramachandran (2007) note that people with a dysfunctional MNS also are less able to engage in metaphorical thinking. Hence we hypothesize,

> Hypothesis 5, (contextual knowledge formation) Salespeople scoring high versus low in customer orientation will strive more to acquire knowledge about different sources in order to solve problems by their customers.

3.3 Method

3.3.1 Participants and calibration Study 1

From the sample of 132 salespeople described in Method study 2 (paragraph 3.3.5), 24 right-handed salespeople were randomly selected for the fMRI study and provided written consent according to guidelines specified by the institutional review board at the Erasmus University Medical Center, Rotterdam, the Netherlands.

In order to test our hypothesis that the activity in regions associated with other-oriented networks in response to viewing emotional expressions is greater for high CO versus low CO salespeople at spontaneous reflexive levels of processing, subjects participated in two experimental tasks during scanning.

First subjects were asked to simply observe a number of actors displaying basic emotions, neutral faces, and moving geometric shapes (MNS task). The task is designed to analyze individual differences in spontaneous or reflexive neural response to viewing emotional expressions, by contrasting the activity during the observation of positive and negative expressions with two control tasks: neutral faces, and moving geometric shapes.

In the next experiment subjects were asked to imitate emotional expressions following a green -X-, and observe emotional expressions following a red -X- (imitation task). The imitation task is designed to analyze individual differences in neural activity associated with the execution of emotional expressions, by contrasting the execution of the observed emotional expressions, with viewing the emotional expressions passively.

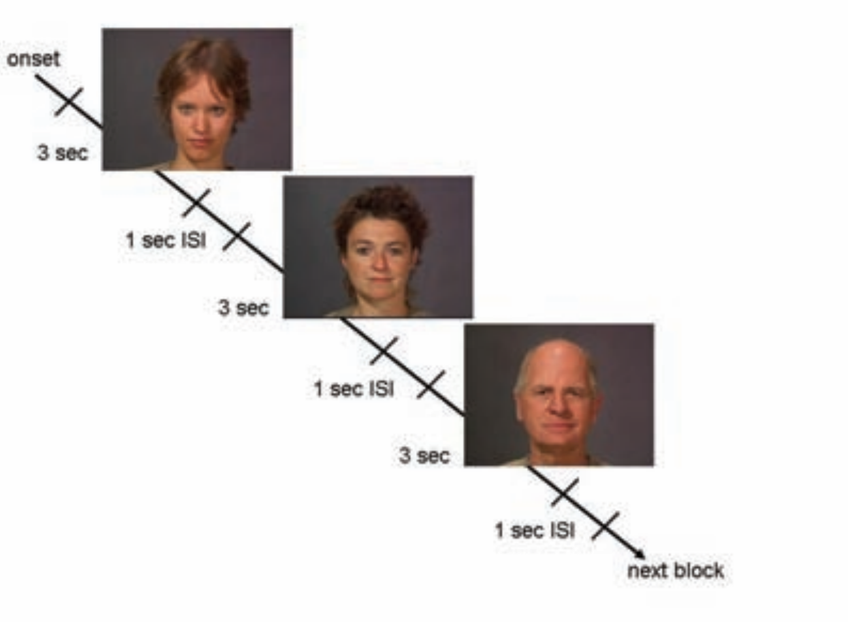
The van der Gaag study (2007) showed that although mirror neurons are spontaneously activated by viewing emotional expressions, the extent of the activations are not immune to attention modulation (e.g. asking participants to subsequently imitate an observed facial expression, increased activity during the 'only observe' conditions). In order to increase the likelihood that we capture spontaneous activations during the first experiment, subjects were unaware of the imitation task that followed.

The imitation task, in the context of mirror neuron experiments is usually implemented to demonstrate that observation and execution of emotional expressions evoke activity in many of the same neural structures. Since our hypotheses are concerned with individual differences between high and low CO in the amount of spontaneous or reflexive processing activity in response to viewing emotional expressions, the imitation task in the present context plays a different role and serves as a control experiment with which we aim to demonstrate that no individual differences occur between high and low CO during execution of emotional expressions. In other words, if we find significant correlations occurring in a certain region between CO scores and neural activity during both MNS and imitation task, then other factors apart from spontaneous, reflexive processing of observed emotional expressions might play a role in explaining the individual differences (e.g. high CO subjects could be more involved in de task). In contrast, finding that individual differences between high and low CO occur only during the MNS task, and not during the imitation task, would additionally support our hypothesis that individual differences between high and low CO are specifically related to spontaneous or reflexive processing of observed emotional expressions.

3.3.2 Stimuli, experimental design, and procedures Study 1

The experimental stimuli consisted of full-face, full-color video clips of 5 males and 5 females displaying various emotional states (anger, disgust, happiness, and surprise; van der Gaag, Minderaa, & Keysers, 2007). The control stimuli were clips of the same actors displaying neutral faces, and video clips with moving geometric shapes. Thus the 4 experimental conditions included: (1) positive emotional faces: happy and surprise, (2) negative emotional faces: angry and disgust, (3) neutral faces, and (4) moving geometric shapes. Each clip was played for 3 seconds in 12 second blocks of 3 clips, plus inter stimulus intervals of one second between each clip. Each condition (Figure 1.) was presented 12 times in a pseudo randomised order, and consisted of either only positive, negative, or neutral emotions or moving geometric shapes. Counterbalanced versions of the stimuli were employed.

Figure 1. Example of a block with neutral faces



For the imitation task that followed the mirror neuron task, 72 clips with emotional expressions were presented in a random order, each clip was separated by six consecutive 1 second intervals displaying a red –X–, followed by six consecutive intervals displaying a green –X–. Subjects were asked to passively observe emotional expressions following a red –X–, and imitate emotional expressions following a green a –X–.

3.3.3 fMRI acquisition

All imaging was performed on a 3T MRI scanner (General Electric, Milwaukee, USA) using a dedicated 8-channel head coil. For anatomical reference, a 3D high-resolution inversion recovery fast spoiled gradient recalled echo T1 weighted image (echo time (TE)/repetition time (TR)/inversion time = 2.1/10.4/300 ms, flip angle = 18°, matrix = 416 x 256, field of view (FOV) = 25 cm, slice thickness 1.6 mm with 50% overlap) was acquired.

For functional imaging, a single-shot gradient-echo echo-planar imaging (EPI) sequence in transverse orientation was used that is sensitive to blood oxygenation level dependent (BOLD) contrast (TR/TE 3000/30 ms. 64 x 96 matrix with a rectangular field-of-view of 22 cm, 2.5 mm slice thickness, 39 contiguous slices; voxel size of 3.5 x 3.0 x 2.5 mm^3), covering the entire brain. Acquisition time was 9:51 minutes with a time series of 192 imaging volumes for the mirror neuron task, and 5:03 minutes for the imitation task (including 15 seconds of dummy scans that were discarded).

The experiment was performed in near darkness with all lights turned off except for the video projector. Visual stimuli were shown by means of back projection with video images projected onto a translucent screen in front of the scanner. Participants viewed this screen with a mirror system on top of the head coil. The total field-of-view extended 21 degrees horizontally and 17 degrees vertically. Stimuli were presented by the stimulation software package, Presentation (Neurobehavioral Systems, Albany, California, USA).

3.3.4 Functional image analysis

The functional imaging data were analyzed using statistical parametric mapping software (SPM 5, distributed by the Wellcome Department of Cognitive Neurology, University College London, UK) implemented in MATLAB (Version 6.5, Mathworks, Sherborn, MA, USA). Motion correction and co-registration with the anatomical image were done according to the methodology provided by SPM5. Brain volumes were normalized to the standard space defined by the Montreal Neurological Institute (MNI) template. The normalized data had a resolution of 2 x 2 x 2 mm and were spatially smoothed with a three-dimensional isotropic Gaussian kernel, with a full width half maximum of 8 mm.

Statistical parametric t-maps were calculated for each subject. Movement parameters resulting from the realignment pre-processing were included as regressors of no interest to reduce motion artifacts. The model was estimated with a high pass filter with a cut-off period 128 seconds. For each participant, t-contrast maps were calculated for positive and negative emotional expressions versus neutral faces, and positive and negative emotional expressions versus moving geometric shapes. The individual t-contrasts maps were used for second level random effects analysis, in which individual scores on the SOCO measure were entered as covariates in a regression analyses. Results were thresholded at p=.05 (corrected for multiple comparisons).

3.3.5 Method Study 2

The CO, SO, and three implementation scales for alliance building (i.e., discerning capabilities and practices in the buying center, knowledge acquisition from customers, and contextual knowledge formation) were administered to a sample of 132 salespersons from a variety of firms across multiple industries and who participated in an executive education program at the cooperating university within Europe. This sample consisted of 71% men, 29% women, with an average age of 36.3 years (SD = 9.1) and an overage experience in selling of 10.4 years (SD = 8.0). Questionnaire items from the original versions in English were translated into the language of the salespersons under study. The reliabilities of the aforementioned scales for this sample were .84, 79, .79, .77, and .79, respectively. The items for the three implementation scales were generated from interviews with salespersons and the literature reviewed above, especially the article by Johnson et al. (2004). Table 2 shows the 15 items used in Study 2.

Table 2. Implementation of Customer Orientation: Building Buyer-Seller Alliance

Capabilities and Practices in the Buying Center Social Network	
1.	I seek to find out in great detail the training members of the buying center have and how they keep up with the developments in their industry.
2.	In great detail I gauge what is the influence of a specific person in the buying process.
3.	I try to get a feel to what degree customers act as professionals.
4.	I always ask how people in the buying center truly perceive us.
Knowledge Acquisition form Customers	
1.	I feel stimulated to come up with new ideas when people by the customer express their thoughts and ideas.
2.	I notice that many of my ideas have been generated when customers asked me challenging questions.
3.	When customers make suggestions or make complaints I seek to learn from it.
4.	When customers ask me difficult and challenging questions I get stimulated.
5.	When customers ask me challenging questions it brings me in a state of flow.
Contextual Knowledge Formation	
1.	I try to keep up by reading journals related to my industry.
2.	I ask myself what the important issues in my work are and then I ask how new information fits into this framework.
3.	I combine my experiences and insights concerning the industry where I work.
4.	I gather knowledge from my industry from different perspectives.
5.	I regularly talk to people who work in my industry in order to keep up with new developments.
6.	I study my competitors during trade fairs and conferences.

3.4 Results

3.4.1 Results Study 1

For the mirror neuron experiment in which subjects observe emotional expressions, neutral faces, and moving geometric shapes, the most prominent findings occur when contrasting the brain activations during the observation of negative emotional expressions versus neutral faces. The CO score was associated with brain activation in 14 brain regions. Table 3 summarizes the findings.

Table 3. Significant brain activations for the regression analysis with Customer Orientation score for negative emotional expressions versus neutral faces

		MNI coordinates			Cluster size	Statistics	
Anatomical Region	Hemiphere	x	y	z	k	z-value	r
Superior temporal pole	L	-48	4	-20	64	3.58#	.58**
Superior temporal pole	R	44	8	-26	12	3.23#	.57**
Superior temporal gyrus	L	-46	38	20	78	3.69#	.49*
Middle temporal gyrus	L	-54	-4	-22	362	5.28#	.75**
Inferior temporal gyrus	L	-40	-16	-22	43	4.06#	.66**
Superior temporal gyrus	R	58	-2	4	123	3.68#	.62**
Precuneus	R	10	-76	42	237	3.25#	.57**
Precuneus	L	-12	-42	76	22	3.23#	.57**
Supplemental motor area	R	2	-2	52	67	3.12#	.55**
Precentral gyrus	R	62	6	24	858	4.91#	.72**
Postcentral gyrus	R	48	-20	62	1051	4.18#	.67**
Pars opercularis/pars triangu laris	R	62	6	22	267	4.80#	.72**
Amygdala	L	-22	2	-20	5	2.64#	.49*
Fusiform gyrus	L	-34	-76	-16	19	3.21#	.57**

Note: * = $p < .05$, ** = $p < .01$, # = $p<0.05$ corrected for multiple comparisons at cluster level with small volume corrections of a sphere of 5mm radius.

The results reveal significant positive correlations between CO scores and activity along the temporal lobes: left STP ([-48 4 -20], $r = .58$, $p < .01$), right STP ([44 8 -26], $r = .57$, $p < .01$), left STG ([-46 38 20], $r = .49$, $p < .01$), left MTG ([-54 -4 -22], $r = .75$, $p < .01$), left ITG ([-40 -16 -22], $r = .66$, $p < .01$), right STG([58 -2 4], $r = .62$, $p < .01$).

The 7th and 8th rows in Table 3 present the findings for the precuneus region. Recall that this region is implicated in perspective taking and self-other differentiation (e.g., Cavanna and Trimble, 2006). The results show significant positive correlations with CO scores: right precuneus ([10 -76 42], $r = .57$, $p < .01$), and left precuneus ([-12 -42 76], $r = .57$, $p < .01$).

Next, rows 9 to 12 in Table 3 present the results for classical mirror neuron activations. In these regions the amount of activity was significantly positively correlated with CO scores: right supplemental motor area ([2 -2 52], $r = .55$, $p < .01$), right precentral gyrus ([62 6 24], $r = .72$, $p < .01$), right postcentral gyrus ([48 - 20 62], $r = .67$, $p < .01$), and right pars opercularis ([62 6 22], $r = .72$, $p < .01$).

The findings for the activation of the amygdala can be found in row 13 in Table 3, the significance of the interaction was only found in 5 voxels, which is not uncommon for activity in the amygdala. The results reveal significant positive correlations with customer orientation scores: left amygdala ([-22 2 -20], $r = .49$, $p < .05$).

The final result for the contrast of negative emotional expressions versus neutral faces appears in row 14 in Table 3 and is for the fusiform gyrus which registers perception and attention paid to human faces (e.g., McCarthy et al., 1997; Wojciulik, Kanwisher, and Driver, 1998). The findings show a significant positive correlation with CO scores: left fusiform gyrus ([-34 -76 -16], $r = .57$, $p < .01$).

Furthermore, a similar but weaker trend was observed when negative emotional expressions were contrasted with moving geometric shapes. No significant correlations were found between CO scores and neural activations when positive emotional expressions were contrasted with neutral faces, or when positive emotional expressions were contrasted with moving geometric shapes. No significant negative correlation with the CO score was found for all contrasts. Finally, no significant correlations were found between scores on the SO scale and brain activations for all contrasts.

For the second experiment the ‘surprise’ imitation task, in which subjects are asked to execute emotional expressions following a green -X- and observe emotional expressions following a red -X-, we report that the amount of neural activity during the task reviewed no significant correlations with CO scores, as expected in Hypothesis 2 (spontaneous/reflexive processing).

In sum, the results partially support our hypothesis, that is at a level of spontaneous, reflexive processing in response to viewing negative emotional expressions versus neutral faces high CO salespeople versus low CO salespeople displayed significantly greater neural activations at 14 different locations in the brain in which activity has previously been associated with the MNS and other-oriented networks. This effect however only occurred during the viewing of negative emotional expressions versus neutral faces, and did occur during the viewing of positive emotional expressions versus neutral faces. A similar pattern was observed when negative and positive emotional expressions were contrasted with moving geometric shapes, although fewer activations achieved significant results. In addition, correlations with neural activity between customer orientation versus selling orientation, showed that only the CO items yield significant correlations.

3.4.2 Results Study 2

We ran a confirmatory factor analysis to test the relationships between CO and SO on the one hand, and the three dimensions of alliance building actions taken by salespersons on the other hand. According to hypotheses 6-8, we expect relatively high correlations between CO and the three dimensions and relatively low correlations between SO and the three dimensions. The model fit the data well: $\chi^2(25) = 50.87$, NNFI = .96, CFI = .98, and SRMR = .035. Customer orientation correlated .56, .66, and .44, respectively, with discernment of capabilities and practices in the buying center, knowledge acquisition from customers, and contextual knowledge formation. By contrast, the respective correlations between SO and the three dimensions were .25, .41, and .21.

3.5 Discussion

3.5.1 Discussion Study 1

In Study 1, we used fMRI to identify a pattern of neural activation in the brain undergirding CO, and tested at what level of processing these individual differences occur (deliberate or spontaneous). We predicted and found that salespeople high versus low in CO displayed greater activations in regions of the brain similar to those found in emerging research on mirror neurons, empathy, and autism, when viewing negative emotional expressions.

The difference we found associated with high versus low scores on CO was an elevated level of embodied simulation processes in response to viewing negative emotional expressions. This embodied aspect of empathy entails a sharing of emotional concern and experiences with another person with whom one interacts. It functions to build a shared identity, to facilitate the ascription of intentions to others, to forge emotional bonds, and in general to foster intersubjective understanding and communication. Other evidence for empathic concern can be seen in non-conscious imitation or mimicry of gestures, facial expressions, mannerisms, and posture. The experience of empathy as manifest in the MNS is linked to emotions through the insula. In this regard it is worth mentioning that people with a dysfunctional MNS are unable to fully attune with others interpersonally, and these symptoms are characteristic of persons with autistic spectrum disorders (Oberman and Ramachandran, 2007). Our findings of differences in neural processing between salespersons scoring high versus low on the CO scale support this conjecture.

Why did individual differences in neural processing only occur during the viewing of negative emotions? We hypothesized that high CO subjects relative to low CO subjects would display elevated levels of processing during both positive and negative emotions. Not finding significant individual differences in the level processing during the viewing of positive emotions can be considered a weakness in the present study. We therefore advice researchers to interpret our inferences that a customer orientation is associated with greater engagement of the mirror neuron system, with caution. Our study is the first to explore this relation, and we find only partial support for our hypothesis.

On the other hand, we would like to argue that not a single significant negative correlation was observed between CO measures and neural activations. In addition, finding that significant positive correlations were observed at 14 different locations in the brain that have previously been associated with 'other oriented networks', is strong evidence that at least during the viewing of negative emotional expressions high CO subjects displayed a pattern of activation suggestive of a higher involvement of embodied simulation processes. In this regard, the results could be interpreted that higher engagement of embodied simulation processes in response to specifically negative emotions is what drives a salesperson to orientate towards solving a customer's problems and needs. This could be an interesting new finding that deserves future research.

Why did only the CO items and not the SO items achieve significant correlations with neural activations? The finding that only the CO items versus the SO items yielded significant correlations with the neural activations is additional evidence of both the achievement of criterion-related validity of the measures of CO and the lack thereof for the measures of SO, which is also reflected by the following correlations. We administered the following scales with the results noted. Customer orientation was significantly negatively correlated (r = -.42, p < .01) with feelings of personal distress, as measured by Davis' (1980) scale. This suggests that the greater the CO, the less distress salespersons feel in interaction with others. The SO scale was not significantly correlated with personal distress ($\underline{r}$ = -.10, ns). Likewise, CO was found to be positively correlated with social competence (Shafer, 1999; Sternberg et al., 1981) at $\underline{r}$ = .51, $\underline{p}$ < .001), whereas SO was only correlated with social competence at a low level ($\underline{r}$ = .19, $\underline{p}$ < .04). Customer orientation was significantly negatively correlated with felt embarrassment in selling situations ($\underline{r}$ = -.34, $\underline{p}$ < .001) and felt anxiety ($\underline{r}$ = -.23, $\underline{p}$ < .01) in sales situations, suggesting that salespeople with a CO are not deterred by the fear of embarrassment or social anxiety, when dealing with customers (for indirect support, see Verbeke and Bagozzi, 2000, 2003). The SO scale did not correlate significantly with either embarrassment ($\underline{r}$ = .03, ns) or anxiety ($\underline{r}$ = -.14, ns).

3.5.2 Discussion Study 2

The findings in Study 2 show that CO as reflected in customer interactions is a competence that bootstraps other capacities which we called collectively, alliance building: (1) discerning capabilities and practices in the buying center social network, (2) knowledge acquisition from customers, and (3) contextual knowledge formation. This shows that a CO is enacted or fulfilled by studying and immersing oneself in the social milieu of the customer, particularly the network of decision makers, learning from and responding appropriately to the content of interactions with customers, and reconciling the requisites of both self and customer firm, as they are impacted by the external environment within which they must function. Alliance building is enhanced when the structures and processes of seller and buyer are harmonized. A key goal for the seller is to induce cooperation and mutual decision making with the customer (e.g., Fligstein, 2001).

3.5.3 Managerial implications

How can sales managers promote a CO and what do our findings of brain activation imply for managerial policies? In this paper, we hypothesized that salespeople high on CO are capable of matching their solutions with the problems and needs of the customer. It is only by stepping into the mental shoes of a customer and understanding their thoughts, feelings and intentions that one can gauge needs and find possible solutions (gathered from networks of relationships with customers and colleagues). Understanding customers can best be understood by exposing salespersons to live interactions (e.g., role playing) and visiting customers and attempt to live inside their brain, so to speak. This is similar to what has been termed the customer imagination: "… In marketing, therefore, the imagination must constantly focus on that objective. It consists simply of letting themselves live, as it were, in their customer's shoes, talking their language, thinking their thoughts, feeling their emotions, responding to their cues…" (Levitt, 1986, pp. 130-134).

Management can also stress a CO versus SO in its coaching, training, and recruitment policies. During such activities emphasis should be placed on interpersonal mentalizing and perspective taking skills, as well as how these explicitly promote a CO (e.g., Comer and Drollinger, 1999). As we stressed, and as substantiated in Study 2, CO comes with ongoing (Hebbian) learning about the customer's goals, intentions, and feelings; through empathizing with customers, it is possible to better understand customer needs and what one can do about these. Training and coaching on how to acquire and share important information are important parts of programs designed to implement CO practices. Future research into neural processes of salespersons could reveal how training and coaching actually works. Tanner et al. (2008) found that mimicry by customers affects their preferences towards products. We found that salespersons high versus low in CO show greater activation of mirror neurons implicated in empathy and imitation. The possibility thus exists for greater persuasion when there is synergy between the CO of salespersons and mimicry by customers.

Indeed, with respect to customers, "…it is possible that even when consumers' guards are up, on a nonconscious level, they might actually be more vulnerable to certain persuasive devices (e.g., mimicry)" (Tanner et al., 2008, p. 756). The research by Tanner et al. (2008), examined mimicry induced in consumers by having a confederate mirror subjects, whereas in our study, we investigated automatic, natural mimicry in salesperson. As a consequence, it would be interesting to study the dual effects of mimicry: conscious mimicry by salespersons as a persuasion strategy and natural mimicry by salespersons as a result of taking a customer orientation.

CHAPTER 4
INTO THE MINDS OF MACHIAVELLIANS: UNCOVERING NEURAL MECHANISMS BEHIND INSTRUMENTAL ACTION IN THE ORGANISATION

Machiavellianism, the personality style that involves manipulation of other persons for personal gain, has been studied extensively by organization researchers and social scientists. However conflicting hypotheses and findings exist concerning the roles that Theory of Mind and empathy play in Machiavellianism, and a need exists for establishing neural correlates to sort-out the differences. Here we show that during a Theory of Mind task Machiavellianism is associated with lower activation of the medial prefrontal cortex, temporo-parietal junction, and precuneus regions. These findings suggest that Machiavellians do not have exceptional mindreading skills. Additionally, we show that during a mirror neuron task Machiavellianism is associated with greater activation of the insula and pars opercularis regions of the brain, two areas implicated in mirror neuron activity and subjective experience of emotions. The results suggest that Machiavellianisms is associated with lower involvement of top-down processes during social interaction, and that Machiavellianism is associated with a higher involvement of bottom-up processes with which they automatically resonate with the emotions of others. Three additional field studies further investigate the relationship between Machiavellianism and various intelligence, personality, and performance variables.

4.1 Conceptual background

4.1.1 Machiavellianism

A considerable body of research is emerging in organizational science and social psychology into the nature and role of Machiavellianism (McIlwain, 2003; Wilson, Near, & Miller, 1996; Schepers, 2003). Machiavellianism is the personality style or trait characterized by "social conduct that involves manipulating others for personal gain" (Wilson et al., 1996). It is sometimes contrasted with benevolent and cooperative actions and plays a central role in politics, business, and legal matters, as well as everyday behavior. For instance, business cases like Enron or the recent crisis in the financial sector have been (at least partially) attributed to Machiavellian behaviors of the actors involved. The goal of this paper is to take an in-depth look at how sales managers operate within their firms and shape their social environment to their advantage. Such an in depth look is needed because most research to date has been based on survey methods, where the correlates and effects of Machiavellianism are measured with self-report scales. While this research is extensive and comprehensive, the findings are sometimes contradictory, explanations are often speculative, and no evidence exists establishing neural correlates of alleged processes.

For example, Machiavellianism is characterized by a strategic orientation to exploit, deceive, manipulate, and act opportunistically (McIlwain, 2003). Yet others surmise that Machiavellians might be genuinely cooperative and trustworthy, when doing so suits their interests (Wilson et al., 1996; Wilson, Near, & Miller, 1998). This has led some researchers to suppose that Machiavellians in fact administer influence in both coercive and prosocial ways (Hawley, 2003). Whatever the inclination of Machiavellians, researchers speculate that their success depends on their ability to read the minds of interaction partners (Langdon, 2003). Yet the only study done to date testing for an association between Machiavellianism and Theory of Mind skills found no relationship (Paal & Bereczkei, 2007). However this latter study was based on paper and pencil measures. One purpose of the present study is to examine the neural network activation of ToM for Machiavellians. We do this experimentally with functional Magnetic Resonance Imaging (fMRI) on real salespersons in Study 1.

A second claim made by psychologists is that Machiavellianism should be associated with perspective taking and empathy because experiencing the emotional states of others can help one understand and influence interaction partners (Nichols, 2001). Nevertheless, self-report correlation studies find that Machiavellianism associates negatively with empathy and positively with psychopathy or sociopathy (Allsopp, Eysenck, & Eysenck, 1991a,b; McHoskey, Worzel, & Szyarto, 1998; Paulhus & Williams, 2002). A second goal of our study is to investigate the neural activation of empathy for Machiavellians. We do this experimentally with fMRI on real salespersons in Study 2.

After experimentally pinpointing the differential involvement of various brain regions in ToM, perspective taking, and empathy for salespeople scoring high versus low on Machiavellianism (Mach IV scale, Christie & Geis, 1970, see Appendix B for original scale), we examine criterion-related, predictive, and ecological validity of measures of Machiavellianism in three field studies. Thus a third aim of our study is to verify key correlates of Machiavellianism in more naturalistic settings with employees across a spectrum of firms: namely, we investigate (Studies 3 and 4) the association of Machiavellianism with measures of general mental ability, social intelligence, emotional intelligence, perspective-taking, customer orientation, adaptive selling, social networking, empathy, and social anxiety. In addition, we investigate (Study 5) certain conditions in organizations that moderate the effects of Machiavellianism on task performance and organizational citizenship behaviors (OCBs). Specifically, we examine managerial control systems as a moderator of the effects of Machiavellianism on performance and OCBs.

4.1.2 Neuroscience Foundations

Research on the neural correlates of ToM implicates a neural system consisting of the involvement of the medial prefrontal cortex (MPFC), temporo-parietal junctions (TPJ), and temporal poles (TP) bilaterally (e.g., Amodio & Frith, 2006; Dietvorst et al., 2009; Frith & Frith, 2003). Contrary to speculation in the social psychology literature, we hypothesize that persons scoring high in Machiavellianism (HMACH) will reveal lower activation of these neural markers than persons scoring low in Machiavellianism (LMACH). Our rationale is that Machiavellians appear to enter social interactions with rigid mindsets where they mistrust others and experience tendencies and predispositions to respond automatically with manipulative intentions (e.g., Wilson, et al., 1998). Compared to non-Machiavellians, they fail to engage interaction partners in open, egalitarian, and cooperative ways but rather are selfish, short-run oriented, socially anxious, and lacking in the ability to build rapport and deeper social relations based on mutuality and give and take (e.g., Repacholi et al., 2003). Game theory research supports such a view as well and finds that HMACHs defect rather than use tit-for-tat or other more cooperative modes of exchange, whereas LMACHs are more cooperative (see Wilson et al., 1996).

Research on empathy, moral judgments, and particularly on perspective taking, identifies the precuneus area of the brain as a key region (e.g., Cavanna & Trimble, 2006; Greene & Haidt, 2002). We hypothesize that HMACHs will exhibit less activation of the precuneus region than LMACHs. Our reasoning is based on correlational research finding a negative association between Machiavellianism and empathy, and other research showing that Machiavellians are emotionally disengaged and distract themselves emotionally from interaction partners in on-going transactions (e.g., Rushton, Chrisjohn, & Fekken, 1981; Christie & Geis, 1970).

4.2 Hypothesis Study 1, and 2

If Machiavellians indeed engage at low levels of ToM processing and are relatively emotionally unattuned to others with whom they interact, as self-report research seems to suggest, why is it that they are successful in manipulating others (e.g., Wilson et al., 1996)? To answer this question, we draw upon recent distinctions made between bottom-up information processing in emotional sharing and top-down information processing in perspective taking, where the opportunity and course of emotional sharing are regulated (e.g., Decety & Lamm, 2006). Although Machiavellians may not experience much perspective taking and empathic concern, they may still participate effectively in imitative and responding at less abstract levels and in less controlled ways than people who are empathic. In other words, emotional contagion and motor mimicry may be high for Machiavellians, yet their executive resources for top-down perspective taking may be less developed. Based on research on empathy (e.g., Decety & Lamm, 2006; Lamm, Batson, & Decety, 2007) and mirror neurons (e.g., Gallese, 2003; Carr et al., 2003; Wicker et al., 2003; Iacoboni & Dapretto, 2006), we hypothesize that HMACHs versus LMACHs will show greater activation in the pars opercularis and insula regions.

In sum, the neural picture we propose for Machiavellians shows them to demonstrate a general lack of ToM, which is an automatic cognitive response, and perspective taking, which is a more executive-like, higher-order or top-down cognitive function; by contrast, we hypothesize that Machiavellians will exhibit an enhanced engagement in imitative, motor mimicry, and emotional contagion processes, which are more bottom-up emotional functions. This implies that HMACHs versus LMACHs will manifest lower activation in the medial prefrontal cortex (MPFC), temporo-parietal junctions (TPJ), and precuneus regions during a Theory of Mind task, and higher activation in the pars opercularis and insula, and lower activation of the precuneus regions during a mirror neuron task.

4.3 Methods Study 1 and Study 2

4.3.1 Subjects in Studies 1 and 2

Professional salespersons in the Netherlands were approached to participate in a study of the personality and neurological processes of employees. Subjects were told that they could take part in either one or both of the two experiments: a Theory of Mind task (ToM, Study 1) and/or a Mirror Neuron task (MN, Study 2). Forty-three healthy salespersons (37 men, 6 women; average age of 35.98 years (SD = 8.23), range 18 to 58 years) volunteered to participate in the ToM experiment, and 24 healthy salespersons (16 men, 8 women; average age of 34.04 years (SD = 6.13, range 21 to 46 years) volunteered to participate in the MN experiment. Eighteen subjects from the MN experiment also participated in the ToM experiment. All subjects were right-handed and provided written consent according to guidelines specified by the institutional review board at the Erasmus University Medical Center, Rotterdam, the Netherlands.

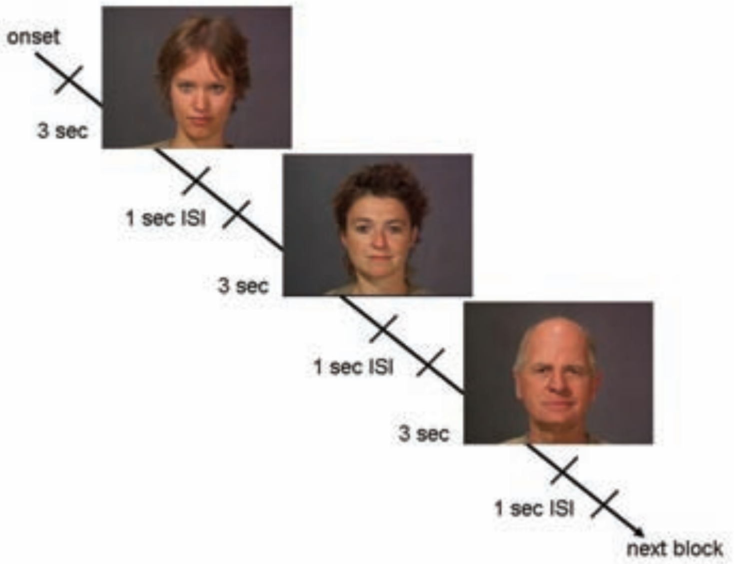
4.3.2 Stimuli and Procedures for Study 1

The stories serving as stimuli were presented auditorily, consistent with the method used by Nieminen-Von Wendt and colleagues (2003). The fMRI protocol consisted of three experimental conditions: interpersonal mentalizing, process, and unlinked sentences. Participants listened to five stories of each type presented in one of two counterbalanced orders. Interpersonal mentalizing is the critical condition, in which the cognitive task involves the use of theory of mind to understand why and how the characters in the story interact. The process condition serves as a closely matching control condition, in which the cognitive task involves nearly the same cognitive processes as in the interpersonal-mentalizing condition, with the exception that the stories do not explicitly require the use of Theory of Mind to understand why and how the characters operate or interact. Finally, in the unlinked-sentences condition, participants listened to a series of sentences that did not form a coherent story. The unlinked-sentences condition serves as a baseline control condition, in which the cognitive task involves the use of language and memory. Under each experimental condition, every story was followed by a question that the respondent was asked to answer silently to him- or herself. The number of words and types of words in the stories were distributed as evenly as possible over the different conditions. The stimuli were presented in the participant's mother tongue; an English translation appears in Appendix F. Every 42 seconds a new story was presented, durations of the stories, including the questions, were between 33 and 36 seconds and, on average, were equivalent in terms of time length across the three experimental conditions. Each participant was then given approximately 6 seconds to think about an answer for each question following the presentation of a story.

4.3.3 Stimuli and Procedures for Study 2

The experimental stimuli consisted of full-face, full-color video clips of 5 males and 5 females displaying various emotional states (anger, disgust, happiness, and surprise; van der Gaag, Minderaa, & Keysers, 2007). The control stimuli were clips of the same actors displaying neutral faces, and video clips with moving geometric shapes. Thus the 4 experimental conditions included: (1) positive emotional faces: happy and surprise, (2) negative emotional faces: angry and disgust, (3) neutral faces, and (4) moving geometric shapes. Each clip was played for 3 seconds in 12 second blocks of 3 clips, plus inter stimulus intervals of one second between each clip. Each block (Figure 1.) was presented 12 times in a pseudo-randomised order, and consisted of either only positive, negative, or neutral emotions or moving geometric shapes. Counterbalanced versions of the stimuli were employed.

Figure 1. Example of a block with neutral faces



4.3.4 Data Recording Procedures in Studies 1 and 2

All imaging was performed on a 3T MRI scanner (General Electric, Milwaukee, USA) using a dedicated 8-channel head coil. For anatomical reference, a 3D high-resolution inversion recovery fast spoiled gradient recalled echo T1 weighted image (echo time (TE)/repetition time (TR)/inversion time = 2.1/10.4/300 ms, flip angle = 18°, matrix = 416 x 256, field of view (FOV) = 25 cm, slice thickness 1.6 mm with 50% overlap) was acquired.

For functional imaging, a single-shot gradient-echo echo-planar imaging (EPI) sequence in transverse orientation was used that is sensitive to blood oxygenation level dependent (BOLD) contrast (TR/TE 3000/30 ms. 64 x 96 matrix with a rectangular field-of-view of 22 cm, 2.5 mm slice thickness, 39 contiguous slices; voxel size of 3.5 x 3.0 x 2.5 mm^3), covering the entire brain.

Acquisition time was 10 minutes and 45 seconds with a time series of 210 imaging volumes for Study 1 (including 15 seconds of dummy scans that were discarded). Acquisition time was 9:51 minutes with a time series of 192 imaging volumes for Study 2 (including 15 seconds of dummy scans that were discarded).

The experiments were performed in near darkness with all lights turned off except for the video projector. Visual stimuli were shown by means of rear projection with a video projector onto a translucent screen in front of the scanner. Subjects viewed this screen with a mirror system on top of the head coil. The total field-of-view extended 21 degrees horizontally and 17 degrees vertically. Stimuli were presented by the stimulation software package, Presentation (Neurobehavioral Systems, Albany, California, USA)

4.3.5 Functional Image Analysis

The functional imaging data were analyzed using statistical parametric mapping software (SPM 5, distributed by the Wellcome Department of Cognitive Neurology, University College London, UK) implemented in MATLAB (Version 6.5, Mathworks, Sherborn, MA, USA). For both studies, motion correction and co-registration were done according to the methodology provided by SPM5. Brain volumes were normalized to the standard space defined by the Montreal Neurological Institute (MNI) template. The normalized data had a resolution of 2 x 2 x 2 mm^3 and were spatially smoothed with a three-dimensional isotropic Gaussian kernel, with a full width half maximum of 8 mm.

Statistical parametric maps were calculated for each subject. Movement parameters resulting from the realignment pre-processing were included as regressors of no interest to further reduce motion artifacts. The model was estimated with a high pass filter with a cut-off period of 250 seconds for Study 1 and 128 seconds for Study 2. For each subject and for both experiments, t-contrast maps were calculated between each condition. For Study 1 these contrasts were interpersonal mentalizing versus process, and interpersonal mentalizing versus unlinked sentences. For Study 2 the contrast were negative emotional expressions versus neutral faces and versus moving geometric shapes, and positive emotional expressions versus neutral faces and versus moving geometric shapes. The individual t-contrast maps were used for second level random effects regression analyses, in which individual Mach-scores (Christie & Geis, 1970) were entered as a covariate.

Because hypotheses for Studies 1 and 2 are based on activity in previously defined regions in the basic neuroscience literature, regression analyses were performed to investigate the differences in brain activation in a Regions of Interest (ROI) approach, for persons based on high versus low Mach-scores. Specifically, the medial prefrontal cortex (MPFC), precuneus, and temporo-parietal junctions (TPJ) bilaterally were investigated for Study 1 (Frith & Frith, 2003; Amodio & Frith, 2006; Dietvorst et al., 2009; Frith, 2003), and the pars opercularis, insula, and the precuneus were investigated for Study 2 (van der Gaag et al., 2007;

Dapretto et al., 2005). At these locations, significance of the interactions was tested by constraining the analysis to the ROI derived from the wfu-pickaltas software package.

4.4 Results Study 1, and 2

4.4.1 Results Theory of Mind experiment

The first study investigated neural activity while subjects listened to 5 'Theory of Mind', 5 'process', and 5 'unlinked sentences' stories in order to test the ToM hypotheses. Comparing the ToM condition versus the Unlinked Sentences condition showed that four regions were significantly more activated in the LMACH versus HMACH, as hypothesized: right MPFC ([8, 64, 20], $r = -.41$, $p < .01$), right TPJ ([48, -68, 30], $r = -.49$, $p < .01$), left TPJ ([-52, -72, 30], $r = -.33$, $p < .05$), and right precuneus ([8, -48, 24], $r = -.32$, $p < .05$) (Table 1, Figure 3a). For the ToM condition versus the Process condition, two regions were significantly more activated in LMACH versus HMACH, as hypothesized: right MPFC ([10, 64, 18], $r = -.40$, $p < .01$) and left precuneus ([-6, -50, 20], $r = -.37$, $p < .05$) (Table 1, Figures 2 and 3b, Figure 2 are coloured brain scans and appear in Appendix H). In sum, HMACHs reveal less activation of regions associated with ToM (MPFC, TPJ) and perspective taking (precuneus) than LMACHs as hypothesized. Furthermore, no positive correlations were found between Machiavellianism and brain activations.

Table 1. Brain activations associated with Machiavellianism (Study 1)

	MNI coordinates					Statistics	
Anatomical Region	L/R	x	y	z	k	Z-value	r
INTERPERSONAL MENTALIZING VERSUS UNLINKED SENTENCES							
Temporo-parietal junction (TPJ)	R	48	-68	30	65	3.31#	-0.49**
Medial prefrontal cortex (MPFC)	R	8	64	20	21	2.76#	-0.41**
Temporo-parietal junction (TPJ)	L	-52	-72	30	2	2.13 (p<0.10)	-0.33*
Precuneus	R	8	-48	24	4	2.1 (p<0.10)	-0.32*
INTERPERSONAL MENTALIZING VERSUS PROCESS							
Medial prefrontal cortex (MPFC)	R	10	64	18	14	2.62#	-0.40**
Precuneus	L	-6	-50	20	5	2.46#	-0.37*

Note: (Z-value) # = p < .05 corrected for multiple comparisons at cluster level with small volume corrections of a sphere of 5mm radius, (r)* = p < .05, ** = p < .01.

Figure 3a. Correlations between Machiavellianism and brain activation for interpersonal mentalizing versus unlinked sentences

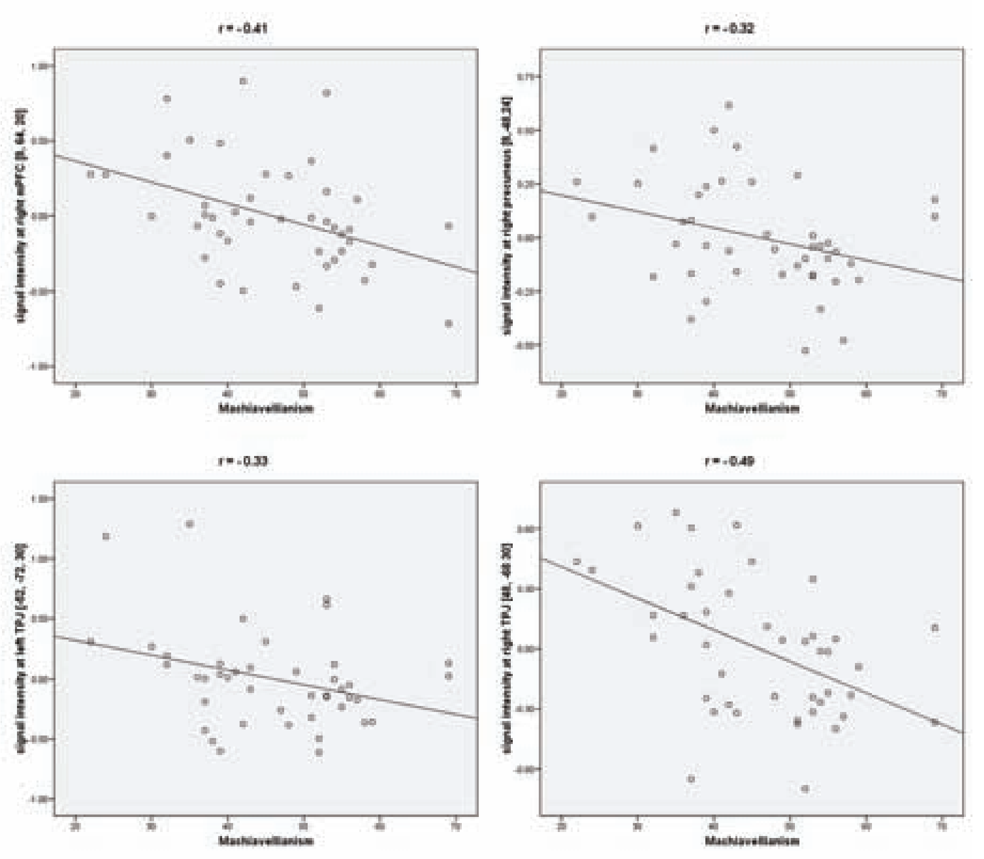
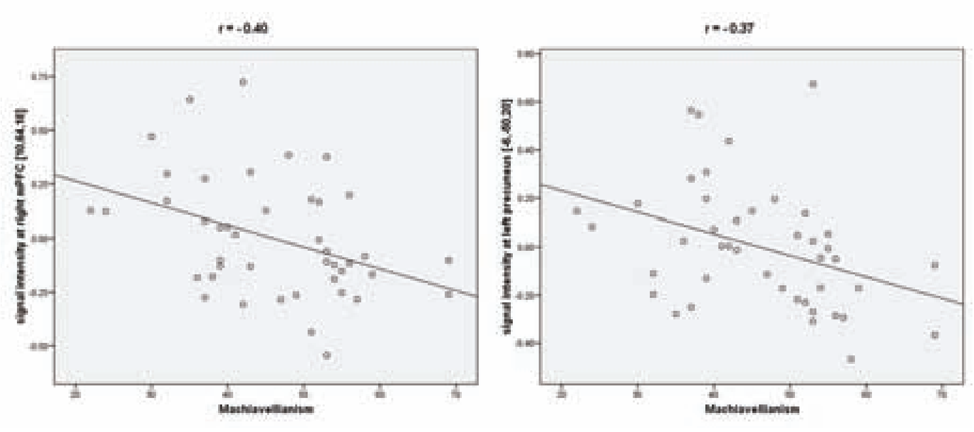


Figure 3b. Correlations between Machiavellianism and brain activation for interpersonal mentalizing versus process



4.4.2 Results Mirror Neuron System experiment

Study 2 examined the mirror neuron system activity during the observation of emotional expressions in human faces. During the observation of negative emotional expressions versus moving geometric shapes, 5 regions were found in which activity showed significant correlations with Machiavellianism: right insula ([50, 18, -12], $r = .64$, $p < .01$), left insula ([-38, 16, -4], $r = .56$, $p < .01$), right pars opercularis ([42, 20, 4], $r = .48$, $p < .05$), and left pars opercularis ([-48, 18, 4], $r = .51$, $p < .01$), left precuneus ([-2, -48, 40], $r = -.52$, $p < .01$) (see Table 2, and Figure 5a). Likewise, during observation of positive emotional expressions versus moving geometric shapes, two regions were found in which activity showed significant correlations with Machiavellianism: left insula ([-44, 14, -2], $r = .40$, $p < .01$) and right insula ([50, 18, -10], $r = .36$, $p < .01$) (see Table 2, Figure 4 and 5b, Figure 4 are coloured brain scans and appear in Appendix H). Mirror neuron system activity is thus greater for HMACHs versus LMACHs, as hypothesized. Confirming the presence of lower perspective taking by HMACHs versus LMACHs, the left precuneus showed a significant negative correlation with Machiavellianism. In sum, HMACHs show greater activation of regions associated with mirror neuron activity (pars opercularis, insula) than LMACHs, as forecast.

Table 2. Brain activations associated with Machiavellianism (Study 2)

		MNI coordinates				Statistics	
Anatomical Region	L/R	x	y	z	k	*Z*-value	*r*
NEGATIVE EMOTIONAL EXPRESSIONS VERSUS MOVING GEOMETRIC SHAPES							
Insula	R	50	18	-12	62	3.36#	.64**
Insula	L	-38	16	-4	60	2.88#	.56**
Precuneus	L	-2	-48	40	13	2.58#	-.52**
Pars opercularis	R	42	20	4	3	2.53#	.48*
Pars opercularis	L	-48	18	4	3	2.52 (p=0.074)	.51**
POSITIVE EMOTIONAL EXPRESSIONS VERSUS MOVING GEOMETRIC SHAPES							
Insula	L	-44	14	-2	81	3.34#	.40**
Insula	R	50	18	-10	66	3.08#	.36**

Note: (Z-value) # = p < .05 corrected for multiple comparisons at cluster level with small volume corrections of a sphere of 5mm radius, (r)* = p < .05, ** = p < .01.

Figure 5a. Correlations between Machiavellianism and brain activations for negative emotional expressions versus moving geometric shapes

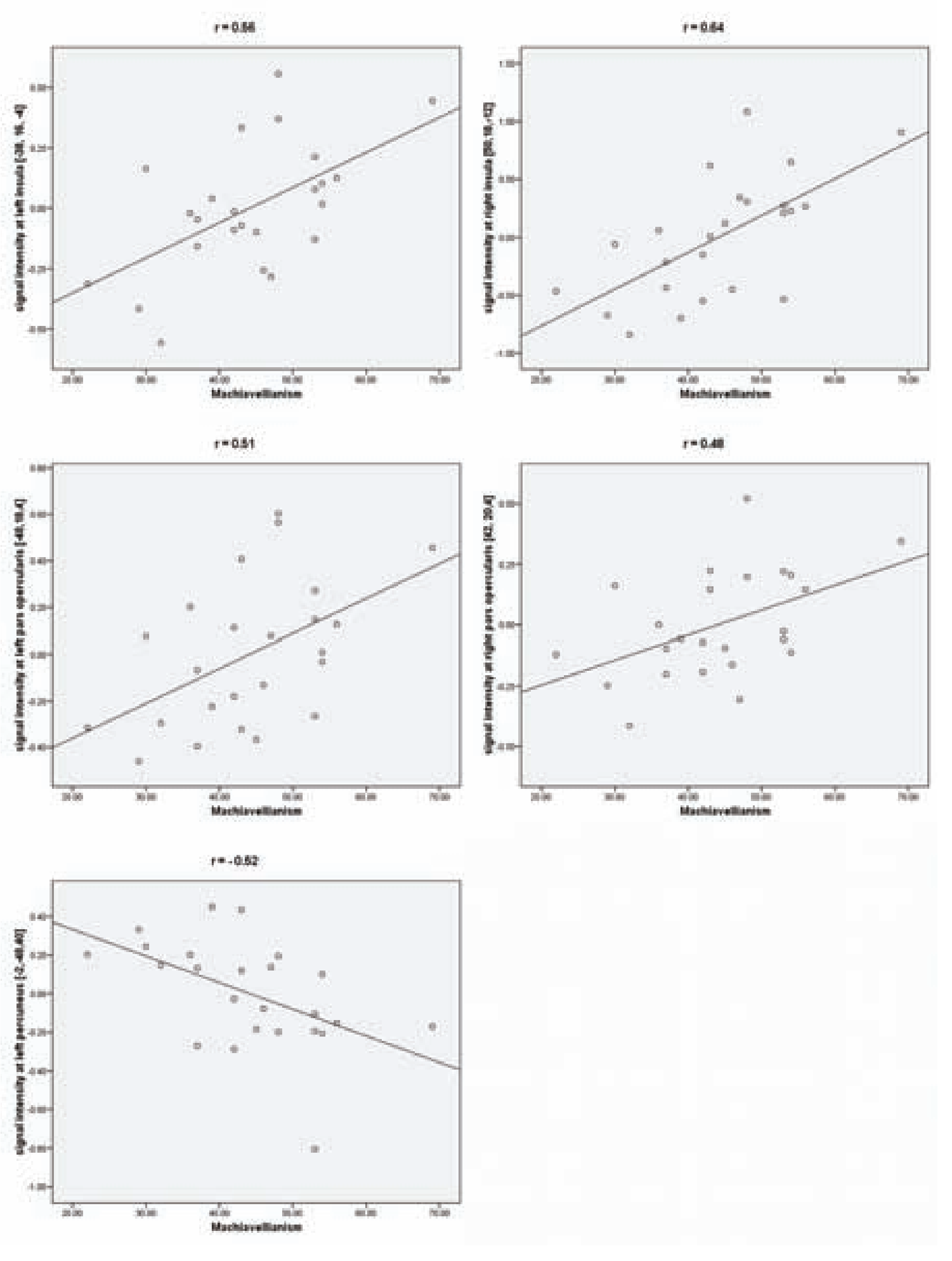
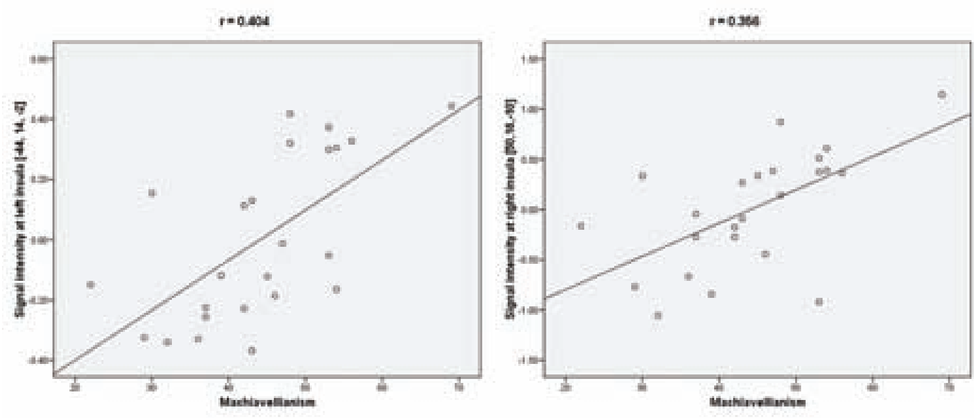


Figure 5b. Correlations between Machiavellianism and brain activations for positive emotional expressions versus moving geometric shapes



4.5 Discussion Study 1, and 2

In sum, our two fMRI studies uncover a complex and seemingly counterintuitive picture of Machiavellianism, at least when contrasted with the results from paper and pencil studies in psychology. Contrary to recent speculation maintaining that Machiavellians should exhibit strong ToM skills (Paal & Bereczkei, 2006), we find that HMACHs in fact show lower levels of ToM processing than LMACHs. At the same time, the current confusion in the psychology literature, which has been unable to reconcile research demonstrating (by use of questionnaires) that Machiavellians are rather unempathic (e.g., McIlwain, 2003; Rushton et al., 1981), with research proposing that Machiavellians are both pro-social and use coercive resource manipulation (e.g., Hawley, 2003), we find in our fMRI studies that Machiavellians disclose a dissociation between top-down and bottom-up information processing related to empathy.

Unlike classic characterizations of empathy, where executive control processes are integral to the concept (e.g., Eisenberg, 2000), we find that HMACHs in fact show significantly lower activition in the precuneus region than LMACHs, which suggests that top-down processes are activated less for HMACHs than LMACHs during the processing of social stimuli. They thus fail to exhibit a long-standing aspect of empathy proposed and found in the social psychology literature, termed, perspective taking (e.g., Davis, Conklin, Smith, & Luce, 1996; Eisenberg, 2000).

By contrast, as divulged by greater activity in the insula and pars opercularis regions of HMACHs, versus LMACHs, it appears that Machiavellianism is characterized by heightened affective resonance and emotion sharing, in a decidedly bottom-up information processing fashion, compared to non-Machiavellians. Thus Machiavellians appear to eschew or be lacking in skills related to ToM and perspective taking in favor of emotional contagion and mimicry processes. It would be incorrect to conclude that Machiavellians are not empathic; indeed, they are facile in one aspect of empathy (bottom-up processing), while being disadvantaged in another (top-down processing). At the same time, Machiavellians are peculiarly disengaged from ToM processes. We turn now to a demonstration of these findings, and reveal interesting covariates, by testing hypotheses on employees in field settings.

4.6 Field studies

4.6.1 Correlational hypothesis

To more closely ground our neural hypotheses to the research in social psychology and organization research, and do so with participants from a common domain relevant to the processes and methods at hand, we also test hypotheses in field studies concerning the relationship between Machiavellianism and general, social, and emotional intelligence, the environment in which subjects work (tightly versus loosely controlled), empathy, perspective taking, social anxiety, various job-related person variables, OCBs, and task (sales) performance.

As with our fMRI experiments, the subjects used in these field studies consist of sales professionals engaged in face-to-face selling activities and therefore permit ideal investigation of social cognitive skills and processes and individual differences in naturalistic settings, and provide opportunities for explicit comparisons between experimental and field research.

In Study 3, we investigate the association between scores on Machiavellianism and general mental ability, social intelligence, and emotional intelligence. We do not expect a significant relationship between general intelligence and Machiavellianism. Wilson et al. (1996) summarize the results from 9 studies relating scores on Machiavellianism to various intelligence measures and note that no study found a significant correlation. They speculate that the lack of a significant correlation between Machiavellianism and general intelligence is due to nonsignificant relationships between success in everyday life and Machiavellian intelligence. Wilson et al. (1996) point out that findings for studies relating Machiavellianism to success in employment situations reveal inconsistent outcomes: 4 cases with no significant correlations, 6 with negative, and two with positive. Only one of the latter 12 studies dealt with sales success, and this study reported no significant correlation.

Although measures of general intelligence fail to relate to Machiavellianism, Cherulnik, Way, Ames, and Hutto (1981) report that people who interact with Machiavellians perceive them to be "intelligent" and "charming". This suggests perhaps that more contextualized measures of intelligence are needed to capture specific social and emotional intellectual skills related to Machiavellianism. Selling jobs such as studied herein rely on interpersonal perceptiveness, the capacity to adjust one's cognitive abilities to different situational demands stemming from interactions with customers, and affective skills to read and cope with emotional consequences of interactions with customers. In line with our hypotheses and findings that salespersons who score high in Machiavellianism are less facile in ToM processing and perspective taking, as registered in activations of appropriate regions of the brain, we hypothesize that social intelligence and emotional intelligence will be negatively correlated with Machiavellianism.

In Study 4, we examine the association between scores on Machiavellianism and perspective taking, customer orientation, adaptive selling, social networking with customers, empathy, and social anxiety. Consistent with our findings from the brain activation studies, we predict that Machiavellianism will be negatively correlated with perspective taking and empathy, confirming what was found at a neurobiological level.

Customer orientation refers to the selling practice whereby salespersons enter interactions with a desire to help customers, uncover customer needs, offer products that satisfy those needs, describe products accurately, and avoid deceptive, manipulative, or high pressure tactics (Saxe & Weitz, 1982). Customer orientation is contrasted to the so-called selling orientation or hard selling, which places gains for self or firm ahead of customer's best interests (see CHAPTER 3). As a consequence, we hypothesize that Machiavellianism will be negatively related to customer orientation.

Adaptive selling is "the degree to which salespersons alter their sales presentation across and during customer interaction in response to the perceived nature of the sales situation" (Spiro & Weitz, 1990, p.61). To the extent that Machiavellians enter interactions with rigid mind-sets and exploitive styles as previous research demonstrates (e.g., Repacholi et al., 2003; Wilson et al., 1996; Wilson et al., 1998), we would expect that adaptive selling and Machiavellianism would be negatively correlated.

Social networking herein refers to aspects of social capital, namely, shared cooperative ties that salespersons and customers jointly value for their ability to achieve mutual ends effectively and efficiently (e.g., Bourdieu, 1986, p. 249; Nahapiet & Ghoshal, 1998). Such cooperative ties are fostered by give and take and the cultivation of interpersonal relationships. Because Machiavellians show tendencies to exploit and deceive others and at the same time mistrust others (e.g., Wilson et al., 1998) and are socially awkward (e.g., Wilson et al., 1996), we expect a negative association between social networking and Machiavellianism.

Machiavellians not only mistrust others but are said to have a predisposition to "strike first" before others take advantage of them (e.g., McIlwain, 2003). They are also uncomfortable in social relations and have difficulty establishing rapport and trust (e.g., Repacholi et al., 2003). As a result, we hypothesize that the higher the score on the Machiavellian scale, the more socially anxious the employee.

4.6.2 Moderating effect hypothesis

In Study 5, we investigate managerial control as a moderator of the effects of Machiavellianism on task performance. Machiavellians value high degrees of freedom in their selling actions (Christie & Geis, 1970). Freedom allows one to cut corners and avoid cooperative imperatives with less fear of provocation or retaliation (Wilson, et al., 1996); freedom also permits one to exploit social networks to take advantage of structural holes and act as knowledge brokers amongst network ties (Burt, 2005). But to the extent that management controls the actions of salespeople, Machiavellians should feel frustrated or threatened in the sense that opportunities for improvisation and coalition building are limited, and constraints may be placed on the use of persuasive or manipulative tactics (Berstein, 2005; Christie & Geis, 1970). In his study of stockbrokers, Shultz (1993) found that the sales performance of Machiavellians was best in organizations with loose structures and low control; LMACHs performed significantly better than HMACHs in organizations with strong rules and procedures and tight control. Hence, we hypothesize that sales performance will be greatest for salespersons scoring low versus high in Machiavellianism and working in organizations with high versus low control.

We also expect managerial control to moderate the effects of Machiavellianism on organization citizenship behaviors (e.g., MacKenzie, Podsakoff, & Fetter, 1991; Podsakoff, MacKenzie, Paine, & Bachrach, 2000). For OCB-Os (e.g., attending organizational functions that are not required but help the company image), which are open and visible, we expect Machiavellians under high managerial control to use these more than under low managerial control. Machiavellians should use OCB-Os to manage their impressions and manipulate their image when supervisory monitoring of their behavior is strong versus week (Bolino, 1999). By contrast for OCB-Is (e.g., touching base with colleagues before initiating actions that might affect them; helping orient new colleagues), which are less publicly observable (and hence less effective for impression management purposes), we anticipate that Machiavellianism will be more strongly negatively related to OCB-Is, when managerial control is high versus low. That is, HMACHs will show fewer OCB-Is than LMACHs, the greater the managerial control.

4.7 Methods for Study 3 to 5

In Study 3, 171 salespeople from a Dutch company selling print advertisements filled in a questionnaire including measures for Machiavellianism (Christie & Geis, 1970), general mental ability (GMA), social intelligence, and emotional intelligence. Participants' scores on Machiavellianism were correlated with their scores on the intelligence scales (Pearson correlations with two-tailed *p*-values). The GMA was measured with the test of nonverbal reasoning (Drenth, 1965), which has been found to correlate positively and significantly with Raven's progressive matrices test, a test of general intelligence (Drenth, Van Wieringen, & Hoolwerg, 2001); social intelligence was measured with a 10-item scale developed by Shafer (1999); emotional intelligence was measured with a 23-item scale developed by Schutte et al. (1998). Table 3 presents the reliabilities for the Machiavellianism, GMA, social intelligence, and emotional intelligence measures.

For Study 4, sales managers in the Netherlands, from different firms and industries participating in an executive education program, were asked to send questionnaires to their salespeople. A total of 101 salespeople anonymously returned the questionnaire including measures on Machiavellianism, perspective-taking, customer orientation, adaptive selling, social networking, empathy, and social anxiety. Scores on Machiavellianism were correlated with the scores on the other social and emotional skills (Pearson correlations, two-tailed *p*-values).

Perspective taking and empathy were measured with 7-item scales each taken from Mehrabian and Epstein (1970). Customer orientation was measured with the Saxe and Weitz (1982) scale. Adaptive selling was measured with the 16-item Spiro and Weitz (1990) scale. Social networking was measured with 5 items developed specifically for the selling situations herein and based on the literature on social capital (e.g., Nahapiet & Ghoshal, 1998). Example items include, "sometimes I speak with colleagues working with key accounts to understand the deeper issues of the industry" and "I organize discussions with my colleagues to stay up to date." Social anxiety was measured with the 20-item sales call anxiety scale reported in Verbeke and Bagozzi (2000). Table 3 shows the reliabilities for the Machiavellianism, perspective-taking, customer orientation, adaptive selling, social networking, empathy, and social anxiety measures.

Finally in Study 5, 198 Dutch salespeople from a variety of companies and industries participated. Salespeople filled out the Machiavellianism scale (Christie & Geis, 1970), the 5-item managerial control scale (Jaworski, Strathkopoulos, & Krishnan, 1993) and the 3-item OCB-O (e.g., "I attend functions that are not required, but that help the company image") and 3-item OCB-I (e.g., "I try to avoid problems for my colleagues") scales taken from MacKenzie et al. (1991). Sales managers also provided performance evaluations of the respondents based on their sales performance over the previous year. The reliabilities of measures were acceptable for Machiavellianism (α = .78), managerial control (α = .83), individual-directed organizational citizenship behaviors (OCB-I, α = .77), and organizationally-directed organizational citizenship behaviors (OCB-O, α = .69).

4.8 Results for Study 3 to 5

Studies 3-5 examine supporting hypotheses based on personality and related correlates of ToM, perspective taking, and imitative processes. Study 3 investigates the association between Machiavellianism and general mental ability, social intelligence, and emotional intelligence. Consistent with prior research, Machiavellianism was not significantly correlated with general mental ability (GMA) (Table 3). We hypothesized, however, that if Machiavellians are less facile with ToM skills, perspective taking, and empathy, they should score lower on measures of social and emotional intelligence. This was in fact the case: the correlation of Machiavellianism with social intelligence was r = -.36, p < .01 and with emotional intelligence was r = -.36, p = .01.

Table 3. Statistics for Measures in Study 3 and Study 4

Scale	Mean	SD	Reliability (Cronbach's Alpha)	Correlation with Machiavellianism
Study 3 (N = 171)				
Machiavellianism	3.01	.40	.67	n/a
General mental ability	24.66	6.38	.84	-.01
Social intelligence	5.51	.57	.71	-.36**
Emotional intelligence	5.43	.57	.88	-.36**
Study 4 (N = 101)				
Machiavellianism	3.19	.71	.74	n/a
Perspective-taking	4.69	.94	.81	-.29**
Customer orientation	5.67	.64	.89	-.47**
Adaptive selling	5.19	.79	.88	-.26**
Social networking	4.47	1.06	.68	-.23**
Empathy	4.52	.88	.78	-.25**
Social anxiety	3.11	.98	.92	.22**

Note: Pearson correlations, two-tailed p-values. * $p < .05$. ** $p < .01$.

Study 4 explores the association of Machiavellianism with many personality and individual difference measures. If Machiavellians are indeed lower in ToM skills, perspective taking, and empathy, they should score accordingly on specific job-related attributes and general personality and individual difference measures designed to measure these characteristics. Consistent with these predictions, we found that Machiavellianism was negatively associated with perspective taking (r = -.29, $p < .01$), customer orientation (r = -.47, $p < .01$), adaptive selling ($r = -.26$, $p < .01$), social networking ($r = -.23$, $p < .01$), and empathy ($r = -.25$, $p < .01$). Likewise Machiavellianism was positively correlated with social anxiety symptoms ($r = .22$, $p < .01$) (Table 3).

The results from Studies 3 and 4 are consistent with the fMRI experiments: HMACHs exhibit social disadvantages compared to LMACHs in the sense that they lack the skills and flexibility to excel in interpersonal exchanges. But if Machiavellians are socially hampered, are there situations where they might excel? Study 5 was designed to address this question. We hypothesized and found that HMACHs thrived in situations where exploitative, opportunistic, and manipulative tactics could be employed in relatively unhindered ways: namely, when managerial control was weak, but not when managerial control was strong.

Multiple linear regression analyses were conducted with OCBs and performance as dependent variables and Machiavellianism and degree of managerial control as independent variables. Interaction effects between independent variables were included in the analysis by adding the multiplicative products of the scores of the interacting variables as interaction terms. All variables in the analysis were centered around their means before computing interaction terms, and the interactions were expressed graphically as recommended by Jaccard and Turisi (2003).

Figure 6 demonstrates that managerial control inhibits the performance of salespersons high in Machiavellianism. Only LMACHs who function under highly controlled environments perform well, as proposed.

Figure 7 shows the moderation of the effects of Machiavellianism on organizationally directed OCBs. Machiavellianism leads to high performance of OCB-Os, even under conditions of high managerial control (Figure 7).

Table 4. Multiple Regression Analyses on the Effects of Machiavellianism (Study 5, N = 198)

	Dependent variables		
	Performance	OCB-O	OCB-I
Machiavellianism	-.08	-.12	.01
Managerial control	.15*	.17*	.15*
Interaction term	-.15**	.19**	-.15*
R^2	.06	.07	.05
F-value	3.07*	4.95**	3.23*

Note: Standardized regression coefficients (beta). * $p < .05$. ** $p < .01$.

Figure 6. Interaction effect of Machiavellianism and managerial control systems on sales volume

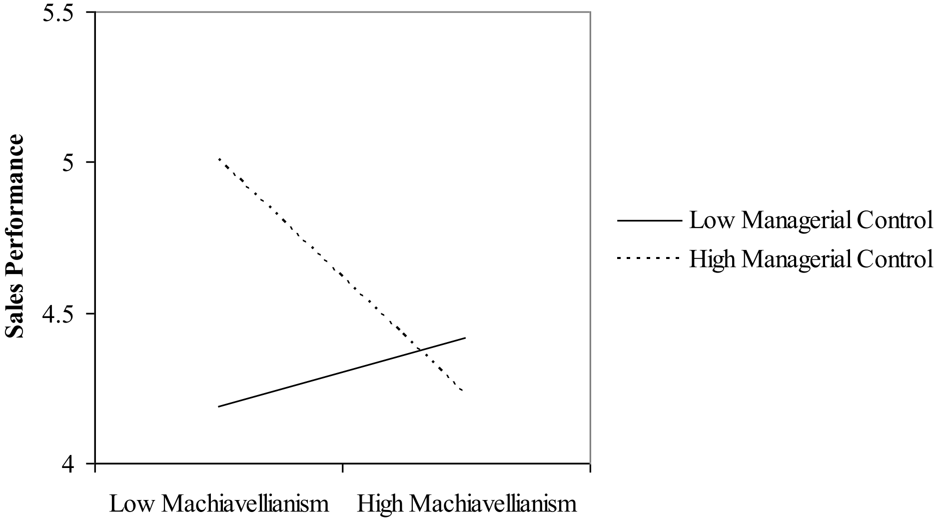


Figure 7. Interaction effect of Machiavellianism and managerial control systems on OCB-O

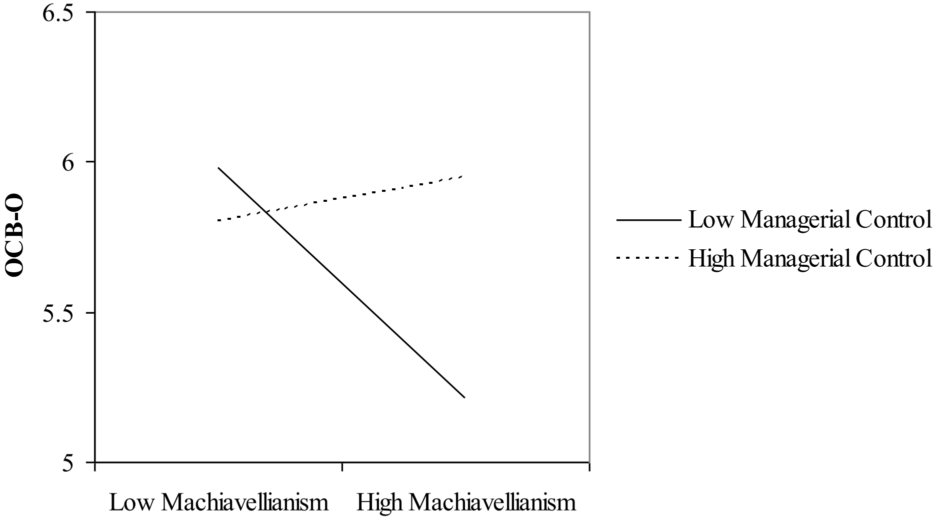
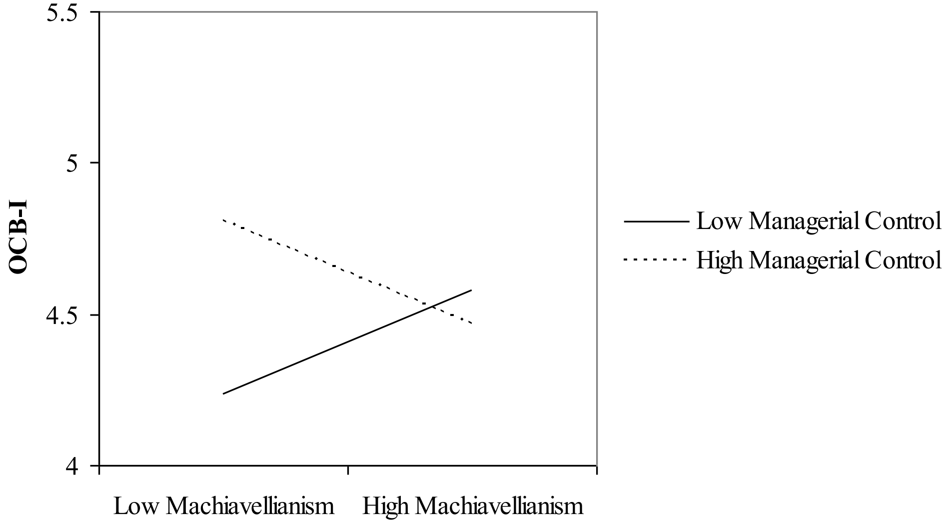


Figure 8. Interaction effect of Machiavellianism and managerial control systems on OCB-I



Finally, as can be seen in Figure 8, the performance of individually directed OCBs is inhibited for those scoring low in Machiavellianism and working in an environment with low managerial control. Nevertheless, compared to the performance of OCB-Os, all salespersons perform less OCB-Is on average (compare Figures 7-8).

4.9 General discussion

4.9.1 Summary and contributions

Our findings help to answer questions concerning conflicting findings or speculations in the literature on Machiavellianism and its effects. At the same time, our study helps to resolve different explanations for how Machiavellianism functions.

Three key processes underlying Machiavellianism and its effects are ToM processes, perspective taking, and empathy. Together the three encompass cognitive and emotional responses that occur in automatic, bottom-up ways and in controlled, top-down fashions. Specific brain activations in these respects occur in coordinated ways across multiple regions of the brain.

A central activity in interpersonal processes is ToM, where people infer the thoughts, and intentions of others with whom they interact. Recent research on autistic spectrum disorders (Amodio & Frith, 2006; Frith & Frith, 2003) and on salespeople (Dietvorst et al., 2009) suggests that the MPFC, and TPJ regions achieve greater activation for those who score higher versus lower on ToM skills, but Machiavellianism has not been scrutinized in this regard prior to our study.

Psychologists have suggested that Machiavellians read the minds of others better than non-Machiavellians (Langdon, 2003). Based on a similar rationale, other researchers speculate that Machiavellians appear to be cooperative and trustworthy (Wilson et al., 1996) and at times utilize prosocial interaction tactics as well (Hawley, 2003). That is, a Machiavellian should be able to succeed when he/she senses that being cooperative, agreeable, kind, and so on will persuade an interaction partner to look favorably upon oneself, one's efforts to make a sale, and one's product offering. Nevertheless, the only study done to date examining ToM and Machiavellianism found no association (Paal & Bereczkei, 2007). However, this study used the 'Reading the mind in the eyes test' in order to find individual differences in ToM functioning. In this test subjects are presented with 36 pictures of eyes, and have to choose the description that matches best with the state of mind reflected by the eyes. This test might be useful in the diagnosis of autistic spectrum disorders, but might not be sensitive enough to detect subtle differences in ToM functioning in a normal population.

Study 1, based on an experimental fMRI approach, evaluated whether Machiavellians are less skilled than non-Machiavellians in ToM processing. Our hypothesis was inspired by findings from studies showing that Machiavellians approach interactions with rigid mind-sets comprised of mistrust of others (e.g., Wilson et al., 1998). Such orientations constrain the dynamics of mental state attribution and therefor hamper ToM processes. The findings supported this interpretation in that Machiavellianism is negatively associated with activation of the medial prefrontal cortex and temporal parietal junctions, outcomes consistent with emerging research in the neuroscience literature concerning ToM processes reviewed above.

If Machiavellians lack ToM skills, then this fails to explain why they allegedly are so successful in many interactions ranging from game theoretic to work situations and everyday life (Wilson et al., 1996). Some researchers maintain that this might be due to greater skills than normal for taking the perspective of others and feeling empathic (e.g., Nichols, 2001). However, correlational studies show a negative association between Machiavellianism and empathy (e.g., Allsopp et al., 1991 a,b; McHoskey et al., 1998; Paulkus & Williams, 2002).

Recent basic research in neuroscience identifies two general aspects of empathy, each of which occurs in different regions of the brain and represents different types of mental processing. More cognitive, top-down processing implicated in perspective taking and differentiation of the self from others happens in the precuneus brain area (e.g., Cavanna & Trimble, 2006; Decety & Lamm, 2006). More affective, bottom-up processing related to empathic concern happens in the pars opercularis and insula regions of the brain (e.g., Decety & Lamm, 2006; Carr et al., 2003). Research in psychology has generally supported a dual interpretation of empathy as being rooted in perspective taking and feeling the emotions of other people whom one witnesses or interacts with (e.g., Davis et al., 1996).

Study 2, an fMRI experiment, addressed the question whether Machiavellianism is associated with perspective taking and empathic responding. Based on the social deficits observed in Machiavellians, their insensitivity to the plight of others, and selfish orientation (e.g., Repacholi et al., 2003; Wilson et al., 1996), we predicted that HMACHs would actually show lower activation of brain regions associated with perspective taking than LMACHs. On the other hand, as a possible explanation of the seeming success of Machiavellians, we hypothesized that HMACHs would show greater activation of brain regions associated with feelings of empathy. These regions, termed the mirror neuron system (Gallese, 2003), respond automatically in imitation of observed others, and were first discovered in parallel regions in the brains of Macaque monkeys. Our findings are consistent with this interpretation in that Machiavellianism is positively associated with activation of the pars opercularis and insula regions negatively associated with activation of the precuneus region of the brain.

The picture that Study 2 suggests is that Machiavellians are less able to take the perspective of others in terms of executive mental functions, nevertheless they actually engage more in emotionally resonating with others in terms of bottom-up processes. It is in this sense that Machiavellians may have an advantage over others in interpersonal interactions. This possibility should be examined in future research. To the best of our knowledge, this is the first study to reveal dissociation between perspective taking and automatic empathic responding (e.g., Decety & Lamm, 2006). Unlike our study, which investigated persons scoring high and low in Machiavellianism, other fMRI studies to date have examined either persons with such mental disorders as autism or else have not looked at people with different undesirable personality traits but rather have selected people from amongst normal functioning populations.

Studies 3-5 investigated a number of main and interaction effects underlying the functioning of Machiavellians in field studies with sales professionals. Study 3 showed that Machiavellianism is uncorrelated with general mental ability, and negatively correlated with both social and emotional intelligence. These findings are consistent with anecdotal and other evidence on non-managers finding that Machiavellians tend to be emotionally disengaged from others with whom they interact (e.g., Rushton et al., 1981; Wilson et al., 1996). Study 4 revealed that, based on paper and pencil tests with sales managers similar to those studied in our fMRI experiments, HMACHs indeed score lower on perspective taking and empathy then LMACHs, and higher on social anxiety. In addition, with regard to context-specific measures for the work situation, the results indicate that Machiavellianism is associated with lower levels of customer orientation, poor adaptive selling, and less social networking. The above findings point to less social engagement by Machiavellians, even with regard to functional mechanisms tied to job success.

Finally, Study 5 disclosed the effects of managerial control as a moderator of the effects of Machiavellianism on performance and OCBs. The first finding of note is that managerial control makes it more difficult for Machiavellians than non-Machiavellians to perform well. This appears to be a consequence of the effect of managerial control on the ability of Machiavellians to apply deceptive or manipulative tactics. By contrast, higher managerial control actually enhances performance for LMACHs in this job situation. Control also regulates the effects of Machiavellianism on OCBs. Machiavellians perform similar OCB-Os under high versus low control as opposed to LMACHs who show substantially lower degrees of OCB-Os under high control. This suggests that Machiavellians are strategic and instrumental in their decisions to engage in more observable OCBs. On the other hand, control does negatively influence the performance of OCB-Is. OCB-Is do not as directly affect the organization as OCB-Os and are less visible to management (i.e., less instrumental for impression management purposes). Again for those low in Machiavellianism, control increases OCB-I's considerably. In sum, Machiavellians perform less well when the environment constrains their opportunistic behaviors. We caution, however that Machiavellians may be inclined to circumvent social and managerial constraints and pursue their own interest to the detriment of the people with whom they interact, as has seemingly happened in numerous business scandals over the years and graphically demonstrated more recently by the collapse of Enron. Our fMRI and field studies possibly disclose key brain processes behind such behaviors (e.g., Greene & Haidt, 2002).

4.9.2 Managerial implications

What are the practical implications of our findings? As illustrated by recent example in business life like the current financial crisis, it may be dangerous to rely on the loyalty and commitment to the company of Machiavellian employees because they may opportunistically pursue personal gain at the expense of customers and their company. Unfortunately it may be difficult for managers to judge the loyalty of their employees based on their behaviors alone, because, as found in our study, high Machiavellians show the highest levels of visible OCBs. Managers should therefore assess their employees on Machiavellianism to better understand their motivations. Only then, should they take appropriate actions on whom to trust (and under which circumstances) and how to supervise their employees.

4.9.3 Future research

In our studies we explored Machiavellianism in an organizational context for salespeople. Even though we assume that the findings for these professionals can be generalized also for other employees, it would be interesting to focus on general managers in future research as these can be expected to have a significant impact on companies' performance and welfare. As scandals like Madoff Investment Securities or Enron illustrate, we should better understand how (top) mangers interact, create their firm networks, and control their firm (see Babiak & Hare, 2006).

Also, not much is known about how to manage Machiavellians. How should supervisors manage their HMACH subordinates? Is it best for a manager of HMACH employees to also be high in Machiavellianism, or under what conditions can LMACH supervisors be effective? How should the composition of teams or departments be formulated when employees differ in Machiavellian tendencies? Organizations use different control mechanisms to affect the performance of their employees. For instance, compensation programs based on extrinsic as opposed to intrinsic rewards might work best with Machiavellians. These and related issues deserve future research.

CHAPTER 5
SUMMARY

In this thesis we study how individual differences in Theory of Mind processing and Mirror Neuron functioning relate to job performance and behavior of sales people. In this chapter the most prominent results and implications for theory and practice are summarized, and directions for future research are discussed.

5.1 Summary

Since the introduction of functional MRI as a research tool, our understanding of the psychological mechanisms that underlie social interaction has greatly enhanced. Especially research on autism, in which the brains of subjects with autistic spectrum disorders were compared with normal functioning brains, showed that having a normal or even well developed ability to reason is not sufficient for a person to be able to cope with the social aspects of their environment. Two prominent breakthroughs that this field has produced are the discovery of the Theory of Mind network, and the mirror neuron system. These two mechanisms are thought to be the key drivers of social intelligence; both mechanisms are highly automatic or reflexive by nature and feed our intuition during social interactions. Although the mechanisms are well described in social neuroscience with regard to what neural structures are involved and what kind of stimuli trigger activity in these neural structures, the vast majority of experiments that find individual differences in the functioning of these mechanisms at a neurological level were conducted by comparing a pathological group (e.g. autism, and alexithymia) with a normal group.

Before we started our own investigation of the role that ToM and mirror neurons play during social interaction, there was no research available that showed whether within a group of normal subjects individual differences exist in neural functioning and whether these differences have behavioral correlates. In this thesis three main questions with regard to individual differences were investigated:

1. Do sales people that exhibit highly developed Theory of Mind skills also perform better? (CHAPTER 2)
2. What are the cognitive and emotional bases of taking a customer orientation? (CHAPTER 3)
3. How does Machiavellian Intelligence relate to Theory of Mind and mirror neuron functioning? (CHAPTER 4)

In CHAPTER 2 we developed a new theory driven scale that measures a salespersons ability to ‘read the mind’ of a customer: the Salesperson Theory of Mind (SToM) scale. Theory of Mind or Interpersonal Mentalizing refers to the attribution of mental states such as intentions, beliefs and desires to other interaction partners. This process is largely automatic or reflexive and encompasses a large symmetrical network of regions in the brain. Research showed that subjects with autistic spectrum disorders in comparison to normal subjects show significantly less activation of the medial prefrontal cortex, the temporo-parietal junctions and the temporal poles during mentalizing tasks. In order to test whether salespeople also exhibit different degrees in their ability to interpersonally mentalize and to what extent this ability is a driver of sales performance we conducted four separate studies. In Study 1, we developed a paper-and-pencil measure (the SToM scale), from which the items were based on descriptions in the literature of social situations in which autistics experience difficulties. The results showed that salespeople exhibit different degrees of interpersonal mentalizing that can be represented in four distinct but related dimensions, and furthermore the measures of SToM achieve convergent, discriminant, and criterion-related validity. We also find that scores on the SToM scale are positively correlated with adaptiveness during sales encounters and the ability to take the perspective of customers, and that the scores on the SToM-scale were negatively correlated with fear of being negatively evaluated by others. In Study 2, in addition to replicating the findings of Study 1, we find that the SToM scale predicts sales performance. In Study 3 the construct and nomological validity of the SToM-scale were tested using the multitrait–multimethod matrix and confirmatory factor analysis. Results revealed that the scale showed high trait variance and very low method variance, and in addition that a considerable proportion of the job performance measure, was driven by the SToM-scale scores. In sum, the psychometric properties of the SToM-scale were found to be excellent.

Finally in Study 4 we validated the scale by adopting techniques from neuroscience. A group of salespeople participated in an experiment in which their brains were scanned while they were listening to stories designed to evoke ToM processing. The brain activity during the listening to the ToM stories was compared with the activity during the listening to 'process stories' and 'unlinked sentences'. We tested our hypothesis in a relatively conservative fashion by testing whether the high IM group (which consisted of high scorers on the SToM-scale) showed significantly more activity than the low IM group in a priori regions of interest which were based on literature on autism. Results showed that our hypotheses were largely confirmed; we found significantly greater activation of the medial prefrontal cortex and the temporo-parietal junctions bilaterally in the high IM group. This effect did however not occur in the temporal poles which were highly active for both high and low IM groups.

During the process of developing the SToM-scale we found that the SToM-scale produces very consistent results over different samples. In addition, the psychometric properties with regard to validity were very satisfying. Interpersonal mentalizing is a process that allows a relatively easy conceptualization in the form of a scale. Using insights from neuroscience in order to develop this scale bared its fruits. Our research shows that interpersonal mentalizing in its present form is a useful tool in the investigation of salesforce behaviors. Our findings should inspire new methods for selecting and training salesforces.

In CHAPTER 3 we investigate what neural processes underlie a salesperson's strategic orientation during sales encounters. Salespeople approach customers with one of two different strategies: some salespeople will focus on how to get a customer to buy as much as possible regardless of how much a wise customer should buy, while other salespeople tend to focus on solving a customer's problem or needs. The difference between these two strategies of salespeople is gauged by the Selling Orientation Customer Orientation-scale (SOCO-scale).

In order to understand more about what psychological individual differences drive salespeople's orientation, we conducted a mirror neuron experiment and tracked activity in 'other oriented networks' and analysed whether high scores on Customer Orientation could be related to the amount of activity in neural networks in response to the mirror neuron task.

The most important results we found was that subjects that have a high Customer Orientation showed significantly more activation in regions in the brain that subserve the ability to resonate with other people's emotions. In addition, the psychometric properties of the SOCO scale revealed that the Customer Orientation measures achieved criterion-related validity, while the Selling Orientation measures did not. When we administered the Customer Orientation items together with other scales to a large sample of salespeople, we found that scores on Customer Orientation were significantly negatively correlated with feelings of personal distress and with felt embarrassment in selling situations, and positively correlated with social competence.

Our research findings suggest that only by stepping into the mental shoes of a customer and understanding their thoughts, feelings and intentions that one can gauge needs and find possible solutions. Management should therefore focus on the difference between having a Selling Orientation versus a Customer Orientation in its coaching, training and recruitment policies. Managers should also explain how skills in Interpersonal Mentalizing and empathy promote a

Customer Orientation, which in its turn leads to more productive relationships with customers in the long run.

In CHAPTER 4, we investigate how Machiavellianism relates to Theory of Mind and mirror neuron functioning. Machiavellianism is the personality style or trait that involves manipulating other persons for personal gain. In order for a person to be able to manipulate another person, it is necessary to know something about the thoughts and feelings of the other person. The link between mind reading skills and manipulative skills seems obvious, and in the literature several studies can be found, that have tried to find relationships between Theory of Mind and Machiavellianism, but results from these studies remain inconclusive. In our own earlier research on salespeople we found that having a highly developed Theory of Mind actually promotes pro-social behavior. In order to reconcile these conflicting findings and to explore the role that social intelligence plays in Machiavellianism we designed 5 different studies.

In Study 1 we used the Interpersonal Mentalizing task described in CHAPTER 2, in which subjects listen to stories designed to test interpersonal mentalizing skills. Based on findings from studies showing that Machiavellians approach interactions with rigid mind-sets comprised of mistrust of others, and on our own earlier results showing that having high ToM skills promotes pro-social behavior, we hypothesized that Machiavellians lack ToM skills. Analysis of the brain activity during the mentalizing task revealed significant negative correlations between Mach-scores (Mach IV scale, Christie & Geis 1970) and neural activity in regions associated with Theory of Mind processing. The picture that Study 1 portrays is that Machiavellians are not particularly facile in their abilities to read the minds of interaction partners.

Finding that Machiavellians lack ToM skills fails to explain what mechanism allow Machiavellians to be such successful players in game theoretical settings and what drives their 'impression management' and abilities to manipulate. In Study 2, we conducted a mirror neuron experiment in which subjects viewed short video clips of actors displaying positive and negative emotions (similar to that employed in CHAPTER 3). We compared the brain activity during the viewing of facial expression, with brain activity in response to viewing neutral faces and moving geometric shapes. Based on Machiavellians insensitivity to the plight of others and selfish orientation, we predicted that Machiavellians would show less activation of brain regions associated with perspective taking. And based on their ability to have a high impression management and manipulate other people during social interactions we hypothesized that Machiavellians would show greater activations in regions associated with subjective experience of emotions during a mirror neuron task.

Our findings are consistent with this interpretation, in that in response to viewing emotional expressions, Machiavellianism was positively associated with the activation of the pars opercularis and insula regions, and negatively correlated with the amount of processing in the precuneus region. The picture that Study 2 portrays is that Machiavellians are less able to experience empathic concern for others in a top-down fashion, but nevertheless do resonate more with other people's emotions at a bottom-up level of processing.

Studies 3-5 investigated a number of main and interaction effects underlying the functioning of Machiavellians in field studies with sales professionals. Study 3 showed that Machiavellianism is uncorrelated with general mental ability, and negatively correlated with both social and emotional intelligence. Study 4 revealed that, based on paper and pencil tests with sales managers similar to those studied in our fMRI experiments, Machiavellians indeed score lower on perspective taking and empathy than non-Machiavellians, and higher on social anxiety. Finally, Study 5 disclosed the effects of managerial control as a moderator of the effects of Machiavellianism on performance and organisational citizenship behaviors (OCBs). The most prominent finding of note is that managerial control makes it more difficult for Machiavellians to perform well. By contrast, higher managerial control actually enhances performance for subjects scoring low on Machiavellianism in this job situation. An explanation here might be that having a high managerial control inhibits Machiavellians to make use of exploitative tendencies.

Our research on Machiavellianism shows that with a neuroscientific approach in which distinction are made between bottom-up and top-down processes and Theory of Mind and mirror neurons, we were able to reconcile some of the contradictive findings around the relationship between Machiavellianism and social intelligence. For future research these distinctions in social intelligence mechanisms deserve further investigation, it would be interesting to learn more about how different configurations of high versus low development of Theory of Mind and mirror neuron functioning relate to how people behave socially and morally.

At a more practical level, our research shows that people should not rely on the loyalty and commitment to the company of Machiavellian employees because they may opportunistically pursue personal gain at the expense of customers and their company. In addition, our research shows that it is unfortunately difficult to recognize Machiavellians in the organisation, because Machiavellians show the highest levels of engagement in visible OCBs. Future research here should focus on how Machiavellians can be detected, and how they should be managed in organizations.

5.2 Nederlandse samenvatting (summary in Dutch)

De prestaties, strategieën en het moreel gedrag van verkopers worden al jaren onder de loep genomen door marketingwetenschappers. De theorieën die zij formuleren zijn gebaseerd op processen die plaatsvinden in de hersenen. Tot nu toe werden in deze onderzoeken echter uitsluitend methoden geïmplementeerd die bewijsvoering ontlenen aan verbale zelfrapportages. Met behulp van ontwikkelingen in neurowetenschappelijk onderzoek zoals functionele MRI, is het, ondanks de relatieve ontoegankelijkheid en complexiteit van het menselijk brein, mogelijk om mentale processen meer direct te meten.

Sinds de ontdekking van het Theory of Mind netwerk en het spiegelneuronensysteem is ons begrip van sociale intelligentie enorm toegenomen. Deze twee mechanismen opereren op een automatisch of reflexmatig niveau en vormen belangrijke pijlers van sociale intelligentie. Wij hebben, met behulp van fMRI en veldstudies, individuele verschillen in het functioneren van deze mechanismen in relatie tot de psychometrische eigenschappen van schalen en de prestaties van verkopers onderzocht.

De resultaten laten zien dat wanneer sociale stimuli worden gepresenteerd tijdens het scannen met fMRI, verkopers individuele verschillen in de hoeveelheid hersenactiviteit laten zien in gebieden die sociale intelligentie ondersteunen. Deze individuele verschillen vertonen associaties met hun prestaties, strategieën en moreel gedrag.

De implicaties voor training en werving & selectie van verkopers worden behandeld. De theoretische contributie is gerelateerd aan de onderzoeksvelden Marketing, Sociale Neurowetenschappen en Persoonlijkheid.

APPENDICES

Appendix A: The general Theory of Mind Scale

1. I find it easy to understand non-verbal signals of other people.
2. I immediately notice when people do not smile sincerely.
3. I notice more quickly than others when people seem to possess a hidden agenda.
4. I find it easy to keep a conversation going about everyday topics or topics that do not have any urgency.
5. When I'm in an elevator with others I can easily start small talk.
6. When I'm sitting on a terrace I tend to elaborate on what motivates or drives people passing by.
7. I enjoy watching movies that provoke me to imagine the experiences of the characters.
8. I often think about deeper motivations of other people.
9. I enjoy speculating on what other people are thinking.
10. I tend to explain people's behavior at a more sophisticated level than others.

All items are answered on a 7 point likert scale ranging from 'strongly disagree' versus 'strongly agree'.

Appendix B: The MACH-IV scale

The Mach-IV scale, Studies in Machiavellianism, Christie & Geis 1970

1. Never tell anyone the real reason you did something unless it is useful to do so.
2. The best way to handle people is to tell them what they want to hear.
3. One should take action only when sure it is morally right. (rev)
4. Most people are basically good and kind. (rev)
5. It is safest to assume that all people have a vicious streak and it will come out when they are given a chance.
6. Honesty is the best policy in all cases. (rev)
7. There is no excuse for lying to someone else. (rev)
8. Generally speaking, people won't work hard unless they are forced to do so.
9. All in all, it is better to be humble and honest than to be important and dishonest. (rev)
10. When you ask someone to do something for you, it is best to give the real reasons for wanting it rather than giving reasons which carry more weight. (rev)
11. Most people who get ahead in the world lead clean, moral lives. (rev)
12. Anyone who completely trusts anyone is asking for trouble.
13. The biggest difference between most criminals and other people is that the criminals are stupid enough to get caught.
14. Most people are brave. (rev)
15. It is wise to flatter important people.
16. It is possible to be good in all respects. (rev)
17. P.T. Barnum was wrong when he said that there's a sucker born every minute. (rev)
18. It is hard to get ahead without cutting corners here and there.
19. People suffering from incurable diseases should have the choice of being put painlessly to death.
20. Most people forget more easily the death of their parents than the loss of their property.

All items are answered on a 7 point likert scale ranging from 'strongly disagree' versus 'strongly agree'. (rev) = reversed items.

Appendix C: The SOCO scale

The SOCO scale: A Measure of the Customer Orientation of Salespeople, Saxe & Weitz 1982

1. I try to give customers an accurate expectation of what the product will do for them. (SO)
2. I try to get customers to discus their needs with me. (SO)
3. If I'm not sure a product is right for a customer, I will still apply pressure to get him to buy. (CO)
4. I imply to a customer that something is beyond my control when it is not. (CO)
5. I try to influence a customer by information rather than by pressure. (SO)
6. I try to sell as much as I can rather than to satisfy a customer. (CO)
7. I spend more time trying to persuade a customer to buy rather than I do trying to discover his needs. (CO)
8. I try to help customers achieve their gaols. (SO)
9. I answer customer's questions about products as correctly as I can. (SO)
10. I tend to agree with customers to please them. (CO)
11. I treat a customer as rival. (CO)
12. I try to figure out what a customer's needs are. (SO)
13. A good salesperson has to have the customer's best interest in mind. (SO)
14. I try to bring a customer with a problem together with a product that helps him solve that problem. (SO)
15. I am willing to disagree with a customer in order to help him make a better decision. (SO)
16. I offer the product of mine that is best suited to the customer's problem. (SO)
17. It is necessary to stretch the truth in describing a product to a customer. (CO)
18. I begin the sales talk for a product before exploring a customer's needs with him. (CO)
19. I try to sell a customer all I can convince him to buy, even if I think it is more than a wise customer would buy. (CO)

20. I paint too rosy a picture of my products, to make them sound as good as possible.
21. I try to achieve my goals by satisfying customers. (SO)
22. I decide what products to offer on the basis of what I can convince a customer top buy, not on the basis of what will satisfy them in the long run. (CO)
23. I try to find out what kind of product would be most helpful to a customer. (SO)
24. I keep alert for weaknesses in a customer's personality so I can use them to put pressure on him to buy. (CO)

All items are answered on a 7 point likert scale ranging from 'Does not describe me at all' versus 'Describes me well'. (SO) = Selling Orientation items, (CO) = Customer Orientation items.

Appendix D: Primer on fMRI and specific procedures used

Functional magnetic resonance imaging (fMRI) is a tool for measuring brain activity over time. It can be used to produce activation maps showing which parts of the brain are involved in particular mental processes. The technique is non-invasive and the data have relatively good spatial and temporal resolution. Whereas conventional MRI provides images of structure (e.g., bone vs. muscle vs. fat), functional MRI provides images that estimate function (brain activity). During the past decade, fMRI has become an important research technique for studying normal brain functions in humans. The primer is necessarily brief; the reader is referred to standard references on fMRI methodology (Buxton 2002; Huettel, Song and McCarthy 2004) for more detailed discussions on key concepts presented in this section.

Data Acquisition

Both conventional MRI and fMRI work by sending out perfectly safe radiofrequency (RF) pulses and then listening for echoes. The RF pulses excite hydrogen protons (found in the water molecules throughout the body) into a higher energy state. When these protons relax into their lower energy state they emit a signal (or echo) that is detected by the MRI machine. The magnetic environment surrounding each proton influences how long it takes it to relax from the high-energy state to the low-energy state. Because bone, muscle, fat, and other types of tissues provide slightly different magnetic environments, the relaxation times of protons in these tissues are different. MRI can detect these differences and can therefore distinguish these different types of tissue.

Functional MRI works according to the same principles. It turns out that blood that is carrying oxygen provides a different magnetic environment than does blood that is not carrying oxygen. MRI machines can be tuned to be particularly sensitive to this difference. And because oxygenated blood tends to be sent to parts of the brain that are active, fMRI can be used to estimate neural activity. It is important to remember that fMRI does not measure neural activity directly, but rather a Blood Oxygen Level Dependent (BOLD) signal that is strongly correlated with neural activity. This BOLD signal tends to lag behind the associated neural activity and to be more spread out in time. Modeling the relationship between neural activity and the BOLD signal (the so-called hemodynamic response function) is therefore critical in analyzing fMRI data.

During a typical fMRI experiment, a subject participant is asked to lie still on his or her back in an MRI machine for up to 90 minutes. An experimental session usually consists of 4 or 5 anatomical/structural scans of the brain taken during either the first or last 6 to 15 minutes. The participant is simply asked to lie still during this period and is not performing any tasks. These anatomical scans serve two purposes. First, they are used as guides in specifying exactly where the functional data should be collected (e.g., throughout the brain, only in the frontal lobe). Second, they provide a high-resolution image of the brain anatomy upon which the functional data can be overlaid; without the anatomical landmarks in a high-resolution structural image, it would be very difficult to determine where any observed brain activity actually occurred.

Functional data are collected in a series of "runs" (usually 5-10), each of which lasts 3 to 10 minutes. During each run, the participant performs whatever tasks the experimenter has designed. Often visual stimuli are projected on a monitor in front of the participant (or onto goggles) and the participant can make responses by making finger presses on buttons. Auditory and tactile stimuli (and even tastes and smells) are sometimes used as well. Vocal responses have occasionally been used but doing so is problematic because it introduces head movement. While the task is being performed, the MRI scanner is recording the BOLD signal throughout the brain every couple of seconds. These images are then analyzed to localize different mental processes to different parts of the brain by identifying areas that are significantly more active during some conditions/tasks than others.

The most common and powerful way of testing the effect of the independent variable on the dependent variable is via a blocked design. As in any blocked-design experiment, a block in an fMRI study is composed of trials that are grouped together in time to represent a level of an independent variable. Thus experimental conditions are separated into distinct blocks with each condition presented for an extended period of time. Blocks can be as short as several seconds and as long as a minute or two, although block length is typically kept constant across conditions. Transitions between blocks represent changes in the level of an independent variable. Although many research questions are amenable to use of block designs, some questions may not be appropriate for blocked designs because the nature of the experimental task preclude the separation of different types of trials into distinct blocks.

Greater experimental flexibility is offered by event-related designs; they allow for detection of neural activity associated with discrete events that are short in duration and whose timing and order need to be randomized. Although event-related designs have reduced detection power relative to blocked designs, they tend to have good estimation power. The design allows for characterization of precise timing and waveform of the hemodynamic response associated with a discrete event. (For a detailed explanation of the relative strengths and weaknesses of the two designs as well as mixed designs, see Liu, Frank, Wong and Buxton, 2001.) Further, impressive gains in estimation power can be realized in event-related designs through the use of "jitter"—i.e., randomization of the intervals between successive presentations of events over some relatively long time period (Ollinger, Shulman and Corbetta 2001).

During the course of an fMRI experiment, functional (BOLD) images of the entire brain are recorded every 1 to 3 seconds. Depending on the length of the experiment, there may be 500 to 1500 of these functional brain images. Each of these images is divided up into a large number of small cubes called voxels (the three dimensional analog of pixels). The size of the voxels is usually on the order of 3 to 5 mm cubic and it typically requires 25,000 to 50,000 voxels to cover the entire brain. Over the course of the entire experiment, the data from a single voxel constitute a time series of BOLD signals from the 500 to 1500 time points. Each of the tens of thousands of voxel time series is analyzed relatively independently in an attempt to identify voxels whose time series are significantly correlated with the experimental manipulations.

Preprocessing

Before the individual voxel timeseries are analyzed, however, a few preprocessing steps are typically performed on the data. Many researchers filter the data to exclude voxels that are outside the brain (in order to reduce analysis time). Some researchers attempt to correct for the fact that different slices within a single brain image are actually collected sequentially rather than at exactly the same point in time. For example, if a functional brain image is collected every two seconds, the first slice in that image is collected nearly two seconds before the last slice in that image. Many researchers will therefore shift the time series in time (via interpolation with earlier and later time points) in order to ensure that the voxels from different slices are in sync with each other.

The most important preprocessing step is probably correcting for motion. As previously mentioned, the timeseries from individual voxels are analyzed in an attempt to identify brain areas whose activity correlates with experimental manipulations. The underlying assumption is that the data from a voxel corresponds to the same brain area throughout the entire experiment. If a participant moves during an fMRI experiment, however, then the brain area to which a specific voxel corresponds will change. Therefore, virtually all researchers perform some kind of motion correction before analyzing the data. The standard approach is to perform a rigid-body transformation that includes six parameters (pitch, yaw, roll, and translation in x, y, and z) on the brain image from each time point until it best fits the brain image from the first time point. This process is called realignment.

The brains of different individuals obviously differ in size and shape. If results from different participants are going to be combined, it is therefore necessary to transform the data into some standard, template brain. This process is called normalization and it involves two steps. First, a set of parameters for a best-fitting, non-linear normalization transformation is computed. This transformation is usually the one that does the best job of mapping the structural brain image into the template brain, because the structural image has a higher resolution than the functional images. Second, this transformation is applied to the functional images to map them into the same space as the template brain (the functional images are usually in the same space as the structural image; if they are not, they must be coregistered into the same space first).

Another common preprocesing step is spatial smoothing. Essentially, functional brain images are blurred a little bit by convolving them with a Gaussian kernel (replacing the value at each voxel with a weighted average of its value and the values of surrounding voxels). There are three motivations for smoothing the data. First, realignment is not perfect and so the brain area to which a given voxel corresponds changes slightly over the course of the experiment. By smoothing the data, differences between nearby voxels due to motion are minimized. Second, normalization is imperfect and so the same voxel in different participants is unlikely to correspond to exactly the same brain area. Again, smoothing the data minimizes the effect of these small differences. Third, when a known smoothing kernel has been applied to the data, it makes it possible to apply a more sensitive correction for multiple comparisons. This issue will be discussed in more depth in the next section.

Model Fitting

Once the data have been preprocessed, each voxel is analyzed individually in an attempt to find voxels whose timeseries are significantly correlated with the experimental manipulations. As previously discussed, there are tens of thousands of voxels to be analyzed, so this approach corresponds to doing many, many univariate analyses. The standard approach is to fit a general linear model against each voxel's time series. The model would include covariates corresponding to the different conditions in the experiment. So, for example, if the participant repeatedly alternated between 10 seconds of visual stimulation and 10 seconds of rest, then the model might include a covariate that had the value 1 for each timepoint corresponding to visual stimulation and the value 0 for each timepoint corresponding to rest. It would probably also include an intercept term (value 1 at all time points) to model the baseline level of fMRI signal in the timeseries (which is typically far from 0). Fitting this model against a voxel's timeseries would then correspond to finding the weighted sum of these covariates that best fits the actual time series. The weights or coefficients associated with each covariate in this best fit are called the beta values and they are used to compute statistical values (e.g., t-values) associated with each voxel for a given contrast of covariates. For example, the t-value corresponding to a single covariate's effect is simply its beta divided by the standard error of the mean. Similarly, the tvalue for a contrast between covariates is the difference between their betas divided by the standard error of the difference of the means. The statistics of interest are computed for every voxel to evaluate the probability that the voxel is consistent with the null hypothesis. The statistical tests from all voxels in the brain are then combined and displayed together in a statistical parametric map (or SPM) which is simply a brain image in which the value at each voxel is its corresponding statistic. These SPMs are in turn thresholded and overlayed on structural images in order to graphically display which areas of the brain exhibit activity that passes the desired threshold of statistical significance. Often different color schemes are used to aid in visualization (e.g., red for t-values above 3.5, yellow for t-values above 5.0, etc.).

In constructing a statistical model for fMRI data, it is important to keep in mind that the data reflect blood-oxygen levels, not direct neural activity. In particular, because blood-oxygen levels are delayed and extended in time relative to the underlying neural activity, the model covariates must also be delayed and extended in time. The standard approach is to create covariates based on experimental conditions and then to convolve those covariates with a model of the hemodynamic response function.

Another important issue to keep in mind is that there is substantial temporal autocorrelation in fMRI data. That is, the data from timepoint X is not statistically independent of the data from timepoint X+1. As a result, the actual number of degrees of freedom is much smaller than it would be if the data from different time points were truly independent. The number of degrees of freedom has a substantial impact on the statistical values and so most analysis packages provide a way of estimating the effective degrees of freedom.

When this kind of analysis is done on voxels over the entire brain, a very substantial multiple comparisons problem arises. After all, when tens of thousands of voxel timeseries are being analyzed, it is quite likely that some of them would exhibit large statistical values by chance alone. The simplest way to address this problem is to apply a Bonferroni correction. Rather than using an alpha level of $p=0.05$ as is customary, one could use an alpha level of $p=0.05/n$ (where n = number of voxels). The more standard approach is to look for clusters of contiguous voxels above some threshold where the cluster size is significant. If one knows how spatially smooth the data being analyzed are, then it is possible to estimate how likely it is to observe a cluster of N contiguous voxels all of which have a statistical value above a given threshold (most analysis packages provide this functionality). Given this approach requires knowing how smooth the data are, many researchers smooth their data during preprocessing as a means of imposing a known amount of spatial smoothness. Another approach for correction of the multiple comparisons problem is to evaluate statistical tests on a small predetermined region-of-interest (or ROI) and to exclude voxels outside the ROI from the analysis altogether.

ROI analysis involves prespecifying a set of anatomical regions of interest, and then to perform statistics across these regions (see Poldrack, 2007, for a discussion of ROI analysis). Because it is generally the case that regions specified in this approach are relatively large (e.g., the entire superior frontal gyrus), even if the region is significantly active, this activation may occur in a small proportion of voxels in the ROI. This would mean that simply averaging across the entire region could swamp the signal from this small number of voxels with noise from the remaining non-activated voxels. This would be problematic because you may well have an a priori hypothesis as to an area of expected activation in a statistical parametric map based on prior findings in the literature. In such a case, to correct for multiple comparisons across the whole image would be too conservative, as you are restricting your interest to a subset of the comparisons being made. More recently, researchers have used a small volume correction approach developed by Worsley et al. (1996) in order to address this problem. This involves restricting the voxel-wise analysis to a ROI and then controlling for multiple comparisons only in those voxels.

Apparatus

Imaging was conducted using a full-body 3.0 T GE scanner (General Electric, Milwaukee, WI) fitted with an 8-channel receive-only head coil.

Imaging Procedures

For the structural imaging, a high resolution image of the brain was acquired with a 3D T1-weighted inversion recovery fast spoiled gradient recalled echo sequence (echo time (TE)/repetition time (TR)/inversion time = 2.1/10.4/300 ms, flip angle = 18°, matrix = 416x 256, field of view (FOV) = 25 cm, slice thickness 1.6 mm with 50% overlap). For the functional imaging, a time series of 210 volumes, with 39 Slices in the transverse plane, was obtained using single shot gradient-echo planar imaging (TR = 3000 ms, TE = 30 ms, flip angle = 75°, resolution =3.5 mm x 3.44 mm x 2.3 mm, and FOV = 22 cm).

Functional image data were preprocessed and analyzed using Statistical Parametric Mapping (SPM2, Wellcome Department of Cognitive Neurology, London, UK). Linear image realignment, co-registration, non-linear normalization to stereotactic anatomical space (MNI), and spatial smoothing 3-dimensional Gaussian kernel, 8mm full-width at half maximum (FWHM) were performed for each participant using standard statistical parametric mapping methods. A high-pass (cutoff period, 250 sec) frequency filter was applied to the time series.

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Appendix E: Definitions of indexes used to interpret the goodness-of fit of confirmatory factor analysis and structural equation models

1. Root Mean Square Error or Approximation (RMSEA). The RMSEA is a population-based index of fit that is defined as

$$\sqrt{\frac{\chi^2 - df}{N-1} / df}$$

where $\chi 2$ = chi-square for a model of interest, df = degrees of freedom, and N = sample size. One set of guidelines maintains that a "close-fit" or "good fit" occurs when RMSEA < .05, a "reasonable fit" or "acceptable fit" happens for values greater than .05 but less than or equal to .08, a "mediocre fit" occurs for values greater than .08 but less than or equal to .10, and a "poor fit" results for values greater than .10. The RMSEA is relatively insensitive to sample size, but of course findings under very low (N<100) and very large (N>1000, say) sample sized, as well as deviations from normality, should be regarded with caution. The RMSEA tends to penalize complex models and favors parsimonious models.

2. Nonnormed Fit Index (NNFI). Also known as the Tucker and Lewis index, the NNFI is defined as

$$\frac{\chi_n^2 / df_n - \chi_f^2 / df_f}{\chi_n^2 / df_n - 1}$$

where χ_n^2 = chi-square for the null model of modified independence (i.e., the model where only error variances are estimated:, $\chi 2$ = chi-square of a focal model to be tested, and *df* = degrees of freedom. Depending on the author, values of the > .90 or > .95 are considered "good fits". The NNFI takes into account model complexity, but again caution should be applied for testing very small or very large samples and nonnormal data.

3. Comparative Fit Index (CFI). The comparative fit index (also called the relative noncentrality index) is defined as

$$\frac{(\chi_n^2 - df_n) - (\chi_f^2 - df_f)}{\chi_n^2 / df_n}$$

Depending on the author, values of the CFI > .90 or CFI > .95 are considered "good fits". Although the CFI is relatively insensitive to sample size (at least for N not too small or too large), it does not compensate for more complexity.

4. Standardized Root Mean Square Residual (SRMR). The SRMR is a measure of the average of residuals in a model and is defined as the square root of the mean squared differences between elements of the predicted and observed variance-covariance matrix. Depending on the author, values of the RMSEA < .08 or < .07 are considered satisfactory.

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Appendix F: Auditorily presented scenarios

All original versions of the following scenarios were presented in Dutch. In this appendix, they have been translated from the original language version into English, and therefore do not always reflect the same time length as the original language version.

Interpersonal Mentalizing task

Scenario 1:

Sjaak is a salesperson who has just explained to Renée his own perspective about future trends in their market. Renée is the buyer in a customer's firm and tries to sell Sjaak's perspective on the market to his colleagues. Suddenly Sjaak realizes that he has provided Renée with the wrong information, and he immediately calls Renée. Renée is irritated and responds, "Do you know that you may have hurt my reputation? Sjaak apologizes and says, "I want to explain my mistakes to your colleagues personally."

Why is it that Sjaak wants to explain his mistakes in person?

Scenario 2:

Before visiting a customer, Jacqueline always browses that customer's website. While browsing one of these websites she notices that the director, whom she has known for a long time, still works for the firm in question; but she also notices that many new people have joined the firm. Jacqueline is especially curious about what these new people think of her firm. However, Jacqueline first decides to talk with the director, the person she has known a long time; therefore she calls him to suggest having dinner together.

Why did Jacqueline ask the director to have dinner with her?

Scenario 3:

Wouter is a street-smart salesperson and always tries to consider the personal interests of his customers. He mentions a customer's personal interests to his secretary so that she can look for a gift that fits the customer's needs exactly. He knows that when he surprises his customers, they invite him for dinner. Before sending a surprise present, Wouter calls the customer and says, "Hey, pal, take note: now I am not sending you a bill!"

Why does Wouter call the customer and make this statement?

Scenario 4:

Henk talks to a buyer, Janine. As the conversation evolves, Henk realizes that Janine shies away from sensitive issues. He starts to realize that Janine's influence in the firm might be far less than he had assumed. Consequently, Henk considers how he can get around Janine without hurting her pride. He tells Janine, "During our next meeting perhaps it would be convenient to have a colleague from our technical staff join us, so would you also invite a colleague of yours?"

Why does Henk suggest that Janine invite other people to join the conversation?

Scenario 5:

Ralph, who is a buyer, talks to Pieter and to Pieter's secretary. Ralph notices that Pieter is unfairly skeptical about his story while Pieter's secretary is more receptive to his arguments. Ralph then adds something to the conversation. He tells Pieter a funny anecdote about how his own secretary once provided him with an insight which allowed him to avoid a grave mistake.

Why does Ralph mention this anecdote about his own secretary?

Process task

Scenario 1:

In a steel company the buying process occurs via a well-defined method: the buyers first study how earlier firms supplied goods; and, in collaboration with the technical staff, they make up a request for a proposal. This RFP is then sent by e-mail to salespersons from different firms, who then indicate by e-mail whether they can match the request for proposal. Subsequently, using economical arguments, the buyers determine which salesperson will deliver the goods.

On what bases do buyers make decisions about which salesperson will deliver goods?

Scenario 2:

An account manager visits his customers every year. According to a well-defined protocol he has to visit all the factory plants; and, in order to plan these visits, he uses a call-plan system. This planning system determines how different plants can be visited in the shortest amount of time. The account manager studies the planning results and notices that the plant in Amsterdam is the last one he has to visit.

Why does the account manager visit the Amsterdam plant last?

Scenario 3:

Long before the Christmas season, Mr. Versteeg, a salesperson, looks at the rules his company has devised for determining how much to spend on presents to be sent to his customers. Next he chooses two presents that match the set price. Another department then determines which present best fits the company policy rules; this evaluation process lasts a few weeks. Finally, presents are bought and are sent by mail to the customers.

Why does Mister Versteeg begin deciding so early what presents to buy for his customers?

Scenario 4:

For the customer, the buying process occurs via well-defined protocols: the buying customer asks for a meeting with the company's technical staff via e-mail. During the meeting, alternatives from different suppliers are discussed in order to determine which supplier best meets the company strategy. The resulting information is then sent to a manager, who instructs others to design a checklist for the buying parties.

How does Miss Maartens, a customer, know that her buying follows the company policy?

Scenario 5:

An account manager of a bio-logistics company visits the customer in order to solve a logistics problem. The problem is that two of the customer's three locations are being supplied by goods beyond the keeping abilities date. He explains to his customer that bio-logistics currently delivers the product in only one plant and that the other two plants are having their goods delivered internally. The account manager suggests that it would be best to have the goods delivered to all the plants.

Why will a customer make more profit with the expansion of this service?

Unlinked sentences task

Scenario 1:

The company alignment has four plants spread over the Benelux. It is now already the second time that Mister Jansen has been invited to give a presentation. Frank has been account manager for 14 years, and he trains new buyers in his firm. Because of the intense competition from the Internet the future looks different. Peter's office is on the third floor. The problems with traffic jams have risen quickly in the Randstad.

On which floor is Peter's office?

Scenario 2:

On Main Street there is a large parking lot from which one can reach the train station. The construction of a network causes delay in information services. Miss Versteeg is an accountant and a mother of three children. The bicycle repairman just repaired a tube. The vacation time planned for this year is a bit unlucky because it falls at the time of an ad campaign. When the train arrives in the station at 4 o'clock we have four more hours before the theater performance starts.

Who repaired the tube?

Scenario 3:

This year the weather warmed so quickly that the skating rink closed one month earlier. The buyer today is not present; he is at the new plant. At the courtroom they say that they will come up with a verdict within 6 weeks. The e-mail did not arrive because many people are working with the server. There is a strike in the public transportation system.

Why did the e-mail not arrive?

Scenario 4:

The new broadcast about the nuclear experiments will be repeated at twelve o'clock. Gerard read enough and now has fallen asleep. Education takes on average five years, but it also can be finished in four years. We now live in an information age. New bridges are always built higher and longer, but where does all this end? It is time to move because this house is past its prime. The shops close at 9 p.m.

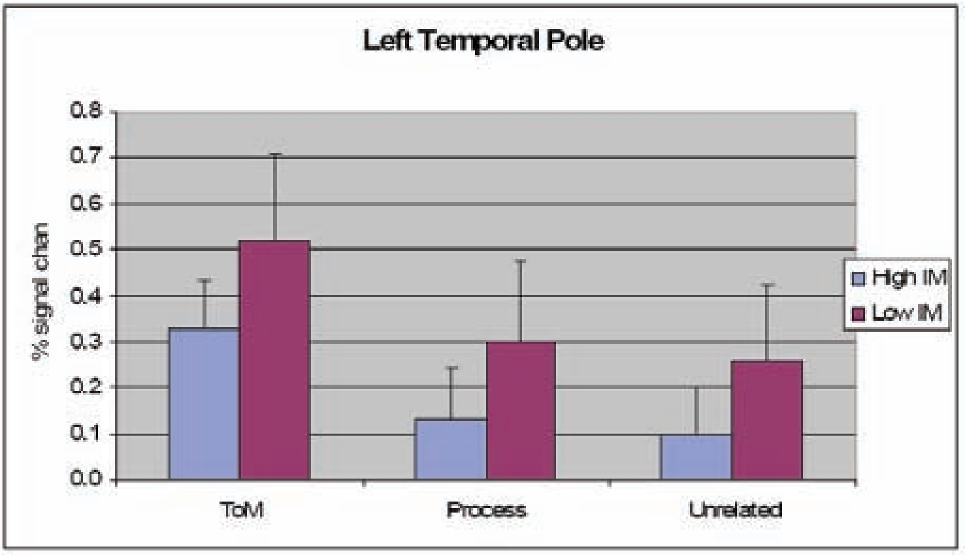
Why is it time to move?

Scenario 5:

People are working hard on the new block, and they expect it to be ready at the end of next year. People are starting to ask when they will come with the new folder? One can ask if our vision about the future will catch on in the marketplace. The number of customers is rising according to a pattern. The housing market at this time is a bit unstable because the future of the tax deduction for rent is unclear. Around the Christmas season, the days are always short.

Why is the housing market unstable?

Appendix G: Temporal pole activations for high and low Interpersonal Mentalizing (IM) groups



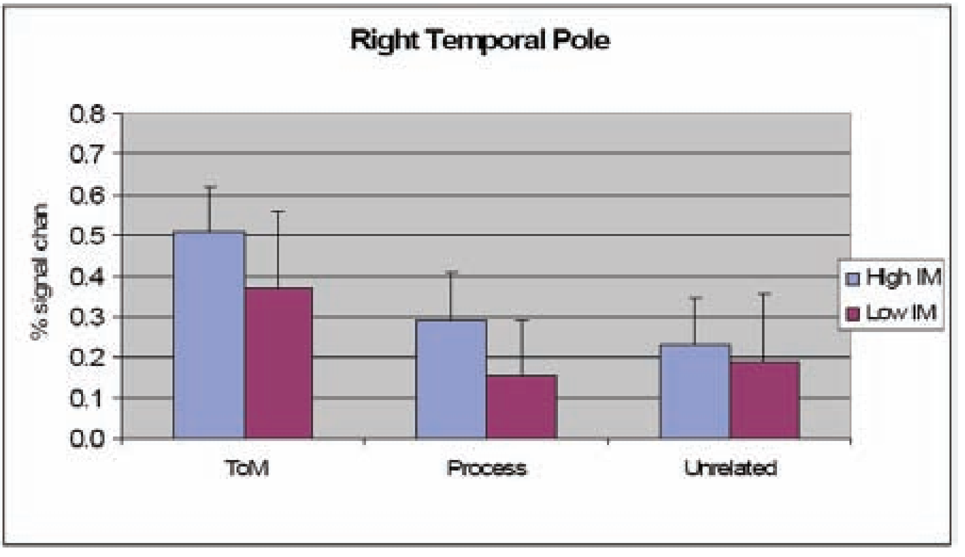
Main effect of Interpersonal Mentalizing Group (High vs. low): $F < 1$
Interaction of IM and Task: $F < 1$

High IM Group:

ToM – Process: $F(1, 9) = 21.00$, $p < .001$
ToM – Unlinked Sentences: $F(1, 9) = 23.02$, $p < .001$

Low IM Group:

ToM – Process: $F(1, 9) = 10.10$, $p < .01$
ToM – Unlinked Sentences: $F(1, 9) = 38.37$, $p < .0001$



Main effect of Interpersonal Mentalizing Group (High vs. Low): $F < 1$

Interaction of IM and Task: $F(2, 18) = 1.04$, $p = .36$

High IM Group:

ToM – Process: $F(1, 9) = 10.16$, $p < .01$

ToM – Unlinked Sentences: $F(1, 9) = 17.00$, $p < .001$

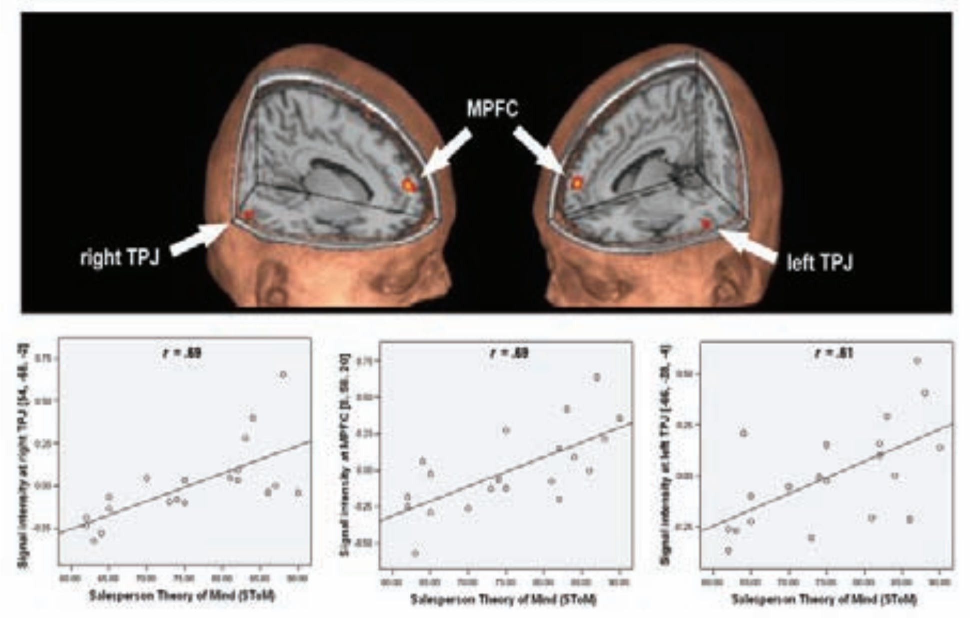
Low IM Group:

ToM – Process: $F(1, 9) = 14.26$, $p < .01$

ToM – Unlinked Sentences: $F(1, 9) = 32.30$, $p < .0001$

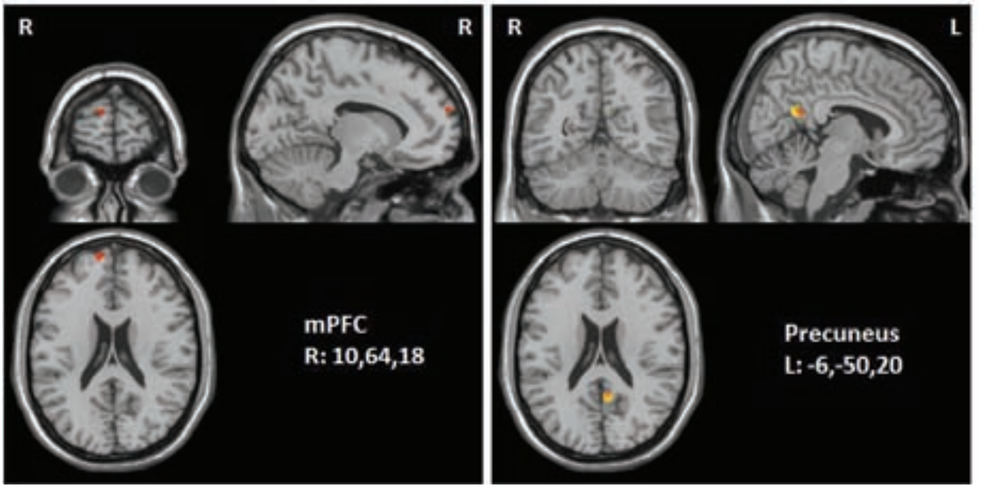
Appendix H: Brain activations

Figure 3. (CHAPTER 2) Significant correlations between SToM scores and neural activity for interpersonal mentalizing versus process condition



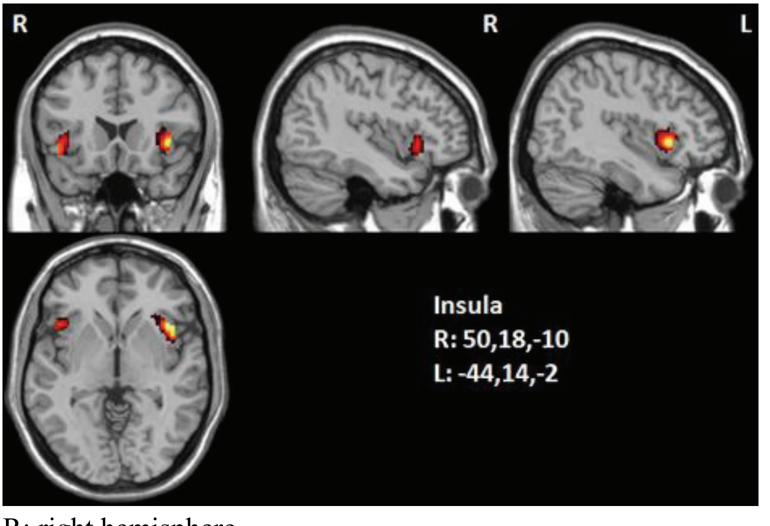
Note: Twenty salespeople completed the Salesperson Theory of Mind (SToM) scale which measured their ability to infer mental states such as beliefs, intentions and desires from customers, and participated in an experiment in which their brain activity was monitored with fMRI during a mentalizing task. Correlation analysis revealed three clusters of regions associated with Theory of Mind that were significantly correlated with SToM scores. Salespeople scoring high on the SToM measure displayed greater activations in right medial prefrontal cortex (MPFC), and right and left temporo-parietal junctions (TPJ). The picture is an overlay of the statistical parametric map, on a template brain, resulting from the correlation of the SToM scores and neural activity for the contrast of interpersonal mentalizing versus process conditions.

Figure 2. (CHAPTER 4) Medial Prefrontal Cortex and Precuneus activations associated with Machiavellianism for interpersonal mentalizing versus process



R: right hemisphere
L: left hemisphere

Figure 4. (CHAPTER 4) Insula activations associated with Machiavellianism for positive emotional expressions versus moving geometric shapes



R: right hemisphere
L: left hemisphere

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NEURAL MECHANISMS UNDERLYING SOCIAL INTELLIGENCE AND THEIR RELATIONSHIP WITH THE PERFORMANCE OF SALES MANAGERS

Identifying the drivers of salespeople's performance, strategies and moral behavior have been under the scrutiny of marketing scholars for many years. The functioning of the drivers of salespeople's behaviors rests on processes going on in the minds of salespeople. However, research to date has used methods based only on verbal self-reports. Advances in techniques from neuroscience such as functional Magnetic Resonance Imaging (fMRI) suggest that despite their complexity and relative inaccessibility, mental processes can be measured more directly.

Theory of Mind and mirror neurons are two mechanisms that operate at an automatic or reflexive level, and are important drivers of social intelligence. We use fMRI and field studies to investigate how individual differences in de functioning of these social intelligence mechanisms relate to the job performance and ethical orientations of salespeople. In addition, we use fMRI to analyse the psychometric properties of scales.

Our results show that when salespeople are presented with social stimuli during fMRI, they display individual differences in the amount of neurological processing in regions that play key roles in social intelligence, and these individual differences show associations with salespeople's performance, strategy and ethical orientations.

Implications for training, selection & recruitment of salespeople are provided. The theoretical contributions relate to the field of Marketing, Social Neuroscience, and Personality.

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