Connected Minds

Connected Minds:
Cognition and Interaction in the Social World

Edited by

Nicolas Payette and Benoit Hardy-Vallee

CAMBRIDGE
SCHOLARS
PUBLISHING

Connected Minds: Cognition and Interaction in the Social World,
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This book first published 2012

Cambridge Scholars Publishing

12 Back Chapman Street, Newcastle upon Tyne, NE6 2XX, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-4438-3902-7, ISBN (13): 978-1-4438-3902-0

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PREFACE

NICOLAS PAYETTE
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KENEXA

This volume was long in the making, but this preface will be short. The origin of the project dates back to the *Cognitio 2007* conference, entitled *Connected Minds: Cognition & Interaction in the Social World*. The "*Connected Minds*" part of the title was dropped for the book, to avoid copyright issues. The website of the conference, where you will find information about past, present and, future editions of the conference, is online at http://cognitio.uqam.ca. At the time of printing this book, *Cognitio 2013* is right around the corner and will be entitled *Creative Minds: Cognitive Sources of Art and Discovery*.

Cognitio always takes place at the Université du Québec à Montréal (UQAM) and was founded in 2004 by Benoit Hardy-Vallée (then a Ph.D. Student). Nicolas Payette joined the organisation in 2006.

It is a "young researchers" conference, and by "young" we mean "young *qua* researcher" (age has nothing to do with it). In practice, it means grad students or freshly appointed professors. Interdisciplinarity is also a big part of Cognitio's ethos. We encourage the mingling of disciplines and throughout the years have had contributions from philosophers, psychologists, computer scientists, sociologists, anthropologists, linguists, biologists, ethologists and even architects! The different themes, though always related to cognition, have also been fairly diverse and have included: the mind-body problem, decision making (Hardy-Vallée 2007), embodied cognition (Hardy-Vallée and Payette 2008) and cultural evolution.

The theme for *Cognitio 2007*, as you might have guessed from the title, was social cognition, construed from a psychological and collective point of view. From the psychological point of view the question is to understand how the human mind processes social information; how it encodes, stores and uses it in the social context. From a collective point of view, the question is to understand how individual cognition is influenced (improved, increased or impaired) by social interactions, for instance in communicating and collaborating with intelligent agents. These two dimensions of social cognition are obviously interdependent: the psychological dimension makes the collective dimension possible, which can in return modify the psychological dimension. The conference's aim was to analyze and improve the understanding of these two dimensions.

So, are these the proceedings of the conference? In a way, the answer is yes, but we would like to suggest that they are a little bit more than that. Authors had submitted drafts of their chapters shortly after the conference, but for reasons we need not go into here, we never got around to the actual proceedings. That is, until a conversation with Rui S. Costa (author of chapter 9 and now a post-doc at Princeton) prompted us to revive the project in 2011. We contacted the original authors, and to our slight surprise and great delight, almost all of them submitted updated and revised papers for this new book. These are the chapters that you will find in here. Some chapters are only slightly altered from their original versions and represent the state of the research at this time, while some have been rewritten from the ground up and reflect more current developments in the field. Despite these differences, we hope you will find all of them to be highly illuminating on a wide range of issues related to social cognition.

The book is divided into four parts that we will very briefly outline. The first part is about socio-cognitive skills. Among those, we count face recognition, imitation learning, embodied social interaction, cheater detection and psychological concept acquisition. The second part is about persons and memories: stereotypes, attraction judgements and impression formation are the subjects at hand. The third part is about understanding each other. A key part of that understanding is the motor system (whether or not we see it as a "mirror"), but community membership itself can also contribute to our understanding of others. The fourth and final part is about social cognition in societies. That section is unified by the common goal of understand how social cognition actually influences the structure of different societies, whether whole cultures, specific social networks, rural communities or even groups of caterpillars!

Before we let you enjoy the book itself, a few acknowledgements are in order. The first "thank you" goes to everyone at the Cognitive Sciences Institute of UQAM (http://www.isc.uqam.ca/), especially its director Pierre Poirier (who also happens to be Nicolas' thesis adviser) and Guillaume Chicoisne, its "research and planification officer," who was a huge part of our little organisation team. Regarding the book itself, I would like to thank the staff at Cambridge Scholars Publishing, particularly Amanda Millar, who guided us through the editing process, and Carol Koulikourdi, who has been our liaison there for this book and two previous. Hopefully,

there will be others in the future. Graham Clarke from cutoutandkeep (http://www.cutoutandkeep.co.uk/) also helped us with the proofreading. And finally, the authors themselves deserve, frankly, all the credit. They have been patient through the whole process and, more importantly, they are the ones who provide all the substance for which this book is merely a container. We now leave you, dear reader, in their hands.

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PART I:

SOCIO-COGNITIVE SKILLS

CHAPTER ONE

OUR OWN FACE VERSUS OUR PARTNER'S FACE: NEURAL DIFFERENTIATIONS

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Despite the fact that faces share a basic configuration, we are very skilled at recognizing hundreds of different faces. Once faces are known, they are linked with semantic and social information which together become the means for distinguishing a person. This is referred to as "person knowledge" which contains information such as social relations and personal traits (Gobbini and Haxby 2007).

The ability to readily process information about a person we encounter influences how we interact with him or her. The human brain processes faces of conspecifics with great efficiency (Dufour, Pascalis and Petit 2006) and functional imaging has been a useful tool for identifying the location of brain functions such that quantitative measurements of activity can be related to the brain structure. There is general agreement among neuroscientists that photographs of faces recruit specific brain areas, including the fusiform gyri, located on the inferior surface of the temporal lobes (e.g., Puce et al. 1996; McCarthy et al. 1997; Fusar-Poli et al. 2009 for a meta-analysis). Although the fusiform gyri are key for the visual recognition of faces (e.g., McCarthy et al. 1997; Eger et al. 2005), the semantic recognition of faces is not limited to their visual characteristics. Familiar faces carry a host of non-visual information, information based on previous social interactions, which renders them higher in social and emotional salience to the viewer. Therefore, current face processing models accept that faces engage a network of brain areas (Ishaii, Haxby and Ungerleider 2002; Ishaii, Schmidt and Boesiger 2005; Gobbini and Haxby 2007; Taylor, Arsalidou, Bayless, Morris, Evans and Barbeau 2009).

Familiarity can change the neural response to faces beyond the simple visual memory of the appearance of a face (Gobbini et al. 2004). Although, there is a general agreement that familiarity modulates activation in the brain (e.g., Arsalidou, Barbeau, Bayless, Taylor 2010; Leveroni et al. 2000; Taylor et al. 2009), a methodological shortcoming in this line of research is the range of familiarity of the face stimuli employed. Researchers’ classification of familiar face stimuli has varied from personally familiar to recently acquired familiarization. For example, photographs of friends and family (Gobbini et al. 2004) would carry long-term social interactions that range in quality; on the other hand photographs of fraternity brothers (Platek et al. 2006) would likely be recent and associated with more variable information, while faces learned in a lab setting to induce familiarity (Gobbini and Haxby 2006; Dubois et al. 1999) would carry limited or no person knowledge to the viewer. Visual familiarity does not entail personal familiarity and the extent and quality of social interactions carry different emotional significance. In addition, personally familiar faces are a special class of faces that have the advantage of being processed frequently and repeatedly, an aspect likely reflected in neural processes even at the visual level.

Neuroimaging studies have modelled the intricate neural networks involved in face recognition. Haxby, Hoffman and Gobbini (2000) initially proposed a model of face recognition that implicates two major neural systems: the core visual processing system, which includes the ventral visual pathways and fusiform gyri, and more extended systems which include limbic structures and frontal areas for processing and emotional and cognitive information contained in faces. This model was updated to include a specific focus on the components that influence recognition of familiar faces (Gobbini and Haxby 2007). The authors propose that recognition of familiar faces first recruits a spatially distributed network in the brain that not only includes areas of visual processing but areas associated with cognitive and social functions. Second, they claim that areas associated with “theory of mind” are also recruited for the spontaneous retrieval of “person knowledge” in the process of face recognition. Lastly, they suggest that social interactions and familiarity recognition modulate the emotional response to familiar faces. These three aspects (core system, person knowledge and emotion) all play a role in the successful identification of a face. According to Gobbini and Haxby (2007), the core system in the brain includes the posterior superior temporal sulci (STS) and inferior occipital and fusiform gyri, which together assess the visual appearance of a face; the person knowledge engages the anterior paracingulate, the posterior STS, the temporo-parietal junction, anterior temporal cortex, the precuneus and the posterior cingulate; emotional processing of faces includes areas such as the amygdalae, the insula and the striatum.

Two of the most important faces in our lives are our own face and our partner’s face. It is a common experience that we feel strongly about our face as well as our partner’s face; however, the reasons may be very different. As the narcissus myth exemplifies, our own face is very special given that it represents our own emotional state and especially how we view ourselves in the world (i.e. self awareness). Kircher and colleagues (2001) suggest that one’s own face entails self-referential processing which requires emotional and associative cognitive processes. They found that one’s own face activated right limbic areas, right insula, left superior temporal gyrus, left inferior parietal gyrus and left prefrontal cortex (BA 8/9 and BA 45/46). A later study by Suguira and colleagues (2005) also investigated the neural correlates of visual self-recognition and found that compared to an unfamiliar face, activation related to one’s own face was present in the right occipito-temporo-parietal junction, right frontal operculum, left fusiform gyrus, bilateral cingulate cortex and parahippocampal gyri. Platek and colleagues (2006) reported activation in the right postcentral, supramarginal and superior temporal gyri linked to one’s own face. These researchers also compared the subject’s own face with another familiar face (fraternity brother), and the subject’s own face activated the right superior frontal gyrus, inferior parietal and medial frontal lobes and left middle temporal gyrus. One’s own face compared to a colleague’s face showed activation in the right inferior frontal gyrus and the right insula (Devue et al. 2007). Digital morphs between their own face and a gender-matched familiar face elicited more activity in the right inferior parietal lobule, inferior frontal gyrus and inferior occipital gyrus for images containing more of one’s face than the familiar face suggesting that this network is engaged in maintaining self/other distinctions (Uddin et al. 2005). Overall, key regions that repeatedly activate to one’s own face are the left fusiform gyrus, bilateral middle and inferior frontal gyri and the right precuneus (see Platek, Wathne, Tierney & Thomson 2008 for a meta-analysis).

In contrast to the visual, cognitive and emotional information that are activated concurrently when we see our image, our partner’s face would likely activate a set of areas associated with our previous social interactions. In social neuropsychology, researchers have used the partner's face as an effective stimulus for eliciting an emotional state (Fisher, Aron & Brown 2005). This research is usually referred to as research on romantic love that investigates the neural correlates of mate choice (Fisher, Aron & Brown 2005, 2006; Bartels & Zeki 2000, 2004). Fisher and colleagues (2005) studied 17 intensely "in love" young adults who were in a relationship between 0.08 to 1.41 years (1-17 months), with a mean relationship length of 0.61 years. The main brain regions showing increased activation for pictures of their beloved were the right ventral tegmental area and right posterior-dorsal body of the caudate nucleus. Some of the participants also showed activity in the right insula, and right anterior and posterior cingulate cortex. The latter findings are in agreement with the study of Bartels & Zeki (2000), who also tested 17 young adults who were in a relationship between 0.7 to 4.1 years, with a mean relationship of 2.4 years. These intensely "in love" participants viewed photographs of their partner and generated activity bilaterally in the medial insula, the anterior cingulate, the caudate nucleus and the putamen. Bartel & Zeki (2000) also reported deactivation in the cingulate gyrus and the amygdalae as well as prefrontal, parietal and middle temporal cortices. Overall, these two studies suggest that early stages of romantic love activate areas in the limbic system when viewing a partner's face (Fisher et al. 2005), which are represented by the emotional system in the model by Gobbini & Haxby (2007). At a later stage in a relationship (Bartel & Zeki 2000) this system seems to evolve to include areas associated with person knowledge. Individuals that sustain relationships that survive many years (e.g., married ten to twenty-nine years) may also elicit activity in areas similar to new love (Acevedo, Aron, Fisher & Brown 2011).

1. Current Study

The current study examined the neural differentiation between one's own face and one's partner's face past the initial intense "in love" period. Familiarity accumulates naturally over years of social interactions and long exposure, thus we defined a long-term relationship as one where a couple has cohabitated for a minimum of two years (X = 9 yrs). The current report was part of a larger investigation including parent and famous faces (Taylor et al. 2009) which are not discussed here.

Compared to baseline (i.e. fixation cross), we anticipated that all faces (own, partner and unfamiliar) would activate areas in the core system such as the posterior superior temporal sulcus, the inferior occipital lobes and fusiform gyri. Based on previous studies we also expected that one's own face would generate activation in areas associated with person knowledge (i.e. self-awareness) to a greater extent than emotional processing and that this activation would be primarily in the right hemisphere. A partner's face was expected to activate areas involved in both the emotional processing system and person knowledge such as the amygdala and anterior cingulate.

1.1 Methods

1.1.1 - Participants

We studied ten heterosexual participants, four males, with a mean age of 35.4 years (7.7 SD), who had lived with their partner for at least two years. Average time together was 9.1± 5.01 years.

1.1.2 - Stimuli

Each subject provided his or her own digitised photographs of their partner's, their own and parents' face following a standardised protocol controlling for neutrality (no emotion on the face), gaze direction (looking straight at the camera) and light conditions. Two unfamiliar photographs and two famous photographs of faces (male and female) were also included, which were different for each participant (see Taylor et al. 2009, for greater detail). The set was processed to remove all information unrelated to the faces themselves (background, paraphernalia, etc.). The photographs were converted to greyscale and contrast level among photographs controlled. A "ghost" image (~ 20 trials) was prepared for each set superposing all photographs. Stimuli were repeated such that at least forty trials of each face type (e.g. partner, own and unfamiliar) were presented. The faces were presented in a pseudo-random order for 500 ms and inter-stimulus interval (ISI) was jittered between 1700 and 2000ms.

1.1.3 - Task Instructions

Participants were asked to focus on the photographs and pressed a button for the rare "ghost" image.

1.1.4 - fMRI Acquisition

All MR imaging was conducted on a 1.5T Signa Twin EXCITE3 scanner (GE Medical Systems, WI; software rev.12M4) with a standard quadrature head coil. Foam padding comfortably restricted head motion. A set of high resolution T1-weighted 3D SPGR images covering the whole brain was acquired (116 slices, voxel size = $1 \times 1 \times 1.5\text{mm}^3$, 2 NEX, 7min) prior to the acquisition of functional images as an anatomical reference. Functional images were acquired with a standard gradient-recalled echo-planar imaging sequence (TE/TR/α = 40ms/2000ms/90º, voxel size = $3.75 \times 3.75 \times 5\text{mm}^3$) over 27 contiguous axial slices with interleaved acquisition.

Face stimuli were displayed on an MR compatible goggle system (CinemaVision, Resonance Technology Inc., CA). Subjects responded to trials using an MR compatible keypad (Lumitouch, Photonics Control, CA). Stimuli were controlled and responses recorded using the software *Presentation* (Neurobehavioral Systems Inc., CA) on a personal computer.

1.1.5 - Data Processing and Analyses

Data analyses were carried out in AFNI (Cox 1996), using motion correction, 8mm spatial smoothing (RMSD), signal intensity normalization for percent signal change. A general linear model was applied to deconvolve the data using a fixed hemodynamic response function for all participants across all face types. Images were transformed into Talairach stereotaxic space and resampled to 3 mm^3. Group images were analyzed using a random effects analysis of variance. The results were thresholded at $p< 0.01$ (corrected) for the whole brain. To control for multiple comparisons we performed 1000 Monte Carlo iterations at an uncorrected p-value of 0.01 for individual voxels on 43,349 voxels, yielding a minimum volume of 5670μl (210 voxels) at a p-value of 0.05.

1.2 Results

The results revealed overall differences between the two types of familiar faces (Fig. 1-1 below). Compared to baseline, partner faces activated bilateral fusiform gyri, bilateral lingual gyri, right cuneus, the right parahippocampal gyrus, right middle temporal gyrus, right superior temporal gyrus, left precuneus and left middle frontal gyrus. Pictures of the participant's face (i.e. own faces) activated bilateral fusiform gyri, bilateral inferior occipital and bilateral lingual gyrus, bilateral cuneus and right precuneus, compared to baseline.

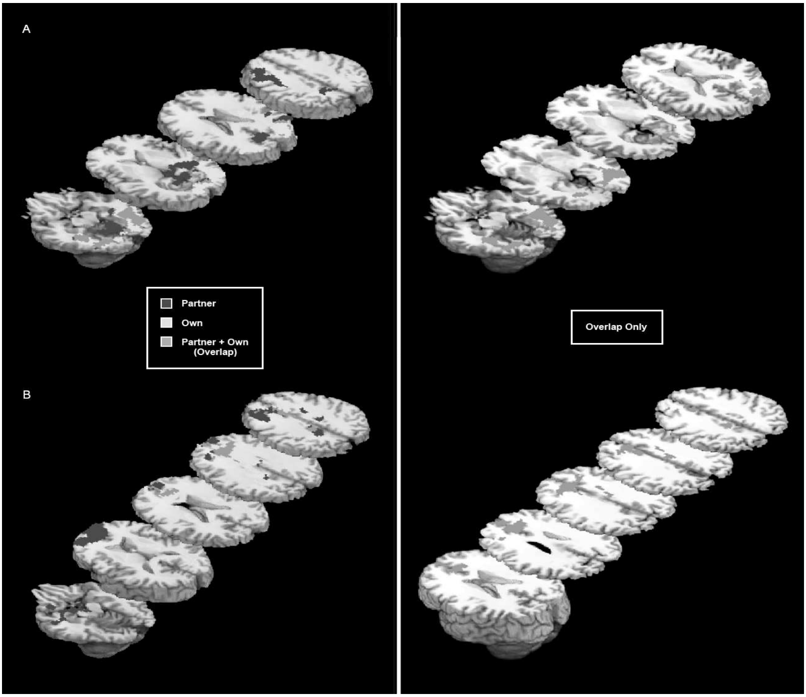

Fig. 1-1. Activity related to own and partner faces when compared to (a) fixation cross and (b) unfamiliar faces.

Own and partner faces were contrasted with unfamiliar faces; the anterior cingulate, cingulate gyrus and medial frontal gyrus bilaterally and left middle frontal gyrus activated more to own faces than unfamiliar faces. There was no significant activation in the comparison between own face and partner's face. However, the partner's face showed the most extended activations compared to unfamiliar faces with bilateral activation in the anterior cingulate, cingulate and medial frontal gyri, as well as activation in the left middle frontal gyrus, left inferior frontal gyrus (BA 47), left middle temporal gyrus, left parahippocampal gyrus, left amygdala, left insula, left thalamus and left precuneus.

1.3 Discussion

We examined the neural differentiations of two types of personally familiar faces. One's face and one's partner's face play an important role in our daily interactions, yet the neural correlates for processing these faces has been rarely investigated together. Several studies examined the neural responses to one's own face and a meta-analysis suggest that brain activity of self-face processing engages the fusiform gyri, as well as extensive regions associated with person knowledge (Platek et al. 2008; Gobbini & Haxby 2007). fMRI studies of the neural correlates of partner's faces cover relationships lengths of less than one year (Fisher et al. 2005), four years (Bartels and Zeki 2000), and to a maximum of twenty-one years (Acevedo et al. 2011). We recruited participants who cohabitated with their partner longer than 2 years, with a mean cohabitation length of 9.1 years. Activation related to own faces and partner's faces is discussed in relation to baseline and unfamiliar faces.

1.3.1 Personally Familiar Faces vs. Baseline

Activations of personally familiar faces compared to baseline were expected to recruit areas associated with the visual recognition of faces (e.g. Puce et al. 1996; McCarthy et al. 1999; Platek et al. 2006). Bilateral activation in the fusiform gyri, as well as lingual gyri and cuneus were present for processing both one's own face and partner's face. The inferior occipital gyri were activated only for own faces. The location of these areas in the occipital lobes is suggestive of their role in visual processing (Kolb & Whishaw 2003). The precuneus, in the parietal lobes, was also activated for both one's own face and partner's face but in the opposite hemispheres, right and left respectively. Among other cognitive functions, the precuneus is associated with the visuospatial analysis of objects (Faillenot, Decety & Jeannerod 1999), a recognition network supporting retrieval (Reber, Wond & Buxton 2002; Nagahama et al. 1999) as well as person knowledge processing or face recognition (Gobbini & Haxby 2006, 2007; Bayle & Taylor 2010).

Unlike own faces, partner's faces also activated the middle and superior temporal gyri, the parahippocampal and the middle frontal gyri (BA 9). Activity in the middle frontal gyrus has been associated with cognitive functions such as working memory and attention (e.g., Petrides 1996; Christoff & Gabrieli 2000). Activation in this area was also associated with personally familiar faces (Bartel & Zeki 2000; Gobbini & Haxby 2006; Platek et al. 2006). In the present study, the middle frontal gyri were probably involved in the system responsible for holding the person information in mind. Middle temporal cortex supports recognition of familiar faces, along with the parahippocampal gyri (Barbeau et al. 2008; Leveroni et al. 2000). The middle temporal cortices, which also activate to mother’s faces (Arsalidou et al. 2010), may be related to self-related processing of personal experiences associated with the person, in this case the partner’s face. The parahippocampal areas are involved in encoding visual information (e.g. Rombouts et al. 1999; Kirchhoff et al. 2000), and in face recognition studies they are associated with memory retrieval of personal and social knowledge (Sugiura et al. 2005). STS areas are linked with the social cognition of faces (Allison et al. 2000) and together with the precuneus, these areas respond to personally familiar faces (Gobbini et al. 2004; Uddin et al. 2005).

Overall, compared to baseline, personally familiar faces exhibited activation primarily associated with the core system of processing faces. Partner faces activated more regions associated with the extended face processing system, which are likely associated with the mnemonic, semantic and emotional attributes of the partner.

1.3.2 Personally Familiar Faces vs. Unfamiliar Faces

Comparisons with unfamiliar faces showed that core system areas including the fusiform gyri did not survive correction, as these regions respond to faces regardless of familiarity (Puce et al. 1996; McCarthy et al. 1997; Gobbini & Haxby 2007), emotional valence or mode of presentation (Arsalidou, Morris & Taylor 2011). These contrasts elicited activity in areas associated with extended affective and cognitive system, which included bilateral anterior cingulate (BA 32), cingulate gyrus, medial frontal gyri and left middle frontal activation for both own face and partner’s face. The cingulate gyrus is recruited in a variety of paradigms of higher cognitive function (Petit et al. 1998), such as executive attention and set shifting (Catafau et al. 1998). Turak and colleagues (2002) concluded that the cingulate gyrus is a multimodal area involved in cognitive activity in general, including executive attention. Specifically, the anterior and dorsal parts of the cinculate gyri were found to be implicated in emotional and cognitive processes, respectively (Bush, Luu & Posner 2000 for review). In relation to face-recognition studies, the anterior cingulate gyrus has been associated with familiar faces (Platek et al. 2006; Suguira et al. 2005) and may play a role in the integration of information (Devue et al. 2007). Similarly, prefrontal regions, such as the middle frontal and medial frontal gyri have been linked to executive functions such as manipulation and monitoring information held in mind (Christoff & Gabrieli 2000). Together, the anterior cingulate gyrus and prefrontal regions may facilitate the integration and monitoring or reminiscing on personal information present in both one’s own face and partner’s face but not in the unfamiliar faces.

Areas responding only to partner’s faces were the left inferior frontal gyrus (BA 47), insula, amygdala and thalamus. A more general function attributed to the inferior frontal gyrus is that of maintenance of a few items in mind (Christoff & Gabrieli 2000). Even though participants in this study were not explicitly asked to maintain information, the presentation of their partner’s face may have implicated different memories and emotional components elicited by the pictures. The inferior frontal gyrus was also found active to mother’s faces when compared to unfamiliar faces, albeit in the opposite hemisphere (Arsalidou et al. 2010). Thus, the inferior frontal regions may be part of the extended network for processing socio-cognitive aspects of a face. Emotional valence has been associated with the insula, the amygdalae and the thalamus (e.g. Britton et al. 2006). In social neuroimaging, insula activity is associated with partner’s faces (Fisher et al. 2005; Bartels & Zeki 2000), as well as modulating emotions (Heinzel et al. 2005). Similarly, the amygdalae have been linked to processing of emotive states (Arsalidou et al. 2011) and social and emotional attachment to faces (Gobbini et al. 2004). Together, the amygdalae and the insula would be linked with the processing of emotions as part of face recognition (Gobbini & Haxby 2007). Compared to unfamiliar faces, own faces recruit areas primarily associated with person knowledge (i.e., self-assessment), while partner’s faces recruit areas associated both with person knowledge and emotional processing.

In conclusion, humans have a complex social organization and faces play a major role in the processing of the relations an individual may have. By capitalizing on the neural correlates of own and partner faces, we showed that in long-term relationships the brain recruits areas referred to as the emotional system as well as person knowledge. Own face processing only recruited areas previously associated with person knowledge, while partner face processing recruited areas associated both with person knowledge and emotions. In a direct comparison, the neural correlates of own faces and partner faces were not significantly different. This can be attributed to the saliency of both faces in terms of person knowledge and to the small sample size, which may not be optimal in investigating the subtle differences that appeared when analyzing each face type separately. These findings contribute to the literature of face processing and romantic love, extending evidence of brain areas implicated in partner’s face processing in a long-term relationship. Future experiments still need to determine the fine-grained differences between processing personally familiar faces and the neural changes occurring across long-term exposure and familiarity.

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CHAPTER TWO

IF THE SITUATION PREDICTED BEHAVIOUR, WOULD SOMEBODY LEARN IT? AN EXAMINATION OF LEARNING CONTINGENCIES BETWEEN HOW PEOPLE BEHAVE AND THE NATURE OF THE SITUATION

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Many everyday activities involve dealing with people, and navigating these interpersonal interactions requires an ability to learn about others and use our knowledge to anticipate their behaviour. It is of little surprise, then, that how we form impressions of others and the processes involved in person learning, memory and judgment are key issues of interest in social, cognitive and personality psychology.

Research shows that our impressions of others and our interpretations of their behaviour are dominated by personality or dispositional information (e.g. Park 1986; Humphrey 1985; Miller 1984; Pietromonaco & Nisbett 1982; Jones & Harris 1967). We also perceive a great deal of constancy in the people we come to know. In other words, we expect others to behave in a manner that is predictable from their disposition and highly consistent across different situations (e.g. Kunda & Nisbett 1986; Ross & Nisbett 1991 for extensive review). Empirical efforts to document that others' behaviour reflects such considerable and context-independent consistency, however, have fallen far short of what personal experience would suggest ought to be a straightforward enterprise (see Mischel 1968 for a review). This discrepancy has generated much interest in the question of what, then, produces our entrenched belief that people differ markedly from one another, in ways that manifest themselves time (and situation) and again.

Mischel and his colleagues have offered an interesting response to this puzzle (Mischel 2004; Mischel, Shoda & Mendoza-Denton 2002; Cervone & Shoda 1999; Mischel & Shoda 1995). They argue that people are coherent and predictable, and we perceive them to be so, not because their actions are invariant across situations, but because each individual's actions are organized by stable *if … then …* relationships between attributes of the situation and how one behaves. In other words, neurotic Susan surely won't be uptight and anxious in *every* situation; instead, she may reliably act that way whenever an authority figure is present. This proposal that situation-behaviour contingencies are central to the essence of individuals and our impressions of them is certainly congruent with extensive research demonstrating how profoundly the situation influences people's thoughts, beliefs and actions (e.g. Asch 1955; Darley & Latané 1968; Milgram 1963; and see Ross & Nisbett 1991 for a review). Moreover, evidence that people can be reliably characterized by contingencies between particular situational attributes and how they act is slowly accumulating (Fleeson 2007; Fleeson 2001; Shoda, Mischel & Wright 1994, 1993a; Mischel & Peake 1982).

However, to account for our pervasive belief that individuals are consistent, it would not only be necessary that the behaviour of individuals' is contingent upon the situation, but also that we readily become sensitive to those contingencies through our experience. Putting aside issues of contingency strength and opportunity for learning, our well-documented insensitivity to the effects of situational forces on others' behaviour (see Ross & Nisbett 1991 for an extensive review and discussion) raises question about how readily we might learn contingencies that involve that very class of information.

Empirical demonstrations that we do become sensitive to interactions between the nature of the situation and how others behave are scarce, although there are a few notable exceptions (Kammrath, Mendoza-Denton & Mischel 2005; Shoda, Mischel & Wright 1993b, 1989). These studies demonstrate sensitivity primarily by showing that impressions and inferences we form about a target differ as the content of the "if … then …" relationship characterizing that target changes. The research presented here extends this sparse body of work by more directly evaluating the extent to which we learn situation-behaviour contingencies that characterize others.

Relationships such as "Susan is nervous when around authority figures" are much like other contingencies in our environment, such as chest pain often signals a heart attack or higher grades are associated with better work ethic. Given this similarity, the current research employs an associative-learning procedure typically used to study contingency learning in domains outside person perception. The procedure, introduced elsewhere (Skye 2007), involves presenting several unique vignettes that each depict how a target behaves and the situation in which the behaviour occurred, and that collectively reflect some contingency between those two variables. Sensitivity to the contingency is then assessed by examining what effect the situational variable has on perceived likelihood of the behaviour in novel vignettes, and also explicit knowledge of the predictive situational variable.

The first experiment evaluates whether our ability to learn situation-behaviour contingencies differs when those contingencies are expressed through the actions of one or many people. Good contingency learning in the individual condition would certainly provide evidence that we are sensitive to "if … then …" signatures reflected in the behaviour of people we encounter. Furthermore, if sensitivity to the same contingencies is weakened when they reflect the actions of a group, this could suggest that we are especially tuned to learn about situation-behaviour relationships within individuals.

Superior contingency learning from information describing individuals compared to groups could result from differences in information processing for the two types of social targets. Hamilton & Sherman (1996) review considerable impression formation research that suggests we process information about individuals in a more integrative manner, and integrative processing is surely involved in contingency learning where discovery of patterns across multiple events is key. More generally, Hamilton & Sherman argue that integrative processing is a positive function of the unity or coherence we expect from any social target. So, to evaluate whether integrative processing as a function of the social target's perceived unity might explain differences in our ability to learn "if … then …" relationships reflected by individuals and groups, the second experiment examined whether contingency learning differed when the vignettes described members of more and less cohesive groups.

1. Learning Contingencies Expressed by Individuals and Groups

This experiment evaluated how well we learn situation-behaviour contingencies expressed by individuals or groups. Participants received vignettes describing behaviours in specific contexts, and the behaviour was perfectly contingent on a situational attribute. All vignettes referred to the same person in the individual target condition. In the group target condition, each vignette mentioned a different name, implying the descriptions reflected a rather random group of people. Contingency learning was evaluated by examining whether the presence of the situational cue increased expectations that the behaviour would occur in novel scenarios, and by asking whether participants could name the situational cue that predicted the target's behaviour. Increased expectations of the outcome in the presence of the cue and explicit knowledge of the situational predictor would indicate participants did learn situation-behaviour contingencies. And, if we are particularly inclined to learn about "if … then …" signatures for individuals, evidence of learning on both measures should be stronger in the individual than in the group condition.

1.1 Method and Procedure

McMaster University students, eleven in the individual and twenty-one in the group target conditions, participated for course credit or $10 cash. Participants ranged in age from eighteen to thirty-five years (mean 20.4), and English was their primary language.

In the individual target condition, participants received twenty vignettes describing one person's behaviour in specific and unique contexts. Across the vignettes, there was a contingency between a situational cue (C) and a behavioural outcome (O). For example, one person tended to be rude to his relatives but not to non-relatives. Examples of the vignettes describing that person include:

> When Graham came home from his job at the recreation centre, Graham flopped down on the couch, grabbed the TV remote and switched channels from the show his brother Peter was watching to the football game without asking.
>
> Graham called VISA about a charge that appeared on his credit card bill. The customer service agent put him on hold, but then she forgot about him. After holding for 20 minutes, Graham hung up and called back. When he got back through to the same agent, he calmly asked what had happened and was very understanding when she explained her error.

As these examples illustrate, each vignette conveys whether the cue was present (e.g. relative vs. non-relative) and whether the outcome occurred (e.g. rude vs. polite). The objective relationship between the cue and outcome can be quantified using ΔP, which reflects the difference in the outcome probability when the cue is present and absent (Allen 1980). To create maximal learning conditions, the cue-outcome contingency was always perfect (i.e., $\Delta P = 1.0$). In other words, the behaviour occurred if and only if the situational attribute was present.

Contingency learning was assessed using two additional vignettes describing novel scenarios in which the cue was present or not. Participants were given two options representing the presence and absence of the behavioural outcome, and they indicated the probability that each would occur in that scenario (total forced to sum to 100). For example, in the cue-absent (C–) vignette below, the absence of the behavioural outcome (O–, or Option B) should be rated more likely than its presence (O+), given that rudeness is contingent upon interacting with relatives.

> Graham bought a stereo from a store in Toronto and he borrowed his friend Justin's car to go and pick it up. When he was finished, Graham …
> (a) returned his friend's car without replacing any of the gas he'd used
> (b) filled up his friend's car with gas before returning it.

Participants were also questioned about their knowledge of the predictive situational variable. For example, they were told "there was actually a simple rule that determined whether Graham was polite or disrespectful," and were asked what that rule was and told to guess if necessary.

The session included three additional replications of the learning and test phases just described. These were identical in procedure and structure of the materials, and differed only in that each used new vignettes to describe a new target character whose behaviour reflected a new if … then … contingency. The three other contingencies involved being active only when it was early, being helpful only when one was available, and being talkative except when a particular individual was present.

The group target condition was identical to the individual target condition, except for a seemingly minor change to the stimuli. To create the sense that the task involved learning about a group of people and predicting its members' behaviour, every vignette and test scenario referred to a different person (e.g. Benjamin, Nicholas, Duane). Names were never repeated across replications, and two replications used all males and the other two used all females. Participants likely regarded these groups of people as fairly random, as no information that defined the nature of the groups was ever provided (although they could have imposed idiosyncratic definitions). Finally, the question probing explicit knowledge of the contingency in this condition was altered to refer more generically to a group member.

Participants were told they would be given several behavioural descriptions and then would answer questions based on that information. Order of the four replications was randomized, as was order of the