Effects of Experimentally Generated Closeness on Self and Other Neural Processing: A Functional Magnetic Resonance Imaging Study

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Abstract of the Dissertation

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Researchers are gaining an understanding of the neural underpinning of the self in terms of brain regions involved in self-recognition and how information regarding the self is processed. Previous research suggests that self-referential processing holds a unique place in our cognition and neural function. Fewer studies have addressed if close other-referential processing also holds a distinct position in neural functioning. Inclusion of Other in the Self Theory (Aron & Aron, 1986) suggests a cognitive overlap between the self and close other. The present study explored whether similar or corresponding brain regions activate during self and close-other judgments. Functional magnetic resonance imaging (fMRI) was used to examine the neural substrates of self and close other processing. Prior to the fMRI portion of the experiment, participants were paired with an unfamiliar partner for a closeness-generating activity and another unfamiliar partner for a script-reading activity. In this study, closeness and familiarity are experimentally controlled for, allowing the two phenomena to be examined separately. After completing these activities, participants underwent fMRI while making judgments about faces and trait adjectives under four conditions (self-relevant, close other-relevant, familiar other-relevant and non familiar other-relevant). Brain activation was compared during each of these conditions. Tentative results suggest that for the most part, different brain regions are involved in processing information about self and close others. The present study examined European-American and Asian American participants. Potential implications of culture and relationship type on neural processing of close others are discussed.

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Self-awareness may be a direct evolutionary precursor to higher-order cognitive functions (Gallup, 1982; Stuss & Benson, 1986). What function does self-awareness have in the brain, and does self-knowledge differ qualitatively from other kinds of knowledge? A growing number of researchers are examining if the self has a unique cognitive or neural structure (Decety & Somerville, 2003; Gillihan & Farrah, 2005; Johnson, 2002; Symons & Johnson, 1997). The recent findings suggest that self-referential processing does indeed hold a unique place in our cognition and neural function (Fossati et al., 2004; Keenan, Wheeler, Gallup, & Pascual-Leone, 2001; Kelley, Macrae, Wyland, Caglar, Inati & Heatherton, 2002; Seger, Stone & Keenan, 2004; Kircher, Brammer, Bullmore, Simmons, Bartels, & David, 2003).

However, most of this previous work has considered the self in isolation, not taking into account its relation to close and familiar others. In humans (and most primates), the self is almost always in an environment filled with social interactions, especially interactions with close others, making information about the people that surround us and their relation to the self essential for reproduction and survival. Because of this it seems probable that neural mechanisms related to the self have evolved in a way that is intricately linked with social processing, particularly that regarding close others. In this introduction recent findings are discussed regarding the neural correlates of self and the shared neural and cognitive representations of self and other, focusing on evidence from social psychology and neuroscience.

In their recent review, Heatherton, Macrae, and Kelley (2004) discuss how advances in the field of neuroscience, in particular, PET and fMRI, has given researchers the ability to explore questions related to the nature of self-referential memory and self recognition that were previously beyond the scope of the field. It is essential to examine how the self relates to other and distinguish between self and other. Decety and Somerville (2003) summarize evidence from developmental science, social psychology and neuroscience that support the view of a common representation network (both at the computational and neural levels) between self and other.

It is becoming well established that certain brain areas seem specialized for self-relevant information (Feinberg; 2001; Heatherton et al., 2004). Craik et al. (1999) used Positron Emission Tomography (PET) and asked participants to make trait adjective judgments, deciding whether or not the adjective applied to themselves or a famous person. Activation in the right prefrontal cortex was seen during ratings of the self condition. One study that contributed to this knowledge used functional magnetic resonance imaging (fMRI) to determine what areas of the brain were active while participants made judgments about trait adjectives (Kelley et al., 2002). Participants were asked to rate traits in three conditions-Self, Other and Case. The trait was presented with a cue telling the participants which type of judgment they were to make. In the Self condition, participants were asked if the trait applied to them self. In the other condition, they were asked to decide if the trait described former U.S. President G. H. Bush. In the Case condition, they were asked to determine if the trait was in upper or lower case letters. The researchers found that self-referential processing is functionally dissociable from other forms of semantic processing. Relevance judgments were characterized by activation in the left inferior frontal cortex and anterior cingulate. More specifically, a region of the medial prefrontal cortex was engaged when participants were making judgments about the self-relevance of the trait adjectives. This suggests that the self holds a unique position in our cognitive and neural networks.

Another study illustrating the neural networks of self used fMRI to research cerebral activation while subjects processed words describing personality traits and physical features using two experiments (Kircher et al., 2002). The first experiment involved intentional self processing. Six healthy right-handed subjects were presented with personality trait adjectives and asked “Does this adjective describe how you typically feel and think about yourself?” Examples of the adjectives used are talented, confident, dishonest, etc. The second experiment involved incidental self processing. Subjects categorized words according to whether they described physical versus psychological attributes. Examples are hairy, tall, fat, etc. Both lists were judged for self descriptiveness 6 weeks before scanning, and words were arranged in blocks according to self descriptiveness.

Results showed a reaction time advantage was present in both experiments for self-descriptive trait words, suggesting a facilitation effect. In both the intentional and incidental experiments the left superior parietal lobe, with adjacent regions of the lateral prefrontal cortex were active. Differential signal changes were present in the left precuneus for the intentional condition. Differential signal changes occurred in the right middle temporal gyrus during the incidental condition. These results indicate that self processing involves discrete processes and can occur on more than one cognitive level with corresponding functional brain regions in areas previously implicated in the awareness of one’s own state.

Extending the literature on neural responses to familiar versus unfamiliar faces, one team of researchers investigated types of neural responses that occur when a mother views her own child (Leibenluft, Gobbini, Harrison, & Haxby, 2004). This study employed event-related fMRI to examine the neural correlates of the mother-child relationship. Participants were seven mothers with children aged 5-12 years old. The mothers performed a one-back detection task in which they were asked to identify pictures of their child, their child's friend, an unfamiliar child, and an unfamiliar adult. Control stimuli were created by phase-scrambling the pictures of faces. Results showed that seeing one's own child versus a familiar child was associated with activation in the amygdala and insula, regions associated with the mediation of emotional responses. Additionally, the anterior paracingulate cortex, and posterior superior temporal sulcus were activated during viewing of one's own child versus a familiar child, regions associated with theory of mind functions. Participants in this study were not asked to give familiarity or closeness ratings. Because these items were not measured explicitly, it is not possible to examine potential effects of closeness and familiarity.

As stated earlier, a vital aspect of human experience is how we relate to those around us. Close relationships are a central focus of human experience (Bersheid & Reis, 1998). This leads to the question of whether self-knowledge completely unique or whether it shares properties with close-other related knowledge. Aron, Mashek and Aron (2004) describe an overlapping cognition in a close relationship in which the other is treated as self or confused with the self. This conceptual framework is described as "including other in the self." This theory describes that in a close relationship each person includes in the self the other's resources perspectives and identities (Aron et al., 2004). In a close relationship, the other's resources are treated as one's own resources. This may include physical items such as a shared house, or intangible items such as knowledge resources. An implication of this inclusion of other's resources in the self is that the other's outcome may be treated as if they were one's own. An example of this was a serious of studies in which participants made allocation decisions involving themselves and another person (Aron, Tudor & Nelson, 1991, study 1 and follow-ups). Participants distributed money about equally to themselves and the other when the other was their best friend, but they distributed more to themselves than the other when the other was an acquaintance.

In addition to the other's resources, another line of research examined including close other's perspectives in the self, with regard to extending to close others self-related attributional and cognitive biases. Many studies have found that the actor-observer difference in the tendency to make situational versus dispositional (Nisbett, Caputo, Legent &

Marecek, 1973) is smaller when the other is someone close to the self such as a best friend or romantic partner (Aron et al., 1991; Aron & Fraley, 1999; Sande, Goethals, & Radloff, 1988). In these instances, the self is experiencing the other's perspective as the self's own perspective tending to make more situational attributions than dispositional attributions.

In regards to including close others' identities in the self, several studies have built on the line of research know as the self-reference effect. This well established line of research consistently shows an advantage in terms of memory and response time for self-relevant versus other-relevant processing. A meta-analysis (Symons & Johnson, 1997) of 126 articles and book chapters on the memory aspect of the self-reference effect found that memory was better for words studied in relation to the self than for words studied in relation to other persons. However, the degree to which self-referent and other-referent processing differs seems to depend on the relationship to the other. Across 65 studies, the researchers found significantly smaller differences in the memory effect between self-reference and other reference when the other was someone who was close to the self. In this way, being in a close relationship seems to undermine the seemingly deep-seated distinction of self from other

It is suggested that judgments regarding trait adjectives referencing another person may depend on the relationship of the other to the participant (Bower & Gilligan, 1979; Keenan & Baillet, 1980). These studies found that the self-reference effect is reduced when judgments are made about a person with whom the participant is close.

An important method of examining a cognitive matrix is to see if different neural networks are used in processing of self and close other recognition. Seger et al. (2004) conducted an fMRI study to compare the neural correlates of self and other-related judgments. Participants viewed food names and made a decision if they liked the food. They also were asked to come up with a person whom they were close to but not very close, such as a roommate or friend, and decide if that person liked the food or not. Participants also made a semantic judgment about the letters in the word presented. Self and other decisions both activated bilateral medial areas of the frontal and parietal lobes and the bilateral insula in comparison to the letter task. Self activated superior medial parietal areas in comparison to other, whereas other led to greater activation in inferior medial parietal and left lateral frontal areas than self. This is one of the first studies to examine both self and other-related processes. The results suggest the neural networks underlying self and other processing may have common neural substrates. This suggests that these processes may indeed overlap, and accordingly self and close other identity may overlap.

Experiments have examined whether processing information about a close other might share a common representation network with self-related processing. Given the apparent cognitive overlap between self and close other (Mashek & Aron, 2004), does close-other processing share a cognitive or neural network with the self? It is possible that there is a network that processes close-other information, and perhaps even overlaps with the regions that process self-relevant information.

Aron and Fraley (1999) used a reaction time measure as well as an attribution (perspective) index. In the attribution index, participants rated themselves and their romantic partner on opposite trait-adjective pairs. They indicated for each pair if they would describe their partner as exemplifying the trait, its opposite, "both," or "neither". For instance, participants were asked if a trait such as "serious" described their partner. They were also asked if the trait's opposite described their partner, for example, "carefree." They completed the same questionnaire for the self. Traits rated "both" were presumed to represent situational attributions, as opposed to dispositional attributions. The index that the researchers used was the residual of number of traits rated "both" for partner after controlling for the number of traits rated "both" for the self. Results showed that there were slightly more opposite-trait pairs rated as "both" for their partner than for the self. This indicated that the close other is treated as the self in the sense that fewer dispositional attributions are made for the close other. For the reaction time measure, participants rated themselves and their romantic partner on each of 90 traits on a 7-point scale, from "unlike" to "extremely alike." Over an hour later, participants were presented with each trait and asked to decide if it was a "me" trait or a "not-me" trait. Their reaction time was assessed for this task. Traits that were different from their partner's were slower at being recognized as "me" traits, whereas traits that were shared with a partner were faster at being recognized as "me" traits.

The study demonstrated that cognitive indices differentiated among relationships of varying degrees of closeness. Additionally, the attribution and reaction time results are consistent with the notion that close relationships represent overlapping knowledge structures. Furthermore, the degree of self-other overlap was associated with subjective feelings of closeness. Aron and Fraley (1999) suggested that if a close other is included in the self, the cognitive representations of the self and the other might occupy overlapping regions of a cognitive matrix.

Additional cognitive aspects of self-processing versus close other-processing have also been examined (Mashek et al., 2003). Three studies were performed where participants were asked to rate different traits for the self, their close other, and a non-close other. There was a surprise source-recognition task in which participants were presented with the same traits and asked who the trait was rated for. A pattern emerged showing more source confusions between the self and the close others than the self and the non-close others. For example, a participant was more likely to think a trait that they rated for their close other was one they had rated for themselves. This did not occur as frequently with traits that the participants had rated for the non-close other. These source confusions occurred to an equal extent whether the close other was a best friend or romantic partner. One possible explanation for this confusion is familiarity—that the participant was more familiar with the close other than with the non-close other. However, two of the studies compared results from best friend and parent, and the pattern was more significant for best friend, with whom participants were closer, despite parent being more familiar. In this college sample, participants were closer with their friends, but more familiar with their parents.

There are significant findings in the domain of close-other processing and cognition, but there is traditionally a confound that only a handful of studies have attempted to tease apart (Aron & Fraley, 1999; Mashek et al., 2003). Familiarity and closeness are often difficult to examine separately. In almost all cases, if a person is close to someone, they are also highly familiar with them. They are often more familiar with a close person than with a less close person. It is inherent in the nature of becoming close to someone that you also become familiar with them. Attempts have been made to separate these two phenomena (Mashek et al., 2003), but this study is among the first to examine participants judgments of a close and non-close person with whom they are equally familiar in an fMRI setting.

One of the first studies to separate familiarity and closeness was performed using a new methodology for creating closeness experimentally (Aron et al., 1997). Pairs of people who were formerly unacquainted carried out a task in which becoming close was the focus. Pairs took turns asking each other self-disclosing and relationship-building tasks that gradually intensified. An example question from this task is "What is your most treasured memory?" A separate set of participants completed a small talk task, during which becoming close was not the goal. An example questions from this task is "Do you read a newspaper often?" The pairs who performed the closeness-generating task reported greater post-interaction closeness than pairs who completed the small-talk task, as measured by the Inclusion of Other in the Self Scale (Aron et al., 1992) and the Subjective Closeness Index (Bersheid et al., 1989). These results are useful in that the all participants were equally familiar with each, having only met during the experiment, but only one pair became close. It also shows that the closeness comes from the specific activity and not from simply spending time together.

While there is an indication that the close other is treated as the self or confused with the self, it has not been demonstrated in terms of brain regions, in particular without separating the confounded nature of familiarity and closeness. If there is indeed an overlapping cognitive matrix between self and close other, it could be demonstrated by showing an overlapping neural matrix, to the extent that this network can be localized.

Researchers have begun to examine the brain activations involved in processing self and close others using functional neuroimaging, with differing results. Several studies found no difference in activity for self and close-other judgments (Heatherton et al.; Seger et al., 2004). Examining the cultural influences on self-representation added weight to previous results that medial prefrontal cortex (mPFC) activation was specific to judgments about the self with one important distinction- this finding only applied to Westerners (native-English –speaking Caucasians) (Zhang, 2006). The opposite result was found for Chinese. Chinese participants recruited mPFC when making judgments about the self as well as their mothers, indicating that Chinese use similar brain regions when making judgments about self and close others. These results were replicated (Zhu, 2007) with results that found that Westerners use mPFC to represent the self, and Chinese individuals use mPFC to represent the self as well as their close other (their mother).

Much of the experimental evidence from studies on self-processing (for the most part based on participants in Western cultures) indicates that right frontal and parietal lobes preferentially process self-referent information (Keenan, 2001; Decety & Somerville, 2003) and that the right parietal lobule is responsible for self-other discrimination (Uddin, 2006). There are also a number of studies indicating the left hemisphere is involved in self-relevant stimuli (Turk et al., 2002) as well as data supporting the theory that midline structures are primarily involved in self-referential processing (Northhoff & Bermpohl, 2004; Uddin, Molnar-Szakacs, I., Zaidel, E. & Iacoboni, M., 2007). Research on split-brain patients has shown that both hemispheres are capable of self-recognition (Sperry et al., 1979; Uddin, Rayman & Zaidel, 2005(1)). Further evidence supporting that both hemispheres are involved in self-referential processing contrasted cerebral responses to self-face and familiar face. Activation was found in the superior frontal gyrus, medial frontal and inferior parietal lobes in the right hemisphere, and middle temporal gyrus in the left hemisphere during self-face detection (Platek et al., 2006).

The present study integrates methods used in previous research studying closeness and combines this technique with trait-rating for self, close-other and familiar-other using functional magnetic resonance imaging. The goal was to determine the neural correlates of the self and how we process information about close others, while eliminating the familiarity confound. Additionally, using experimentally generated closeness eliminated several confounds. For instance, people who become close in a natural setting as opposed to an experimental setting are only able to yield correlational results. The present method of manipulating closeness eliminated this confound.

In addition to the theoretical and scientific applications of the present study, there are potential practical applications as well. A knowledge of the neural correlates of closeness can assist in the treatment and understanding of individuals who are unable to relate to others because of brain injury or conditions such as autism.

Method

Participants

Ten right handed female participants were recruited from Stony Brook University subject pool, between the ages of 18-22, mean age=19. The participants were 60% European American (Caucasian) and 30% Asian-American. All participants were native English speakers because of the conversational nature of the pre-MRI tasks. Only female participants were used as this gave more statistical power to the analysis, and several studies have shown that females tend to be closer with their same-sex friends (Reis, Senchak & Solomon, 1985). Investigators have demonstrated that neural activation can vary depending on the relationship between the race of a person viewing faces and the race of the facial stimuli (Hart et al., 2000; Phelps et. al., 2000). To avoid this potential conflict, all subjects were paired with partners of a similar race. Participants were screened for handedness using the Edinburgh handedness measure (Raczkowski, Kalat, & Nebes, 1974). Only right-handed participants were accepted to permit sufficient power to evaluate hemispheric laterality. Only native-English speakers were accepted to participate due to the complex verbal nature of the closeness and small talk tasks. Participants received either course credit or $50 for their participation. All participants completed a consent form in accordance with the Office of Research Compliance at Stony Brook University, as well as a metal-screening to make sure participants were safe to enter the MRI.

Procedure

Participants entered the lab and were greeted by the experimenter. All participants then completed the consent form. The focal participant was assigned to work with a person of the same sex also from the subject pool for the closeness-generating task, as well as another person from the subject pool with whom they completed a small talk task. Tasks were adapted from Aron, Melinat, Aron, Vallone & Bator (1997) (See Appendices A and B for closeness task and small-talk task instructions, respectively).

Prior to beginning the experiment, it was established that the participants were not formerly acquainted. Following each task, to determine if the manipulation was successful, participants completed the Aron et al. (1992) Inclusion of Other in the Self scale for the partner, as well as a short familiarity scale. Both participants completed the Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988), as well as a likeability scale adapted from Byrne (1971). When the partner participants completed their parts, they were thanked, debriefed, and allowed to leave.

After the closeness task and the small-talk task were completed, the focal participant and the experimenter went to the University Hospital to complete the MRI portion of the experiment. Participants completed another more in-depth metal-screening form and performed a practice run where they rated traits in a simulated experiment on a laptop.

After the scanning portion of the experiment, participants were debriefed and given a chance to tell the experimenter how they experienced the scanning and any thoughts or problems they had.

Imaging Protocol

The imaging studies were conducted at the State University of New York on a 3T GE MRI scanner. Our protocol consisted of this series of scans: a) Axial high resolution 3D-SPGR scan: 3.5 ms TE, 10 ms TR, 30 degree Flip Angel, 25.6 cm FOV, 1 mm slice thickness, 0 mm gap, 256 X 256 matrix size, 150 slices; (b) Axial T1 weighed Spin-Echo Scan: 14 ms TE, 600 ms TR, 90 degree flip angle, 24 cm FOV, 4 mm slice thickness, 0 mm gap, 256 X 256 matrix size, 25 slices (the slice locations are the same for all axial scans); (c) T2 weighed Fast-Spin-Echo (FSE) scan: 100 ms TE, 10000 ms TR, 90 degree flip angle, 32 Echo Train Length (ETL), 24 cm FOV, 4 mm slice thickness, 0 mm gap, 256 X 256 matrix size, 30 slices; (d) T1 weighed SPGR scan: 4.5 ms TE, 52 ms TR, 90 degree flip angle, 24 cm FOV, 4 mm slice thickness, 0 mm gap, 256 X 256 matrix size, 30 slices; (e) Functional T2 weighed Gradient-Echo EPI scan: 70 ms TE, 3000 ms TR, 90 degree flip angle, 24 cm FOV, 4 mm slice thickness, 0 mm gap, 64 X 94 matrix size (zero filled into 128 X 128 before FFT and the resulting 128 X 128 images averaged into 64 X 64 before analysis), 30 slices.

Stimuli were presented using a block design. A block design was chosen to have greater statistical power for signal detection (Wager & Nichols, 2003). Blocks were 18 seconds in length. This relatively short block length was chosen to increase task frequency; making the design less susceptible to low-frequency noise such as scanner drift (Skudlarski, Constable, Gore, 1999).There were 3 runs each lasting 7 minutes, for a total of 21 minutes of functional scan time, with a 1-2 minute rest between runs while the next run was set up. Participants viewed 120 stimuli per run. Stimuli were either face only, trait only, or a combination of face and trait. Faces were of self, partner from closeness activity, partner from small-talk activity, and a stranger (a former participant of the same gender and race). The faces were presented from 3 different angles--facing towards the camera and facing left and right. Traits were a mixture of positive, relatively neutral, and negative traits adapted from Anderson (1968). The stimuli lasted for 2.5s followed buy a .5s fixation (See Appendix C for sample trial). Traits were repeated between subjects.

Task

Pictures of participants' faces were taken individually using a Canon s200 digital camera. Each person was instructed to make a neutral face and draw their hair behind their ears if applicable. Pictures of the faces were presented as 8–bit images. The faces were cropped above the top of the forehead, below the shoulders, and slightly outside each ear on the side of the head. All alterations to the picture were performed using Photoshop. The image was presented randomly and alternatively in mirror-reversed fashion. The mirror-reversed picture is one that is less familiar to the participant, which is important in controlling for familiarity of images, in particular the self-image. Furthermore, participants may try to pick a focus-point, such as a small marking or asymmetry on the face, which might make the identification of the person easier and is often used during fMRI studies of faces (Vinette, Gosselin & Schyns, 2004). When identifying such rapidly presented images, it is easier to pick a single point or feature to recognize the face rather than looking at it as a whole. Using mirror-reversed alternating with non-mirror reversed images reduces the likelihood of this shortcut.

The fMRI paradigm consisted of a task where participants made yes or no judgments via a button press regarding individually presented traits adjectives, faces, or faces and traits, across four conditions (Self, Close, Familiar, and Stranger). During the practice run, participants were given instructions that they would see one of three types of stimuli: face only, trait only, or face and trait. For the trials that involved face, they were told that they would see one of four faces either by itself or with a trait beneath the face picture. In the face only condition, their job was to decide if the face was facing them or facing away from them and indicate yes or no via a button press. In the face and trait condition, traits were presented simultaneously with a picture of the person for whom they are rating the traits. The participant's job was to decide whether or not the participant thinks the trait applies to the face above it. In the trait only condition, a trait was presented on the screen with the word "SELF", "PARTNER A", "PARTNER B" or "KIM" above the trait. Participants were told that partner A was their partner from the first activity, partner B was their partner from the second activity, and Kim was the name of the stranger. Each run had three types of stimuli, face only, trait only, and face and trait, for each condition; self, close other, familiar other, and stranger. Each run had 4 conditions (self, close, familiar and stranger) x 3 stimuli type (face, trait, and face and trait combined) and each was repeated once, giving a total of 24 blocks per run. Conditions were counterbalanced across runs as well as subjects. Traits were not repeated with respect to conditions within a participant.

Data Analysis

Functional MRI activation was determined from the blood oxygenation level dependent (BOLD signal) contrast using a whole brain analysis in Statistical Parametric Mapping (SPM2) software (Wellcome Department of Cognitive Neurology, London, UK) (Friston et al., 1995). For each functional run, data were preprocessed to remove sources of noise and artifact. Functional data were realigned within and across runs to correct for head movement and coregistered with each participant's anatomical data. No subjects had more than 2 mm movement. Spatial normalization was applied using the anatomical image and transformed based on the Montreal Neurological Institute (MNI) which approximates Talairach and Tournoux (Talairach & Tournoux, 1988) atlas space. Finally, functional data was spatially smoothed using a Gaussian kernel of 8mm. Technical problems (ghosting of EPI images) led to the loss of data from one subject.

Results

Manipulation check

As a manipulation check to determine if the closeness activity was successful at generating closeness between pairs, a paired sample t-test was performed for IOS Scale scores for closeness to activity partner versus closeness to small talk activity partner. Results indicate that there was a significant difference in IOS Scale in the correct direction, t (9) = -11.00, $p < .001$. The mean IOS Scale score for closeness partner was a 4.90, range =3-6, and the mean IOS Scale score for familiar partner was 1.60, range =1-2.

The fusiform face area (FFA) is a well documented brain region that reliably activates in normal participants when faces are viewed (Kanwisher, McDermott, & Chun, 1997). In order to check the reliability of the data from the MRI scanner, a face minus no face contrast was examined. No significant activation was found for face-viewing in the FFA. Furthermore, there were several significant areas of activation in regions of the brain such as cerebro-spinal fluid and ventricle, which indicated that ghosting proved to be a technical problem in and the MRI results are unreliable. Brain activations are reported below, but cannot be assumed to be accurate given the tremendous technical problems experienced with image quality from the MRI scanner.

Behavioral Results

Behavioral responses for button presses during the MRI scan were recorded for 5 participants (the other 5 participants' behavioral response data were lost from the button box due to various technical difficulties). Reaction times for each condition are reported here (also see table 1). A one-way ANOVA showed no significant differences between reaction times for self, close other familiar other and stranger $F(3)= .33$, $p = .80$. Mean reaction time for viewing close partner is listed in face, face and trait and trait only conditions. For close partner (face), $M = 907$ ms, close partner (face and trait), $M= 990$ ms. Close partner (trait), $M = 922$ ms. For familiar partner, mean reaction times are as follows: Familiar partner (face), $M = 1006$ ms. Familiar partner (face and trait), $M=1090$ ms. Familiar partner (trait), $M = 979$ ms. When viewing self stimuli, mean reaction times are self (face), $M = 1000$ ms. Self (face and trait), $M = 1063$ ms. Self (trait), $M = 890$ ms. For viewing stimuli of the stranger, means are as follows: Stranger (face), $M = 851$ms. Stranger (face and trait), $M = 1198$ ms. Finally, for stranger (trait), $M = 983$ ms. Collapsing across stimuli type of face only, face and trait, and trait only yielded the following results. When making judgments about a close other, $M = 940$ ms. When making judgments about a familiar other, $M = 1025$ ms. When making judgments about the self, $M = 984$ms. When making judgments about a stranger, $M = 1011$ ms.

fMRI Results

Subtraction analysis for 32 contrasts was conducted from a whole brain analysis performed in SPM2. A voxel-level significance cutoff of $p < .001$ and a voxel minimum of $k = 10$ was applied unless otherwise noted. Uncorrected cluster level significance levels are reported below. Analysis was done for eight conditions- self versus close, self versus familiar, self versus stranger, close versus familiar and the opposite contrasts for each condition. Further analysis was done to examine the face only condition, the trait only condition, and the face and trait combined condition (see table 2). When brain activity associated with close conditions was subtracted from that of self conditions, there were significant activations for self in the right middle occipital gyrus (26 -93 12), $p < .005$, (cluster size = 141), left middle occipital gyrus (-32 -89 10), (cluster size = 130) $p < .005$, left inferior temporal gyrus, (-46 -68 -2), $p < .005$, (cluster size = 33), and left inferior frontal gyrus (-57 9 20), $p <.05$, (cluster size = 14). For the comparison of close minus familiar, the extent threshold was changed to k=5, as no clusters were significant at k=10. Activity was found in the right middle frontal gyrus (46 2 42), (cluster size = 5), post-central gyrus (51 -18 23), (cluster size = 5), and precuneus (14 -5 32), (cluster size = 9), all at $p < .05$, (see figure 2). For the self minus stranger condition, activity was found in the right middle frontal gyrus (38 39 11), $p < .05$, (cluster size= 56), the left middle frontal gyrus (-38 34 -12), $p < .001$, (cluster size = 34), and anterior cingulate (16 49 -1), $p < .05$, (cluster size = 11). In the self minus familiar condition, activation was seen in the middle temporal gyrus (-46 -60 1), p < .005, (cluster size = 92), and the middle occipital gyrus (-42 -81 8), $p < .01$, (cluster size =18), (see figure 1). Significant activation was seen during the familiar minus self condition in the cingulate gyrus (-8 -50 28), (cluster size = 249), and superior frontal gyrus (-48 -8 0), (cluster size = 25), both at $p <.01$. In the close minus self condition, activity was found in the precuneus (BA7) (-10 -72 40), (cluster size = 36), and right parietal lobe, sub-gyral (18 -57 22), (cluster size = 34), both at $p < .005$. No significant activity was found in the familiar minus close condition or the stranger minus self condition at $p <.05$.

When examining the face only condition, the self-face minus close-face subtraction led to activity bilaterally in the right middle occipital gyrus (cuneus), (22 -93 10), (cluster size = 61), and left middle occipital gyrus (-28 -83 8), (cluster size = 12), both at $p < .001$, the left inferior frontal gyrus (-48 37 7), $p < .05$, (cluster size = 12), and the left postcentral gyrus (-50 -25 44), $p < .01$, (cluster size = 19). For the self-face minus familiar-face condition activity was seen in the right anterior cingulate (12 46 -4), $p <.01$, (cluster size = 22), left superior occipital gyrus (-26 -64 49), $p < .05$, (cluster size = 18), left occipital lobe, sub-gyral (-46 -57 -6), $p < .001$, (cluster size = 8), left superior occipital gyrus (-26 -64 49), $p < .05$, (cluster size = 18), left superior parietal lobule (-26 -64 49), $p < .05$, (cluster size = 15), and the left inferior frontal gyrus (-46 41 11), $p < .01$, (cluster size =15). For close-face minus familiar-face, there was significant activation in right frontal lobe, sub-gyral (40 18 14), $p < .01$, (cluster size = 20), and the cingulate (10 -14 27), $p < .01$, (cluster size = 10). For familiar-face minus self- face, activity was seen in the anterior cingulate (-8 38 17), $p < .001$, (cluster size = 16). In the self-face minus stranger-face condition, activity was found in the left middle temporal gyrus (-48 -58 0), $p<.001$, (cluster size = 222), insula (-36 6 12), $p < .01$, (cluster size = 33), and cuneus (-24 -78 32), $p < .01$, (cluster size =

28). There were no significant clusters in the close-face minus self-face condition, stranger-face minus self-face or familiar-face minus close-face condition at $p < .001$.

In the trait only condition, the self minus close comparison yielded activity in the left middle frontal gyrus (-44 -69 13), (cluster size = 99), right superior frontal gyrus (2 12 55), (cluster size = 98), right superior temporal gyrus (48 4 -9), (cluster size = 64), and right middle frontal gyrus (48 2 42), (cluster size = 26), all at $p < .005$. For the close minus self condition, activation was found in the right superior frontal gyrus (2 10 60), (cluster size = 98), p < .005 and the right superior temporal gyrus (48 6 -10), (cluster size = 64), $p < .005$. For familiar minus self, activity was seen in the right cingulate gyrus (8 -32 32), (cluster size = 10), $p < .05$. When areas associated with familiar trait were subtracted from areas associated with close trait, activity was found in the paracentral lobule (2 -28 58), (cluster size = 49), and bilaterally in the right and left middle frontal gyrus (34 30 -4 and -46 28 18, respectively), (cluster size = 41 and 45, respectively), $p < .005$. No significant activity was found in the self minus familiar condition, familiar minus self condition, close minus familiar, self minus stranger or stranger minus self condition.

When examining the conditions in which both face and trait were seen, the self minus familiar condition yielded significant activity in the posterior cingulate (-8 -58 14), (cluster size =72), the precuneus (4 -87 10), (cluster size = 46), the left middle frontal gyrus (-32 50 -3), (cluster size = 29), and the right cuneus (4 -87 10), (cluster size = 17), all at $p < .005$. The close minus familiar condition led to activation in the right cingulate gyrus (8 -42 29), (cluster size = 40), the right temporal lobe (36 -67 11), (cluster size = 35), and the right postcentral gyrus at $p <.005$, (cluster size=20). For the self minus stranger condition, activity was significant in the right precentral gyrus (57 0 30), (cluster size = 100), the left middle frontal gyrus (-28 50 -3), (cluster size = 47), and the left insula (-44 -20 18), (cluster size = 30), $p < .005$. Close minus self yielded activity in the right precuneus (16 -57 29), (cluster size = 232), the right precentral gyrus (61 -10 36), (cluster size = 108), the right cingulate gyrus (12 -40 34), (cluster size = 102), and the right medial frontal gyrus (12 46 -8), (cluster size = 60), p < .005. Comparing familiar minus self led to activity in the right frontal lob, sub-gyral (24 -6 20), (cluster size =14), at $p < .01$. No significant results were found at $p < .001$ for close minus self, stranger minus self or familiar minus close.

Discussion

Research on the self has become abundant in recent years, and is often conducted in reference to familiar or close others. Fewer studies have begun to examine how we process information about those familiar and close others. Some behavioral research has shown that intimate-other-reference judgments produce poorer recall than that found with self-reference judgments (Heatherton et al., 2006), while others have found that the self-reference effect is diminished when judgments are made about a close other (Aron & Fraley, 1999; Bower & Gilligan, 1979; Keenan & Baillet, 1980). Studies thus far have not used an experimental method for generating closeness, and therefore familiarity and closeness are confounded.

Data here support a bilateral model of self-processing that primarily involves the left hemisphere but also recruits the right hemisphere as well. Data show that areas of the brain involved in making self-judgments are primarily distinct from areas of the brain involved in processing information about close others.

The primary concern of the present study is to determine the possibility of a neural overlap between self and close other. However, much of the data here is also useful in replicating data on processing self-face stimuli as well as areas of the brain recruited when making trait judgments.

Results from the present study confirm many of the prior findings regarding areas of the brain that process self-face (Uddin, et al. 2005(2)). Studies involving a collosotomy patient showed a right hemisphere advantage from self-face processing (Keenan, Wheeler, Platek, Lardi & Lessonde, 2003). The present data failed to replicate that finding, indicating a bilateral network involved in self-face recognition. In the self-face minus familiar-face condition, activity occurred in the left occipital lobe, anterior cingulate, superior occipital gyrus, superior parietal lobule and inferior frontal gyrus. In the self-face minus stranger-face condition activity was found in the left middle temporal gyrus and left middle occipital gyrus, regions previously found to be associated with visual self-recognition (Devue et al., 2007).

Brain response to self-face, when contrasted with familiar face, invoked activity in the left superior occipital gyrus, right anterior cingulate, inferior frontal gyrus, and superior parietal lobule. Previous studies have found that the right hemisphere is preferentially accessed when identifying self-face (Keenan et al., 2001). One study found that the hemisphere involved is dependant on the type of face-task used (Sugiura et al., 2000). When comparing activity for familiar-face minus self-face activation was found only in the anterior cingulate gyrus, which supports previous finding (Platek et al., 2005). Platek et al. (2005) used fMRI to examine the neural correlates of self face and familiar face. Participants made judgments about their self face as well as a familiar other, in this case a fraternity brother. When the researchers compared familiar-face minus self face and only found activity in the anterior cingulate gyrus.

Relative to familiar-other judgments, close other judgments activated regions in the right parietal lobule, middle frontal gyrus and the precuneus. Each of these regions has been previously found to be associated with various aspects of self-referential processing (Northoff & Bermpohl, 2005). In a recent meta-analysis, activity in the precuneus was found to be associated with the neural correlates of self-consciousness, engaged in self-related mental representations during rest (Cavanna & Trible, 2006). TMS disruption to the right parietal lobule was found to disrupt the ability to discriminate between self and other, indicating that this brain region is involved in identifying self versus other (Uddin et al., 2006)

For trait ratings, the self minus close condition yielded activation in the right superior frontal and middle frontal gyrus, left and left superior temporal gyrus and middle temporal gyrus. Previous fMRI studies using trait adjective judgments as stimuli have found activity related to self-relevant and other-relevant judgments in the left inferior frontal cortex and anterior cingulate (Kelley, 2002). More specifically, self-relevant judgments engaged the medial prefrontal cortex.

Results of the present study indicate for the most part, separate regions are used to process information about self and close others. This result is consistent with previous studies using subjects from Western cultures that found no neural overlap between self and close other (Heatherton et al., 2006). However, results also suggest that a few of the brain regions involved in processing information about the self may also be employed during processing information about a close other, in agreement with researchers such as Zhu et al. (2007). In comparison to familiar, self and close other both employ the cingulate gyrus. Furthermore, several of the brain regions found to be traditionally involved in making self-relevant decisions were also activated when making close-other-relevant decisions, such as the middle frontal gyrus and the precuneus.

It is possible that there are more areas in the brain that overlap between self and close others, but the conditions of the present experiment did not allow for them to be shown. One of the greatest limitations in this study is that the data from the MRI scanner is not reliable, as shown by the FFA test, indicating that the areas where activity is shown may indeed not be accurate. Furthermore, data from 9 subjects is not sufficient to draw accurate conclusions. Another limitation is the level of closeness that was achieved between participants during the closeness activity. While several participants reported being extremely close to the close partner on the IOS scale, it is possible this was subject to a desirability effect, or that participants were afraid their partner would see the result (even though participants were told that results would be kept confidential).

Furthermore, it is important to note that the close other in the present experiment was someone whom the participant had just met. While the manipulation seemed to have worked and most participants reported feeling close with their partners, there is the possibility that different neuronal responses would be found had the close other been someone with whom the subject was more close with, such as a mother, best friend, spouse or long term partner. Further research on such types of partners is essential in exploring the possibility of a neural overlap between self and close other.

Reaction time results, although only from a small sample of 5 participants, do show the general trend of self and close judgments being processed more quickly than stranger and familiar judgments. This is consistent with previous studies finding an advantage for self-processing and the self reference effect (Symons & Johnson, 1997). It is also consistent with previous studies indicating that the self-reference effect is reduced when judgments are made about a person with whom the participant is close (Bower & Gilligan, 1979; Keenan & Baillet, 1980). In order to explore this trend further, data from more participants is required.

Ideal experimental conditions would also dictate that participants proceed directly from the conversational activities to the MRI task with minimal time in between. The closeness activity does not lead to long-term closeness and is most powerful immediately following the activity. Due to limited use of the MRI scanner, participants often had to wait 1-2 hours between the activities. Furthermore, the waiting was done in a hospital waiting room with lots of commotion and a television on. It is possible that all the environmental cues and busy atmosphere of the hospital waiting room diminished the feeling of closeness towards the partner. One potential remedy for this is to conduct the activity in a quiet room near the MRI and to ask participants to complete the Inclusion of Other in the self scale after the experiment is finished as well.

Additionally, 4 runs lasting 7 minutes long were planned for this experiment. Due to the nature and limited access to the MRI scanner, most subject were only able to complete 3 runs lasting 7 minutes, and 2 subjects were able to only complete 2 runs.

There was a variety of levels of closeness achieved through the closeness-generating activity. Pre-screening subjects for tendency to achieve closeness and desire for intimacy would be useful in order to assure that maximum closeness was achieved.

Several studies in the field of cognitive and social psychology have examined the overlap of self and other. This is one of the first studies to examine the potential neural overlap between self and close other and to examine familiarity separately than closeness by using a method of experimentally generated closeness and thus controlling for self-selection of close others. Studies that have found a neural overlap between self and close other (Zhang, 2006; Zhu, 2007) have found evidence of this using mother as a close other. It is likely not possible to experimentally generate the closeness between a mother and child. Therefore, it would be useful to examine other types of close relationships amongst East Asians to see if the neural overlap is replicated with different types of close relationships and levels of closeness. Future studies could explore this issue by using experimentally generated closeness as well as looking at participants from Eastern and Western cultures.

Furthermore, it is essential that the clinical applications of which brain regions are involved in processing information about those we feel close to are further explored. Several of the brain regions involved in processing information about others also applies to theory of mind and being able to think about how another feels. Researchers have found that people with autism process stimuli differently than those without autism, such as processing face stimuli outside the Fusiform Face Area (Pierce et al., 2001). When more is known about the specific brain regions involved in processing information about a close other, scientists can begin to understand the potential brain regions that perhaps aren't functioning properly in patients with Autism and other disorders involving difficulty becoming close to others.

Examining the brain regions involved in processing information about close others and separating that from familiar others is essential to understanding theory of mind, empathy and close relationships. Additionally, it is evident that a cultural difference may be in effect in how we process information about others and close others. This difference could help enlighten theories on nature versus nurture as well and how culture and social relationships shape brain responses.

Table 1. Behavioral Responses during fMRI (Reaction Times in milliseconds)

	Face	Face and Trait	Trait
Self	1000	1063	890
Close	907	990	922
Familiar	1006	1090	979
Stranger	851	1198	938

Table 2. Brain Activations for subtraction analysis

Condition/Regions	L/R	Talairach Coordinates x	y	z	*T*-value	Cluster size (mm3)
Self minus Stranger						
Middle Frontal Gyrus	R	46	-52	0	5.57	56
Middle Frontal Gyrus	L	-38	34	-12	4.61	34
Anterior Cingulate	R	16	49	-1	4.03	11
Close minus Familiar						
Precuneus	R	14	-53	32	5.47	9
Middle Frontal Gyrus	R	46	2	42	7.47	5
Postcentral Gyrus	R	51	-18	23	6.56	5
Self minus Familiar						
Middle Temporal Gyrus	L	-46	-60	1	7.67	92
Middle Occipital Gyrus	L	-42	-81	8	7.36	18
Self minus Close						
Middle Occipital Gyrus	R	26	-93	12	11.29	141
Middle Occipital Gyrus	L	-32	-89	10	5.67	130
Inferior Temporal Gyrus	L	-46	-68	-2	7.96	33
Inferior Frontal Gyrus	L	-57	9	20	6.75	14
Familiar-Self						
Cingulate Gyrus	L	-8	-50	28	8.47	249
Superior Frontal Gyrus	L	-8	-56	23	5.37	25
Close-Self						
Precuneus	L	-10	-72	40	9.41	36
Parietal Lobe, sub-gyral	R	18	-57	22	7.28	34
Face Only						
Self-Close						
Cuneus	R	22	-93	19	11.61	61
Postcentral Gyrus	L	-50	-25	44	6.81	19
Middle Occipital Gyrus	L	-38	-83	8	8.04	12
Inferior Frontal Gyrus	L	-48	37	7	7.28	12
Self minus Familiar						89
Occipital Lobe sub-gyral	L	-46	-57	-6	7.13	
Anterior Cingulate	R	12	46	-4	5.99	22
Superior Occipital Gyrus	L	-32	-84	26	6.70	18
Superior Parietal Lobule	L	-26	-64	49	5.89	15
Inferior Frontal Gyrus	L	-46	41	11	5.47	15

Close minus Familiar						
Frontal Lobe, sub-gyral	R	40	18	16	6.86	20
Cingulate	R	10	-14	27	5.45	10
Familiar minus Self						
Anterior Cingulate	L	-8	38	17	5.61	16
Self-Stranger						
Middle Temporal Gyrus	L	-48	-58	0	9.65	222
Insula	L	-36	6	12	6.88	33
Cuneus	L	-24	-78	32	3.71	28
Trait Only						
Self-Close						
Middle Temporal Gyrus	L	-44	-69	13	8.30	99
Superior Frontal Gyrus	R	2	12	55	10.74	98
Superior Temporal Gyrus	R	48	5	-9	9.04	64
Middle Frontal Gyrus	R	48	2	42	8.42	26
Close-Self						
Superior Frontal Gyrus	R	2	10	60	8.42	98
Superior Temporal Gyrus	R	48	6	-10	8.30	64
Familiar-Self						
Cingulate Gyrus	R	8	-32	32	7.83	10
Close-Familiar						
Paracentral Lobule	R	2	-28	58	7.40	49
Middle Frontal Gyrus	L	-46	28	18	7.81	45
Middle Frontal Gyrus	R	34	30	-4	7.37	41
Face and Trait						
Self-Familiar						
Posterior Cingulate	L	-8	-58	14	8.04	72
Precuneus	L	-6	-60	36	5.56	46
Middle Frontal Gyrus	L	-32	50	-3	11/29	29
Cuneus	R	4	-87	10	5.81	17
Close-Familiar						
Cingulate Gyrus	R	8	-42	28	7.72	40
Temporal Lobe	R	36	-67	11	8.12	35
Postcentral Gyrus	R	55	-24	20	4.32	20
Self minus Stranger						
Precentral Gyrus	R	57	0	30	8.86	100
Middle Frontal Gyrus	L	-28	50	-3	8.19	47
Insula	L	-44	-20	18	7.52	30

Close minus Self						
Precuneus	R	16	-57	29	9.10	232
Precentral Gyrus	R	61	-10	36	4.72	108
Cingulate Gyrus	R	12	-40	34	7.02	102
Medial Frontal Gyrus	R	12	46	-8	5.48	60
Familiar minus Self						
Frontal Lobe, sub-gyral	R	24	-6	30	8.16	14

Activations significant at $p<.001$. L=Left Hemisphere, R=Right Hemisphere, BA=Approximate Brodmann's Area, T= t-value for peak voxel, Coordinates are from the Talairach and Tournoux (1998) atlas.

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Appendix A: Closeness Task

INSTRUCTIONS (Please both read carefully before continuing)

This is a study of interpersonal closeness, and your task, which we think will be quite enjoyable, is simply to get close to your partner. We believe that the best way for you to get close to your partner is for you to share with them and for them to share with you. Of course, when we advise you about getting close to your partner, we are giving advice regarding your behavior in this demonstration only, we are not advising you about your behavior outside of this demonstration.

In order to help you get close we've arranged for the two of you to engage in a kind of sharing game. You're sharing time will be for about one hour, after which time we ask you to fill out a questionnaire concerning your experience of getting close to your partner.

You have been given three sets of slips. Each slip has a question or a task written on it. As soon as you both finish reading these instructions, you should begin with the Set I slips. One of you should read aloud the first slip and then BOTH do what it asks, starting with the person who read the slip aloud. When you are both done, go on to the second slip--one of you reading it aloud and both doing what it asks. And so forth.

As you go through the slips, one at a time, please don't skip any slips--do each in order. If it asks you a question, share your answer with your partner. Then let him or her share their answer to the same question with you. If it is a task, do it first, then let your partner do it. Alternate who reads aloud (and thus goes first) with each new slip.

You will be informed when to move on to the next set of slips. It is not important to finish all the slips in each set within the time allotted. Take plenty of time with each slip, doing what it asks thoroughly and thoughtfully.

You may begin! Turn to Set I slip 1.

Task Slips for Closeness-Generating Procedure

Set I

1. Given the choice of anyone in the world, whom would you want as a dinner guest?

2. Would you like to be famous? In what way?

3. Before making a telephone call, do you ever rehearse what you are going to say? Why?

4. What would constitute a "perfect" day for you?

5. When did you last sing to yourself? To someone else?

6. If you were able to live to the age of 90 and retain either the mind or body of a 30-year-old for the last 60 years of your life, which would you want?

7. Do you have a secret hunch about how you will die?

8. Name three things you and your partner appear to have in common.

9. For what in your life do you feel most grateful?

10. If you could change anything about the way you were raised, what would it be?

11. Take 4 minutes and tell your partner your life story in as much detail as possible.

12. If you could wake up tomorrow having gained any one quality or ability, what would it be?

Set II

13. If a crystal ball could tell you the truth about yourself, your life, the future, or anything else, what would you want to know?

14. Is there something that you've dreamed of doing for a long time? Why haven't you done it?

15. What is the greatest accomplishment of your life?

16. What do you value most in a friendship?

17. What is your most treasured memory?

18. What is your most terrible memory?

19. If you knew that in one year you would die suddenly, would you change anything about the way you are now living? Why?

20. What does friendship mean to you?

21. What roles do love and affection play in your life?

22. Alternate sharing something you consider a positive characteristic of your partner. Share a total of 5 items.

23. How close and warm is your family? Do you feel your childhood was happier than most other people's?

24. How do you feel about your relationship with your mother?

Set III

25. Make 3 true "we" statements each. For instance "We are both in this room feeling. . ."

26. Complete this sentence: "I wish I had someone with whom I could share. . . "

27. If you were going to become a close friend with your partner, please share what would be important for him or her to know.

28. Tell your partner what you like about them; be very honest this time saying things that you might not say to someone you've just met.

29. Share with your partner an embarrassing moment in your life.

30. When did you last cry in front of another person? By yourself?

31. Tell your partner something that you like about them already.

32. What, if anything, is too serious to be joked about?

33. If you were to die this evening with no opportunity to communicate with anyone, what would you most regret not having told someone? Why haven't you told them yet?

34. Your house, containing everything you own, catches fire. After saving your loved ones and pets, you have time to safely make a final dash to save any one item. What would it be? Why?

35. Have you made friends since coming to college, and have there been any difficulties finding people you get along with?

36. Where would you go for your dream vacation?

37. If you won a million dollars, what would you do with the money?

38. Of all the people in your family, whose death would you find most disturbing? Why?

39. Do you believe in “the one” or feel that there are many possible partners for each of us.

40. Share a personal problem and ask your partner's advice on how he or she might handle it. Also, ask your partner to reflect back to you how you seem to be feeling about the problem you have chosen.

41. Was your family religious when you were growing up? What was the best/worst thing about that?

42. What is your favorite thing about being in a romantic relationship (if you have been in one), and your favorite thing about being single?

Appendix B: Small Talk Task

Instructions: Take turns asking and giving directions to your partner.

Part 1

You are at the Student Activities Center. You just had lunch, but now it is time for class in the Union auditorium. How do you get to the Union? And where is the auditorium. Ask a stranger for help.
(Remember to switch roles!)

You have just walked out of the Humanities building. After a cup of coffee in the café there, you’re ready for class in Harriman Hall, but you don’t know how to get there. Where is Harriman Hall? Ask a stranger for help.

You aren’t feeling very well. You would like go to the Student Health Center/Infirmary. You are on the third floor of the Main Library. How do you get to the Health Center? Ask a stranger for help.

You just got our class in the Javits Lecture Center. Now you need to go to the library to do some research on a paper. How do you get to the library from Javits? Ask a stranger for help.

You have to go pick up your loan check in the Administration building. You have just finished your workout at the Sports Complex. How do you get to Administration from there? Ask a stranger for help.

You want to go buy books for your classes. You are coming from the Social & Behavioral sciences (SBS) Building. How do you get from there to the on-campus bookstore? Ask a stranger for help.

Now, please answer the following questions.

1. Was your partner good at giving directions?

2. Which scenario was easiest for you?

3. Which scenario was hardest for you?

Part 2

In this task, you and the partner you will participate in a geography game. Please read the following instructions before beginning.

1. Decide who goes first. That person begins by saying the name of a city, state, country or province. For example: Boston.
2. The second person response with the name of a city, state, country or province that begins with the last letter of Boston(N), for example, Nigeria.
3. The object of this task is to continue naming as many cities, states, countries or provinces as possible, using the last letter of the name “handed off” to you.
4. You cannot use the same place more than once.
5. Try to keep the “chain” going as long as possible. Keep track of the name of the location that ended the chain and record it at the bottom of this form (so both partners will be recording the same name).
6. If you reach a stopping point, start the relay again. Continue until you have completed four relates all the way to the stopping point.

Record the names of the locations that ended each chain.

Relay 1:

Relay 2:

Relay 3:

Relay 4:

Part 3

In this task, you and your partner will take turns reading passages from a book. Decide who is Reader #1 and Reader #2, then out loud the respective paragraphs.

Reader #1

In 1898 a psychologist named Triplett made an interesting observation. In looking over speed records of bicycle racers, he noticed that better speed records were obtained when cyclists raced against each other than when they raced against the clock. This observation led Triplett to perform the first controlled laboratory experiment ever conducted in social psychology. He instructed children to turn a wheel as fast as possible for a certain period of time. Sometimes two children worked at the same time in the same room, each with his own wheel; at other times, they worked alone. The results confirmed his theory: Children worked faster in coaction, that is, when another child doing the same thing was present, than when they worked alone.

Reader #2

He hadn't been happy with his wife, but he'd pretty much gotten used to her. When she died, he had been very lonely. So he asked a shop buddy for a dog and he'd gotten this one very young. He had to feed it from a bottle. But since a dog doesn't live as long as a man, they ended up being old together. "He was bad-tempered," Hodge s said. We'd have a run-in every now and then. But he was a good dog just the same." I said he was well bred and Hodges looked pleased "And," he added," you didn't know him before he got sick. His coat was the best thing about him." Every night and every morning after the dog had gotten that skin disease, Hodges rubbed him with ointment.

Reader #1

He wanted to know if I had hired an attorney. I admitted I hadn't and inquired whether it was really necessary to have one. "Why do you ask?" he said. I thought my case was pretty simple. He smiled and said "That's your opinion. But the law is the law. If you don't hire an attorney yourself, the court will appoint one." I thought it was very convenient that the court should take care of those details. I told him so. He agreed with me and concluded that it was a good law.

Reader #2

There were the cigarettes, too. When I entered prison, they took away my belt, my shoelaces, my tie, and everything I had in my pockets. My cigarettes in particular. One I was in my cell, I asked to have them back. But I was told I wasn't allowed. The first few days were really rough. That may be the thing that was hardest for me. I would suck on chips of wood that I broke off my bed planks. I walked around nauseated all day long. I couldn't understand why they had taken them away when they didn't hurt anybody. Later on I realized that that too was part of the punishment. But by then I had gotten used to not smoking and it wasn't a punishment anymore.

Reader #1

It is a thing well known to both American and English whale-ships, and as well a thing placed upon authoritative record years ago by Scoresby, that some whales have been captured far north in the Pacific, in whose bodies have been found the barbs of harpoons darted in the Greenland seas. Nor is it to be gainsaid, that in some of these instances it has been declared that the interval of time between the two assaults could not have exceeded very many days. Hence, by inference, it has been believed by some whalemen, that the Nor' West Passage, so long a problem to man, was never a problem to the whale. So that here, in the real living experience of living men, the prodigies related in old times of the inland Strello mountain in Portugal (near whose top there was said to be a lake in which the wrecks of ships floated up to the surface); and that still more wonderful story of the Arethusa fountain near Syracuse (whose waters were believed to have come from the Holy Land by an underground passage); these fabulous narrations are almost fully equaled by the realities of the whalemen.

Reader #2

By now Betsy had circled around to my desk and was trying to peer over my shoulder at the magazine in my lap, and Gabby, my evil coworker, was looking out way, her beady brown eyes squinting for signs of trouble, thick fingers poised over her keyboard so that she could instantly e-mail the bad news to her pals. I slammed the magazine closed. I took a successful deep breath, and waved Betsy back to her seat. I flipped to the front, where Contributors were listed in thumbnail profiles beneath arty black –and-white head shots. And there was Bruce, with his shoulder-length hair blowing in what was assuredly artificial wind. He looked, I thought uncharitably, like Yanni.

Reader #1

The Halloween feast was always good, but it would taste a lot better if he was coming to it after a day in Hogsmeade with everyone else. Nothing anyone said made him feel any better about being left behind. Dean Thomas, who was good with a quill, had offered to forge Uncle Vernon's signature on the form, but as Harry had already told Professor McGonagall he hadn't had it signed, that was no good. Ron halfheartedly suggested the Invisibility Cloak, but Hermione stamped on that one, reminding Rob what Dumbledore had told them about the dementors being able to see through them. Percy had what were possible the least helpful words of comfort.

Reader #2

I began to wander around the estate as the Baron had asked, past the cherry trees heavy with their blossoms, bowing here and there to the guests and trying not to seem too obvious about looking around for the Chairman. I made little headway, because he would have someone snap a picture of us standing together, or else walk me along the lake to the little moon-viewing pavilion, or wherever, so his friends could have a look at me-just as he might have done with some prehistoric creature he'd captured in a net.

Reader # 1

Back when I was a little girl of five or six, and had never so much as thought about Kyoto once in all my life, I knew a little boy named Noburu in our village. I'm sure he was a nice boy, but he had a very unpleasant smell, and I think that's why he was so unpopular. Whenever he spoke, all the other children paid him no more attention than if a bird had chirped or a frog had croaked, and poor Noburu often sat right down on the ground and cried. In the months after my failed escape, I came to understand just what life must have been like for him, because no one spoke to me at all unless it was to give me an order.

Appendix C. Post Activity-Questionnaire (Byrne Judgment Scale and Inclusion of Other in the Self Scale)

Please carefully read and answer the following questions. We assure you that your partner will never see your responses, and that your answers will be completely confidential.

For each question, choose the point on the line that best describes your opinion, from 1 to 7.
(1 = not at all, 7 = very much).

1) How much would you like to work with your partner again on a project?

Not at All 1 2 3 4 5 6 7
Extremely

2) How much do you like your partner?

Not at All 1 2 3 4 5 6 7
Extremely

3) Relative to all your other relationships, both same and opposite sex, how would you characterize your relationship with your partner?

Not at All Close 1 2 3 4 5 6 7
Extremely Close

4) Relative to what you know about other people's close relationships, how would you characterize your relationship with your partner?

Not at All Close 1 2 3 4 5 6 7
Extremely Close

5) How comfortable were you interacting with your partner during the activity?

Not at All 1 2 3 4 5 6 7
Extremely

6) How tense or anxious were you interacting with your partner during the activity?

Not at All 1 2 3 4 5 6 7 Extremely

7) How much did you enjoy participating in this activity?

Not at All 1 2 3 4 5 6 7 Extremely

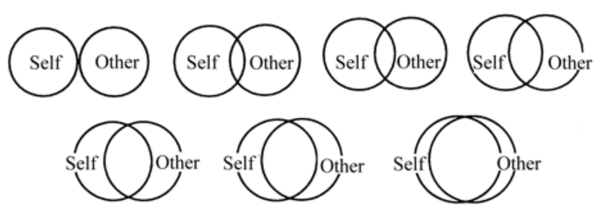
8) What were today are activities? ____

9) What did you like about them?____

10) What did you dislike about them?____

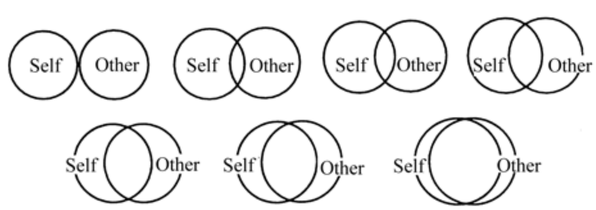
11) Please circle the picture below that best describes your current relationship with your partner.

Self = you
Other = your part



12) Please circle the picture below that best describes HOW YOU WISH your relationship with your partner would have been at the end of the experiment.

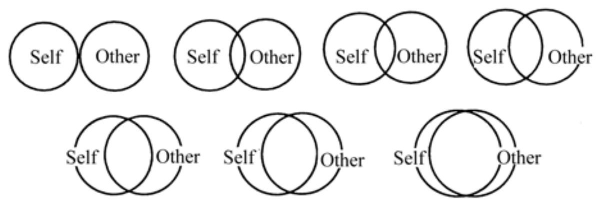
Self = you
Other = your partner



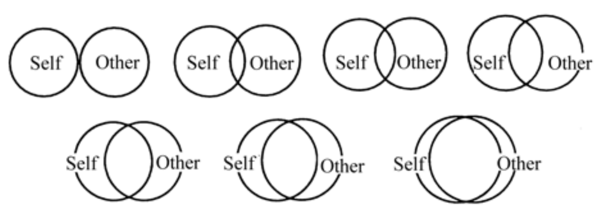
Please answer the following questions as if YOU WERE YOUR PARTNER. That is, please answer the same two final questions, only please tell me what you think he/she would have said.

13) Please circle the picture below that best describes your current relationship with your partner.

For this statement, my partner would say…



14) Please circle the picture below that best describes HOW YOU WISH your relationship with your partner would have been at the end of the experiment.



For this statement, my partner would say…

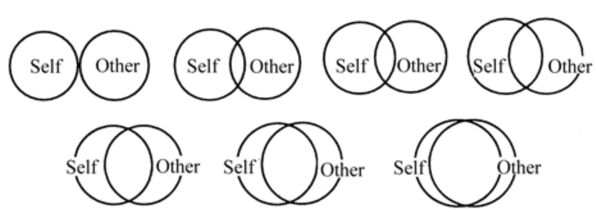
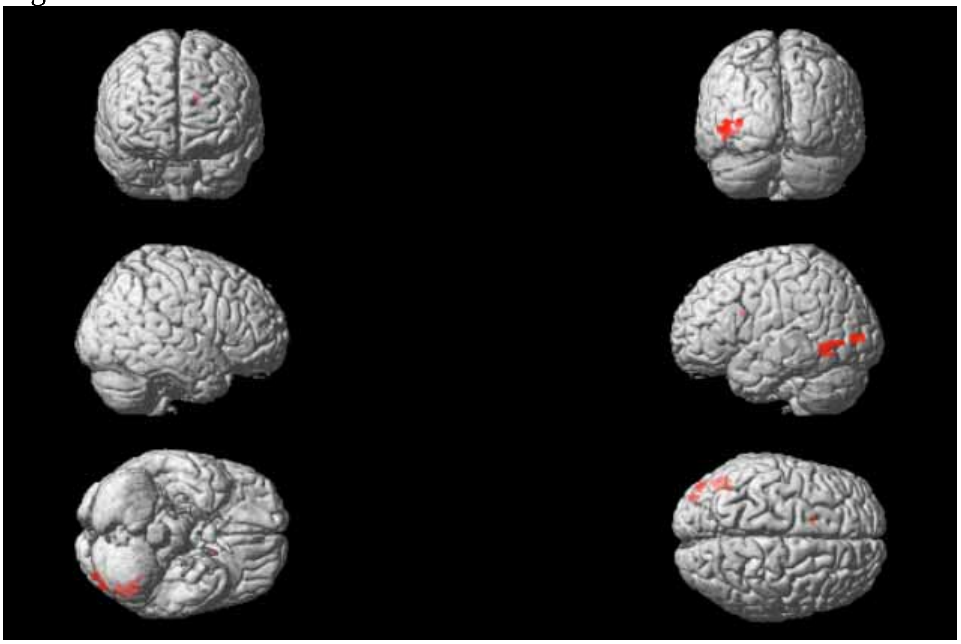
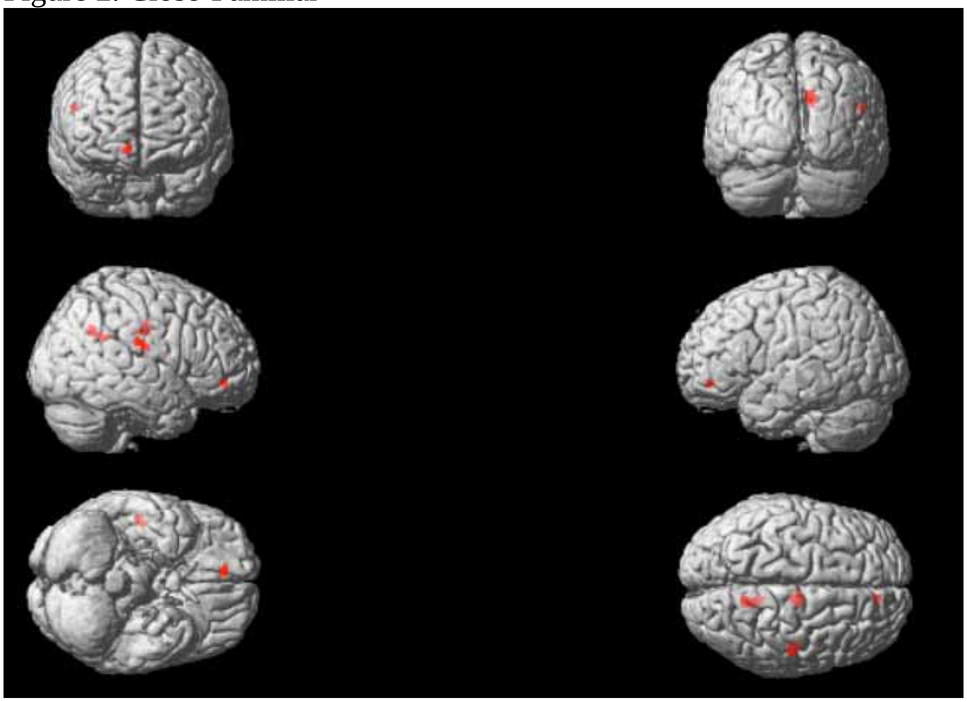


Figure 1. Self-Familiar



Activations in Middle Temporal Gyrus (BA 37) Left Middle Occipital Gyrus

Figure 2. Close-Familiar



Activations in the Right Middle Frontal Gyrus, Right Postcentral Gyrus, Right Precuneus