The current stance that the right hemisphere (in particular, right fronto-parietal structures) may mediate self-awareness and other higher-order meta-representations was recently postulated by us in a recent issue of *Cortex* (Keenan et al., 2005). The idea that the self can be localized at all is a controversial hypothesis (e.g., Dennett, 1992; Gillihan and Farah, 2005), and as such, deserves further attention. The questions raised by Alain Morin are in fact no different than those we have raised ourselves, and we are grateful for the opportunity to further elucidate why a growing number of researchers would suggest a right hemisphere dominance for the self.

As this journal is focused on neuroscience, we will limit the main ideas as they relate directly to the brain, rather than solely on behavior. If readers wish to further examine behavioral data, there are a number of resources where full discussions of self-face recognition and other issues of self-awareness are presented (Keenan et al., 2003; de Veer et al., 2003; Ferrari and Sternberg, 1998). However, an ancillary update of behavioral data is worth noting as it will set the stage for the direct examinations of the brain and the self. Three final caveats must be put in place prior to proceeding, one is the reference to the previous review published in this journal that we hope not to repeat unless absolutely necessary (Keenan et al., 2005). The second is that space requirements will focus us on the self, in particular, the self-face. A debate on Theory of Mind (ToM) is not possible in this space, though we will briefly mention a number of studies involving causality. We will also not review the evidence on medial prefrontal or medial parietal regions activated for self tasks (Mitchell et al., 2005). These data are reviewed elsewhere (Ochsner et al., 2005), and as such, will not be examined here, though they will be commented on.

**THE SELF AND EXPERIMENTATION**

One is wise to note that the study, definition, or elucidation of self-awareness or any other higher-order cognitive ability is vastly complicated. Based upon this notion, one would be equally wise to employ multiple approaches to such study from an experimental perspective. Simply, we must move from correlation to causation, be it at the level of brain, behavior or both. When doing so, one will realize, as the critic potentially suggests by giving us such a provocative title, that it is the brain, rather than the researcher, that is selective in terms of the self.

Importantly, the author of the previous critique placed claims that there is a lack of causal evidence linking the right hemisphere to self-awareness. Ironically, he claims the need for non-correlational data, while basing his own arguments for a possible left hemisphere advantage relying on correlational techniques. This is an error that likely did not pass the critical readers of this esteemed journal. Such readers would claim, and rightly so, that functional imaging (e.g., fMRI) is generally thought of as a correlational technique. As many of us teach our students, an area ‘lighting up’ in the scanner merely establishes a correlation between the brain and the behavior of interest (Keenan, 2001). Thus, while clearly asking to move beyond correlation, the author has built the crux of his argument on correlation. Regardless, we take this as a chance to demonstrate further the causal link between self-awareness and the brain.

The self-face is a robust (Tong and Nakayama, 1999) and unique stimulus (Bredart et al., 2006) that clearly correlates with self-awareness (Platek and Gallup, 2002). Behavioral studies not only demonstrate that there is a link between the self-face and self-awareness (Platek et al., 2003a; Platek and Gallup, 2002; Platek et al., 2003b), but that such a link is behaviorally correlated with the right hemisphere (Platek et al., 2003b; Keenan et al., 1999, 2000a, 2000b; Platek et al., 2004).

However, if one is not satisfied by the correlational evidence that self-face recognition is related to self-awareness (Lewis et al., 1989), certainly experimental manipulation of the self-face would further the idea that there is a relationship between these factors. In fact, such studies have been performed in which the self-face is manipulated and subsequent self-related abilities are measured. For example, Buckle (1997) varied self-face exposure to determine if such experience would increase other self-related abilities such as
episodic retrieval. She found that increased self-face exposure influenced self-related, but not other related memories. We have also found a direct relation between self-face exposure and deception detection abilities, such that increased exposure to the self-face increases deception detection (Barnacz et al., 2005).

One may also examine the manipulation of mirror exposure in monkeys. No amount of mirror-exposure results in self-recognition (Gallup, 1977). Even after 2,400 hours of exposure, monkeys continue to treat their own reflected images as if they are con-specifics. This finding is particularly peculiar as 1) monkeys can recognize con-specific faces, 2) monkeys can use mirrors appropriately to retrieve rewards, and 3) monkeys can identify marks on their own body without the mirror. Thus, if self-face recognition was as simple as understanding that the body is an entity, as suggested, mirror exposure or training should result in mirror self-recognition. However, this null result provides evidence that there is more to passing the self-recognition test than body awareness (Gallup et al., 2003).

Thus, even at a behavioral level, causality has been established such that manipulation of the self-face influences self-awareness. We mention these, and the following behavioral studies as they are of interest to neuroscientists. First, language is not a precursor for self-awareness. We have found that even in Asperger’s disorder, children with normal verbal language abilities and even bilingual children can fail the mirror-test while children with no verbal language abilities can pass the test (Christiana et al., under review). That is, verbal language is neither necessary nor sufficient to create or maintain self-awareness. This result is not surprising as Asperger’s patients are found to be highly similar to individuals with non-verbal learning disorder and that the underlying cortical abnormality appears to be mediated via the right hemisphere (Gunter et al., 2002).

Second, self-face recognition is something that is, to put simply, ‘special’. While animals can be ‘trained’ to pass the mirror-test, an account of spontaneous recognition in an animal other than the primates or dolphins has failed. Interestingly, Asian elephants were recently found to pass the mirror test (Plotnik et al., 2006). Still, no monkey has passed the test despite all attempts to do so (Gallup and Suarez, 1991). Though beyond the scope of this review, this should interest those who investigate mirror-neurons (e.g., Rizzolatti and Craighero, 2004). As this system is identified in monkeys, an animal lacking in self-awareness, we know that mirror-neurons themselves are not responsible for self-awareness, at least as initially identified. However, they may contribute to self-awareness processes when combined with right hemispheric structures, as speculated by a number of researchers (Uddin et al., 2005a, 2007).

THE SELF-FACE AND THE RIGHT HEMISPHERE: SPLIT-BRAIN

Before moving to studies that may demonstrate a causal role between the right hemisphere and the self, we must ask why there may be conflicting reports as suspected by the uninformed reader. While the evidence is clearly supportive for a right hemisphere dominance for self, there are still suggestions that the left hemisphere may be dominant. The most often cited study of left hemisphere activation for the self has become the study performed by the Dartmouth group (Turk et al., 2002). The other, and possibly only other line of evidence comes from Kircher et al. (2000, 2001, 2002).

While we will deal with the Turk study momentarily, we should provide a note on the studies of Kircher. As has been noted previously, if one reanalyzes the data of Kircher (2001) which are often thought to suggest left hemisphere activation, one will find that there is actually greater right hemisphere activation (Keenan et al., 2003). Further, the controls have since been found to be less than ideal (see below), and as such, some suspect that the activations are more reflective of the controls used than the variable of interest.

The Turk (2002) study is taken as evidence of left hemisphere dominance. However, a number of other recent split-brain studies have failed to demonstrate anything of the sort and it is worth momentarily examining other studies using split-brain studies to determine what might be occurring. A recent study was published which is sometimes taken as evidence of no hemispheric dominance (Uddin et al., 2005b). However, this is likely not the case. I (JPK) have argued with the authors personally and now publicly that the signal detection method employed was inappropriate. On a number of occasions, the authors and I debated over this, and despite my affinity for them professionally and personally, I remain unconvinced with their conclusions. The essence of the debate hinges on the notion that a 50/50 (self/other) morph is a reasonable set-point for signal detection. Having such a point would conflict studies which find a ‘self’ effect (Keenan et al., 2000a, 2000b). In other words, most people see their own face in morphs beyond the 50% morph level, and labeling such activity as erroneous, is not reasonable.

Second, recent studies have found that not only self-faces (Keenan et al., 2003a, 2003b), but self-voices (Rosa et al., under review), are identified more successfully via the right hemisphere in callosotomy patients. These findings are consistent with those of Preilowski (1977) who performed the first, and perhaps, the most elegant of the split-brain experiments. Briefly, he found that while both hemispheres can self-recognize, the right hemisphere appears to have the more appropriate
and more accurate representation of the self. In this study, presentation of the self-face to the right hemisphere resulted in greater physiological response than either a) presentation of self-faces to the left-hemisphere, or b) the presentation of familiar faces. We have found similar results using WADA. Subjectively, we observed that while there is recognition with both hemispheres, responses remain normal during left hemisphere but not following right hemisphere anesthesia.

In terms of these findings, Sugiura et al. (2005) provide a reconciliatory account of the Turk et al. findings by suggesting that their test was in fact sensitive to familiar face recognition differences. As such, the study by Turk et al., (2002) is the only study demonstrating a left-hemisphere bias in terms of self-face recognition, and a number of subsequent studies have failed to replicate it (Keenan et al., 2003a; Uddin et al., 2005). As any neuroscientist is aware, it is possible that there was not a complete disconnection of the cerebral hemispheres in any of these patients, as is the case with any study of this sort (e.g., callosotomy). These are, after all, “dysfunctional” brains and as such, we have always used caution in interpreting data from these populations as there is also heterogeneity between these samples. Thus, the discrepancy between the findings may be attributed to pre-surgical condition, the nature of the surgery, post-operative response, a difference in testing methods, or perhaps an interaction between these variables. We therefore must examine additional evidence to convince the skeptical reader.

THE SELF-FACE AND THE RIGHT HEMISPHERE: fMRI

Another basic functional imaging principle is the importance of the control condition. Simply, one can only determine using fMRI the nature of the activation compared to a control condition. We spent years developing controls for the self-face, and in fact, some interesting findings came out of such work (Keenan et al., 1999, 2000a, 2000b). We found, for example, that opposite sex pairings were often confounded by the effect of gender such that the gender effect was larger than the self-effect. This, as it turns out, would readily explain some of the findings in the literature, such as those by Kircher et al. (2001) in which opposite partners were used as contrasts. Kircher’s study also used a relatively low subject number (N = 6) and confounded hand response which clearly influences brain functioning in terms of self (Platek et al., 2003).

This being stated, a complete update of the most recent fMRI studies on self-face recognition clearly establish that networks of the right hemisphere are correlated with self-recognition. Sugiura et al. (2005) found that the right TPO (temporal-parietal-occipital) junction, the right frontal region and left fusiform gyrus were selectively activated for self-faces. The authors speculated that the left fusiform activation (also seen in other studies) is likely related to differences in lexical processing (e.g., naming the face in question). They note appropriately the consistency of the right hemisphere activations with previous research, with some interesting speculations between the self and a motoric system.

Similar activations were noted with a recent study performed by Platek et al. (2006). In this study, the self-face was contrasted with a series of familiar controls. Significant activations varied based on the control conditions (e.g., familiar or unfamiliar faces). In the critical self-familiar contrast, regions of both right and left hemisphere were found active, in areas similar to those of Sugiura (2005). Amazingly, there were 2.7 times more pixels activated in the right hemisphere as compared to the left. When contrasted with the distracter, the self-face activated 2.6 times as many pixels in the right hemisphere compared to the left. Therefore, while it is true that bilateral activations were observed, we can clearly see that there is a right hemisphere dominance in the processing of the self-face.

Taking their research further, the Sugiura team examined the correlates of self-face and other self-body (and motion) correlates (Sugiura et al., 2006). This study, perhaps the most comprehensive study investigating self-faces with fMRI, revealed a number of interesting results. First, using a conventional analysis, there was a clear right hemisphere dominance. Combining all of the conditions (‘Mean’), the group found activation bilaterally in a region extending over the fusiform and inferior temporal gyri. However, the majority of activation was right hemisphere dominated. Activation peaks in the right posterior brain were located at the occipito-parietal junction, posterior superior parietal lobule, intraparietal sulcus, and supramarginal gyrus. There was additional right frontal activations in the precentral sulcus, and one in inferior frontal gyrus. A right hemisphere dominance was seen through all of the conditions. Movies of the body and the face, as well as static images of the body and the face all revealed significant right hemisphere activations, mainly in parieto-frontal regions. There was left fusiform activation noted through many of the conditions. The authors also performed a principle components analysis (PCA), which too revealed peak right hemisphere activations. These analyses also revealed right fronto-parietal activations. While bilateral fusiform is activated through many of the analyses, the dominance of the right fronto-parietal is clearly observed, no matter which self-stimulus was used or which analysis was performed.

These studies were published after preparation of our original thesis, as were a number of other fMRI studies. One of the most interesting of these was performed by the UCLA group, who were also
The casual role of the right hemisphere in self-awareness

involved in the split-brain studies indicated above, Uddin et al. (2005) employed a self-face morph design using highly familiarized, gender-matched controls for the 'other' faces. These controls were similar to those employed in previous studies, which balance the effect of both gender as well as familiarity (Keenan et al., 1999, 2000a, 2000b). Contrasting the self-face morphs to the familiar-face morphs, activations were found in the right inferior frontal, and right inferior parietal lobes. Activations were also found in the right inferior frontal gyrus, the right inferior occipital sulcus, and the right superior parietal lobe (Figure 1). The authors note the dominance of the right hemisphere activation, which they speculate may involve right hemisphere mirror neurons. Comparing their findings to previous research, the authors note that the gender matching might account for differences between their report and that of Kircher et al. (2001), as might the smaller sample size and blocking design used by Kircher et al.

Also published recently was a report by Platek and his colleagues (Platek et al., 2004). In this study, the authors examined the correlates of self-face recognition as well as a theory of mind (ToM) task (the Mind in the Eyes test-MIE). When self-face processing was compared with familiar famous face processing, significant activation in right superior, middle, and inferior frontal gyri was found. The MIE, was associated with activation in the right superior and middle frontal gyri, medial superior frontal gyrus, and left middle frontal gyrus and superior temporal gyrus. Self-face recognition and mental state attribution were co-localized to the right middle and superior frontal gyri, a result similar to the study on which it was based, which contrasted first- and third-person perspective taking (Vogeley et al., 2001). These data support the notion that the self-face activates right hemisphere structures as well as provide a further link between self-face recognition and ToM.

After reviewing the most recent studies, the fMRI evidence continues to be highly suggestive of a right hemisphere dominance for self-face recognition. In all of the fMRI studies published since the original thesis (Sugiura et al., 2005; Platek et al., 2004; Uddin et al., 2005; Sugiura et al., 2006; Platek et al., 2006), there is a clear right hemisphere dominance. Such fMRI data are highly suggestive of the fact that self-faces selectively activate right prefrontal and parietal cortices. Left hemispheric activation, which is only found consistently in the fusiform face regions, is likely due to either a) lexical processing, or b) familiar face recognition not controlled for appropriately. Clearly, the recent literature bears out what we and others speculated previously, which is a correlation between self-face processing and the right hemisphere.

PATIENT DATA

Despite highly convincing correlational evidence from neuroimaging studies, it still remains necessary to establish a causal link between the right hemisphere and the self. One such link is provided by patient data, which can provide causal evidence that should help solidify our position. Briefly stated, one is hard pressed to find any self-related disorder that is found consistently following left hemispheric lesions (Feinberg and Roane, 2005; Feinberg and Keenan, 2005). On the other hand, almost all disorders of self-awareness have been repeatedly linked to the right hemisphere. Cases of delusional mirrored self-misidentification or “mirror sign” indicate a causal link between damage to the right hemisphere and a disability to self-recognize (Spangenberg, 1998; Breen et al., 2001; Breen, 1999; Spangenberg-Postal, 2005). Among these cases, researchers report that despite being able to recognize other people and other objects in the mirror space, these patients have an inability to recognize themselves and insist that their reflection is merely someone who follows them around.

Alien hand syndrome is yet another disorder of the self in which a patient’s hand behaves involuntarily and feels foreign to the patient. While most of these cases involve lesions to the corpus callosum alone or with dominant medial frontal cortex, a significant number of cases of alien hand syndrome have been reported in which patients suffer from lesions in right posterior locations while their corpus callosums remain intact (Groom et al., 1999; Bundick and Spinella, 2000; Marez-Lopez et al., 2002; Levine and Rinn, 1986; Ventura et al., 1995).
Patients that suffer from asomatognosia fail to recognize a part of their body as their own. Feinberg (2001) describes a large number of patients who attribute a part of their body, usually a limb, as belonging to the doctor or even a dead relative. Having had knowledge of nearly a hundred cases, he concludes that he has never experienced a case that has occurred in conjunction with strictly left hemisphere damage. Claims such as this demonstrate the strength of the relationship between the right hemisphere and self-awareness.

Yet another disorder of the self, anosognosia, involves denial and lack of awareness of a patient’s own disabilities or disorders. For example, a patient suffering from hemiplegia may deny his or her poor functioning and insist that he or she can still feel and move the affected area. Stone et al. (1993) examined 171 consecutive acute hemispheric stroke patients and found that incidents of anosognosia were significantly higher for right hemisphere patients than those with left damage. Likewise et al. (2004) observed 64 hemiplegic stroke patients and concluded that anosognosia was most commonly associated with right hemisphere damage. More recently, Karnath et al. (2005) examined 27 stroke patients and linked anosognosia more specifically to the right posterior insula. Numerous other studies have also reported anosognosia is dominated by right hemisphere dysfunction (Feinberg et al., 2000; Jehkonen et al., 2000; Bisiach et al., 1986).

Further evidence suggest that patients with right hemisphere lesions tend to have skewed self concepts, as they provide inconsistent self-reports and have limited ability at determining adequacy of self-concept descriptions (Vanderhaeghen, 1986). After administering several tests to a group of 126 unilateral brain damaged patients followed by a self-evaluation task, Mizuno (1991) found right hemisphere patients underestimate their errors at a significantly greater rate than left hemisphere patients. Similarly, Andelman et al. (2004) found that right hemisphere patients overestimated their abilities on a memory task.

While space constraints limit this discussion, the interested reader will find a number of reviews from the neurology/ neuropsychology literature that clearly demonstrate the causal role of the right hemisphere in terms of self (Feinberg, 1997; Joseph, 1988; Stuss and Anderson, 2004; Devinsky, 2000; Schore, 2003). Devinsky (2000), for example, relates several disorders of the self to right hemisphere deficits including impaired abilities to relate between the self and the environment, disorders of autobiographical memory, social disorders, ego boundary disorders, and emotional disorders.

Further, Devinsky provides an evolutionary perspective on the benefits of hemispheric specialization of self-awareness to human survival. In another review of developmental and adult lesion studies, Stuss and Anderson (2004) conclude that the right frontal lobe appears to be particularly involved in developmental and adult disorders of self-awareness.

Though not the focus here, it is interesting to note that many deficits of ToM have also been linked to damage in the right hemisphere. While it appears that ToM abilities relate to a slightly more distributed network (Brune and Brune-Cohrs, 2006), many studies report greater ToM deficits in right hemisphere patients than left hemisphere patients with a particular emphasis on frontal regions. For example, in a comparison of left versus right hemisphere patients, Siegal et al. (1996) found that right hemisphere patients had disabilities with correctly drawing inferences in false belief tasks. Likewise, Stone et al. (1998) compared the performances of patients with bilateral damage to orbito-frontal cortex to those with unilateral damage to the left dorsolateral prefrontal cortex in several ToM tasks. Their results showed bilateral patients to have deficits in complex ToM tasks, while left unilateral patients showed none.

Deficits in the attribution of mental states have also been found to occur in right hemisphere patients when compared to controls; such deficits are not observed in left hemisphere patients (Happe et al., 1999). Shaw et al. (2005) found that damage to the right prefrontal cortex can be linked to poorer recognition of negative emotions. Yet another study linked bilateral prefrontal lesions to deficits in empathy (Shamay-Tsoory et al., 2003). Other studies have revealed that patients with right hemisphere damage have trouble distinguishing lies from jokes (Winner et al., 1998) and recognizing irony and faux pas (Shamay-Tsoory et al., 2003). Finally, Stuss et al. (2001) report that bifrontal and right frontal lesions contribute to deficits in visual perspective-taking and deception tasks, while both non-frontal and left frontal lesions were found to have no such effect.

Overall, the data from numerous lesion studies provide overwhelming support for a causal link between self-awareness and the right hemisphere, as well as a strong link with ToM tasks. As these studies demonstrate, patients that suffer from right hemisphere damage are more likely to show deficits in self-awareness and ToM than those with left hemisphere damage. These data lead to a parsimonious explanation of the role of the right hemisphere, such that the right hemisphere can be seen as being dominant in social awareness related to the self (Wasserstein and Stefanatos, 2000; Schore, 2003).

SELF-AWARENESS AND THE RIGHT HEMISPHERE: EXPERIMENTAL CAUSALITY

But is there further causal evidence between the brain and self-awareness? Most would be satisfied
We first used this technique in the study of self-awareness by stimulating regions of the prefrontal cortex (Keenan, 1999). It was found that the only consistent disruption of self occurred following TMS delivered to the right prefrontal cortex, including the disruption of both morphed and non-altered self-faces. This initial examination was significantly improved upon by the UCLA group led by Uddin et al. (2006). This study used a subset of participants that were first scanned using fMRI in the study previously discussed (Uddin et al., 2005). The authors then applied 1Hz (low-frequency) TMS to the right and left inferior parietal lobe using a task involving self-face recognition. It was found that TMS applied to the right parietal lobe selectively disrupted self-face recognition while left parietal TMS had no such effect. These data, in which image-guided TMS was employed, provide strong evidence for the link between the right hemisphere and the self. That is, direct manipulation of a specific brain region (the right parietal lobe) resulted in behavioral changes related to the self. Further, these data confirm initial findings, not only in patients in which TMS delivered to the right hemisphere was found to alter self-awareness (Kober et al., 2005), but that a right hemisphere network is likely necessary for self-related cognitive processing.

A further link between the right hemisphere and the self provided by TMS involves perspective taking (Guise et al., in press). In this study, the avatar stimuli used by Vogeley (Vogeley et al., 2004), were employed with TMS being delivered to the left and right frontal cortex. It was found that right frontal TMS significantly disrupted first-person perspective taking, while there was no influence following left frontal TMS. A further benefit of employing TMS (when using single-pulse in particular), is the ability to determine the timing of events. In this study, TMS applied to the right frontal lobe at 300 msec (and not 150 ms, the other timing employed) disrupted first-person perspective taking. Again, these data, obtained in normal healthy participants, support the notion that the right hemisphere plays a dominant role in self-related behavior and cognition.

A further use of TMS involves stimulating the motor cortex while simultaneously measuring the activity in the contra-lateral limb (often muscles of the hands) using motor evoked potentials (MEPs). This method provides a direct measure of cortico-spinal excitability, and is valuable in comparing excitation between the hemispheres (e.g., Tormos et al., 1997). This method allows for a further method of confirming fMRI data (Keenan and Pascual-Leone, 1999). The first use of this method examining self-awareness revealed that the presentation of self-morphs to participants resulted in greater right hemispheric activation compared to activity in the left hemisphere (Keenan et al., 2001). These data were recently followed up using
that the regions involved in these abilities (such as Decety and Grezes, 2006; Vogele et al., 2001), and identical cortical regions (e.g., Platek et al., 2004; Johnson et al., 2004, 2005; Happe, 2003; Barnacz et al., 2004; Seger et al., 2004), the data indicate a right hemisphere dominance for the self. While the cortical midline structures certainly demonstrate a right hemisphere dominance in terms of mediating self-awareness. Unfortunately, we did not examine lateralization in our study. However, lateralization has been examined in a number of other research designs using similar versions of the adjective attribution task. Follow-up studies, using both fMRI and TMS, demonstrate a right hemisphere bias, confirming the initial Craik findings (Craik et al., 1999). Fossati et al. (2003) found, using fMRI, that positive and negative self-related words activated the right dorsal prefrontal cortex. This study was followed up by the same group with similar right frontal findings (Fossati et al., 2004). This work was further confirmed through the use of TMS and MEPs by a separate group of researchers who found a clear right hemisphere bias for the rating of self-related words across all conditions and that drastic ratings (either saying a word ‘always’ or ‘never’ described the self) was related to right hemisphere activation (Molnar-Szakacs et al., 2005).

CONCLUSION

While space has limited this paper (e.g., a full discussion of ToM would require its own issue), we believe that both correlational and causal studies demonstrate a right hemisphere dominance for the self. While the cortical midline structures certainly play a role, as our own group has reported (Lou et al., 2004; Seger et al., 2004), the data indicate a clear dominance for the right parietal and right frontal cortex in terms of mediating self-awareness. Though space has not allowed us to address in detail the role of ToM, we are certainly swayed by both behavioral and neurological evidence that there is a relationship between self-awareness and ToM (Johnson et al., 2004, 2005; Happe, 2003; Barnacz et al., 2004) such that both subserve similar (but not identical) cortical regions (e.g., Platek et al., 2004; Decety and Grezes, 2006; Vogele et al., 2001), and that the regions involved in these abilities (such as distinguishing self from other) involve right parietal regions (e.g., Decety and Sommerville, 2003).

In terms of the claim that we have been selective in our review of the literature, it is noted that the fMRI studies reported here in terms of the self-face were all published following our report and all indicate a right hemisphere dominance for the self. Thus, we suggest our model has been somewhat successful in predicting experimental outcomes (Platek et al., 2004; Sugiura et al., 2005; Uddin et al., 2005a; Platek et al., 2006).

It is hoped that the causal evidence taken from patient and TMS experiments (as well as the recent correlational fMRI studies), demonstrate that the brain appears to have lateralized networks for the self. We hope that this debate moves away from left hemisphere claims to examinations of the complex relationship between the right hemisphere and the medial cortex or how the mirror-neuron system might provide a “skeleton” for self-awareness.

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