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Brief Report

Corticospinal Excitability During a Perspective Taking Task as Measured by TMS-induced Motor Evoked Potentials

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Abstract: Only by understanding the ability to take third-person perspective can we begin to elucidate the neural processes responsible for one's inimitable conscious experience. The current study examined differences in hemispheric laterality during a first-person perspective (1PP) and third-person perspective (3PP) taking task, when using Transcranial Magnetic Stimulation (TMS). Participants were asked to take either the 1PP or 3PP when identifying the number of spheres in a virtual scene. During this task, single-pulse TMS was delivered to the motor cortex of both the left and right hemispheres of 10 healthy volunteers. Measures of TMS-induced motor-evoked potentials (MEPs) of the contralateral abductor pollicis brevis (APB) were employed as an indicator of lateralized cortical activation. The data suggest that the right hemisphere is more important in discriminating between 1PP and 3PP. These data add a novel method for determining perspective taking and add to the literature supporting the role of the right hemisphere in meta representation.

Keywords: Perspective Taking; Self-Awareness; Self-Representation; Metarepresentation; Theory of Mind; Transcranial Magnetic Stimulation

Perspective taking is a fundamental aspect of human existence and a likely driver of human brain evolution (Fabbro, Cantone, Feruglio, & Crescentini, 2019; Heyes & Frith, 2014), including the enhancement of aspects of the frontal (Sherwood et al., 2006) and parietal lobes (Patel, Sestieri, & Corbetta, 2019). With the emergence of a variety of imaging techniques, a number of regions have been identified in perspective taking (Heleven & Van Overwalle, 2018; Lamm, Rütgen, & Wagner, 2019; Quesque & Brass, 2019). Across both patients (Dichter, 2012; Vucurovic, Caillies, & Kaladjian, 2020) and experimental studies, converging evidence appears to implicate the Right Temporal Parietal Junction- rTPJ (Dichter, 2012; Patel et al., 2019; Vucurovic et al., 2020) and Medial Prefrontal Cortex- MPFC (Li, Mai, & Liu, 2014; Schurz, Radua, Aichhorn, Richlan, & Perner, 2014; Smith & Lane, 2015) in adopting another person's perspective.

One of the essential features of consciousness is *perspective* (Taylor, 2001; Schilbach et al., 2006). At the most basic level, all mammals possess a first person-perspective (1PP), also termed "central-representation" or "primary representation" (Vogeley, 2004). This is the non-reflexive ability to simply *know* without explicit reflection or meta-representation of any kind. During 1PP, one would not *think*, "I am here", but rather just *be* here (Eilan, 1995). The second person-perspective (2PP) is commonly defined as the ability to monitor one's own mental state in a self-representational capacity, other-

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wise known as being *self-aware* (Gallup, 1970; Krachun, Lurz, Mahovetz, & Hopkins 2019). In doing so, one is able to attend to one's own cognitions in a proprietary, self-reflective manner. Differentiating between 1PP and 2PP is dependent upon the ability to actively monitor or mentalize one's thoughts in the past, present, and future (2PP) as opposed to mere present awareness (1PP).

Previous research into the understanding of perspective taking has utilized linguistic paradigms (e.g., Molnar-Szakacs, Uddin, and Iacoboni, 2005; Platek, Myers, Critton, & Gallup, 2003; Platek, 2010; Richardson et al., 2020), self-face paradigms (e.g., Keenan, Wheeler, Gallup, Pacual-Leone, 2000; Liu et al., 2020; Platek, Keenan, Gallup, Mohamed, 2004; Sperry, Zaidel, & Zaidel, 1979; Preilowski et al.,1977; Sugiura, 2014), affective interpretation tasks (e.g., Simon Baron-Cohen, 1996; Rutherford, Baron-Cohen, & Wheelwright, 2002; Golan, Baron-Cohen, Hill & Rutherford, 2006; Eidelman-Rothman et al., 2016), tactile tasks (e.g., Schaefer, Xu, Flor, & Cohen, 2009; Schaefer, Heinze & Rotte, 2012) and lesion studies (e.g., Feinberg & Keenan., 2005; Breen, Caine & Coltheart, 2001; Stuss, Gallup, & Alexander, 2001), using both on-line and off-line approaches (e.g., Perner & Lang, 1999).

Evidence suggests that 2PP and 3PP may recruit similar cortical areas, lending support for an underlying neuroanatomical network that mirrors their applied functional similarity. A number of brain regions have been implicated in these meta-representational functions, including: the right prefrontal cortex (e.g., Keenan et al., 2000; Platek et al., 2003; Feinberg et al., 2005; Tullett, Harmon-Jones & Inzlicht, 2012), parietal regions (e.g., Wolper, Goodbody, Hussain, 1998; Lou, Luber, Crupain, Keenan, Nowak, et al., 2004; Lou, Luber, Stanford & Lisanby, 2010; Taylor, 2001; Northoff & Bermpohl, 2004), the medial prefrontal cortex (MPFC; e.g., Duran et. al., 2020; Mitchell, Banaji, & Macrae, 2005; Johnson, Raye, Mitchell, Touryan, Greene & Nolan-Hoeksems, 2002; Gallagher, Happe, Brunswick, Fletcher, Frith, & Frith, 2000; Johnson, Schmitz, Kawahara-Baccus, Rowley, Alexander, Lee, & Davidson, 2005; Vogeley et al. 2001; David et al. 2006; Schilbach et al., 2006; Pfeiffer et al., 2014; Zysset, Huber, Samson, Ferstl, & Yves von Cramon, 2002), orbitofrontal regions (e.g., Berthoz, Armony, Blair & Dolan, 2002; Gregory et al., 2002; Bouc et al., 2012; Sabbagh, 2004) and the posterior cingulate cortex (e.g., Johnson et al., 2002; Kircher et al., 2002; Lou et al., 2010; Oschner et al., 2005).

Of key interest is that although a large body of evidence has examined the link between 2PP and 3PP, very little is known about the contrast between primary-representation (1PP) and that of the meta-representational states of 2PP and 3PP. It is unclear whether 1PP relies on similar or disparate cortical regions as those involved during 3PP and if 1PP is preferentially lateralized in the RH. One way in which 1PP has been successfully studied is through visio-spatial tasks which require the "centering on one's multimodal experiential space upon one's own body, thus operating in an egocentric reference frame" (Vogeley, May, Ritzl, Falkai, Zilles, & Fink, 2004). Vogeley et al. (2004) created a visio-spatial paradigm in which the individual is required to shift between one's own body axis perspective (1PP) and taking another's vantage point as their own (3PP).

1. Motor Evoked Potentials (MEPs)

Transcranial Magnetic Stimulation (TMS) delivered to the 'hand area' of the motor cortex elicits a Motor Evoked Potential (MEP) in the contra-lateral digits (Barker, Jalinous, & Freeston, 1985; Klomjai, Katz, & Lackmy-Vallée, 2015). MEPs have become a part of almost every TMS application as they are used to measure individual differences in motor threshold (MT: Lefaucheur, 2019; Maeda, Keenan, Tormos, Topka, & Pascual-Leone, 2000), and it is generally thought unsafe to use TMS without gauging some aspect of MT (Anand & Hotson, 2002; Groppa et al., 2012; Wassermann et al., 1996; Zis et al., 2019). Since its inception, MEPs have been used for wide-ranging investigations including post-stroke recovery (Kubis, 2016), ALS (Vucic et al., 2018), schizophrenia (Kaskie & Ferrarelli, 2018), intrinsic brain rhythm activity (Hanajima & Ugawa, 2019) and even veterinary medicine (Journée et al., 2019).

In terms of perspective taking, a study examined piano players who were presented with music they practiced previously. When they thought the left hand part of the music was being played by another person, the MEPs in the left arm were greater, and MEPs increased as the participant's empathy increased (Novembre, Ticini, Schütz-Bosbach, & Keller, 2012). Further, previous work by our lab demonstrated that adopting another's perspective (e.g., pretending to be a fan of an opposing sports team) led to greater left motor cortex/right hand MEPs (Kelly et al., 2009).

Centered on first-person perspective, a number of researchers employed TMS induced motor-evoked potentials (MEPs) to measure lateralized cortical excitability during the presentation of self-descriptive adjectives (Molnar-Szakacs, Uddin, & Iacoboni, 2005). The adjectives identified as highly or not at all descriptive of the individual resulted in increased right hemisphere excitability, indicating that the degree of self (including rejecting descriptions of oneself) could be discriminated via MEPs. The amount of one's *self-perception* can alter MEPs such that participants' positivity or sense of personal power results in differing senses of personal space (Vergallito et al., 2019).

Differences in perspective taking that exist in motor areas are not surprising. Lateralized hand response differences (e.g., reaction time and identification) exist such that there is a tendency for left-handed responses to be quicker for self-related stimuli (Keenan, Freund, Hamilton, Ganis, & Pascual-Leone, 2000; Keenan, Ganis, Freund, & Pascual-Leone, 2000; Keenan et al., 1999; Ma & Han, 2010). Furthermore, the handedness of the individual plays a significant role in how self (compared to other) is processed in the brain. While right-handed individuals tend to be more consistent and right-hemisphere dominant for self-processing, left-handed individuals display greater variability (and more left hemisphere involvement) in cortical response (Morita, Asada, & Naito, 2020). Therefore, both the hand that performs the task and an individual's hand dominance influence perspective taking.

In order to further our understanding of the cortical mechanisms involved during 1PP and 3PP, we employed the same task in which participants were presented with virtual scenes of an avatar (i.e., a virtual character) and a number of red spheres (Vogeley et al., 2004). Participants were instructed to report how many red balls would be visible either from their own (1PP) or the avatar's perspective (3PP). The current study administered TMS to both the right and left motor cortices (MC) to determine the degree of lateralization during 1PP and 3PP. It was predicted that TMS administration to the right MC would generate larger MEPs during assumption of the avatar's perspective (3PP). This prediction is suggestive of the greater involvement of the RH during Theory of Mind (ToM), lending support to the theoretical, anatomical and cognitive similarity between 2PP and 3PP. The advatnatge of MEPs over traditional neuroimaging is the direct assay of excitability rather than the possibility that increased signal may be indicating inhibitory firings (Maeda, Keenan, Tormos, Topka, & Pascual-Leone, 2000). Therefore, if difference are found, a more direct interpretation is possible.

2. Materials and Methods

2.1. Participants

Ten right-handed adults (4 men, 6 women) were recruited via flyer and word of mouth from Montclair State University and Seton Hall University (for similar samples, see Brady et al., 2019; Kim et al., 2019; Kumru, Kofler, Valls-Sole, & Vidal., 2019). . The mean age of the participants was 22.1 (SD=2.84). Participants were appropriately screened using the TMS safety guidelines established by Wasserman (1996, 1998). All subjects received $25 for participation in the study and were treated in accordance with the standards and guidelines set forth by the Institutional Review Board (IRB) of

Montclair State University. Written informed consent was obtained from all subjects. (IRB code: MSU IRB 424)

2.2. Materials

A TMS-Magstim 200 MonoPulse device with a 70mm figure-8 coil was used to stimulate cortical areas of the brain. Stimuli were presented using SuperLab (Cedrus Corporation, Version 2.01) on a Dell computer with a 17" inch CRT monitor. MEPs were acquired using Biopac MP150 amplifiers and accompanying acquisition software installed on a Dell computer. MEPs were recorded using three surface electrodes attached to areas of the hand, using EC2 electrode paste and surgical tape.

2.3. Procedure

For each subject, three surface electrodes were affixed to both hands, at the abductor pollicis brevis (APB) and the belly-tendon montage. A ground electrode was placed on the back of the wrist. Subjects were fitted with earplugs and a swim cap and then seated in front of a computer monitor with their head in a chin rest, 30 inches away from the computer monitor. Due to individual differences in corticoexcitability, Motor Threshold (MT) was first established. The MT was determined by stimulating the area of the primary motor cortex (M1) responsible for hand movement. The Motor Threshold is achieved by slowly increasing the stimulation intensity until hand movements a) can be visually detected, in the contralateral hand, in 5/10 cortical stimulations (Wasserman, 1996) and b) met the IFCN guideline of MEP's over 50 (Rossini et al., 1994). MT determination was established for both hemispheres, for each subject.

Subjects were then presented with a virtual scene that included an avatar and a varying number (1-3) of red spheres within or out of sight of the avatar (Figure 1). The subjects were asked to determine "how many balls they see" (1PP) or "how many balls the avatar sees" (3PP; Vogeley et al., 2004). The experimenter recorded verbal responses. Single-pulse TMS was administered to the motor cortex of either the left or right hemisphere 150 ms or 300 ms following stimulus presentation onset. All stimulation was delivered at 100% MT due to IRB regulations at MSU which capped TMS at 100%. In each condition and for each hemisphere, 48 trials were presented (left hemisphere, 1PP; left hemisphere, 3PP; right hemisphere, 1PP; and right hemisphere, 3PP; 192 total pulses per individual were given). All stimuli remained on the screen until the participant made a verbal response. Reaction times were not recorded (that is, onset of verbal response time). Trials were separated by an inter-trial-interval (ITI) of 1500 ms between each trial within condition. The left and right hemispheres were stimulated separately with the order of stimulation and conditions counterbalanced across subjects. TMS onset post-stimulus presentation was randomized for each condition.

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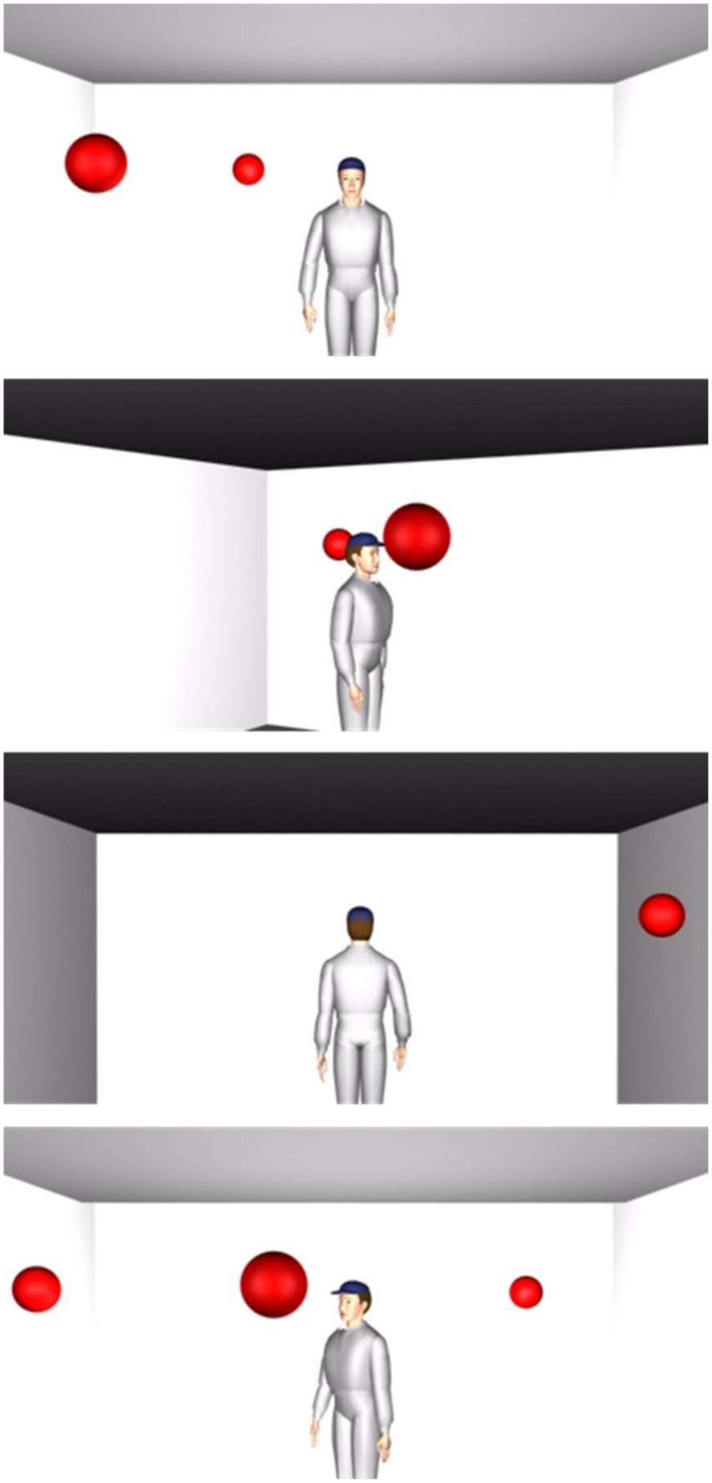

Figure 1. Stimuli of avatar and spherical balls. Each frame presented here demonstrates a different correct response for 1PP and 3PP. Stimuli were adapted from (Guise et al., 2007; Vogeley et al., 2004).

Measures of TMS-induced MEPs of the APB were recorded. The EMG signal was amplified by a factor of 1,000, filtered (bandpass amplifier filter between 1 Hz - 500 Hz), and digitized using a sampling rate of 500 samples per second. All data were stored on a computer for off-line analysis. MEP data were filtered off-line using a Finite Impulse Response (FIR) linear bandpass filter (between 10-250 Hz) employing BIOPAC provided software. The remaining data were then rectified and averaged within-subject by condition. The threshold for data rejection was defined as baseline amplitudes that exceeded 100 μv. Following data rejection, group means were computed.

3. Results

For each condition (1PP and 3PP), measures of TMS-induced MEPs for grand-averaged data were analyzed in terms of peak amplitude, area under the curve (AUC) and overall variability (SD). We began out analyses be directly testing a number of apriori comparisons. The timing of TMS onset was first analyzed using an independent samples t-test. Across conditions, the TMS pulse onset (150 vs 300 msec) did not impact MEP peak, AUC or variability (p>.05). As such, pulse onset was collapsed across all trials and conditions. A 2x2x2 (1PP/3PP; Left/Right Hemisphere Stimulation; 150/300 msec TMS-Onset) repeated measures Analysis of Variance (ANOVA) was performed. In the absence of a 3-way interaction (F(1,23) = .72, p>.05), a significant interaction between Hemisphere x Perspective was found (F(1,23) = 6.55, p<.02). The Right Hemisphere x 1PP differed significantly from all other conditions. 1PP, during right hemisphere stimulation, resulted in a significant decrease in peak amplitudes when compared to all other conditions. Additionally, a significant main effect for Perspective was found (F(1,23) = 5.57, p<.05), in that 1PP yielded less robust peak amplitudes as compared to 3PP (Figure 2). There were no other significant main effects (p’s>.05).

Figure 2. The Peak (A), AUC (B) and SD (C) across Hemisphere for 1PP and 3PP. In all 3 measures, the 1PP Right Hemisphere condition differed significantly from all other conditions (all p’s<.05). All other comparisons were non-significant. A representative rectified, smoothed MEP is given for the 1PP (D) for RH and LH.

A second repeated-measures ANOVA was calculated to examine AUC differences. There was no significant 3-way interaction (F(1,23) = .02, p>05). However, a significant interaction between Hemisphere x Perspective was found (F(1,23) = 11.63, p=.002). A significant main effect was found for the 1PP/3PP condition (F(1,23) = 8.029, p<.05), revealing a decrease in MEP AUC during the 1PP condition. A main effect for Hemisphere was also revealed (F(1,23) = 6.63, p<.05), such that the LH AUC was significantly greater than the RH AUC. The interaction between Hemisphere and Perspective, for both peak amplitude and AUC, indicates decreased right hemisphere activation during 1PP only.

Lateralized differences in MEP variability may offer unique insights into the consistent nature of the cortical response during differing perspectives. We therefore examined differences in SD using ANOVAs. There was no significant 3-way interaction (F(1,23) = .004, p>05). There was no interaction between TMS Onset and Hemisphere or TMS Onset and Perspective (p’s>.05); however, a significant interaction between Hemisphere and Perspective was found (F(1,23) = 8.86, p<.007). Using the Bonferroni correction for multiple comparisons, post-hoc analysis revealed that the variability of the self-right hemisphere condition was significantly lower compared to all other conditions (p’s<.05). Additionally, a significant main effect for Perspective was found (F(1,23) = 11.66, p<.002), such that the self-condition was less variable than the other-condition. Main effects for Hemisphere and TMS onset were not found (p’s > .05).

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4. Discussion

The current study sought to identify lateralized differences during first- and third-person perspective-taking. These data revealed significant differences within the RH for perspective taking. Both peak amplitude and AUC differed significantly between perspectives within the RH. No such differences were observed in the LH. An MEP reduction (for both amplitude and AUC) was noted for the RH during primary-representation, indicating that 1PP may require less activation in the RH. While it is not surprising to see a general decrease in MEP measures from 3PP to 1PP, as a function of task difficulty, the RH is considered to be dominant in spatial processing. In keeping with this, the LH did not evidence a decrease in MEP measures across perspectives.

The question remains: if meta-representational abilities of 1PP and 3PP seem to be lateralized in the RH, why was no significant difference in corticoexcitability between hemispheres during the 3PP condition found? There are a few possible explanations. First, although not significant, the RH did produce larger peak amplitudes than the LH during 3PP. However, the AUC measures were more similar. This may suggest inherent differences in MEP latency and length. As such, some studies indicate that the analysis of the MEP silent period (PMSP; Pascual-Leone, Bartres-Faz & Keenan, 1999) may provide an alternate means of interpretation. However, these analyses were not possible with the data we collected, because our MEP recordings were not long enough to capture the inhibitory response (i.e., typically 300 ms). Furthermore, there is some evidence to suggest that the left motor cortex produces a greater MEP response as a function of greater activation of the left motor cortex in general (Pascual-Leone, Bartres-Faz & Keenan, 1999).

Previously (Théoret, Kobayashi, Merabet, Wagner & Tormos, Pascual-Leone, 2004), an increase in MEPs were found for self-related processing. While one can describe the difference in results through task dissimilarity, a further explanation may be provided by a paper on Alexithymia (Moriguchi et al., 2006). Using functional magnetic resonance imaging (fMRI) during a perspective taking task, researchers found that the Alexithymic group demonstrated greater activation in the RH compared to the non-Alexithymic group, though performance was superior for the non-Alexithymic group. Furthermore, and perhaps critical, is that activation in the right superior parietal cortex in the Alexithymic group increased as a function of symptom severity. Therefore, it is possible that reduced MEPs may indicate a region is particularly adept or specialized at processing stimuli. As we have previously reported (Kelly, Murray, Barrios, Gorman, Ganis & Keenan, 2009), during a linguistic processing task, we found reductions in cortical activation during ToM tasks as ToM ability increases. Therefore, the possibility is likely more than speculative (Kobayashi, Glover & Temple, 2008).

Because much research has indicated regions such as the MPFC (e.g., Courtney & Meyer, 2020; D'Argembeau, Feyers, Majerus, Collette, Van der Linden, et al., 2008; Kedia et al., 2019; Lieberman, 2007; Molnar-Szakacs, Uddin, Zaidel, Iacoboni, 2007; Oschner, Beer, Robertson, Cooper, Gabrieli, et al., 2005; Lou, Luber, Crupain, Keenan, Nowak, et al., 2004; Seger, Stone & Keenan, 2004; Schilbach, Ritzl, Krämer, Newen, Zilles, et al., 2006 ; Zhao et al., 2016) as critical for self/other differentiation, this study is limited in its scope. However, the current study further supports lateralized findings by demonstrating that self/other discriminations are significantly different between the hemispheres. These data add to a growing amount of evidence that the RH appears critical in evaluating self/other differences, tested across a number of different modalities in non-patient (e.g., Keenan, Nelson, O'Connor & Pascual-Leone, 2001; Keenan, Wheeler, Platek, Lardi & Lassonde, 2003; Kotlewska & Nowicka, 2015; Morita, Asada, & Naito, 2020; Morita et al., 2008; Naito et al., 2017; Sugiura, Miyauchi, Kotozaki, Akimoto & Nozawa, et al., 2014; Uddin, Molnar-Szakacs, Zaidel & Iacoboni, 2007; Prencipe & Zelazo, 2005) and patient populations (e.g., Candini et al., 2018; Delgado & Bogousslavsky, 2018; Dieguez, 2018; Feinberg & Keenan, 2005; Frassinetti et al., 2012; Frassinetti, Maini, Romualdi, Galante, & Avanzi, 2008)). Decety and Lamm (2007) have suggested that superior right parietal processing may be critical for both switching and differentiating self/other distinctions. Our current data support this possibility.

An underused measure of MEPs has been variability between responses, and here we show that the right MC has less variability in response. While it remains unclear what this may mean, we suggest that intuitively reduced variability may indicate increased efficiency. Typically, MEP variability is looked at in terms of either population differences (Richter, Ehlis, Jacob & Fallgatter, 2007) or physiological changes (Darling, Wolf & Butler, 2006). We suspect that a further use may be in terms of efficiency, though we admit this is speculative. We believe that testing other paradigms; in particular those that simulate ‘real-life’ situations (Klichowski & Kroliczak, 2020) such as knowing what another driver sees vs. what one sees would be a valuable line of investigation. Future studies should also examine the associate priming (Werner, von Ramin, Spruyt, & Rothermund, 2018) and we believe that a well-designed study could tease out both (the ecological significance and the degree of semantic or associative priming the two tasks have).

Further, our participant number could be increased in future studies. Likewise, additional measures of 1pp and 3pp should be collected in future studies.

References

1. Anand, S., & Hotson, J. (2002). Transcranial magnetic stimulation: neurophysiological applications and safety. *Brain Cogn, 50*(3), 366-386. doi:10.1016/s0278-2626(02)00512-25r
2. Barker, A. T., Jalinous, R., & Freeston, I. L. (1985). Non-invasive magnetic stimulation of human motor cortex. *Lancet, 1*(8437), 1106-1107. doi:10.1016/s0140-6736(85)92413-4
3. Baron-Cohen, S., Cox, A., Baird, G., Swettenham, J., Nightingale, N., Morgan, K., Drew, A., & Charman, T. (1996). Psychological markers in the detection of autism in infancy in a large population. The British journal of psychiatry : the journal of mental science, 168(2), 158–163. https://doi.org/10.1192/bjp.168.2.158
4. Berthoz, S., Armony, J., Blair, R., & Dolan, R. (2002). An fMRI study of intentional and unintentional (embarrassing) violations of social norms. *Brain, 125*(8), 1696-1708.
5. Brady, R. O., Jr, Gonsalvez, I., Lee, I., Öngür, D., Seidman, L. J., Schmahmann, J. D., Eack, S. M., Keshavan, M. S., Pascual-Leone, A., & Halko, M. A. (2019). Cerebellar-Prefrontal Network Connectivity and Negative Symptoms in Schizophrenia. The American Journal of Psychiatry, 176(7), 512–520.
6. Breen, N., Caine, D., & Coltheart, M. (2001). Mirrored-self misidentification: Two cases of focal onset dementia. *Neurocase, 7*(3), 254-254.
7. Bouc, R. L., Lenfant, P., Delbeuck, X., Ravasi, L., Lebert, F., Semah, F., & Pasquier, F. (2012). My belief or yours? Differential theory of mind deficits in frontotemporal dementia and Alzheimer's disease. *Brain, 135*(10), 3026-3038.
8. Candini, M., Avanzi, S., Cantagallo, A., Zangoli, M. G., Benassi, M., Querzani, P., . . . Frassinetti, F. (2018). The lost ability to distinguish between self and other voice following a brain lesion. *Neuroimage Clin, 18*, 903-911. doi:10.1016/j.nicl.2018.03.021
9. Courtney, A. L., & Meyer, M. L. (2020). Self-Other Representation in the Social Brain Reflects Social Connection. J Neurosci, 40(29), 5616-5627. doi:10.1523/jneurosci.2826-19.2020
10. D’Argembeau, A., Feyers, D., Majerus, S., Collette, F., Van der Linden, M., Maquet, P., & Salmon, E. (2008). Self-reflection across time : Cortical midline structures differentiate between present and past selves. *Social Cognitive and Affective Neuroscience*, 3, 244-252.
11. Darling, W. G., Wolf, S. L., & Butler, A. J. (2006). Variability of motor potentials evoked by transcranial magnetic stimulation depends on muscle activation. *Experimental Brain Research. Experimentelle Hirnforschung. Experimentation Cerebrale*, *174*(2), 376–385.
12. David, N., Bewernick, B., Newen, A., Lux, S., Fink, G.R., Shah, N.J., Vogeley, K, (2006). The self-other distinction in social cognition: Perspective-taking and agency in a virtual ball-tossing game. Journal of Cognitive Neuroscience 18, 898-910.
13. Decety, J., & Lamm, C. (2007). The role of the right temporoparietal junction in social interaction: How low-level computational processes contribute to meta-cognition. *The Neuroscientist*, 13, 580-593.
14. Delgado, M. G., & Bogousslavsky, J. (2018). Misoplegia. *Front Neurol Neurosci, 41*, 23-27. doi:10.1159/000475689
15. Dichter, G. S. (2012). Functional magnetic resonance imaging of autism spectrum disorders. *Dialogues Clin Neurosci, 14*(3), 319-351.
16. Dieguez, S. (2018). Cotard Syndrome. *Front Neurol Neurosci, 42*, 23-34. doi:10.1159/000475679
17. Frassinetti, F., Fiori, S., D'Angelo, V., Magnani, B., Guzzetta, A., Brizzolara, D., & Cioni, G. (2012). Body knowledge in brain-damaged children: a double-dissociation in self and other's body processing. *Neuropsychologia, 50*(1), 181-188. doi:10.1016/j.neuropsychologia.2011.11.016
18. Duran, K. A., O'Halloran, H., Soder, H., Yasin, S., Kramer, R., Rosen, S., Brenya, J., Chavarria, K., Savitska, L., & Keenan, J. P. (2020). The medial prefrontal cortex: a potential link between self-deception and affect. The International journal of neuroscience, 1–7. Advance online publication. https://doi.org/10.1080/00207454.2020.1753729

19. Eidelman-Rothman, M., Goldstein, A., Weisman, O., Schneiderman, I., Zagoory-Sharon, O., Decety, J., & Feldman, R. (2016). Prior exposure to extreme pain alters neural response to pain in others. *Cognitive, Affective, & Behavioral Neuroscience, 16*(4), 662-671.
20. Eilan, N. (1995). Primitive consciousness and the 'hard problem'. *Journal of Consciousness Studies, 7*(4), 28-39.
21. Fabbro, F., Cantone, D., Feruglio, S., & Crescentini, C. (2019). Origin and evolution of human consciousness. *Prog Brain Res, 250*, 317-343. doi:10.1016/bs.pbr.2019.03.031
22. Feinberg, T.E. & Keenan, J.P. (2005). The lost self: Pathologies of the brain and identity. New York: Oxford University Press.
23. Fossati P. Imaging autobiographical memory. *Dialogues Clin Neurosci*. 2013;15(4):487-490.
24. Frassinetti, F., Maini, M., Romualdi, S., Galante, E., & Avanzi, S. (2008). Is it mine? Hemispheric asymmetries in corporeal self-recognition. *J Cogn Neurosci, 20*(8), 1507-1516. doi:10.1162/jocn.2008.20067
25. Frassinetti, F., Ferri, F., Maini, M., Benassi, M. G., & Gallese, V. (2011). Bodily self: an implicit knowledge of what is explicitly unknown. Experimental brain research, 212(1), 153–160. https://doi.org/10.1007/s00221-011-2708-x
26. Gallup, G.G. (1970). Chimpanzees: Self-recognition. *Science,* 167, 86-87.
27. Gallagher HL, Happé F, Brunswick N, Fletcher PC, Frith U, Frith CD. Reading the mind in cartoons and stories: an fMRI study of 'theory of mind' in verbal and nonverbal tasks. *Neuropsychologia*. 2000;38(1):11-21. doi:10.1016/s0028-3932(99)00053-6
28. Golan, O., Baron-Cohen, S., Hill, J. J., & Rutherford, M. D. (2006). The 'Reading the Mind in the Voice' Test-Revised: A Study of Complex Emotion Recognition in Adults with and Without Autism Spectrum Conditions. *Journal of Autism and Developmental Disorders, 37*(6), 1096-1106.
29. Gregory, C., Lough, S., Stone, V., Erzinclioglu, S., Martin, L., Baron-Cohen, S., & Hodges, J. R. (2002). Theory of mind in patients with frontal variant frontotemporal dementia and Alzheimer's disease: Theoretical and practical implications. *Brain, 125*(4), 752-764.
30. Groppa, S., Oliviero, A., Eisen, A., Quartarone, A., Cohen, L. G., Mall, V., Kaelin-Lang, A., Mima, T., Rossi, S., Thickbroom, G. W., Rossini, P. M., Ziemann, U., Valls-Solé, J., & Siebner, H. R. (2012). A practical guide to diagnostic transcranial magnetic stimulation: report of an IFCN committee. *Clin Neurophysiol, 123*(5), 858-882. doi:10.1016/j.clinph.2012.01.010
31. Guise, K., Kelly, K., Romanowski, J., Vogeley, K., Platek, S. M., Murray, E., Keenan, J.P. (2007). The anatomical and evolutionary relationship between self-awareness and theory of mind. *Human Nature (2007)* 18, 132-142.
32. Hanajima, R., & Ugawa, Y. (2019). Triad TMS of the human motor cortex. *Neurosci Res*. doi:10.1016/j.neures.2019.11.005
33. Heleven, E., & Van Overwalle, F. (2018). The neural basis of representing others' inner states. *Curr Opin Psychol, 23*, 98-103. doi:10.1016/j.copsyc.2018.02.003
34. Heyes, C. M., & Frith, C. D. (2014). The cultural evolution of mind reading. *Science, 344*(6190), 1243091. doi:10.1126/science.1243091
35. Johnson, M.K., Raye, C.L., Mitchell, K.J., Touryan, S.R., Greene, E.J., Nolan-Hoeksema, S. (2002). Dissociating medial frontal and posterior cingulated activity during self-reflection. *Social Cognitive and Affective Neuroscience,* 1, 56-64.
36. Johnson, S. C., Schmitz, T. W., Kawahara-Baccus, T. N., Rowley, H. A., Alexander, A. L., Lee, J., & Davidson, R. J. (2005). The Cerebral Response during Subjective Choice with and without Self-reference. *Journal of Cognitive Neuroscience, 17*(12), 1897-1906.
37. Journée, S. L., de Meeus d'Argenteuil, C., De Maré, L., Boshuizen, B., Vanderperren, K., Journée, L. H., de Bruijn, M., Bergmann, W., & Delesalle, C. (2019). State-of-the-Art Diagnostic Methods to Diagnose Equine Spinal Disorders, With Special Reference to Transcranial Magnetic Stimulation and Transcranial Electrical Stimulation. *J Equine Vet Sci, 81*, 102790. doi:10.1016/j.jevs.2019.102790
38. Kaskie, R. E., & Ferrarelli, F. (2018). Investigating the neurobiology of schizophrenia and other major psychiatric disorders with Transcranial Magnetic Stimulation. *Schizophr Res, 192*, 30-38. doi:10.1016/j.schres.2017.04.045
39. Kedia, G., Mussweiler, T., Adam, R., Ischebeck, A., Ihssen, N., & Linden, D. E. J. (2019). So pretty! The neural correlates of self-other vs familiar-other attractiveness comparisons. Soc Neurosci, 14(1), 41-52. doi:10.1080/17470919.2017.1397544
40. Keenan, J. P., Ganis, G., Freund, S., & Pascual-Leone, A. (2000). Self-face identification is increased with left hand responses. Laterality, 5(3), 259-268. doi:10.1080/713754382
41. Keenan, J. P., Freund, S., Hamilton, R. H., Ganis, G., & Pascual-Leone, A. (2000). Hand response differences in a self-face identification task. Neuropsychologia, 38(7), 1047-1053. doi:10.1016/s0028-3932(99)00145-1
42. Keenan, J. P., McCutcheon, B., Freund, S., Gallup, G. G., Jr, Sanders, G., & Pascual-Leone, A. (1999). Left hand advantage in a self-face recognition task. Neuropsychologia, 37(12), 1421–1425. https://doi.org/10.1016/s0028-3932(99)00025-1
43. Keenan, J. P., Nelson, A., O'Connor, M., & Pascual-Leone, A. (2001). Self-recognition and the right hemisphere. *Nature, 409*, 305.
44. Keenan, J. P., Wheeler, M., Platek, S. M., Lardi, G., & Lassonde, M. (2003). Self-face processing in a callosotomy patient. *European Journal of Neuroscience, 18*, 2391-2395.
45. Keenan, J. P., Gallup, G. G., & Falk, D. (2003). *The face in the mirror: The search for the origins of consciousness*. New York, NY: HarperCollins Publishers Inc.
46. Kelly, K., Murray, E., Barrios, V., Gorman J., Ganis, G., & Keenan, J. P. (2009) The effect of deception on motor cortex excitability. Social Neuroscience 4:6570-574.
47. Keysers C., Fadiga L. (2008). The mirror neuron system: new frontiers. Soc. Neurosci. 3, 193–198
48. Klichowski, M., & Kroliczak, G. (2020). Mental Shopping Calculations: A Transcranial Magnetic Stimulation Study. Frontiers in Psychology, 11, 1930. Retrieved from https://www.frontiersin.org/article/10.3389/fpsyg.2020.01930

49. Kim, D. R., Wang, E., McGeehan, B., Snell, J., Ewing, G., Iannelli, C., O'Reardon, J. P., Sammel, M. D., & Epperson, C. N. (2019). Randomized controlled trial of transcranial magnetic stimulation in pregnant women with major depressive disorder. Brain Stimulation, 12(1), 96–102.
50. Kircher, T. T., Brammer, M., Bullmore, E., Simmons, A., Bartels, M., & David, A. S. (2002). The neural correlates of intentional and incidental self processing. *Neuropsychologia, 40*(6), 683-692.
51. Klomjai W, Katz R, Lackmy-Vallée A. Basic principles of transcranial magnetic stimulation (TMS) and repetitive TMS (rTMS). Ann Phys Rehabil Med. 2015;58(4):208-213. doi:10.1016/j.rehab.2015.05.005
52. Kobayashi, C., Glover, G., & Temple, E. (2008). Switching language switches mind: linguistic effects on developmental neural bases of "Theory of Mind." *Social Cognitive Affective Neuroscience, 3*, 62-70.
53. Kotlewska, I., & Nowicka, A. (2015). Present self, past self and close-other: Event-related potential study of face and name detection. *Biol Psychol, 110*, 201-211. doi:10.1016/j.biopsycho.2015.07.015
54. Krachun C, Lurz R, Mahovetz LM, Hopkins WD. Mirror self-recognition and its relationship to social cognition in chimpanzees. *Anim Cogn*. 2019;22(6):1171-1183. doi:10.1007/s10071-019-01309-7
55. Kubis, N. (2016). Non-Invasive Brain Stimulation to Enhance Post-Stroke Recovery. *Front Neural Circuits*, *10*, 56. doi:10.3389/fncir.2016.00056.
56. Kumru, H., Kofler, M., Valls-Sole, J. & Vidal, J. (2019). Brainstem reflex excitability after high-frequency repetitive transcranial magnetic stimulation in healthy and spinal cord injury subjects. Brain Research Bulletin, 147, 86-91.
57. Lamm, C., Rütgen, M., & Wagner, I. C. (2019). Imaging empathy and prosocial emotions. *Neurosci Lett*, *693*, 49-53. doi:10.1016/j.neulet.2017.06.054
58. Lefaucheur, J. P. (2019). Transcranial magnetic stimulation. *Handb Clin Neurol*, *160*, 559-580. doi:10.1016/b978-0-444-64032-1.00037-0
59. Lieberman, M. D. (2007). Social cognitive neuroscience: A review of core processes. *Annual Review of Psychology*, 58, 259-289.
60. Li, W., Mai, X., & Liu, C. (2014). The default mode network and social understanding of others: what do brain connectivity studies tell us. *Front Hum Neurosci*, *8*, 74. doi:10.3389/fnhum.2014.00074
61. Liu G, Zhang N, Teoh JY, et al. Self-compassion and dorsolateral prefrontal cortex activity during sad self-face recognition in depressed adolescents [published online ahead of print, 2020 Jul 23]. *Psychol Med*. 2020;1-10. doi:10.1017/S0033291720002482
62. Lou, H., Luber, B., Crupain, M., Keenan, J.P., Nowak, M., Kjaer, T.W., Sackhein, H.A., & Lisanby, S.H. (2004). Parietal cortex and representations of the mental self. *Proceedings of the National Academy of Science, 101*(17), 6827-6832.
63. Lou, H. C., Luber, B., Stanford, A., & Lisanby, S. H. (2010). Self-specific processing in the default network: A single-pulse TMS study. *Experimental Brain Research, 207*(1-2), 27-38.
64. Maeda, F., Keenan, J. P., Tormos, J. M., Topka, H., & Pascual-Leone, A. (2000). Modulation of corticospinal excitability by repetitive transcranial magnetic stimulation. *Clin Neurophysiol, 111*(5), 800-805. doi:10.1016/s1388-2457(99)00323-5
65. Ma, Y., & Han, S. (2010). Why we respond faster to the self than to others? An implicit positive association theory of self-advantage during implicit face recognition. J Exp Psychol Hum Percept Perform, 36(3), 619-633. doi:10.1037/a0015797
66. Mitchell, J.P., Banaji, M.R., & Macrae, C.N. (2005). The link between social cognition and self-referential thought in the medial prefrontal cortex. *Journal of Cognitive Neuroscience, 17*(8), 1306-1315.
67. Molnar-Szakacs, I., Uddin, L. Q., & Iacoboni, M. (2005). Right-hemisphere motor facilitation by self-descriptive personality-trait words. *Eur J Neurosci, 21*(7), 2000-2006. doi:10.1111/j.1460-9568.2005.04019.x
68. Morita, T., Asada, M., & Naito, E. (2020). Right-hemispheric Dominance in Self-body Recognition is Altered in Left-handed Individuals. Neuroscience, 425, 68-89. doi:10.1016/j.neuroscience.2019.10.056
69. Morita, T., Itakura, S., Saito, D. N., Nakashita, S., Harada, T., Kochiyama, T., & Sadato, N. (2008). The role of the right prefrontal cortex in self-evaluation of the face: a functional magnetic resonance imaging study. J Cogn Neurosci, 20(2), 342-355. doi:10.1162/jocn.2008.20024
70. Moriguchi, Y., Ohnishi, T., Lane, R. D., Maeda, M., Mori, T., Nemoto, K., Matsuda, H., & Komaki, G. (2006). Impaired self-awareness and theory of mind: an fMRI study of mentalizing in alexithymia. NeuroImage, 32(3), 1472–1482. https://doi.org/10.1016/j.neuroimage.2006.04.186
71. Naito, E., Morita, T., Saito, D. N., Ban, M., Shimada, K., Okamoto, Y., . . . Asada, M. (2017). Development of Right-hemispheric Dominance of Inferior Parietal Lobule in Proprioceptive Illusion Task. Cereb Cortex, 27(11), 5385-5397. doi:10.1093/cercor/bhx223
72. Northoff, G., Bermpohl, F. (2004). Cortical midline structures and the self. *Trends in Cognitive Science, 8*(3), 102-107.
73. Novembre, G., Ticini, L. F., Schütz-Bosbach, S., & Keller, P. E. (2012). Distinguishing self and others in joint action. Evidence from a musical paradigm. *Cereb Cortex, 22*(12), 2894-2903. doi:10.1093/cercor/bhr364
74. Oschner, K.N., Beer, J.S., Robertson, E. R., Cooper, J. C., Gabrielli, J.D.E., Kihsltrom, J.F. & D'Esposito. (2005). The neural correlates of direct and reflected self-knowledge. *NeuroImage*, 28, 797-814.
75. Pascual-Leone, A., Bartres-Faz, D., & Keenan, J. P. (1999). Transcranial magnetic stimulation: studying the brain-behaviour relationship by induction of "virtual lesions". *Philosophical Transactions of the Royal Society B: Biological Sciences*, *354*(1387), 1229–1238.
76. Patel, G. H., Sestieri, C., & Corbetta, M. (2019). The evolution of the temporoparietal junction and posterior superior temporal sulcus. *Cortex, 118*, 38-50. doi:10.1016/j.cortex.2019.01.026
77. Perner, J., & Lang, B. (1999). Development of theory of mind and executive control. *Trends in Cognitive Sciences*, *3*(9), 337-344.

78. Pfeiffer, U. J., Schilbach, L., Timmermans, B., Kuzmanovic, B., Georgescu, A. L., Bente, G., & Vogeley, K. (2014). Why we interact: On the functional role of the striatum in the subjective experience of social interaction. *NeuroImage, 101*, 124-137
79. Platek, S. M., Critton, S. R., Myers, T. E., & Gallup, G. G. (2003). Contagious yawning: The role of self-awareness and mental state attribution. *Cognitive Brain Research, 17*(2), 223-227.
80. Platek, S. M., Keenan, J. P., Gallup, G. G., Mohamed, F. B. (2004). Where am I? The neurological correlates of self and other. *Cognitive Brain Research*, 19, 114-122.
81. Platek, S. M. (2010). Yawn, Yawn, Yawn, Yawn; Yawn, Yawn, Yawn! The Social, Evolutionary and Neuroscientific Facets of Contagious Yawning. *The Mystery of Yawning in Physiology and Disease Frontiers of Neurology and Neuroscience,* 107-112.
82. Preilowski, B. (1977). Self-recognition as a test of consciousness in left and right hemisphere of "split-brain" patients. *Activitas Nervosa Superior (Praha), 19* (Suppl. 2), 343-344.
83. Prencipe, A., & Zelazo, P. (2005). Development of Affective Decision Making for Self and Other: Evidence for the Integration of First- and Third-Person Perspectives. *Psychological Science, 16*(7), 501-505.
84. Quesque, F., & Brass, M. (2019). The Role of the Temporoparietal Junction in Self-Other Distinction. *Brain Topogr, 32*(6), 943-955. doi:10.1007/s10548-019-00737-5
85. Richardson, H., Koster-Hale, J., Caselli, N., Magid, R., Benedict, R., Olson, H., Pyers, J., & Saxe, R. (2020). Reduced neural selectivity for mental states in deaf children with delayed exposure to sign language. *Nature communications*, *11*(1), 3246. https://doi.org/10.1038/s41467-020-17004-y
86. Richter, M.M., Ehlis, A..C., Jacob, C..P., Fallgatter, A.J. (2007) Cortical excitability in adult patients with attention-deficit/hyperactivity disorder (ADHD). *Neuroscience Letters*, 419, 137-141.
87. Rossini, P. M., Barker, A. T., Berardelli, A., Caramia, M. D., Caruso, G., Cracco, R. Q., Dimitrijević, M. R., Hallett, M., Katayama, Y., & Lücking, C. H. (1994). Non-invasive electrical and magnetic stimulation of the brain, spinal cord and roots: basic principles and procedures for routine clinical application. Report of an IFCN committee. Electroencephalography and clinical neurophysiology, 91(2), 79–92. https://doi.org/10.1016/0013-4694(94)90029-9
88. Rutherford, M. D., Baron-Cohen, S., & Wheelwright, S. (2002). Reading the Mind in the Voice: A Study with Normal Adults and Adults with Asperger Syndrome and High Functioning Autism. *Journal of Autism & Developmental Disorders, 32*(3), 189-195.
89. Sabbagh M. A. (2004). Understanding orbitofrontal contributions to theory-of-mind reasoning: implications for autism. Brain and cognition, 55(1), 209–219. https://doi.org/10.1016/j.bandc.2003.04.002
90. Schaefer, M., Xu, B., Flor, H., & Cohen, L. G. (2009). Effects of different viewing perspectives on somatosensory activations during observation of touch. *Human Brain Mapping, 30*(9), 2722-2730.
91. Schaefer, M., Heinze, H., & Rotte, M. (2012). Embodied empathy for tactile events: Interindividual differences and vicarious somatosensory responses during touch observation. *NeuroImage, 60*(2), 952-957.
92. Schilbach, L., Ritzl, A., Krämer, NC., Newen, A., Zilles, K., Fink, G.R., & Vogeley, K. (2006) Being with virtual others: Neural correlates of social interaction. *Neuropsychologia* 44, 718-730.
93. Schurz, M., Radua, J., Aichhorn, M., Richlan, F., & Perner, J. (2014). Fractionating theory of mind: a meta-analysis of functional brain imaging studies. *Neurosci Biobehav Rev, 42*, 9-34. doi:10.1016/j.neubiorev.2014.01.009
94. Seger, C.A., Stone, M., Keenan, J.P. (2004). Cortical activations during judgements about the self and an other person. *Neuropsychologia*, 42, 1168-1177.
95. Sherwood, C. C., Stimpson, C. D., Raghanti, M. A., Wildman, D. E., Uddin, M., Grossman, L. I., . . . Hof, P. R. (2006). Evolution of increased glia-neuron ratios in the human frontal cortex. *Proc Natl Acad Sci U S A, 103*(37), 13606-13611. doi:10.1073/pnas.0605843103
96. Smith, R., & Lane, R. D. (2015). The neural basis of one's own conscious and unconscious emotional states. *Neurosci Biobehav Rev, 57*, 1-29. doi:10.1016/j.neubiorev.2015.08.003
97. Sperry, R. W., Zaidel, E., & Zaidel, D. (1979). Self recognition and social awareness in the deconnected minor hemisphere. *Neuropsychologia, 17*(2), 1979, 153-166.
98. Stuss, D.T., Gallup, G.G., Alexander, M.P. (2001). The frontal lobes are necessary for 'theory of mind'. *Brain*, 124, 279-286.
99. Sugiura, M., Miyauchi, C. M., Kotozaki, Y., Akimoto, Y., Nozawa, T., Yomogida, Y., Hanawa, S., Yamamoto, Y., Sakuma, A., Nakagawa, S., & Kawashima, R. (2014). Neural Mechanism for Mirrored Self-face Recognition. *Cerebral Cortex (New York, NY), 25*(9), 2806–2814.
100. Sugiura M, Mano Y, Sasaki A, Sadato N. Beyond the memory mechanism: person-selective and nonselective processes in recognition of personally familiar faces. *J Cogn Neurosci*. 2011;23(3):699-715. doi:10.1162/jocn.2010.21469
101. Taylor, J.G. (2001). The central role of the parietal lobes in consciousness. *Consciousness and Cognition*, 10, 379-417.
102. Théoret, H., Kobayashi, M., Merabet, L., Wagner, T., Tormos, J., & Pascual-Leone, A. (2004). Modulation of right motor cortex excitability without awareness following presentation of masked self-images. *Cognitive Brain Research, 20*, 54-57.
103. Tullett, A. M., Harmon-Jones, E., & Inzlicht, M. (2012). Right frontal cortical asymmetry predicts empathic reactions: support for a link between withdrawal motivation and empathy. *Psychophysiology*, *49*(8), 1145–1153. https://doi.org/10.1111/j.1469-8986.2012.01395.x
104. Uddin LQ, Kaplan JT, Molnar-Szakacs I, Zaidel E, & Iacoboni M. (2005) Self-face recognition activates a frontoparietal "mirror" network in the right hemisphere: an event-related fMRI study. *Neuroimage.* 2005;25:926–935.
105. Uddin, L. Q., Iacoboni, M., Lange, C., & Keenan, J. P. (2007). The self and social cognition: The role of cortical midline structures and mirror neurons. *Trends in Cognitive Sciences, 11*(4), 153-157.

106. Vogeley, K., Bussfeld, P., Newen, A., Herrmann, S., Happe, F., Falkai, P., Maier, W., Shah, N. J., Fink, G. R., & Zilles, K. (2001). Mind reading: Neural mechanisms of theory of mind and self-perspectives. *Neuroimage, 14*, 170-181.
107. Vogeley, K. May, M., Ritzl, A., Falkai, P., Zilles, K., Fink, G.R. (2004). Neural correlates of first-person-perspective as one constituent of human self-consciousness. *Journal of Cognitive Neuroscience* 16, 817-827.
108. Vucurovic, K., Caillies, S., & Kaladjian, A. (2020). Neural correlates of theory of mind and empathy in schizophrenia: An activation likelihood estimation meta-analysis. *J Psychiatr Res, 120*, 163-174. doi:10.1016/j.jpsychires.2019.10.018
109. Vucic, S., van den Bos, M., Menon, P., Howells, J., Dharmadasa, T., & Kiernan, M. C. (2018). Utility of threshold tracking transcranial magnetic stimulation in ALS. *Clin Neurophysiol Pract, 3*, 164-172. doi:10.1016/j.cnp.2018.10.002
110. Wasserman, E.M. (1998). Risks and safety of repetitive transcranial magnetic stimulation. *Electroencephalography Clinical Neurophysiology, 108*, 1-16.
111. Wasserman, E.M., Grafman, J., Berry, C., et al. (1996). Use and safety of a new transcranial magnetic stimulator. *Electroencephalography Clinical Neurophysiology, 101*, 412-417.
112. Werner, B., von Ramin, E., Spruyt, A., & Rothermund, K. (2018). Does sunshine prime loyal … or summer? Effects of associative relatedness on the evaluative priming effect in the valent/neutral categorisation task. Cognition and Emotion, 32(1), 222-230. doi:10.1080/02699931.2017.1282855
113. Wolpert DM, Goodbody SJ, Husain M. Maintaining internal representations: the role of the human superior parietal lobe. *Nat Neurosci*. 1998;1(6):529-533. doi:10.1038/2245
114. Zhao, W., Yao, S., Li, Q., Geng, Y., Ma, X., Luo, L., . . . Kendrick, K. M. (2016). Oxytocin blurs the self-other distinction during trait judgments and reduces medial prefrontal cortex responses. Hum Brain Mapp, 37(7), 2512-2527. doi:10.1002/hbm.23190
115. Zis, P., Shafique, F., Hadjivassiliou, M., Blackburn, D., Venneri, A., Iliodromiti, S., Mitsikostas, D. D., & Sarrigiannis, P. G. (2019). Safety, Tolerability, and Nocebo Phenomena During Transcranial Magnetic Stimulation: A Systematic Review and Meta-Analysis of Placebo-Controlled Clinical Trials. *Neuromodulation*. doi:10.1111/ner.12946
116. Zysset, S., Huber, O., Samson, A., Ferstl, E., & Yves von Cramon, D. (2002). Functional specialization within the anterior medial prefrontal cortex: a functional magnetic resonance imaging study with human subjects. *Neuroscience Letters*, 335, 183-186.