



Libyan International Medical University
Faculty of Basic Medical Science



**Mirror touch synesthates compared with individuals
by social cognition tests**

Mohamed Eljazwi

Supervised by: Dr. Abeer Muftah

Assisted by: Dr. Rehan

Report Submitted to fulfill the requirements for Scientific Research Activity

Date of Submission: 27/2/ 2020

Abstract

Individuals with mirror touch synaesthesia (MTS) phenomenon experience touch on their own body whilst observing others being touched. A recent study proposes that such rare experiences could be linked to dysfunction in self-other representations. Here we tested individuals with MTS on a number of social cognition tests and Found that comparing it to non-synaesthete controls, the MTS group showed dysfunction in imitation-inhibition but not in visual perspective taking or theory of mind. Even though all of these socio-cognitive abilities depend on the control of self other representations, they differ as to whether the self, or other, should enhance or inhibit the representation. In the visual perspective taking and in the theory of mind tasks the representation of the other should be enhanced and the self-representation should be inhibited, whereas the opposite is true for the imitation-inhibition task where they show self enhancement and other inhibition . The findings of this study suggest that MTS is associated with a specific deficit in inhibiting representation of other individuals and shed light on the functioning of the processes underlying typical social cognition.

Introduction

Synesthesia is a group of rare neurologic phenomenon in which a single sense is perceived as if one or more sensations are sensed. Synesthesia can be divided into two major categories;

First of all there is projective synesthesia in which the synesthete can see, hear, feel, smell or taste the second sensation which is triggered by the initial stimulus. An example of this is a synesthete smelling apples whenever they hear a piano playing a certain note. The smell of the grapes is as real for the synesthete as the sound they are hearing. ⁽¹⁾

The second major category is associative synesthesia. Synesthetes who are categorized in this group feel the connection between a stimulus and a sense by which it is not normally perceived. In the above example, while a synesthete with associative synesthesia will not smell grapes, they will feel a strong association between piano music and the smell of grapes. There is to our knowledge, some gray area between these two types of synesthesia, as there are synesthetes who describe their experiences in both a projected and associative manner, with the types occurring both independently and in a mixed or concurrent fashion. ⁽¹⁾

There are about 60 types synesthesia but the most common types are: 1. Grapheme-Color Synesthesia 2. Ordinal Linguistic Personification 3. Chromesthesia 4. Spatial Sequence Synesthesia 5. Mirror-Touch Synesthesia 6. Auditory- Tactile Synesthesia 7. Number Form Synesthesia 8. Lexical- Gustatory (And Sound-Gustatory) Synesthesia 9. Misophonia. ⁽²⁾

Mirror touch synesthesia is the most electrifying neurologic condition where the mirror touch synesthete experiences the same tactile sensation they visualize. If an individual is slapped on the right cheek, the mirror touch synesthete will experience the same sensation on his left cheek. ⁽³⁾

Aim of this report

Is to show that mirror touch synesthetes show dysfunctional correlation in social cognition tests

Methods and materials

Participants: Sixteen mirror touch synaesthetes (10=female , 6=male, age M=32,SD=12.2 years) and sixteen non synaesthetic control participated in this study. All mirror touch synaesthetes were confirmed using a visual-tactile congruity paradigm that provides evidence for the authenticity of the condition.⁽⁴⁾

The procedure: The participants completed three tasks which are: The imitation- inhibition task, the visual perspective-taking task and the theory of mind task

In Imitation-inhibition task the participants were told to respond with and index(index=1) or middle(middle=2)finger that appeared between the fingers on a stimulus hand on screen. With the appearance of the number cue, the stimulus hand executed a lifting movement of either the index or middle depending on the number. The relationship between the observed movement and the movement induced by the number cue defined two trail types.⁽⁴⁾

On the congruent trail the required movement was the same as the observed movement, on the other hand the incongruent trails the required finger movement was different from the observed movement. Meaning the incongruent trails, the participants were required to inhibit the tendency to imitate the stimulus hand.so the self-representation are enhanced and other representations are inhibited.

The perspective-taking task Required the participants to copy the idea of a ‘director’ who instructs

to move objects on a shelf. In the experimental trials it involved a conflict between the director and the participant's perspective, showing control of self and other representations was necessary for accurate performance. In contrast to the imitation-inhibition task, performance on this task requires enhancement of the other and inhibition of the self perspective.

The theory of mind was measured with the movie assessment of social cognition they watched a 15 minute film and were asked about the mental states of the characters. In the film it shows four people socially interacting. The video was paused at various points and participants are required to answer a multiple-choice question about the latest scene. Two types of questions were asked : theory of mind (e.g., "why is Cliff saying this?") and other control questions (e.g., "what kind of pasta sauce are the characters preparing?"). Errors of the MASC are of three types (complete lack of, insufficient, or excessive/over-interpretative mental state reasoning) ⁽⁴⁾

Results

Imitation-inhibition task

Three of MTS participants reported a 'tingling' sensation in some of the trials. To avoid any additional tactile sensations contributing to performance, the three participants were removed from the analysis. The response times (RT) from the remaining participants (MTS N = 13, controls N = 16) were analysed using the ANOVA (Analysis of variance) with Group as the between-subjects factor (MTS vs. Control) and Trial Type as the within-subject factor (Congruent vs. Incongruent).

participants responded faster on congruent than on incongruent trials. The results MTS group were slower at responding to both types of trials than the Control group. The Group × Trial Type interaction was also significant. Simple effects analysis shows that this interaction was driven by the MTS group taking longer when responding to incongruent trials than the control group whereas the group comparison for congruent trials was not significant, indicating that the mirror touch synesthetes found it more difficult to inhibit the tendency to imitate than did participants from the control group. These results confirm the greater difficulty experienced by the mirror-touch synesthetes when required to control self-other representations. ⁽⁴⁾

Visual Perspective

Faulty equipment lead to the data from 4 participants in the MTS group were not recorded. The accuracy and RT data from the remaining participants (MTS N = 12; controls N = 16) are reported below. As no significant differences were found between the two types of control trials, data was analyzed as a single control trial. An ANOVA was performed experimental vs. control as the within-subjects factor. ⁽⁴⁾

RT

The results showed Participants responded faster to the control trials than to the experimental trials. No other main effects or interactions were significant. Notably, performance on experimental trials by the synesthetes was the same as controls suggesting that perspective-taking abilities are not impaired in MTS ⁽⁴⁾

Theory of Mind

The MASC data was taken on two different analysis. The first analysis included the accuracy rate for theory of mind and control questions and the second was to investigate if there were group differences in the type of errors participants made. The first analysis revealed that overall, participants' accuracy was higher for control questions than for questions requiring mental state attribution. Neither the main effect of Group, nor the Group \times Question Type interaction were significant. The analysis of error data revealed a significant main effect of Error Type, pairwise comparisons showed that overall, participants made more excessive theory of mind errors than errors reflecting either insufficient theory of mind or lack of theory of mind ability. performance of the crucial experimental condition (theory of mind questions) was high on both groups, these results imply that mirror-touch synesthetes' ability to attribute mental states to other individuals remains unimpaired. ⁽⁴⁾

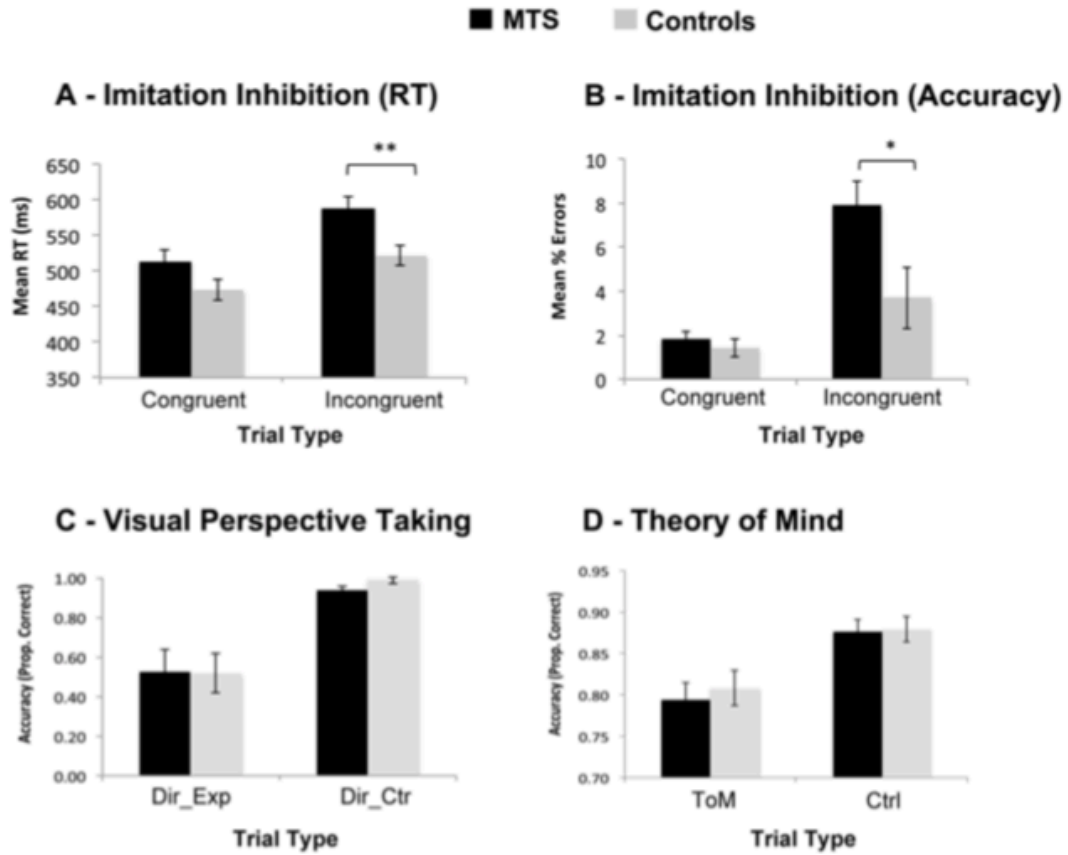


Figure 1. Mirror-touch synaesthetes (MTS, black bars) show selective impairment in imitation inhibition (A and B), but not in visual perspective taking and theory of mind (C and D) compared to a matched control group (grey bars).

Discussion

This study was done to investigate if individuals with MTS display unusual self-other processing as measured by three different socio-cognitive abilities. The results from the imitation-inhibition task indicate that mirror-touch synesthetes have difficulties in self-other processing, as implied by their impaired performance on incongruent trials compared to control participants. These data provide further support for the hypothesis of faulty self-other monitoring mechanisms in MTS. However, no performance differences were observed between the synesthetes and control participants in either visual perspective-taking or theory of mind.⁽⁵⁾ Successful performance on the imitation-inhibition task requires participants to inhibit other representations and enhance self-representations. In contrast, to perform accurately in the visual perspective-taking and theory of mind tasks participants should enhance other representations and inhibit self-representations. The fact that individuals with MTS perform poorly on the imitation-inhibition test, while their visual perspective taking and theory of mind abilities remain intact, suggests that faulty self-other processing in mirror touch synesthetes might be limited to situations in which representations of the other should be suppressed but not when they should be enhanced. The relationship between imitation inhibition and visual perspective taking is not as straight forward.⁽⁶⁾ Differences were found between the MTS and control groups; although the non-synesthete participants showed similar interference effects (RT) in both tasks, they found it more difficult when the requirement was to inhibit other and enhance self during the imitation-inhibition task.. While a variety of features appear to be shared between traditional forms of synesthesia⁽⁷⁾ and mirror-sensory experiences, it has been argued that overt mirror-sensory experiences do not constitute a form of synesthesia because a) the experiences are limited to a single synesthetic inducer (i.e. the stimulus that evokes synesthesia) and the concurrent experiences (i.e. the experience that is evoked by the inducer) in conditions like MTS appear more systematic than idiosyncratic. In the finding it showed that individual with MTS show difficulties inhibiting representation of another's action in the absence of any other experience suggesting that unlike other types of synesthesia.⁽⁸⁾ MTS can be induced by 15 functioning mechanisms that interact interactions between self- other processing and vicarious representations that are present in us all. In this regard, one may consider MTS as an instance of atypical self-other processing that is characterized by visually induced tactile sensations, rather than a traditional form of synaesthesia per se.⁽⁹⁾

Conclusion

Each task showed different results, In the imitation inhibition task showed self enhancement and other inhibition on the other hand the visual perspective taking and the theory of mind tasks showed self inhibition and other enhancement. Three theories are believed to explain what really happens in the brain of a mirror touch synesthate

Future work

fMRI scans show enhanced imaging in the region of mirror neurons suggesting that overactivity of these regions conduct that the mirror neurons are firing at an undefined rate this could help to understand the physiology of this phenomenon. Trails are still under progress to identify what theory explains the hypothesis of mirror touch synesthesia.

References

1. Ward, J. (2013). Synesthesia. *Ann Rev Psychol.*, *64*, 49-75. doi:10.1146/annurev-psych-113011-14384
2. Ward, J., & Banissy, M.J. (In Press). Explaining mirror-touch synaesthesia. *Cognitive Neuroscience*
3. Maister, L., Banissy, M. J., & Tsakiris, M. (2013). Mirror-touch synaesthesia changes representations of self-identity. *Neuropsychologia*, *51*(5), 802-8. doi:10.1016/j.neuropsychologia.2013.01.020
4. Santiesteban I, Bird G, Tew O, Cioffi MC, Banissy MJ. Mirror-touch synaesthesia: Difficulties inhibiting the other. *Cortex; a Journal Devoted to the Study of the Nervous System and Behavior*. 2015 Oct;71:116-121. DOI: 10.1016/j.cortex.2015.06.019.
5. Holle, H., Banissy, M., Wright, T., Bowling, N., & Ward, J. (2011). "That's not a real body": Identifying stimulus qualities that modulate synaesthetic experiences of touch. *Conscious Cogn.*, *20*(3), 720-6. doi:10.1016/j.concog.2010.12.002
6. Holle, H., Banissy, M. J., & Ward, J. (2013). Functional and structural brain differences associated with mirror-touch synaesthesia. *NeuroImage*, *83*, 1041-50. doi:10.1016/j.neuroimage.2013.07.073
7. Banissy, M. J., & Ward, J. (2007). Mirror-touch synesthesia is linked with empathy. *Nat Neurosci.*, *10*(7), 815-6. doi:10.1038/nn1926
8. Banissy, M. J., Cohen Kadosh, R., Maus, G., Walsh, V., & Ward, J. (2009). Prevalence, characteristics, and a neurocognitive model of mirror-touch synaesthesia. *Exp Brain Res.*, *198*, 261-272.
9. Banissy, M. J., & Ward, J. (2013). Mechanisms of self-other representations and vicarious experiences of touch in mirror-touch synesthesia. *Front Hum Neurosci.*, *7*, 112. doi:10.3389/fnhum.2013.00112

