# Rorschachiana

## The Effects of Neurological Priming on the Rorschach: A Pilot Experiment on the Human Movement Response

--Manuscript Draft--

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| **Keywords:** | Neurological Priming; Rorschach; Human Movement; Mirror Neurons. |
| **Abstract:** | This article introduces a new scientific paradigm that might allow to investigate the neurological correlates of the Rorschach test without using expensive and time-consuming tools such as the fMRI or the EEG. Based on the literature on the 'Mozart effect', we anticipated that pre-activation of a given brain network before exposure to the Rorschach cards would associate with increased production of responses (or determinants) presumed to associate with that same network. To pilot test this hypothesis, we focused on the postulated link between human movement (M) responses and mirror neuron system (MNS) activity, and investigated whether pre-activation of the MNS would associate with increased production of M responses. Specifically, 30 students were administered a subset of Rorschach cards immediately after watching three short videos aimed at activating the MNS at three different levels (no/low/high activation). Although no statistically significant differences among the three conditions were found, a linear trend in the expected direction ($p = 0.107$), with medium effect size ($Eta^2 = .087$) was observed. In addition to providing information on the M response, this article introduces a new scientific paradigm to investigate the neurological correlates of the Rorschach. |
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Running Head: RORSCHACH AND NEUROLOGICAL PRIMING

# The Effects of Neurological Priming on the Rorschach: A Pilot Experiment on the Human Movement Response

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# The Effects of Neurological Priming on the Rorschach: A Pilot Experiment on the Human Movement Response

In the last few decades, it has been proposed that the pre-activation of certain areas of the cortex might "prime" behaviors and competences that are related to such neural areas. One of the most famous examples of this phenomenon – also called "neurological priming" – is probably the Mozart effect, which was discussed for the first time in a 1993 issue of *Nature*. In the study, Rauscher, Shaw, and Ky (1993) observed that brief exposure to Mozart's "Sonata for Two Pianos in D Major, K.448" led to higher short-term enhancement of spatial intelligence scores as compared to exposure to silence or a relaxation tape. These initial findings were later replicated or extended by the same authors (e.g., Rauscher & Shaw, 1998; Rauscher, Shaw, & Ky, 1995) and other researchers (e.g., Auon, Jones, Shaw, & Bodner 2005; Ho, Mason & Spence, 2007; Rauscher, Robinson, & Jens, 1998). According to Rauscher, Shaw, and Ky (1993), the higher spatial performance after exposure to Mozart's sonata might be the result of the music priming the brain for spatial activity. Indeed, both musical (Bever & Chiarello, 1974), spatial (De Renzi, 1982; Desrocher, Smith, & Taylor, 1995; Kimura, 1969), and attentional (Liederman, 1986; Mesulam, 1981) processing are thought to be associated with right hemisphere activation (Leng & Shaw, 1991). Thus, listening to Mozart's music might activate brain areas that are also involved in spatial processing, and this, in turn, might prime spatial cognition such that spatial performance is improved.

Although there is some controversy (e.g., Newman, Rosenbach, Burns, Latimer, Matocha & Vogt, 1995; Steele, Ball, & Runk, 1997; Stough, Kerkin, Bates, & Mangan, 1994), such a neurological explanation for the Mozart priming effect is supported by several studies. First, listening to Mozart's music not only improves spatial performance but also affects brain functioning, as indicated by electroencephalography (EEG) recordings (Jausovec & Habe, 2005). In addition, not only spatial abilities but also visuo-spatial attention – another function of the right hemisphere – improves after listening to Mozart (Ho et al., 2007). Moreover, Rideout, Dougherty, and Wernert (1998) found that a similar effect to the Mozart effect could also be observed by using Yanni's "Acroyali/Standing in Motion", a musical composition deemed to be similar to the Mozart piece used in the first study. Furthermore, the Mozart effect occurs in non-musicians, who process melodic information exclusively in the right hemisphere, but not in musicians, who process melodic information in both hemispheres (Aheadi, Dixon, & Glover, 2009). Other evidence also supports this view (Chokron, Bartolomeo, Colliot, & Auclair, 2002; Coupard & Kapoula, 2005; Kittler & Turkewitz, 1999; Mildner, 2002).

The phenomenon of "neurological priming" finds a theoretical foundation in the trion model of the cortical column (Leng & Shaw, 1991; McGrann, Shaw, Silverman & Pearson, 1991; Shaw, Silverman & Pearson, 1985, 1988; Silverman, Shaw & Pearson, 1986), which is a mathematical representation of Mountcastle's (1978) columnar model of the cerebral cortex. Roughly speaking, the main idea of the model is that small units of neurons have different levels of firing activity, and different clusters of these units can produce complex spatial-temporal firing patterns. As a result, a change in a few units or clusters can affect broader patterns of spatial-temporal firing. In line with this model, similar units or clusters of neurons might fire, for example, when either listening to music or doing activities requiring spatial ability (Leng & Shaw, 1991). Accordingly, listening to music might affect and prime multiple patterns of spatial-temporal firing, including those that are related to the execution of tasks requiring spatial ability, i.e., hearing Mozart's music might 'warm-up' neurons prior to completing a spatial task, thus improving the performance (Rauscher, Shaw, & Ky, 1993).

The idea that pre-activating specific cerebral regions might prime functions related to such regions also comes from many other research areas. For example, Reuter-Lorenz, Kinsbourne and Moscovitch (1990) have shown that activating the left hemisphere by requiring to complete a verbal task leads to an improvement in other tasks processed by the left hemisphere, such as processing times or efficiency for information presented. As another example, Brunel, Lesourd, Labeye and Versace (2010), investigating the sensory priming effects in semantic categorization, have recently suggested that a facilitatory effect could be explained in terms of pre-activation of auditory areas. A further example, Sterr (2006), working on the response-priming paradigm (Neumann & Klotz, 1994; Vorberg, Mattler, Heinecke, Schmidt, & Schwarzbach, 2003), has proposed that performance differences between response and no-response priming conditions may be due to different pre-activations of motor regions evoked by the prime stimuli. Many other examples could also be found, especially in research areas dealing with visuomotor priming and action imitation abilities (e.g., Gillmeister, Catmur, Brass & Heyes, 2008; Vogt, Taylor & Hopkins, 2003).

## Neurological Priming and the Rorschach

In recent years there has been increasing interest in the neurological correlates of the Rorschach (Rorschach, 1921), and some fMRI (e.g., Asari et al., 2010a; Asari et al., 2010b) as well as EEG (e.g., Giromini, Porcelli, Viglione, Parolin, & Pineda, 2010; Pineda, Giromini, Porcelli, Parolin, & Viglione, 2011; Porcelli, Giromini, Parolin, Pineda, & Viglione, 2013) studies on this topic have been conducted. However, both EEG and fMRI methodologies require technical neurophysiological knowledge and skills, as well as equipment and monetary resources that may not be available to many Rorschach investigators. Thus, to date the research on the Rorschach has not yet taken full advantage of the recent advances in neuroimaging techniques (see also Meyer, Viglione, & Giromini, 2014).

To advance research on the neurological correlates of the Rorschach, this article introduces a new methodological approach that makes use of the phenomenon of neurological priming. Specifically, we anticipated that pre-activation of a given brain network would associate with increased production of Rorschach responses presumed to associate with that same network. Because of our experience with the topic, we focused on the link between the activity of the mirror neuron system (MNS; di Pellegrino, Fadiga, Fogassi, Gallese, & Rizzolatti, 1992; Gallese, Fadiga, Fogassi, & Rizzolatti, 1996; Rizzolatti, Fadiga, Gallese, & Fogassi, 1996) and the Human Movement response to the Rorschach (M; Exner, 2003; Meyer, Viglione, Mihura, Erard, & Erdberg, 2011).

**M Responses and MNS.** In the Rorschach, the M code is typically scored when the respondent perceives a response object engaged in a human movement, with the described movement reflecting a human activity (e.g., “two people dancing”). Because the Rorschach inkblots do not move, the movement is not a characteristic of the stimulus, but rather something that the respondent adds to it. Accordingly, it is deemed that M responses reveal important information about the personality and functioning of the respondents (Exner, 2003; Malmgren, 2000; Meyer et al., 2011; Rorschach, 1921). Rorschach (1921), in particular, firmly believed that the M response reflects an identification mechanism, so that Ms would be central to the interpretation of the test.  In line with this view – albeit with some theoretical differences – almost all other Rorschach authorities have conceived the Ms as one of the best sources of information about the respondent’s inner life, human representations, personality dynamics, and functioning (e.g., Beck, 1944; Mayman, 1977; Piotrowski, 1977; Rapaport, Gill, & Schafer, 1946). Thus, it is not surprising that both the Comprehensive System (CS; Exner, 2003) and the Rorschach Performance Assessment System (R-PAS; Meyer et al., 2011) have retained the M code.

Because the M presumably depends on an identification mechanism, and likely reveals important information about the individual's ability to identify with and understand another person, a few years ago Giromini et al. (2010) hypothesized that M responses would occur with MNS activity. Indeed, the MNS is supposed to be directly responsible for embodied simulation (Gallese, 2003) – a mechanism through which viewing movement performed by another person automatically activates in the observer the internal representations of the body states associated with such movement, as if the observer was performing, rather than just observing, that same movement (Freedberg & Gallese, 2007). Furthermore, the MNS is considered the neural basis for unique human skills such as empathy and theory of mind (Gallese, 2003; Rizzolatti & Craighero, 2004). Thus, both the response process presumably behind the production of the M (i.e., an identification/embodied simulation mechanism) and its interpretation (i.e., the M is indicative of high social cognition skills) suggest that the MNS may be involved in the production of M responses.

Support for the link between the M response and the MNS comes from three published articles, based on two independent EEG studies. In a first study, Giromini et al. (2010) administered a subset of Rorschach cards to a small student sample, while recording their EEG. By using the 8-13 Hz EEG frequency suppression over the sensorimotor cortex as an index of MNS activity (for a review, see Pineda, 2005), the authors found the postulated association with M, observing a statistical significance of $p$ = 0.004, and a medium effect size of $\eta^2$ = 0.06. One year later, these findings were replicated with a larger sample size, and using the entire set of Rorschach cards (Pineda et al., 2011). Of note, increasing the sample size and fixing a number of methodological issues produced a larger effect size of $\eta^2 = 0.17$. Lastly, Porcelli et al. (2013) recently re-analyzed the data discussed by Pineda et al. (2011) to test some clinically important distinctions (e.g., M with ordinary form quality vs. M with unusual or distorted form quality), and their results further confirmed that the MNS may be the neural network responsible for the production of M responses.

**The Current Study.** The current study tested whether pre-activation of the MNS is associated with increased production of M responses. On the one hand, this investigation aimed at providing additional information about the link between MNS and M. On the other hand, we also aimed at introducing a new scientific and experimental paradigm to investigate the neurological correlates of the Rorschach. Given that this new approach does not require any particular resources or technical skills (e.g., it does not need an EEG or fMRI equipment), we anticipate that it might be used by many Rorschach researchers, in various circumstances, to investigate the neurological correlates of various Rorschach responses. Given the small sample size and other technical limitations, however, this study is to be intended only as a pilot or demonstration study.

## Materials and Methods

Thirty students were administered a subset of three Rorschach cards immediately after watching three short videos aimed at activating the MNS at three different levels. It was anticipated that if the M response was linked to MNS activity, then the participants would produce more M responses when exposed to the videos that elicit higher activation of the MNS, as a result of a neurological priming.

## Participants

The sample was composed of 30 students of the University of Milano-Bicocca, ranging in age from 18 to 25 years (*M* = 22.6; *SD* = 4.3). Sixty percent (*n* = 18) of them were female. All were Italian citizens and spoke Italian. Although they were college-level psychology students, nobody attended any Rorschach classes before volunteering for the experiment. All received class credit for their participation.

## Priming Stimuli & Rorschach Presentation

The stimuli consisted of three videos and three Rorschach cards. The videos were taken from Oberman, Pineda and Ramachandran (2007), with the purpose to activate the MNS of the participants at different levels. One video (A; baseline, no activation) consisted of a full-screen television static (mean luminance 3.7 $cd/m^2$); one video (B; low MNS activation) showed three individuals tossing a ball up in the air to themselves; one video (C; high MNS activation) showed the same three individuals tossing a ball to each other and occasionally throwing the ball off the screen toward the viewer. Thus, MNS activation increases from video A, to B, to C (Oberman et al., 2007), so that we anticipated that the production of M responses would follow the same pattern, with the greatest number of M responses in condition C, that is after exposure to video C.

The three Rorschach cards (cards II, III, and VII) with the greatest M response frequency (Exner & Erdberg, 2005) were selected so as to avoid problems with repeating the videos while maximizing effect size and statistical power. Each of the three cards was presented three times, one per condition: once after exposure to video A, once after exposure to video B and once after exposure to video C.  Participants were required to give a different response to each card in each condition for a total of nine responses. The entire presentation, i.e., both the order of the cards and the order of the videos was randomized.

**Procedure**

After giving written consent for participation, each participant was individually taken into a quiet room to begin the experiment. The videos and Rorschach cards were then presented on a computer monitor. First, the participant viewed one of the videos for 10 seconds with the prior instruction to watch it. Then a Rorschach card appeared, with the participant being asked to tell the experimenter what the inkblot might be, which is the standard instruction. Though only one response was allowed, no time limit was given for responding. Listening to the participant verbalize the response, the experimenter (the third author) transcribed it verbatim. Subsequently, this same procedure was repeated twice for a total of three times. Afterwards, the experimenter inquired the responses in line with both CS and R-PAS methods. She was blind to the purposes of the study, and at the time the study was conducted, she had already used the Rorschach for clinical and research purposes for about ten years.

**Data Preparation**

All responses were promptly coded for the presence vs. absence of M. Prior to analyzing the data, inter-rater reliability for the coding of M was examined. Specifically, an experienced Rorschach user (the first author) who had been using the Rorschach for research purposes for many years, and who was blind to the codes of the experimenter who collected the data and to the three conditions, independently recoded all responses of all records for the presence vs. absence of M. At the response-level, Cohen's Kappa was 0.96; at the protocol-level, intraclass-correlation coefficient also was 0.96. These findings are comparable to previous studies on the inter-rater reliability of the Rorschach (Viglione, Blume-Marcovici, Miller, Giromini, & Meyer, 2012; Meyer, 2004; Viglione & Taylor, 2003) and confirm the excellent inter-rater reliability of the M response.

## Results

To test the hypothesis that higher pre-activation of the MNS would lead to greater production of M responses, a repeated-measures within-subject ANOVA was calculated with M as the dependent variable and the three conditions (i.e., after exposure to video A, after exposure to video B, and after exposure to video C) as the three levels of the within-subject factor. The hypothesis itself was tested by examining the linear trend with the expectation that the number of M increase from condition A to condition B to condition C. This linear trend indicating M as progressively more frequent from condition A to B to C was not significant but could be understood as approaching significance when a nonconservative threshold ($\alpha = 0.10$) is considered, $F$ (1, 29) = 2.767, $p = 0.107$, $\eta^2 = 0.087$ (Fig. 1). Also, the partial eta squared value fell in the medium range of suggested benchmarks (small = 0.01; medium = 0.06; large = 0.14) (Kittler, Menard & Phillips, 2007).

ENTER FIGURE 1 ABOUT HERE

## Discussion

This pilot/demonstration study aimed at exploiting the “neurological priming” phenomenon to investigate the association between M responses and MNS activity. It was hypothesized that if the association between M and MNS activity held true, then a pre-activation of the MNS prior to exposure to the Rorschach stimuli would increase the production of M responses, because of a neurological priming effect. Thus, three videos believed to activate the

MNS at different levels were utilized, and the participants were administered a few Rorschach cards three times, each time after exposure to one of the videos. According to our hypotheses, it was expected that the mean number of M responses produced by the respondents in each condition (i.e., after exposure to each of the videos) would be linearly related to the level of MNS activation formerly elicited by the video.

The results did not fully confirm our main hypotheses, in that no significant differences among the three conditions were found. However, within our small sample, the highest mean frequency of M responses was observed for condition C, i.e., for responses produced after exposure to the video associated with the highest MNS activation (see Fig. 1, condition C). Also, when a nonconservative threshold of $\alpha = .10$ was considered, a marginally significant linear trend in the expected direction was observed. Furthermore, the effect size of this linear trend was medium, and in the expected direction.

On the one hand, it should be noted that some alternative explanations, unrelated to the MNS theory, are possible. For example, the putative relationship between M and the video condition could be due to a psychological priming effect unrelated to neural mirroring activation. On the other hand, however, this explanation is unlikely, because of the evidence of the close relationship between M responses and mirror neurons activity found in our previous investigations (Giromini et al., 2010; Pineda et al., 2011; Porcelli et al., 2013).

Some methodological issues may have reduced the power of our analyses. First, the same three videos were presented to all participants many times during the experiment. Therefore, it is possible that habituation occurred, thus reducing the priming effect of the videos. Second, not to make the administration too long, only three Rorschach stimuli were selected. As a result, for each condition the number of M responses that could theoretically be produced ranged from zero to three. Such a low variability may have reduced the possibility to measure precisely the effects of neurological priming. Third, the same three Rorschach cards were administered three times to each participant, which might have reduced the effective power of the analyses. In this regard, however, it is important to note that the frequency with which examinees produce M responses varies from one card to another (Exner & Erdberg, 2005). Thus, using different Rorschach cards for different priming conditions would make it difficult to distinguish between the effects of MNS priming and the effects of the Rorschach stimuli on the propensity to see human movement in the ambiguous inkblots.

All in all, given the medium effect size observed, and the marginally significant trend found ($p \approx 0.10$), there is reason to believe that with larger sample sizes and some technical adjustments to the research design, a more notable effect would be observed. Thus, future research might consider using a greater number of videos (e.g., 9 videos for condition A, 9 videos for condition B, and 9 videos for condition C) and/or more stimuli, perhaps also including non-Rorschach stimuli. Additionally, the length of the videos might be manipulated, so as to find an optimal duration of the videos, so as to ensure that neurological priming occurs with no habituation effects. Furthermore, in future research, the Rorschach stimuli might be presented in a more ecologically valid way, rather than using the screen of a laptop. Along the same lines, future research might try to establish a baseline frequency of M responses “naturally” given by each of the participants prior to the experiment, to further discriminate the effects of the neurological priming procedure. Many other adjustments might also be considered.

Regardless of its limitations, this pilot study provides some suggestions for a non-traditional methodological approach for investigating neurological correlates of the Rorschach without using expensive and time-consuming tools such as fMRI or EEG. Indeed, we anticipate that our new method might be used for various purposes, with many Rorschach variables, and to test a variety of hypotheses. For example, one might want to use the phenomenon of neurological priming to investigate the link between color responses – deemed to associate with affective/emotional resources – and brain networks involved in the processing of emotions, such as the limbic system. In this example, one might for instance seek to investigate whether short videos proven to activate the limbic system would increase (or not) the number of color responses to the colored Rorschach cards. Many other applications are also possible. A pre-requisite for this method to be used, however, is that its technical parameters – such as the length of the videos, the number of repetitions, etc. – be carefully investigated in future experimental studies. Its applicability, in other words, awaits further research.

## References

Aheadi, A., Dixon, P., & Glover, S. (2010). A limiting feature of the Mozart effect: Listening improves spatial cognition in nonmusicians but not musicians". *Psychology of Music, 38*, 107-117.

Aoun, P., Jones, T., Shaw, G. L., & Bodner, M. (2005). Long-term enhancement of maze learning in mice via a generalized Mozart effect. *Neurological Research, 27*, 791–796.

Asari, T., Konishi, S., Jimura, K., Chikazoe, J., Nakamura, N., Miyashita, Y. (2010). Amygdalar enlargement associated with unique perception. *Cortex, 46(1)*, 94–9.

Asari, T., Konishi, S., Jimura, K., Chikazoe, J., Nakamura, N., Miyashita, Y. (2010). Amygdalar modulation of frontotemporal connectivity during the inkblot test. *Psychiatry Research, 182 (2)*, 103-10. doi: 10.1016/j.pscychresns.2010.01.002.

Beck, S.J. (1944). *Rorschach's test: basic processes*. New York, NY: Grune and Stratton.

Bever, T. G., & Chiarello, R. J. (1974). Cerebral dominance in musicians and nonmusicians. *Science, 185*, 137–139.

Brunel, L., Lesourd, M., Labeye, E., & Versace, R. (2010). The sensory nature of knowledge : sensory priming effects in semantic categorisation. *Quarterly Journal of Experimental Psychology, 63(5)*, 955-964.

Chokron, S., Bartolomeo, P., Colliot, P., & Auclair, L. (2002). Effect of gaze orientation on tactile-kinesthetic performance. *Brain and Cognition, 48*, 312–317.

Coupard, O. A., & Kapoula, Z. (2005). Inhibition of saccade and vergence eye movements in 3D space. *Journal of Vision, 5*, 1–19.

De Renzi, E. (1982). *Disorders of space exploration and cognition.* Chichester: Wiley.

Desrocher, M. E., Smith, M. L., & Taylor, M. J. (1995). Stimulus and sex differences in performance of mental rotation: Evidence from event-related potentials. *Brain and Cognition, 28*, 14–38.

di Pellegrino, G., Fadiga, L., Fogassi, L., Gallese, V., & Rizzolatti G. (1992). Understanding motor events: A neurophysiological study. *Experimental Brain Research, 91*, 176-180.

Exner, J. E., Jr. (2003). *The Rorschach: A comprehensive system (4th ed.)*. New York: Wiley.

Exner, J.E., & Erdberg, P. (2005). *The Rorschach: A Comprehensive System*. *Vol. 2. Advanced Interpretation*. 3rd edition. New York, NY: John Wiley & Sons.

Freedberg, D., & Gallese, V. (2007). Motion, emotion and empathy in esthetic experience. *Trends in Cognitive Sciences, 11*, 197-203.

Gallese, V. (2003). The roots of empathy: the shared manifold hypothesis and theneural basis of intersubjectivity. *Psychopathology, 36*, 171–180.

Gallese, V., Fadiga, L., Fogassi, L., & Rizzolatti G. (1996). Action recognition in the premotor cortex. *Brain, 119*, 593-609.

Gillmeister, H., Catmur, C., Brass, M., & Heyes, C. (2008). Experience-based priming of body parts: a study of action imitation. *Brain Research, 1217*, 157-170.

Giromini, L., Porcelli, P., Viglione, D. J., Parolin, L., & Pineda, J. A. (2010). The feeling of movement: EEG evidence for mirroring activity during the observations of static, ambiguous stimuli in the Rorschach cards. *Biological Psychology, 85*, 233-241.

Ho, C., Mason, O., & Spence, C. (2007). An investigation into the temporal dimension of the Mozart effect: Evidence from the attentional blink task. *Acta Psychologica, 125*, 117–128.

Jausovec, N., & Habe, K. (2005). The influence of Mozart's sonata K. 448 on brain activity during the performance of spatial rotation and numerical tasks. *Brain Topography*, *17*, 207–218.

Kimura, D. (1969). Spatial localization in left and right visual fields. *Canadian Journal of Psychology, 23*, 445–458.

Kittler, J.E., Menard, W., & Phillips, K.A. (2007). Weight concerns in individuals with body dysmorphic disorder. *Eating Behaviors, 8*, 115–120.

Kittler, P., & Turkewitz, G. (1999). The talking face: Effects of concurrent speech on hemispheric lateralization of face recognition. *Developmental Neuropsychology, 16*, 253–271.

Leng, X., & Shaw, G. L. (1991). Towards a neural theory of higher brain function using music as a window. *Concepts in Neuroscience, 2*, 220–258.

Liederman, J. (1986). Determinants of the enhancement of the right visual field advantage by bilateral vs. unilateral stimuli. *Cortex, 22,* 553–565.

Malmgren, H. (2000). Rorschach's idea of a "movement" response in the light of recent philosophy and psychology of perception. *Rorschachiana, 24,* 1-27.

Mayman, M. (1977). A multidimensional view of the Rorschach movement response. In M.A. Rickers-Ovsiankina (Ed.). *Rorschach psychology* (2nd ed., pp. 229-250). Huntington, NY: Krieger.

McGrann, J. V., Shaw, G. L., Silverman, D. J., & Pearson, J. C. (1991). Higher temperature phases of a structured neuronal model of cortex. *Physical Review, A 43,* 5678-5682.

Mesulam, M. M. (1981). A cortical network for directed attention and unilateral neglect. *Annals of Neurology, 10,* 309–325.

Meyer, G. J. (2004). The reliability and validity of the Rorschach and TAT compared to other psychological and medical procedures: An analysis of systematically gathered evidence. In M. Hilsenroth & D. Segal (Eds.), Personality assessment. Volume 2 in M. Hersen (Ed.-in-Chief), *Comprehensive handbook of psychological assessment* (pp. 315-342). Hoboken, NJ: John Wiley & Sons.

Meyer, G. J., Viglione, D. J., & Giromini, L. (2014). An introduction to Rorschach assessment. In R. P. Archer and S. R. Smith (Eds.), *Personality Assessment*, 2nd Ed. (pp. 301-369). New York, NY: Routledge.

Meyer, G. J., Viglione, D. J., Mihura, J. L., Erard, R. E., & Erdberg, P. (2011). *Rorschach Performance Assessment System: Administration, coding, interpretation and technical manual.* Toledo, OH: Rorschach Performance Assessment System.

Mildner, V. (2002). Languages in space. *Brain and Cognition, 48*, 463–469.

Mountcastle, V. B. (1978). An organization principle of cerebral function: The unit module and the distributed system. In G. M. Edelman & V. B. Mountcastle (Eds.), *The mindful brain* (pp. 1–50). Cambridge, MA: MIT.

Neumann, O., & Klotz, W. (1994). Motor responses to non-reportable, masked stimuli: Where is the limit of direct parameter specification?. In C. Umiltà & M. Moskovitch: *Attention and Performance,* XV (pp. 123-150). Cambridge, MA: MIT Press.

Newman, J., Rosenbach, J. H., Burns, K. L., Latimer, B. C., Matocha, H. R., & Vogt, E. E. (1995). An experimental test of ‘the Mozart effect’: Does listening to his music improve spatial ability? *Perceptual and Motor Skills, 81*, 1379–1387.

Oberman, L.M., Pineda, J.A., & Ramachandran, V.S. (2007). The human mirror neuron system: a link between action observation and social skills. *Social Cognitive and Affective Neuroscience, 2,* 62–66.

Pineda, J. A., Giromini, L., Porcelli, P., Parolin, L., & Viglione, D. J. (2011). Mu suppression and human movement responses to the Rorschach test. *NeuroReport, 22*, 223–226.

Pineda, J.A. (2005). The functional significance of mu rhythms: translating “seeing” and “hearing” into “doing”. *Brain Research Reviews, 50*, 57–68.

Piotrowski, Z.A. (1977). The movement response. In M.A. Rickers-Ovsiankina (Ed.). *Rorschach psychology* (2nd ed., pp. 189-227). Huntington, NY: Krieger.

Porcelli, P., Giromini, L., Parolin, L., Pineda, J. A., & Viglione, D. J. (2013). Mirroring Activity in the Brain and Movement Determinant in the Rorschach Test. *Journal of Personality Assessment, 95 (5),* 444-456, doi: 10.1080/00223891.2013.775136.

Rapaport, D., Gill, M., & Schafer, R. (1946). *Diagnostic psychological testing*. Vol.2. Chicago, IL: Yearbook Publishers.

Rauscher, F. H., & Shaw, G. L. (1998). Key components of the Mozart effect. *Perceptual and Motor Skills, 86*, 835–841.

Rauscher, F. H., Robinson, K. D., & Jens, J. J. (1998). Improved maze learning through early music exposure in rats. *Neurological Research, 20*, 427–432.

Rauscher, F. H., Shaw, G. L., & Ky, K. N. (1993). Music and spatial task performance. *Nature, 365*, 611.

Rauscher, F. H., Shaw, G. L., & Ky, K. N. (1995). Listening to Mozart improves spatial-temporal reasoning: Towards a neurophysiological basis. *Neuroscience Letters, 6,* 44–47.

Reuter-Lorenz, P. A., Kinsbourne, M., & Moscovitch, M. (1990). Hemispheric control of spatial attention. *Brain and Cognition*, *12*, 240–266.

Rideout, B. E., Dougherty, S., & Wernert, L. (1998). Effect of music on spatial performance: A test of generality. *Perceptual and Motor Skills, 86,* 512–514.

Rizzolatti, G., & Craighero, L. (2004). The mirror neuron system. *Annual Review of Neuroscience*, *27*, 169–192.

Rizzolatti, G., Fadiga, L., Gallese, V., & Fogassi L. (1996). Premotor cortex and the recognition of motor actions, *Cognitive Brain Research, 3*, 131-141.

Rorschach, H. (1921). *Psychodiagnostik*. Bern: Bircher.

Shaw, G. L., Silverman, D. J., & Pearson, J. C. (1985). Model of cortical organization embodying a basis for a theory of information processing and memory recall. *Proceedings of the National Academy of Sciences, USA, 82*, 2364-2368.

Shaw, G. L., Silverman, D. J., & Pearson, J. C. (1988). Trion model of cortical organization and the search for the code of shortterm memory and information processing. In: *Systems with learning and memory abilities* (Levy J., Delacour J. C. S., eds), pp 411-435. New York. Elsevier.

Silverman, D. J., Shaw, G. L., & Pearson, J. C. (1986). Associative recall properties of the trion model of cortical organization. *Biological Cybernetics, 53*, 259-271.

Steele, K. M., Ball, T. N., & Runk, R. (1997). Listening to Mozart does not enhance backwards digit span performance. *Perceptual and Motor Skills*, *84*, 1179–1184.

Sterr, A. (2006). Preparing not to move: does no-response priming affect advance movement preparation processes in a response priming task?. *Biological Psychology, 72*, 154-159.

Stough, C., Kerkin, B., Bates, T., & Mangan, G. (1994). Music and spatial IQ. *Personality and Individual Differences, 17*, 695.

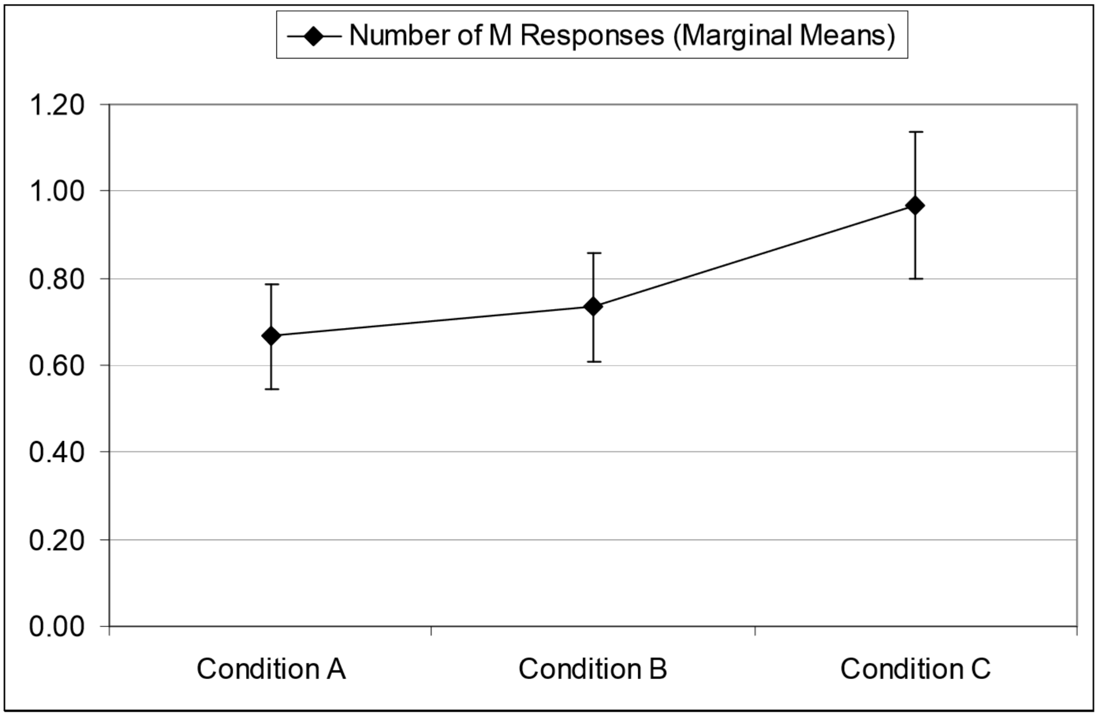
Viglione, D. J., Blume-Marcovici, A. C., Miller, H. L., Giromini, L., & Meyer, G. J. (2012). An inter-rater reliability study for the Rorschach Performance Assessment System. *Journal of Personality Assessment, 94*, 607-612. doi: 10.1080/00223891.2012.684118.

Viglione, D.J., & Taylor, N. (2003). Empirical support for interrater reliability of the Rorschach Comprehensive System coding. *Journal of Clinical Psychology, 59(1),* 111-121.

Vogt, S., Taylor, P., & Hopkins, B. (2003). Visuomotor priming by pictures of hands: perspective matters. Neuropsychologia, 41, 941-951.

Vorberg, D., Mattler, U., Heinecke, A., Schmidt, T., & Schwarzbach, J. (2003). Different time courses for visual perception and action priming. *Proceedings of the National Academy of Sciences of the USA, 100*, 6275-6280.

Fig. 1. Mean Number of M Responses after Exposure to Videos A, B, and C.




Mean number of M responses produced after exposure to video A (baseline), B (low MNS pre-activation), and C (high-MNS pre-activation). Error bars represent the standard error of the mean.

## Summary

It has been proposed that the Rorschach human movement (M) response may be associated with activity of the mirror neuron system (MNS), a neurological network responsible for imitation learning, action understanding and, possibly, empathy. To date, however, this hypothesis has only been explored by two studies, which measured EEG markers of MNS activity simultaneous to Rorschach cards presentation. The current study adopted a different approach and tested whether pre-activation of the MNS would be associated with increased production of M responses. Thirty students were administered a subset of Rorschach cards immediately after watching three short videos aimed at activating the MNS at three different levels. Video A (no MNS activation) consisted of a full-screen television static; Video B (low MNS activation) showed three individuals tossing a ball up in the air to themselves; Video C (high MNS activation) showed the same three individuals tossing a ball to each other and occasionally throwing the ball off the screen toward the viewer. Each of the selected Rorschach cards was administered three times, i.e., once following each of the videos. First, one of the videos was presented on a computer screen for 10 seconds. Next, a Rorschach card was administered and the participant's response transcribed verbatim. Afterward, another video was shown, followed by another Rorschach card, and so forth until the end of the experiment. We anticipated that the mean number of M would be highest in condition C and lowest in condition A, consistent with the idea that pre-activation of the MNS associates with increased production of M responses. To test this hypothesis, a repeated-measures within-subject ANOVA was calculated with M as the dependent variable and the three conditions (A, B, and C) as the three levels of the within-subject factor. The hypothesis itself was tested by examining the linear trend with the expectation that the number of M increase from condition A to condition B to condition C. This linear trend

indicating M as progressively more frequent from condition A to B to C was not significant but could be understood as approaching significance when a nonconservative threshold ($\alpha = 0.10$) is considered. Also, the partial eta squared value fell in the medium range of suggested benchmarks. In addition to providing information on the M response, this article introduces a new scientific paradigm to investigate the neurological correlates of the Rorschach.

**Riassunto**

È stato ipotizzato che la risposta Movimento Umano (M) al Rorschach potrebbe essere associata all'attività del sistema dei neuroni specchio (MNS), un network neuronale responsabile dell'apprendimento per imitazione, della comprensione delle azioni e, probabilmente, dell'empatia. Ad oggi, comunque, questa ipotesi è stata esplorata solamente da due studi, i quali hanno usato l'EEG per valutare l'attivazione del MNS durante la presentazione delle tavole Rorschach. Il presente studio propone un approccio differente e valuta se la pre-attivazione del sistema dei neuroni specchio possa essere associata ad un incremento della produzione di risposte M. A trenta studenti è stata quindi somministrata una parte del test di Rorschach, immediatamente dopo aver guardato tre brevi video finalizzati all'attivazione del MNS a intensità variabile: il video A (nessuna attivazione del MNS) mostrava uno schermo vuoto; il video B (bassa attivazione) mostrava tre persone che si lanciavano una pallina; il video C (elevata attivazione) mostrava le stesse tre persone che si lanciavano una pallina e che occasionalmente lanciavano la pallina anche contro lo schermo, verso lo spettatore. Ciascuna delle tavole è stata somministrata tre volte, ovvero una volta dopo ciascun video. All'inizio, ogni video veniva mostrato sullo schermo di un computer per 10 secondi. Successivamente, compariva una tavola Rorschach e la risposta dei partecipanti veniva trascritta parola per parola. Dopodiché, un altro video veniva mostrato, seguito da un'altra tavola Rorschach, e così via fino alla fine dell'esperimento. La nostra ipotesi era che la media di risposte M sarebbe stata più alta nella condizione C e più bassa nella condizione A, coerentemente con l'idea che una pre-attivazione del MNS si associ ad un incremento della produzione di risposte M. Per verificare questa ipotesi, è stata calcolata una ANOVA a misure ripetute, con M come variabile dipendente e le tre condizioni (A,B,C) come i tre livelli del fattore. L'ipotesi in sé è stata testata esaminando

il trend lineare dell'ANOVA, in linea con l'aspettativa che il numero di M sarebbe progressivamente aumentato dalla condizione A, alla B, e alla C. Questo andamento lineare, sebbene non sia risultato statisticamente significativo, potrebbe essere inteso come vicino ad un valore significativo se si considera una soglia non conservativa ($\alpha = 0.10$). Inoltre, il valore della partial $\eta^2$ può essere considerato come "medio", secondo i valori di riferimento comunemente adottati. Oltre a fornire informazioni sulla risposta M, questo articolo introduce un nuovo paradigma scientifico per studiare i correlati neurali del Rorschach.

**Résumé**

On a supposé que la réponse de mouvement humain (M) au Rorschach peut être associée à l'activité du système de neurones miroirs (MNS), un réseau neuronal responsable de l'apprentissage par imitation, de la compréhension des actions et, probablement, de l'empathie. Toutefois, à ce jour, cette hypothèse a été seulement explorée par deux études, lesquelles ont utilisé le EEG pour évaluer l'activation du MNS pendant la présentation des planches du Rorschach. Cette étude adopte une approche différente et mesure si la pré-activation du système de neurones miroirs serait associée à une augmentation de la production de réponses M. Une partie du test du Rorschach a été administré à trente étudiants, immédiatement après avoir vu trois brèves vidéos visant a activer le MNS à trois niveaux différents: la vidéo A (aucune activation du MNS) était composée d'un écran de télévision statique; la vidéo B (activation basse) exhibait trois personnes lançant une balle en l'air; la vidéo C (activation élevée) exhibait les mêmes personnes lançant une balle entre eux et, occasionnellement, lançant la balle hors écran, vers le spectateur. Chacune des planches sélectionnées a été administrée trois fois, c'est-à-dire une fois après chacune des vidéos. Au début, chaque vidéo a été présentée sur l'écran d'un ordinateur pendant 10 secondes. Ensuite, une planche du Rorschach a été administrée, et la réponse des participants était transcrite mot à mot. Enfin, une autre vidéo a été présentée, suivie d'une autre planche du Rorschach, et ainsi de suite jusqu'à la fin de l'expérience. Nous avons supposé que la moyenne des réponses M serait plus élevée dans la condition C et plus basse dans la condition A, en accord avec l'idée qu'une pré-activation du MNS est associée à une augmentation de la production de réponses M. Pour vérifier cette hypothèse, une ANOVA à mesures répétées a été calculée, avec M comme variable dépendante, et les trois conditions (A, B, C) comme les trois niveaux du facteur. L'hypothèse elle-même a été testée en examinant la

tendance linéaire, avec l'attente que le nombre de M serait progressivement augmenté de la condition A à la condition B, et de la condition B à la condition C. Cette tendance linéaire, qui indique M comme progressivement plus fréquent de la condition A à la B à la C, n'était pas significative, mais pourrait être considérée comme proche d'une valeur significative au seuil $\alpha = 0.10$. De plus, la valeur du partiel $\eta^2$ était dans la tranche moyenne, selon les valeurs de référence standard. En plus de fournir des informations sur la réponse M, cet article introduit un nouveau paradigme scientifique pour l'étude des corrélats neurologiques du Rorschach.

## Resumen

Se ha hipotizado que la respuesta del movimiento humano Rorschach (M) podría asociarse con la actividad del sistema de neuronas espejo (MNS), una red neuronal responsable del aprendizaje de imitación, comprensión de acciones y, posiblemente, empatía. Hasta hoy, de todas formas, esta hipótesis ha sido explorada sólo por dos estudios que medían los marcadores de la actividad del MNS simultánea a la presentación de las cartas de Rorschach. El actual estudio ha adoptado una estrategia diferente y ha probado la posibilidad de que la preactivación del MNS pudiera asociarse con una mayor produción de respuestas M. Se suministró un subconjunto del Rorschach a 30 estudiantes inmediatamente después de que hubiesen visto tres vídeos cortos con el objetivo de activar el MNS a tres niveles diferentes. Video A (no activación de MNS) consistió en una televisión estática con pantalla completa (full-screen television static); Video B (baja activación de MNS) mostraba tres individuos que se tiraban una pelota uno al otro y ocasionalmente tiraban la pelota fuera de la pantalla hacia el espectador. Cada una de las cartas del Rorschach seleccionadas se suministró tres veces, i.e. cada una siguiendo cada uno de los vídeos. Primero, uno de los vídeos se presentaba sobre la pantalla de un ordenador durante 10 segundos. Enseguida se suministraba una de las cartas de Rorschach y se transcribía textualmente la respuesta del participante. Luego, se mostraba otro vídeo seguido de otra carta de Rorschach y así hasta el final del experimento. Hemos supuesto que la media de respuestas M tenía que ser mayor en la condición C y más baja en la condición A, congruente con la idea de que la preactivación del MNs se asocia a una mayor producción de respuestas M. Para ensayar esta hipótesis se calcularon ANOVAS en medidas repetidas intra-sujeto con M como variable dependiente y las tres condiciones (A, B y C) como los tres niveles del factor intra-sujeto. La hipótesis misma fue ensayada examinando la tendencia lineal con la previsión de que el número

de M aumentase de la condición A a la condición B y a la condición C. Esta tendencia lineal que evidencia cómo M es progresivamente más frecuente que la condición A a la condición B y a la condición C no fue significativo pero se pudo considerar significativo cuando se considera un umbral no conservativo ($\alpha$=010). también el valor de la parcial $\eta^2$ puede caer en la gama media de los implicados puntos de referenciaa. Además de aportar información sobre la respuesta M, este artículo introduce un nuevo paradigma científico para investigar las correlaciones neuronales del Rorschach.