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Self-awareness, depression and neurocognitive functions in patients with moderate and severe traumatic brain injury

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Abstract

Introduction: Traumatic Brain Injury (TBI) is the most common cause of disability in young patients. In the self-awareness deficits that can arise after TBI, patients experience difficulties in understanding the disabilities resulting from their injury. This is an important problem that affects the rehabilitation processes. Materials and methods: Self-awareness, neurocognitive functions and depressive symptoms were observed in 31 outpatients with a diagnosis of moderate or severe TBI, aged between 16 and 45 years. Instruments: Patient Competency Rating Scale (PCRS), Neurocognitive Assessment and Hamilton Depression Rating Scale (HDRS). Results: Correlations were found between self-awareness and its dimensions with visuospatial skills, executive functions (double task and cognitive inhibition), episodic memory (Rey Auditory-Verbal Learning Test and Montevideo short story) and depressive symptoms. Conclusions: Patients who have suffered a moderate or severe TBI may have impaired self-awareness. Self-awareness is the ability to objectively perceive (perceive our own self), while maintaining a sense of subjectivity, It is a complex function that needs to use executive functions and episodic memory. The relationship found between interpersonal self-awareness and depressive symptoms does not seem to be conclusive, since this association is probably more complex, and involves other variables not considered in this study.

Keywords*:* Depression; neurocognitive functions; self-awareness; traumatic brain injury

Autoconciencia, depresión y funciones neurocognitivas en pacientes con traumatismo encefálico-cráneo moderado y severo

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Resumen

Introducción: Los Traumatismos Craneanos-Encéfalicos (TCE) constituyen la causa más común de discapacidad en pacientes jóvenes. En los déficits de autoconciencia, los pacientes experimentan dificultades para comprender sus discapacidades. Este es un problema clínico que afecta los procesos de rehabilitación. Materiales y Métodos: Se observó la autoconciencia, funciones neurocognitivas y sintomatología depresiva en 31 pacientes con diagnóstico de TCE moderado o severo, con edades 16 y 45 años. Instrumentos: Índice de Competencia del Paciente, evaluación neurocognitiva y Escala de Depresión Hamilton. Resultados: Se encontraron correlaciones entre autoconciencia y sus dimensiones con habilidades visuoespaciales, funciones ejecutivas (doble tarea e inhibición cognitiva), memoria episódica (aprendizaje audioverbal y cuento corto Montevideo) y sintomatología depresiva. Conclusiones: Los pacientes que han sufrido un TCE moderado o grave pueden tener alteración de la autoconciencia. La autoconciencia es la capacidad de percibirse objetivamente (percibir nuestro propio self), manteniendo al mismo tiempo un sentido de subjetividad, es una función compleja que necesita servirse de funciones ejecutivas y de memoria episódica. La relación entre la autoconciencia interpersonal y sintomatología depresiva, no parece ser concluyente, dicha asociación es más compleja, e involucra otras variables no contempladas en este estudio.
Palabras clave: Autoconciencia; depresión; funciones neurocognitivas; traumatismo craneoencefálico

Introduction

Traumatic Brain Injury (TBI) represent a major health problem and are one of the leading causes of death and disability worldwide, mainly in young people. People who survive a TBI may suffer a lifelong disability, mainly due to disorders, sensory motor, neurocognitive, self-awareness, psychological and social cognition (Azouvi, Arnould, Dromer & Vallat-Azouvi, 2017; Roozenbeek, Maas & Menon, 2013).

In Impairment Self-Awareness deficits (ISA) that can arise after TBI, patients experience difficulties in understanding the disabilities resulting from their injury and the impact these deficiencies have on their functional capacity, these characteristics make these patients very difficult to treat in rehabilitation plans (Noé et al., 2005; Prigatano, 2005; Prigatano & Sherer, 2020; Vales, 2020). They fail to assess their neurobehavioral competencies, particularly with regard to cognitive and social functioning, they have a reduced ability to adopt the perspective of another person (Bivona et al., 2014; Chesnel et al., 2018).

Self-awareness from cognitive neuroscience

Self-awareness is commonly affected after a TBI, this is an important clinical problem because it affects and limits the rehabilitation processes. In a meta-analysis carried out on self-referential processing (Northoff et al., 2006), it was found that the structures of the midline of the cerebral cortex that would be a correlate of the "core" of the self, are in turn linked, both with the processing of "reading" one's own mind, as well as that of others. In another meta-analysis of functional neuroimaging studies on the self, on their own or others' judgments, they were associated with a spatial gradient of the activity of the medial prefrontal cortex, which goes from the ventral to the dorsal extension, as well as the common activation of the left temporoparietal junction and posterior cingulate (Denny, Kober, Wager & Ochsner, 2012). In another study of the neural bases in the impairment of self-awareness in TBI patients, she postulates that it was not explained by the location of the focal brain lesion, nor by the amount of traumatic diffuse axonal lesion, but by the breakdown of the functional interactions between the nodes within the fronto-parietal control network (Ham et al., 2014).

Self-awareness can be defined as:

> The capacity to perceive the "self in relatively "objective" terms while maintaining a sense of subjectivity, this will be a natural paradox of human consciousness: on the one hand, it seeks "objectivity", that is, the perception of the situation and at the same time the sense of a private, subjective interpretation of an experience. "Self-awareness or awareness of higher brain functions involves an interaction of thoughts and feelings" (Prigatano & Schacter, 1991, p. 13).

This definition implies that self-awareness is a complex phenomenon that covers cognitive and emotional aspects. Therefore, what would be the relationship with the neurocognitive functions that support self-awareness? As well as what emotional aspects would be involved.

Self-awareness is a complex function, in its alteration there is a lack of subjective experience of the deficiencies due to the lack of integration of "feelings and thoughts", by the underlying neurocognitive and emotional aspects. The emotional reaction in these patients can be greatly diminished or absent altogether, they are often described as "neutral" or "perplexed" when indicated or asked about their neuropsychological de-

ficiencies and associated behavioral disturbances. They appear "insipid", "apathetic" or "indifferent" to a deficiency that is obvious to an observant clinician (Prigatano & Sherer, 2020).

In this sense, it is relevant to study the mood, since it has an important link with the patient's social functioning (Carroll & Coetzer, 2011; Ylvisaker & Feeney, 2000); sadness may appear as a reaction to the loss of their previous identity, their family and social role, and therefore their possible relationship with self-awareness.

In a study on the evaluation of a treatment on self-awareness, it is postulated that the level of self-awareness before treatment was related to the recognition of emotions (Lamberts, Fasotti, Boelen & Spikman, 2017). In another study, the hypothesis is proposed that self-awareness is not usually associated with depression and anxiety, but rather with apathy and cognitive inflexibility (Bivona et al., 2019), as did another study where no association with depression was found (Geytenbeek, Fleming, Doig & Ownsworth, 2017).

Although the research of Bach and David (2006) speaks of a certain independence of self-awareness with executive functions, there are studies that propose its relationship with some of the underlying neurocognitive functions that support or would be related to self-awareness, such as episodic memory and executive functions (such as semantic verbal fluency and cognitive flexibility) (Bivona et al., 2019; Zimmermann, Mograbi, Hermes-Pereira, Fonseca & Prigatano, 2017).

However, in a study conducted four years after TBI, with 90 patient-family pairs, the lack of self-awareness only significantly influenced the burden perceived by the family member, and was not related to the severity of the initial trauma, the sociodemographic data, the severity of impairments (neurocognitive and mood), limitations of activity or participation or quality of life of the patient (Chesnel et al., 2018).

Therefore, it is important to carry out studies on the structures and processes related to self-awareness, in such a way that they allow the construction of models and / or theories that permit a better understanding and treatment of these patients.

Methodology

Objective

Describe and analyze self-awareness and its relationship with neurocognitive functions and depressive symptoms in moderate or severe TBI patients.

Patients and methods

Outpatients with a diagnosis of moderate or severe TBI according to the Glasgow Scale score, who attended the Neuropsychology Department of the Hospital de Clínicas (Montevideo - Uruguay) between April and December 2016, accepted and signed the informed consent, age between 16 and 45 years, 6 months or more after the TBI, sensory resources (seeing and hearing) that allow you to perform the tests normally, and a valid companion who can provide reliable information.

Instruments

An initial interview was carried out, where ethical aspects of the research were raised and the pertinent tests began to be carried out in case of acceptance.

Patient information collected in the initial interview: age, sex, marital status, years of schooling, manual dominance, Glasgow score, neurosurgery, time of evolution of TBI.

Neurocognitive functions: The patients were evaluated with a specific neuropsychological protocol that consisted of the evaluation of the following functions.

· *Attentional processes and executive functions*

- Digits backward (Wechsler, 2002).
- Symbol digit (Lezak, Howieson, Bigler & Daniel, 2012).
- TMA and TMB (Lezak et al., 2012; Tombaugh, 2004).
- Stroop test (Stroop, 1935).
- Verbal fluency task by letter and semantic categories (letter P and Animals) (Marino & Alderete, 2010).
- Complex Figure Rey-Osterrieth (CFRO)-copy strategy (Lezak et al., 2012).
- Similarities (Wechsler, 2002).

· *Working memory*

- Digits Forward (Wechsler, 2002).

· *Episodic memory*

- CFRO evocation.
- Short story Montevideo (MDV) (Dalmás, Fontán & Bocos, 1989).
- Rey Auditory-Verbal Learning Test (AVLT) (Lezak et al., 2012; Rey, 1964).

· *Visuoconstructive skills*

- CFRO.
- Clock drawing test (Lezak et al., 2012).

Patient Competency Rating Scale (PCRS): It is a 30-question self-report scale, assesses the patient's level of competence and self-awareness after a brain injury.

Each question is answered according to a 5-point Likert type scale: which goes from 1 = "cannot do it" to 5 = "can do it without problem". Both the version for the patient and for the companion are the same, except that the questions change to refer to the patient's attitude (Prigatano & Fordyce, 1986). There is a validated version in Spanish (Ramírez & Ostrosky, 2008).

It has 4 dimensions: Interpersonal Relationships (IntP), Activities of Daily Living (ADL), Cognitive functioning (Cog) and Emotional functioning (Emot).

A PCRS score is obtained for the patient (PCRS-P) and another for the valid relative or companion (PCRS-F), each with its corresponding dimensions. The self-awareness value results from the difference between PCRS-P - PCRS-F, and there is also a self-awareness that corresponds to the differences between each dimension.

This scale has been used in another study very satisfactorily in the TBI population at the Hospital de Clínicas in Montevideo (Diarce, Dansilio & Vales, 2016), and in different studies with TBI patients (Bach & David, 2006; Bivona et al., 2015; Fleming, Strong & Ashton, 1996).

Hamilton Depression Rating Scale (HDRS): It is a scale for the assessment of depressive states - depressive symptomatology, with the aim of quantitatively assessing the severity of symptoms and assessing the changes in the depressed patient. It is valued according to the information obtained in the clinical interview and accepts complementary information from other secondary sources. In this research, information is taken from the companion, for this reason this scale is used and not the Beck self-administered depression inventory, be-

cause many TBI patients may have deficits in their self-awareness and / or have anosognosia of their current state.

Its original version consisted of 21 items, but the 17-item version is the most used, each item has between three and five responses, with a score of 0-2 or 0-4 respectively. The total score ranges from 0 to 52 (Hamilton, 1960).

In turn, the Spanish version of this scale has been validated (Ramos-Brieva & Cordero-Villafafila, 1988), and has been used with patients with acquired brain injury (Mauri, Paletta, Colasanti, Miserocchi & Altamura, 2014).

· *Statistic analysis*

Shapiro Wilk Test is applied to examine the normality of the variables. Student's t test is used to compare groups with normal distribution, and Wilcoxon test for non-normal distribution. Pearson's correlation coefficient is used to correlate variables with normal distribution, and Spearman's coefficient for non-normal distributions.

Ethics

The present study and its corresponding informed consent were approved by the Ethics Committee of the Hospital de Clínicas belonging to the University of the Republic, in the city of Montevideo (Uruguay) on April 6, 2016.

Results

31 patients (20 men and 11 women) participated in this study, with an average age of 30.87 years, 23 of them single, 4 with a partner and 4 divorced, the years of schooling ranged between 2 and 16 years, the average being 8, 19 years old, 26 were unemployed, 3 with a pension, one with a medical license, only one was employed, 29 were right-handed, 2 were left-handed.

Regarding data related to TBI, the mean score of the Glasgow scale was 6.59 + - 2.91 (21 severe, 10 moderate), 19 patients underwent neurosurgery, the mean evolution time was 48 months, 27 they were due to traffic accidents, 3 due to a gunshot wound and another due to domestic violence.

Table 1.
Results of the neurocognitive evaluation

Test or scale	Mean (SD)	Median
Digits Backward	3.2 (0.89)	3
Trail Making A (TMA)	110 (53.26)	101
Trail Making B (TMB)	212.6 (65.48)	210
Stroop test	48.26 (14.85)	50
Verbal fluency task (animals)	12.03 (4.37)	11
Symbol digit	19.82 (6.63)	19
Clock post interference evocation test	6.812 (2.99)	8.5
Similarities (Wechsler)	13.16 (4.62)	13
Digits Forward	5 (1.08)	5
Short story Montevideo immediate evocation	6.86 (3.98)	6
Short story Montevideo deferred evocation	4.63 (4.29)	3.5
Rey Auditory-Verbal Learning Test post interference evocation	34.14 (9.52)	34
Rey Auditory-Verbal Learning Test total score	34.14 (9.52)	34

Source: Authors.

TABLE 2.
Competence according to the patient and the family member, self-awareness and its dimensions

Test o scale	Mean (SD)	Median
Patient competence reported by the patient (PCRS-P)	116.19 (25.60)	126
Patient competence reported by the family member (PCRS-F)	110.26 (24.82)	115
Self-awareness (SA)	5,94 (25.83)	5
Self-awareness of activities of daily living (SAdla)	2.36 (11.73)	2
Interpersonal Self-awareness (SAi)	2.16 (8.68)	1
Cognitive Self-awareness (SAc)	0 (5.42)	0
Emotional self-awareness (SAe)	1.42 (7.05)	2

Source: Authors.

TABLE 3.
Significant correlations between self-awareness, neurocognitive functions and depressive symptoms

Correlations	*r*	*p*
SA - Clock drawing test	+0.52	0.04
SAi - TMB	-0.57	0.02
SAi – Rey Auditory-Verbal Learning Test - total score (AVT)	+0.43	0.05
SAc – Stroop test	-0.53	0.01
SAc - Short story Montevideo - immediate evocation (MVDI)	+0.41	0.03
Depressive symptoms (HDRS) – PCRS-P	-0.43	0.02
Depressive symptoms (HDRS) – PCRS-F	-0.48	0.01
Depressive symptoms (HDRS) – SAi	+0.38	0.03

Source: Authors.

Regarding depressive symptoms according to the Hamilton depression rating scale (HDRS), the average value was 10.39 with a standard deviation of 7.2 and a median of 9 (Tabla 1, Tabla 2, Tabla 3).

Associations with low and high levels of impairment self-awareness

With the absolute value of self-awareness and its dimensions, the median was taken, and two groups were differentiated: a group with low Impairment Self-Awareness (ISA) (values lower than the median) and a group with high ISA. (values greater than and equal to the median). Student's t or Wilcoxon tests were performed for low and high levels of ISA - with neurocognitive functions and depressive symptoms.

A significant difference was found (p = 0.02), the group with low ISA had a higher value in post-interference Rey Auditory-Verbal Learning Test (AVPI) (mean = 7.63 *SD* = 4.31) compared to the group with high ISA (mean = 3.92 SD = 2.43).

In turn, a significant difference was found (p = 0.04), the group with low ISA had a lower value in the trail making A (TMA) (mean = 89.64 *SD* = 32.80) compared to the group with high ISA (mean = 129.00 *SD* = 62.24).

DISCUSSION

In the present study, 52% of the patients studied presented an impairment self-awareness (Ramírez & Ostrosky, 2008), these difficulties are related to what was described by other authors when studying self-awareness in patients with TBI (Bach & David, 2006; Bivona et al., 2015; Fleming et al., 1996).

According to the results, when evaluating the neurocognitive functions, some outstanding results could be observed. In reference to visuoconstruction, the clock drawing test was used, which has been a test originally used to explore the unilateral visuospatial inattention most commonly associated with right parietal dysfunction, however it is also a complex task that is sensitive to a variety of injuries , incorporating not only visuo-perceptual and visuospatial skills, but also receptive language, numerical knowledge, working memory and executive functions (Lezak et al., 2012). There have been studies with the clock drawing test with TBI patients, finding that there are deteriorations in the performance of said test (De Guise et al., 2010, 2011). It should be noted that in this study, the quantitative value is taken into account, which is often less useful to identify the location of focal lesions (for example, right versus left, anterior versus posterior, or cortical versus subcortical), not thus the qualitative ones (Lezak et al., 2012). The association of self-awareness with the clock drawing test may not only have to do with visuospatial functions, but also with the different functions that the clock assesses previously described.

An association was found between the interpersonal dimension of self-awareness and tests of an executive functions (double task and cognitive inhibition), low and high levels of self-awareness deficit are associated with processing speed, as well as tests of episodic memory and learning audioverbal and memory of the short story of Montevideo. The analysis of these associations is linked to the previous section, although there are also studies that have found deficits in these neurocognitive functions with patients with low levels of self-awareness (Bivona et al., 2014).

Self-awareness, as mentioned above, can be defined as the ability to objectively perceive (perceive our own self), while maintaining a sense of subjectivity (Prigatano & Schacter, 1991). This ability to perceive oneself is linked to consciousness, as a process that fluctuates between two variants. For Damasio (2010) there would be a consciousness centered on the here and now, it is the feeling of being and being in a moment, and Another consciousness of consciousness, that is, a consciousness that evaluates that central or nuclear consciousness (called expanded, extended or autobiographical consciousness), for this it accesses the past to our memory and projects and tries to anticipate the future, providing an elaborate the feeling of what happens, linked to their identity and personality (Damasio, 2010). By accessing the past, it takes the memories, links them and relates them to the central consciousness, that is, to what is happening at this moment. Without these memories we would not have a sense of the past or future, and there would be no historical continuity, there would be no self-awareness (Damasio, 2010; Tirapu-Ustárroz & Goñi-Sáez, 2016).

The development and concept of self-awareness described above would imply that it would need to use neurocognitive functions for its functioning, as shown in this study, as well as others already mentioned (Bivona et al., 2019; Zimmermann et al., 2017).

In this study, depressive symptoms were also evaluated using the Hamilton Depression Rating Scale (HDRS). The mean HDRS was not very high (mean = 10.39 SD = 7.20), registering 61% of patients without depressive symptoms, 30% with mild symptoms and 9% with moderate symptoms. These data differ from some studies where they have found a higher prevalence of depressive symptoms in TBI patients (Carroll & Coetzer, 2011; Malec, Testa, Rush, Brown

& Moessner, 2007). In turn, no associations were found with neurocognitive functions.

According to the literature reviewed, there is controversy among the authors whether depressive symptoms are associated with difficulty in self-awareness. In a study with TBI patients, where identity changes and self-awareness are exploited after a TBI, an association has been found between self-awareness and depressive symptoms (Carroll & Coetzer, 2011). However, other authors do not associate self-awareness difficulties with depressive symptoms (Bivona et al., 2019), but with the apathy produced by the same TBI (Prigatano & Sherer, 2020).

In the present study, an association between depressive symptoms and ISA was evidenced in interpersonal relationships. In other words, the higher the interpersonal ISA the patient would have more depression. This finding could be contradictory, since an inverse association between both concepts would be expected, that is to say that the patient when making contact with their interpersonal difficulties (interpersonal self-awareness) would have higher levels of depression.

On the other hand, the patient's depression was negatively associated with the patient's competence both perceived by the patient and by the family member, showing the importance of interpersonal relationships for the patient. This last result is in line with the study of impairment of self-awareness that occurs four years after TBI, which is related only to the burden of the family member and not to other variables (Chesnel et al., 2018).

This data probably implies that the relationship between self-awareness and depression is more complex, involving elements not explored in this study.

Conclusions

Self-awareness " or awareness of higher cerebral functions thus involves an interaction of "thoughts" and "feelings ... that it is the highest of all integrated functions" (Prigatano & Schacter, 1991). For this, self-awareness needs to be used for neurocognitive functions for their functioning. This study shows a possible link with visuo-perceptual and visuospatial skills (clock drawing test), executive functions (double task and cognitive inhibition) and episodic memory (Rey Auditory-Verbal Learning Test and Short story of Montevideo), as in other studies (Bivona et al., 2019; Zimmermann et al., 2017).

Although our analysis reveals an association of interpersonal self-awareness with depression, contradicting other research (Bivona et al., 2019; Geytenbeek et al., 2017). This finding does not seem to be conclusive, since the aforementioned association is probably more complex, and involves difficulties linked to the subjective experience that self-awareness implies, resulting in a person making decisions and behaviors experiencing reactions that negatively impact their functioning in daily life (Prigatano & Sherer, 2020) or as other research suggests, that self-awareness is related to apathy and executive functions and not to depression (Bivona et al., 2019).

Given the relationship between depression and the patient's competence, congruent with the study that relates self-awareness with the overload of the family member with TBI (Chesnel et al., 2018), it is important to have therapeutic strategies that allow the impairment self-awareness of patient as well as involved aspects of the family member or caregiver.

Deepening the study of neurocognitive functions and their relationship with self-awareness would allow the design of intervention strategies that benefit patients with TBI.

References

Azouvi, P., Arnould, A., Dromer, E. & Vallat-Azouvi, C. (2017). Neuropsychology of traumatic brain injury: An expert overview. *Revue Neurologique*, 173(7-8), 1–12. https://doi.org/10.1016/j.neurol.2017.07.006

Bach, L. J. & David, A. S. (2006). Self-awareness after acquired and traumatic brain injury. *Neuropsychological Rehabilitation*, 16(4), 397–414. https://doi.org/10.1080/09602010500412830

Bivona, U., Costa, A., Contrada, M., Silvestro, D., Azicnuda, E., Aloisi, M., Catania, G., Ciurli, P., Guariglia, C., Caltagirone, C., Formisano, R. & Prigatano, G. (2019). Depression, apathy and impaired self-awareness following severe traumatic brain injury: a preliminary investigation. *Brain Injury*, 33(9), 1245–1256. https://doi.org/10.1080/02699052.2019.1641225

Bivona, U., Formisano, R., De Laurentiis, S., Accetta, N., Di Cosimo, M. R., Massicci, R., Ciurli, P., Azicnuda, E., Silvestro, D., Sabatini, U., Falletta Caravasso, C., Carlesimo, G. A., Caltagirone, C. & Costa, A. (2015). Theory of mind impairment after severe traumatic brain injury and its relationship with caregivers' quality of life. *Restorative Neurology and Neuroscience*, 33(3), 335–345. https://doi.org/10.3233/RNN-140484

Bivona, U., Riccio, A., Ciurli, P., Carlesimo, G.-A., Donne, V.-D., Pizzonia, E., Caltagirone, C., Formisano, R. & Costa, A. (2014). Low Self-Awareness of Individuals With Severe Traumatic Brain Injury Can Lead to Reduced Ability to Take Another Person ' s Perspective. *Journal of Head Trauma Rehabilitation*, 29(2), 157–171. https://doi.org/10.1097/HTR.0b013e3182864f0b

Carroll, E. & Coetzer, R. (2011). Identity, grief and self-awareness after traumatic brain injury. *Neuropsychological Rehabilitation*, 21(3), 289–305. https://doi.org/10.1080/09602011.2011.555972

Chesnel, C., Jourdan, C., Bayen, E., Ghout, I., Darnoux, E., Azerad, S., Charanton, J., Aegerter, P., Pradat-Diehl, P., Ruet, A., Azouvi, P. & Vallat-Azouvi, C. (2018). Self-awareness four years after severe traumatic brain injury: discordance between the patient's and relative's complaints. Results from the PariS-TBI study. *Clinical Rehabilitation*, 32(5), 692–704. https://doi.org/10.1177/0269215517734294

Dalmás, J. F., Fontán, L. y Bocos, L. (1989). Evaluación neuropsicológica de la función mnésica: protocolo de Montevideo. Documento presentado al *Primer Congreso Latinoamericano de Neuropsicología*. Sociedad latinoamericana de neuropsicología, Buenos Aires, Argentina.

Damasio, A. (2010). *Y el cerebro creó al hombre*. Barcelona: Destino.

De Guise, E., Gosselin, N., Leblanc, J., Champoux, M.-C., Couturier, C., Lamoureux, J., Dagher, J., Marcoux, J., Maleki, M. & Feyz, M. (2011). Clock drawing and mini-mental state examination in patients with traumatic brain injury. *Applied Neuropsychology*, 18(3), 179–190. https://doi.org/10.1080/09084282.2011.595444

De Guise, E., LeBlanc, J., Gosselin, N., Marcoux, J., Champoux, M.-C., Couturier, C., Lamoureux, J., Dagher, J. H., Maleki, M. & Feyz, M. (2010). Neuroanatomical correlates of the clock drawing test in patients with traumatic brain injury. *Brain Injury*, 24(13–14), 1568–1574. https://doi.org/10.3109/02699052.2010.523052

Denny, B. T., Kober, H., Wager, T. D. & Ochsner, K. N. (2012). A meta-analysis of functional neuroimaging studies of self- and other judgments reveals a spatial gradient for mentalizing in medial prefrontal cortex. *Journal of Cognitive Neuroscience*, 24(8), 1742–1752. https://doi.org/10.1162/jocn_a_00233

Diarce, X., Dansilio, S. y Vales, L. (octubre, 2016). Evaluación de los cambios conductuales post-tec mediante el Patient Competency Raiting Scale. Estudio Piloto. Poster presentado al *XII Congreso Argentino de Neuropsicología, SONEPSA*. Universidad de Buenos Aires, Buenos Aires, Argentina. Disponible en https://sifp.psico.edu.uy/evaluaci%C3%B3n-de-los-cambios-conductuales-post-tec-mediante-la-patient-competency-rating-scale-estudio

Fleming, J. M., Strong, J. & Ashton, R. (1996). Self-awareness of deficits in adults with traumatic brain injury: how best to measure? *Brain Injury*, 10(1), 1–15. https://doi.org/10.1080/026990596124674

Geytenbeek, M., Fleming, J., Doig, E. & Ownsworth, T. (2017). The occurrence of early impaired self-awareness after traumatic brain injury and its relationship with emotional distress and psychosocial functioning. *Brain Injury*, 31(13–14), 1791–1798. https://doi.org/10.1080/02699052.2017.1346297

Ham, T. E., Bonnelle, V., Hellyer, P., Jilka, S., Robertson, I. H., Leech, R. & Sharp, D. J. (2014). The neural basis of impaired self-awareness after traumatic brain injury. *Brain*, 137(2), 586–597. https://doi.org/10.1093/brain/awt350

Hamilton, M. (1960). A rating scale for depression. *Journal of Neurology, Neurosurgery, and Psychiatry*, 23(1), 56. https://doi.org/10.1136/jnnp.23.1.56

Lamberts, K. F., Fasotti, L., Boelen, D. H. E. & Spikman, J. M. (2017). Self-Awareness after Brain Injury: Relation with Emotion Recognition and Effects of Treatment. *Brain Impairment*, 18(1), 130–137. https://doi.org/10.1017/BrImp.2016.28

Lezak, M. D., Howieson, D. B., Bigler, E. D. & Daniel, T. (2012). *Neuropsychological assessment*. New York: Oxford university press.

Malec, J.-F., Testa, J.-A., Rush, B.-K., Brown, A.-W. & Moessner, A.-M. (2007). Self-assessment of impairment, impaired self-awareness, and depression after traumatic brain injury. *The Journal of Head Trauma Rehabilitation*, 22(3), 156–166. https://doi.org/10.1097/01.HTR.0000271116.12028.af

Marino, J. C. y Alderete, A. M. (2010). Valores Normativos de Pruebas de Fluidez Verbal Categoriales, Fonológicas, Gramaticales y Combinadas y Análisis Comparativo de la Capacidad de Iniciación. *Revista Neuropsicología, Neuropsiquiatría y Neurociencias*, 10(1), 79–93. Recuperado de http://nebula.wsimg.com/784156971be8bc86021717e54949fe35?AccessKeyId=F7A1C842D9C24A6CB962&disposition=0&alloworigin=1

Mauri, M. C., Paletta, S., Colasanti, A., Miserocchi, G. & Altamura, A. C. (2014). Clinical and neuropsychological correlates of major depression following post-traumatic brain injury, a prospective study. *Asian Journal of Psychiatry*, 12(1), 118–124. https://doi.org/10.1016/j.ajp.2014.07.003

Noé, E., Ferri, J., Caballero, M. C., Villodre, R., Sanchez, A. & Chirivella, J. (2005). Self-awareness after acquired brain injury: Predictors and rehabilitation. *Journal of Neurology*, 252(2), 168–175. https://doi.org/10.1007/s00415-005-0625-2

Northoff, G., Heinzel, A., de Greck, M., Bermpohl, F., Dobrowolny, H. & Panksepp, J. (2006). Self-referential processing in our brain--a meta-analysis of imaging studies on the self. *NeuroImage*, 31(1), 440–457. https://doi.org/10.1016/j.neuroimage.2005.12.002

Prigatano, G. (2005). Disturbances of Self-awareness and Rehabilitation of Patients with Traumatic Brain Injury: a 20-year perspective. *Journal of Head Trauma Rehabilitation*, 20(1), 19–29. https://doi.org/10.1097/00001199-200501000-00004

Prigatano, G. & Fordyce, D. J. (1986). Cognitive dysfunction and psychosocial adjustment after brain injury. In: G. P. Prigatano, D.J. Fordyce, H. K. Zeiner, J. R. Roueche, M. Pepping & B. Wood (Eds.), *Neuropsychological Rehabilitation after Brain Injury*, (pp. 1–17). Baltimore: The Johns Hopkins University Press.

Prigatano, G. & Schacter, D. L. (1991). *Awareness of deficit after brain injury: Clinical and theoretical issues*. New York: Oxford University Press.

Prigatano, G. & Sherer, M. (2020). Impaired Self-Awareness and Denial During the Postacute Phases After Moderate to Severe Traumatic Brain Injury. *Frontiers in Psychology*, 11, 1–12. https://doi.org/10.3389/fpsyg.2020.01569

Ramírez, M. y Ostrosky, F. (2008). Datos Normativos de la Escala PCRS para la Autoconsciencia en México y la Influencia de la Cultura. *Revista Neuropsicología, Neuropsiquiatría y Neurociencias*, 8, 21–33. Recuperado de http://nebula.wsimg.com/3e48cf32a271a139946142ae5c1c4568?AccessKeyId=F7A1C842D9C24A6CB962&disposition=0&alloworigin=1

Ramos-Brieva, J. A. & Cordero-Villafafila, A. (1988). A new validation of the Hamilton Rating Scale for Depression. *Journal of Psychiatric Research*, 22(1), 21–28. https://doi.org/10.1016/0022-3956(88)90024-6

Rey, A. (1964). L'examen clinique en psychologie [*The clinical psychological examination*]. París: Presses Universitaires de France.

Roozenbeek, B., Maas, A. I. R. & Menon, D. K. (2013). Changing patterns in the epidemiology of traumatic brain injury. *Nature Reviews Neurology*, 9(4), 231–236. https://doi.org/10.1038/nrneurol.2013.22

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18(6), 643–662. https://doi.org/10.1037/h0054651

Tirapu-Ustárroz, J. & Goñi-Sáez, F. (2016). El problema cerebro-mente (II): sobre la conciencia. *Revista de Neurología*, 63(4), 176–185. https://doi.org/10.33588/rn.6304.2016231

Tombaugh, T. N. (2004). Trail Making Test A and B: Normative data stratified by age and education. *Archives of Clinical Neuropsychology*, 19(2), 203–214. https://doi.org/10.1016/S0887-6177(03)00039-8

Vales, L. (2020). Neuropsicoanálisis: el "nuevo paso", diálogo fructífero entre el psicoanálisis y las neurociencias. Cuadernos de Neuropsicología / Panamerican *Journal of Neuropsychology/Panamerican Journal of Neuropsychology*, 14(1), 112–128. Disponible en http://www.cnps.cl/index.php/cnps/article/view/405

Wechsler, D. (2002). Test de Inteligencia para Adultos. *WAIS-III*. Buenos Aires: Paidós.

Ylvisaker, M. & Feeney, T. (2000). Reconstruction of identity after brain injury. *Brain Impairment*, 1(1), 12–28. https://doi.org/10.1375/brim.1.1.12

Zimmermann, N., Mograbi, D. C., Hermes-Pereira, A., Fonseca, R. P. & Prigatano, G. P. (2017). Memory and executive functions correlates of self-awareness in traumatic brain injury. *Cognitive Neuropsychiatry*, 22(4), 346–360. https://doi.org/10.1080/13546805.2017.1330191

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