

## **Conceptualizing the relations between metacognition and executive functions in Amyotrophic Lateral Sclerosis (ALS) patients' caregivers.**

### **A preliminary study**

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**Abstract:** Executive Functions are goal-directed neurocognitive processes that allow the management of cognition and behavior. Executive Functions are essential to allow people to set goals, self-monitor, inhibit inappropriate responses, and generally engage in well-planned, flexible, future-oriented behavior. Metacognitive processes, in close alliance with executive functions, are viewed as integral components of awareness and emotional regulation. The influence of metacognition on planning, monitoring and mental flexibility has not been investigated. The aim of this pilot study was to examine the relationship between metacognition and executive functions in Amyotrophic Lateral Sclerosis patient's caregivers. Twenty-two

caregivers were evaluated using the following instruments: Metacognition Questionnaire-30 and Wisconsin Card Sorting Test.

Data analysis was performed using SPSS for Windows applying correlational analysis (Spearman's Rho). We founded that total score of metacognition is positive correlated with number of perseverative errors made in Wisconsin (0.75  $p < .001$ ). In particular, need to control thoughts is positive correlated with number of perseverative errors (0.78  $p < .001$ ). Results could suggest the importance to explore the relationship between metacognitive processes and executive functions in order to cope disease's changes and optimize the relative daily living management. Providing care to a Amyotrophic Lateral Sclerosis relative may cause feelings of burden, psychological distress, anxiety or depression, in particular in case of dysfunctional metacognitions. So, our future researches will be oriented to explore the relationship between psychopathological symptoms and metacognition and executive functions in ALS' caregivers in order to contain caregiver emotional burden.

**Keywords:** Amyotrophic Lateral Sclerosis (ALS), executive functions, metacognition, caregiver.

## **Introduction**

Executive Functions (EF) are goal-directed neurocognitive processes that allow the control and management of cognition and behaviour (Luria, 1966; Welsh & Pennington, 1988). EF are essential to allow people to set goals, self-monitor, inhibit inappropriate responses, and generally engage in well-planned, flexible, future-oriented behaviour (Alvarez & Emory, 2006; Welsh & Pennington, 1988). Metacognitive processes, strictly connected with Executive Functions, are considered as integral components of awareness and emotional regulation (Wells & Matthews, 1996). According to recent findings, there is a strong relationship between emotion processes, cognitions, metacognitive beliefs and behaviours (Brune, 2006). We examined these processes in Amyotrophic Lateral Sclerosis (ALS) patients' caregivers.

Amyotrophic Lateral Sclerosis (ALS) is a progressive and fatal neurological disease. It is characterized by degeneration of motor neurons controlling voluntary muscles and leads to a progressive weakness until the complete loss of autonomy.

Symptoms include difficult in moving, speaking, swallowing and breathing. The increasing difficult in activities of daily living requires a multidisciplinary assistance (neurologists, pulmonologists, nurses, physical therapists, speech pathologists, psychologists). In this complex management, the primary caregiver plays a key-role. Primary caregiver has to face disease's changes, solve daily problems, manage medical therapy, and support relative's therapeutic choices. Therefore, caregiving requires abilities such as cognitive flexibility, emotional and behavioural self-regulation, self-consciousness related to metacognitive processes and executive functioning.

The influence of metacognition on planning, monitoring and mental flexibility has not been investigated yet (Spada et al. 2010). The aim of this study was to examine the relationship between executive functions and metacognition in ALS patients' caregivers.

## **Materials and methods**

### *Subjects*

Twenty-two patients' caregivers were included in the study, ALS diagnosed according to El Escorial Criteria (Brook et al., 2000). All subjects were recruited through the NEMO Clinical Center in Messina.

Inclusion criteria concerned with being the primary caregiver of an ALS patient and being an unpaid caregiver. Exclusion criteria were the presence of cognitive impairment, the presence of serious diseases and functional limitations. Before their participation in the study, all individuals gave written consent.

### *Measures*

All the subjects underwent the following instruments:

- *Wisconsin Card Sorting Test (WCST, Berg, 1948)* is a neuropsychological test indicated as specific to reveal frontal lobes dysfunctions. It consists of 128 response cards and 4 stimulus cards. Participants try different rules to find a correct method for sorting the cards. During the course of the test, the matching rules change. Once the subject has made a specified number of consecutive sorts according to the initial "correct" principle, the rule changes. In this study, the test is scored in terms of the number of cards used, perseverative errors, non-perseverative errors and sum of errors.

- *Metacognitions Questionnaire 30 (MCQ-30, Wells, Cartwright-Hatton, 2004; Quattropani et al., 2014)* is a 30 items self-report questionnaire which measures a range of metacognitive beliefs and processes relevant to vulnerability and maintenance of emotional disorders. The items are rated on a 4-point Likert scale from 1 ('do not agree') to 4 ('completely agree'). It can be divided in five subscales: CC-Cognitive Confidence (confidence in attention and memory); CSC-Cognitive Self-Consciousness (tendency to monitor own thoughts); POS-Positive beliefs about worry (positive beliefs about own perseverative thoughts); NEG-Negative beliefs about worry concerning uncontrollability and danger (negative beliefs about own perseverative thoughts); NC-Need to control thoughts (need to suppress certain type of thoughts).

### *Statistical analysis*

Data analysis was performed using SPSS for Windows applying correlational analysis (Spearman's Rho). The significance levels for the correlation coefficients was  $p < 0.05$  and  $p < 0.01$ .

## **Results**

### *Group characteristics*

The sample of caregivers consisted of 22 individuals (9 males; 13 females). Caregivers' demographic characteristics are detailed in Table 1.

**Table 1.** Sociodemographic Characteristics

Characteristics	Caregivers
Mean age $\pm$ SD, years	52.3 $\pm$ 14.7
Gender (n, percent)	
Male	9 (41%)
Female	13 (59%)
Mean education level $\pm$ SD, years	11.5 $\pm$ 4.5
Caregiver Type (n, percent)	
Partner/Spouse	

Son/Daughter	12 (55%)
Brother/Sister	9 (41%)
	1 (4%)

### *Correlational analysis (Rhos)*

As can be seen in Table 2, the results of correlational analysis show significant associations between WCST and MCQ-30.

The number of cards used in WCST (W\_N\_CARDS) is positively correlated with the total score in MCQ-30 (MCQ\_TOT  $r = 0.523$ ;  $p < .05$ ) and specifically with the subscale “Negative beliefs about worry concerning uncontrollability and danger” (MCQ\_NEG  $r = 0.515$ ;  $p < .05$ ) and with the subscale “Need to control thoughts” (MCQ\_NC  $r = 0.519$ ;  $p < .05$ ). Furthermore, this subscale (MCQ\_NC) is positive related with the sum of errors made in WCST (W\_N\_ERRORS  $r = 0.457$ ;  $p < .05$ ) and with the number of perseverative errors (W\_PERS\_ERR  $r = 0.637$ ;  $p < .01$ ) and with the number of non-perseverative errors (W\_NONPERS\_ERR  $r = 0.459$ ;  $p < .05$ ).

**Table 2. Correlational analysis between WCST and MCQ-30**

	W_N_CARDS	W_N_ERRORS	W_PERS_ERR	W_NONPERS_ERR
MCQ_POS	-0,004	-0,220	-0,263	-0,203
MCQ_NEG	0,515(*)	0,273	0,393	0,189
MCQ_CC	-0,004	-0,089	0,021	-0,144
MCQ_NC	0,519(*)	0,457(*)	0,637(**)	0,459(*)
MCQ_CSC	0,300	0,320	0,332	0,318
MCQ_TOT	0,523(*)	0,263	0,372	0,254

Note: W\_N\_CARDS= WCST number of cards used; W\_N\_ERRORS= WCST sum of errors;

W\_PERS\_ERR= WCST number of perseverative errors; W\_NONPERS\_ERR= WCST number of non-perseverative errors; \* $p < 0.05$ , \*\* $p < 0.01$

### **Discussion**

The absence of literature on metacognitive beliefs in ALS patients' caregivers (Spada et al. 2010) took us to explore associations between metacognition and executive functions. Metacognition, in close alliance

with Executive Functions, is defined as “the aspect of information processing that monitors, interprets, evaluates and regulates the contents and processes of its organization” (Wells & Purdon, 1999). So, we also hypothesized a relationship in both functions.

Preliminary results seem to corroborate our hypotheses. We found a relationship between metacognitive processes and executive functions. Specifically, our pilot study revealed an association between the beliefs about need to control certain type of thoughts and the number of perseverative errors made in WCST. So, we may suppose that tendency to perseverate is closely linked to dysfunctional metacognitive beliefs, seen as expression of a specific inflexibility in thinking processes.

### **Conclusions**

Our research suggests the importance to explore the relationship between metacognitive processes and executive functions and empower cognitive and metacognitive functional processes by means specific psychological treatments, in order to cope disease's changes and optimize the relative daily living management.

Providing care to a Amyotrophic Lateral Sclerosis relative may cause feelings of burden (Pagnini et al., 2010), psychological distress, anxiety or depression (Goldstein et al., 2006; Yilmaz et al., 2011; Pagnini, Lunetta et al., 2012), in particular in case of dysfunctional metacognitions (La Foresta et al., 2015). So, our future researches will be oriented to explore the relationship between psychopathological symptoms and metacognition and executive functions in ALS'caregivers in order to contain caregiver emotional burden (Qutub et al., 2014; Settineri et al., 2014).

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