

# Importance of Coping in the Relationship Between Executive Function and Quality of Life in People with Multiple Sclerosis

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**Background:** Maximizing quality of life (QOL) for people with multiple sclerosis (MS) is a primary focus of health care management professionals. Research has shown a relationship between QOL and a person's coping style and that coping provides an indirect link between cognition and stress, depression, and anxiety in MS. This research assessed whether coping moderates or mediates the relationship between executive function and QOL in people with MS.

**Methods:** We assessed 107 people with relapsing-remitting (n = 83) or secondary progressive (n = 24) MS using executive function tasks and self-report coping and QOL inventories.

**Results:** Coping strategies that mediated the relationship between executive function and QOL in people with MS included behavioral disengagement, acceptance, growth, and religion, while moderating strategies were denial, active, religion, adaptive, and total coping indices. Less cognitively demanding coping strategies that were related to *increased* QOL in people with poorer executive function included acceptance, growth, and religion, and maladaptive strategies associated with *poorer* QOL were behavioral disengagement and denial.

**Conclusions:** These results suggest that lessening avoidant coping strategies and strengthening use of less cognitively demanding adaptive coping strategies may improve QOL in people with MS who experience deficits in executive function. Consideration should be given to the development of psychoeducation and interventions with this focus. *Int J MS Care*. 2019;21:201-206.

The aim of health care management for people with multiple sclerosis (MS) is to maximize the person's quality of life (QOL), that is, their perceived physical, psychological, and social functioning and well-being.<sup>1(p1405)</sup> People with MS report lower QOL than do people in the general population or those with other chronic neurologic conditions. Many factors, including physical disability, MS subtype, and disease duration, influence QOL in people with MS.<sup>2</sup>

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Coping style has been linked to QOL in people with MS. Coping is the cognitive and behavioral response used to manage distress related to a person's perception that desired goals have been harmed, threatened, or lost.<sup>3</sup> Compared with controls, people with MS use fewer adaptive coping strategies, such as social support and problem-solving, and more detachment coping styles, considered maladaptive.<sup>4,5</sup> Accepting responsibility (a self-blaming strategy), avoidance, and wishful thinking have predicted poorer QOL,<sup>4,6,7</sup> whereas finding meaning, positive attitude, problem-solving, and social support have been related to increased QOL.<sup>4,6</sup> Coping has been proposed as a mediator of emotions,<sup>8</sup> and understanding this role provides an opportunity to improve mental health outcomes for people with MS because coping is amenable to change.<sup>3</sup>

Cognitive deficits are present in approximately 50% of people with MS.<sup>9</sup> The relationship between cognition and QOL has been inconsistent. Some studies have found that cognitive deficits relate to lower QOL,

including at the early stage of the disease,<sup>2,10</sup> whereas other research, specific to executive function, has found no relationship.<sup>11</sup> Coping has mediated and moderated the relationship between cognition and stress, depression, and anxiety in people with MS.<sup>12,13</sup> Rabinowitz and Arnett<sup>12</sup> proposed that cognition is a coping resource due to the ability of cognitive performance to affect depression through coping. Their research, which used a coping index, found that reduced cognition impaired the use of adaptive coping strategies, resulting in a greater likelihood of using maladaptive strategies. However, when coping strategies are individually analyzed it has been shown that people with MS with lower cognitive ability still used adaptive coping strategies, although these strategies were less cognitively demanding (eg, coping through acceptance rather than problem-solving).<sup>13</sup>

It is plausible that the relationship between cognition and coping is determined by executive function. Hofmann et al<sup>14</sup> argued that executive function is a principal mechanism in self-regulatory goal pursuits, particularly cognitive flexibility, working memory, and inhibition. Research has shown a relationship between executive function and coping in people with MS<sup>15</sup> and other clinical populations, including people with schizophrenia<sup>16</sup> and acquired brain injury.<sup>17</sup> This relationship is proposed because active coping strategies, such as problem-solving, require foresight, planning, and perspective taking. Impairment in these cognitive abilities results in a likelihood that the person will default to less cognitively demanding coping strategies (eg, acceptance or avoidance).<sup>17</sup>

Given that research supports a relationship between executive function and coping<sup>15</sup> and between coping and QOL,<sup>4,6</sup> and that previous research has shown that coping mediates and moderates the relationship between cognition and depression, stress, and anxiety,<sup>12,13</sup> the aim of this study was to assess whether coping would mediate or moderate the relationship between cognition, specific to executive function, and QOL.

## Methods

### Participants

This analysis was undertaken as an extension of previously published research, and a more detailed description is available in the studies by Grech et al.<sup>18,19</sup> Briefly, 107 people aged 18 years or older with relapsing-remitting or secondary progressive MS, per the 2010 revision of the McDonald diagnostic criteria,<sup>20</sup> were recruited to the study after receipt of informed consent. Participants' treating neurologists were contacted to provide confirmation of diagnosis, subtype, and Expanded Disability Status Scale (EDSS) scores. Ethical approval was

obtained through the Department of Health, Victoria, Multi-Site Streamline Ethical Review System.

### Materials

All of the following tasks and inventories have been previously validated and used in MS research.

#### *Cognitive Assessment*

Executive function was assessed using a battery of tasks combined for analysis into indices consistent with previous theory and research.<sup>14,21</sup> A core index comprising tasks fundamental to efficient executive functioning included tasks of attention, working memory, inhibitory control, and cognitive flexibility.<sup>14</sup> This index consisted of Visual Elevator and Elevator Counting with Distraction from the Behavioural Assessment of the Dysexecutive Syndrome,<sup>22</sup> Reading Span,<sup>23</sup> the Symbol Digit Modalities Test,<sup>24</sup> the Hayling Sentence Completion Test,<sup>25</sup> and the Trail Making Test.<sup>26</sup> A higher-level index combined tasks reliant on core executive function and consisted of planning, problem-solving, and decision-making tasks, including Action Programming, Modified Six Elements Test, and Zoo Map from the Behavioural Assessment of the Dysexecutive Syndrome<sup>22</sup> and the Iowa Gambling Task.<sup>27</sup> A verbal fluency index comprised word list generation tasks (F and animals) because verbal fluency measures aspects of verbal ability and executive control.<sup>21</sup>

#### *Self-report Inventories*

The 60-item COPE inventory measures dispositional coping and derives 15 coping styles.<sup>28</sup> Total coping was calculated from the sum of responses, and an adaptive coping index was calculated using the method reported by Rabinowitz and Arnett.<sup>12</sup> The QOL was measured using the physical health, mental health, and overall QOL composite scores from the Multiple Sclerosis Quality of Life-54.<sup>29</sup>

### Procedures

Participants attended a 3- to 4-hour research appointment, including scheduled breaks, where they were administered a battery of cognitive tasks in a standardized order. The coping and QOL inventories were mailed to participants for completion in the week before the appointment.

### Statistical Analysis

Cognitive indices were calculated by transforming task scores into *z* scores, summing, and dividing the total by the number of tasks. Mediation and moderation analyses were systematically performed for each executive function index and for physical, mental, and overall QOL, with coping variables as the mediator/moderator, following the instructions and script developed by

Hayes for IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp, Armonk, NY), and Mplus (Muthén & Muthén, Los Angeles, CA).<sup>30-32</sup> Significant indirect effects were identified using bootstrapping.<sup>32</sup> Demographic and disease-related variables that correlated with the outcome variable were covaried to control effects, including age, visual acuity, EDSS score, MS subtype, antidepressant drug use for physical health QOL, and antidepressant and benzodiazepine use for mental health and overall QOL.

## Results

### Participant Characteristics

Data from 107 people with MS were used for analysis. See Table 1 for demographic details. Given that EDSS scores,<sup>33</sup> provided by participants' treating neurologists, were available for only 70 participants, the analysis was performed for participants with and without EDSS scores. There were no significant between-group differences for sex, MS subtype, age, diagnosis duration, time since onset, education, disease-modifying medication use, or antidepressant or benzodiazepine medication use (all  $P > .05$ ) (analysis not shown).

### Mediation and Moderation

Table 2 displays significant indirect results (mediation), and significant interaction results (moderation) are displayed in Table 3. Regression slopes significantly different from zero for either low or high coping are discussed in the following subsections.

#### Mediation

**Mental Health QOL.** Poorer executive function (core, higher-order, and total indices) indirectly pre-

**Table 1. Demographic and disease-related characteristics of the 107 study participants**

Characteristic	Value
Sex, M/F	24 (22.4)/83 (77.6)
RRMS/SPMS	83 (77.6)/24 (22.4)
Age, y	48.8 ± 11.1 (26.2-74.5)
Time since diagnosis, y	9.82 ± 7.46 (0.3-31.2)
Time since onset, y	14.77 ± 9.23 (1.0-44.5)
EDSS score (n = 70)	2.9 ± 2.31 (0-8)
Education	
Secondary	30 (28.0)
Technical college	21 (19.6)
Undergraduate	34 (31.8)
Postgraduate	22 (20.6)
Disease-modifying medication use	86 (80.4)
Antidepressant drug use	40 (37.4)

Note: Values are given as number (percentage) or mean ± SD (range). Abbreviations: EDSS, Expanded Disability Status Scale; RRMS, relapsing-remitting multiple sclerosis; SPMS, secondary progressive multiple sclerosis.

dicted poorer mental health QOL through higher use of behavioral disengagement coping and better mental health QOL through greater use of acceptance and positive reinterpretation and growth coping (core and total executive function indices). Better verbal fluency performance indirectly predicted better mental health QOL through higher scores on the adaptive coping index.

**Overall QOL.** Poorer core, higher-order, and total executive function indirectly predicted better overall QOL through greater use of acceptance and turning to religion coping and greater use of growth coping (core and total executive function indices only).

#### Moderation

**Mental Health QOL.** There was a significant moderating relationship across all executive function indices for denial coping. When denial coping was high, better executive function was associated with higher mental health QOL, which was not present when denial coping was low. When scores on the adaptive coping index were high there was a relationship between lower higher-order executive function scores and higher mental health QOL, which was not present when adaptive coping was low.

**Physical Health QOL.** When active coping was low there was a relationship between better core, higher-order, and total executive function and higher physical health QOL, which was not present when active coping was high. Similarly, when total coping was low there was a relationship between total executive function and physical health QOL, which was not present when active coping was high.

**Overall QOL.** There was a relationship between better core executive function and increased QOL for high, but not low, endorsement of religion coping; similarly, there was a relationship between higher total executive function and higher overall QOL when denial coping was high, but not low.

## Discussion

This research assessed the capability of coping to mediate and moderate the relationship between executive function and QOL in people with MS. The mediating coping strategies that were found included acceptance, growth, religion, behavioral disengagement, and the adaptive coping index, and the moderating strategies included active, religion, denial, and the total coping index.

Lower core, higher-order, and total executive function indices were related to better mental health and overall QOL through higher use of acceptance, growth (core and overall executive function only), and religion (overall QOL only) coping. In addition, there was an

**Table 2. Significant results for indirect relationship with coping as mediator and between executive function indices and QOL**

Index and QOL	Mediator	a	b	c	c'	IE	Bootstrapped 95% CIs for IE	Partial standardized effect
Verbal fluency								
Mental health QOL	Adaptive index	0.44 <sup>a</sup>	2.08 <sup>b</sup>	0.26	-0.65	0.90	0.04 to 2.45	0.06
Core executive function								
Mental health QOL	Acceptance	-1.03 <sup>a</sup>	1.61 <sup>a</sup>	1.47	3.14	-1.66	-3.92 to -0.42	-0.10
	Growth	-0.81 <sup>b</sup>	1.83 <sup>c</sup>	1.47	2.95	-1.48	-3.96 to -0.12	-0.09
	Behav dis	-0.52 <sup>a</sup>	-3.47 <sup>b</sup>	1.54	-0.24	1.79	0.12 to 4.75	0.11
Overall QOL	Acceptance	-1.03 <sup>a</sup>	-0.15 <sup>a</sup>	-0.09	-0.25	0.16	0.03 to 0.38	0.10
	Growth	-0.81 <sup>b</sup>	-0.18 <sup>d</sup>	-0.09	-0.23	0.14	0.01 to 0.40	0.08
	Religion	-0.69 <sup>d</sup>	-0.48 <sup>a</sup>	-0.10	-0.43	0.33	0.08 to 0.78	0.20
Higher-order executive function								
Mental health QOL	Acceptance	-1.23 <sup>b</sup>	1.53 <sup>a</sup>	1.31	3.19	-1.88	-4.84 to -0.36	-0.12
	Behav dis	-0.84 <sup>a</sup>	-3.87 <sup>b</sup>	0.92	-2.34	3.26	0.35 to 9.50	0.20
Overall QOL	Acceptance	-1.23 <sup>a</sup>	-0.16 <sup>a</sup>	-0.23	-0.43	0.19	0.03 to 0.49	0.11
	Religion	-0.52 <sup>b</sup>	-0.44 <sup>b</sup>	-0.20	-0.44	0.23	0.02 to 0.71	0.14
Total executive function								
Mental health QOL	Acceptance	-1.13 <sup>a</sup>	1.58 <sup>a</sup>	1.75	3.53	-1.78	-4.34 to -0.40	-0.11
	Growth	-0.90	1.82 <sup>c</sup>	1.75	3.40	-1.64	-4.55 to -0.17	-0.10
	Behav dis	-0.64 <sup>a</sup>	-3.56 <sup>b</sup>	1.74	-0.53	2.28	0.22 to 6.00	0.14
Overall QOL	Acceptance	-1.13 <sup>a</sup>	-0.15	-0.12	-0.29	0.17	0.04 to 0.42	0.10
	Growth	-0.09	-0.18 <sup>d</sup>	-0.12	-0.28	0.10	0.009 to 0.25	0.06
	Religion	-0.79 <sup>a</sup>	0.49 <sup>a</sup>	-0.11	-0.50	0.39	0.09 to 0.90	0.24

Note: All significant IEs have been obtained using bootstrapping of 5000 samples and provide 95% CIs, as recommended by Hayes.<sup>32</sup> Relationships for outcome variable—overall QOL—should be viewed in reverse because this variable underwent a reflect transformation. Therefore, relationships that appear negative are positive and relationships that appear positive are negative. Increased scores on all executive function indices indicate increased performance. Tasks included in each index are as follows: verbal fluency—Word List Generation Animals and Word List Generation 'F'; core executive function—Symbol Digit Modalities Test, Hayling Sentence Completion Test, Trail Making Test, Visual Elevator, Elevator Counting with Distraction, and Reading Span; higher-order executive function—Iowa Gambling Task, Action Programming, Moderated Six Elements Test, and Zoo Map; and total executive function—all tasks listed in verbal fluency, core, and higher-order executive function indices.

Abbreviations: Behav dis, behavioral disengagement; Growth, positive reinterpretation and growth; IE, indirect effect; QOL, quality of life; Religion, turning to religion.

<sup>a</sup> $P < .01$ .

<sup>b</sup> $P < .05$ .

<sup>c</sup> $P < .0001$ .

<sup>d</sup> $P < .001$ .

indirect relationship between poorer performance on the core, higher-order, and total executive function indices and lower mental health QOL through higher use of behavioral disengagement coping. These coping strategies might be considered less cognitively demanding, or passive, and are often used in the absence of perceived control.<sup>3</sup> This suggests that in people with MS with poorer executive function, compensation by using passive adaptive coping strategies is important to enhance QOL and should be encouraged. However, when cognitive resources are lower, specifically, processes related to executive function or directly supporting executive function, such as working memory and information processing, there is a risk of the person using more passive

maladaptive coping, of concern because of the link with lower QOL.

These results are consistent with the proposal by Hofmann et al<sup>14</sup> that executive function is important to the pursuit of self-regulatory goal-directed behavior. Similarly, Krpan et al<sup>17</sup> argued that active coping requires foresight, planning, and perspective taking and that reduced cognitive abilities may result in a person defaulting to less cognitively demanding coping strategies, such as behavioral disengagement, acceptance, growth, and religion, which impact QOL. The present results are also consistent with the mediating relationship that cognitively less-demanding adaptive coping strategies

**Table 3. Significant results for moderating relationship of coping between executive function indices and QOL**

Index and QOL	Moderator	$\Delta R^2$	F	Low slope	t test	High slope	t test
Verbal fluency							
Mental health QOL	Denial	0.04	5.33 <sup>a</sup>	-2.16	-1.17	7.77	1.98 <sup>a</sup>
Core executive function							
Mental health QOL	Denial	0.06	7.40 <sup>b</sup>	-3.67	-1.43	8.22	2.33 <sup>a</sup>
Physical health QOL	Active	0.06	5.91 <sup>a</sup>	11.41	2.85 <sup>b</sup>	-2.60	-0.75
Overall QOL	Religion	0.03	4.23 <sup>a</sup>	0.08	0.27	-0.86	-2.48 <sup>b</sup>
Higher-order executive function							
Mental health QOL	Denial	<i>0.05</i>	<i>6.20<sup>b</sup></i>	<i>-6.03</i>	<i>-1.66</i>	<i>8.08</i>	<i>1.84<sup>t</sup></i>
	Adaptive index	0.06	7.50 <sup>b</sup>	6.31	1.81 <sup>t</sup>	-10.73	-2.27 <sup>a</sup>
Physical health QOL	Active	<i>0.04</i>	<i>3.83<sup>a</sup></i>	<i>7.99</i>	<i>1.39</i>	<i>-8.61</i>	<i>-1.75<sup>t</sup></i>
Total executive function							
Mental health QOL	Denial	0.07	10.12 <sup>b</sup>	-5.25	-1.75 <sup>t</sup>	11.16	2.68 <sup>b</sup>
Physical health QOL	Active	0.07	7.16 <sup>b</sup>	13.99	2.68 <sup>b</sup>	-5.66	-1.37
	Total coping	0.04	4.44 <sup>a</sup>	11.05	2.11 <sup>a</sup>	-1.72	-0.50
Overall QOL	Denial	0.04	5.17 <sup>a</sup>	0.37	1.10	-0.93	-2.02 <sup>a</sup>

Note: All significant interactions between moderator and outcome variables are listed in table. For interest, interactions with a slope approaching significance ( $\leq 0.08^t$ ) are displayed in italics, although only significant slopes are discussed in Results section of this article. Relationships for outcome variable—overall QOL—should be viewed in reverse because this variable underwent a reflect transformation. Therefore, relationships that appear negative are positive and relationships that appear positive are negative. Increased scores on all executive function indices indicate increased performance. Tasks included in each index are as follows: verbal fluency—word list generation animals and word list generation F; core executive function—Symbol Digit Modalities Test, Hayling Sentence Completion Test, Trail Making Test, Visual Elevator, Elevator Counting with Distraction, and Reading Span; higher-order executive function—Iowa Gambling Task, Action Programming, Moderated Six Elements Test, and Zoo Map; and total executive function—all tasks listed in the verbal fluency, core, and higher-order executive function indices.

Abbreviations: QOL, quality of life; Religion, turning to religion.

<sup>a</sup> $P < .05$ .

<sup>b</sup> $P < .01$ .

have had for other psychosocial outcomes, such as stress, depression, and anxiety.<sup>13</sup>

In the present study, the relationship between reduced executive function and lower mental health and overall QOL when denial coping was high, and lower physical health QOL when active coping was low, is consistent with Rabinowitz and Arnett's<sup>12</sup> proposal that low adaptive coping or high maladaptive coping places an individual with cognitive deficits at risk for poorer depression, and extends this to QOL. Higher scores on the adaptive coping index mediated the relationship between higher verbal fluency and mental health QOL and moderated the relationship between poorer higher-order executive function and better QOL, which is generally consistent with the proposal that cognitive function is a coping resource and adaptive coping is protective against poorer psychosocial outcomes when cognitive function is low.<sup>34</sup>

The present findings highlight the important role that coping plays in the relationship between executive function and QOL for people with MS, and the need to assess coping strategies as part of a comprehensive neuropsychological assessment. Coping is amenable to change,<sup>3</sup> and these results point to the potential to improve QOL for people with MS with executive function difficulties,

through psychoeducation aimed at patient awareness of his or her coping patterns and potential links with poorer psychosocial outcomes and interventions aimed

## PRACTICE POINTS

- People with MS and reduced executive function may use less cognitively demanding or "active" coping strategies that require a greater level of foresight, planning, and perspective taking.
- Less cognitively demanding coping strategies that seem to affect quality of life (QOL) in people with MS and reduced executive function may be adaptive (acceptance, positive reinterpretation and growth, and turning to religion) or maladaptive (behavioral disengagement and denial [avoidance strategies]).
- Psychoeducation and interventions that improve coping through acceptance, positive reinterpretation and growth, and turning to religion may improve QOL in people with MS who have reduced executive function.
- Use of avoidance coping strategies should be discouraged in people with MS and reduced executive function because they have been linked to lower QOL.

at modifying the use of less adaptive coping strategies (for example, aiming to reduce the use of denial and behavioral disengagement in favor of more adaptive strategies within the individual's cognitive means, such as acceptance, growth, and religion). Cognitive behavioral therapy and motivational interviewing interventions have shown efficacy for restructuring coping in people with acquired brain injury, suggesting that these interventions may be useful for people with MS also.<sup>35</sup>

Notably, some coping strategies did not show a mediating or moderating relationship, including planning, suppression of competing activities, restraint, instrumental and emotional social support, focus on and venting of emotions, and substance abuse. Furthermore, the adaptive strategies that showed a relationship may not be suitable for all people or disease stages. For example, encouraging acceptance and growth for people too early after diagnosis may be considered insensitive and interpreted as minimization of emotional difficulties. Similarly, religion coping is not likely to be useful for people without underlying religious or spiritual values. The present sample primarily had relapsing-remitting MS and, on the whole, had mild disability measured using the EDSS. Therefore, these results may not be generalizable to people with higher physical disability. In addition, this study was cross-sectional, limiting the ability to attribute causality.

In conclusion, this research has shown the importance of coping as a mediator and moderator in the relationship between executive function and QOL in people with MS and the valuable role of less cognitively demanding adaptive coping strategies, such as acceptance and growth, and increased QOL when executive function is reduced. Interventions aimed at reducing maladaptive coping and increasing adaptive coping may be beneficial to improving QOL in people with MS who experience difficulties in executive function, warranting future research. □

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