

Can assessment of multi-tasking inform the cognitive-motor function in people living with COPD?

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Chronic Obstructive Pulmonary Disease (COPD) is a heterogeneous condition characterized by airflow obstruction and associated symptoms of dyspnea, cough, and sputum production.^{1,2} COPD is associated with increased morbidity and is the third leading cause of mortality globally.³ COPD often exhibits extra-pulmonary manifestations including fatigue, physical inactivity, cognitive and physical impairments.⁴ Physical impairments can have multiple contributors such as chronic hypoxemia, corticosteroid use, immobility and muscle weakness.⁵ Most of our daily activities rely on motor control, which involves integration of cognition and several body systems, including the respiratory system, limb and respiratory muscles, sensory motor, vision and hearing (**Figure 1**).⁶

The neural integration of physical and cognitive systems required for multi-tasking can be limited in people living with COPD. Increased respiratory muscle recruitment with the associated aversive and unpleasant sensation of dyspnea requires increased cortical and subcortical activation.^{7,8} The neuromotor control pathways required for balance or walking have been shown to be diminished with aging^{9,10} and may be similarly affected in COPD. Taken together, cognitive interference from dyspnea and muscle recruitment (respiratory and non-respiratory) may limit neural capacity available for multi-tasking, which requires integration of both physical and cognitive tasks,¹¹ as shown in **Figure 2**. The compensatory-related utilization of neural circuits hypothesis theory (CRUNCH)¹² proposes that aging results in decreased neural capacity but requires higher cortical activation with simpler tasks. Moreover, this theory may be applicable to people living with COPD and in part, contribute to decreased independence with self-care activities and lower health related quality of life.

Pulmonary rehabilitation often focuses on dyspnea management and improving functional and motor performance but may not address cognitive impairments. Recent studies reported that cognitive impairments in COPD patients ranged between 10% to 61%.^{13,14} Some of the cognitive domains affected in patients with COPD are attention, memory, processing speed, and executive function.¹⁵⁻¹⁸ Cognitive limitations can further impact quality of life, COPD management, treatment adherence, and ability to perform instrumental activities of daily living (ADL).^{14,19} However, what about daily activities that require integration of cognition and physical performance? For most ADL, the performance of more than one task simultaneously requires 'multi-tasking'. When implemented as a research paradigm, this is known as 'dual tasking' and tests the ability to perform two tasks simultaneously.²⁰

A recent systematic review and meta-analysis included five studies which assessed dual task performance in COPD patients (GOLD II-IV; 92%) compared to age matched healthy controls.²² All studies included had protocols involving a motor and cognitive task. The predominant motor task was walking combined with cognitive tasks such as counting backwards or spelling words backwards. A decline in the

dual task performance was reported as dual task interference with individuals with COPD having greater interference with slower gait speed and worse cognitive performance compared to age matched healthy adults. This review highlights the importance of considering both motor and cognitive tasks when evaluating daily function in COPD.²¹ Interestingly, none of the studies in the review assessed upper limb activity as a motor task. Given the age-related decline in manual dexterity and hand function,²² their impact on inhaler use and medication management requires further exploration in COPD.

In conclusion, safe and independent ADL requires the integration of both cognitive and motor systems, as most of our daily activities require multi-tasking. The addition of motor-cognitive training in pulmonary rehabilitation can potentially help with instrumental ADL such inhaler use, grocery shopping or crossing busy intersections. A better understanding of multitasking for individuals with chronic lung disease can aid with strategizing, simplifying task complexity, and more importantly performance of ADL.

Figures:

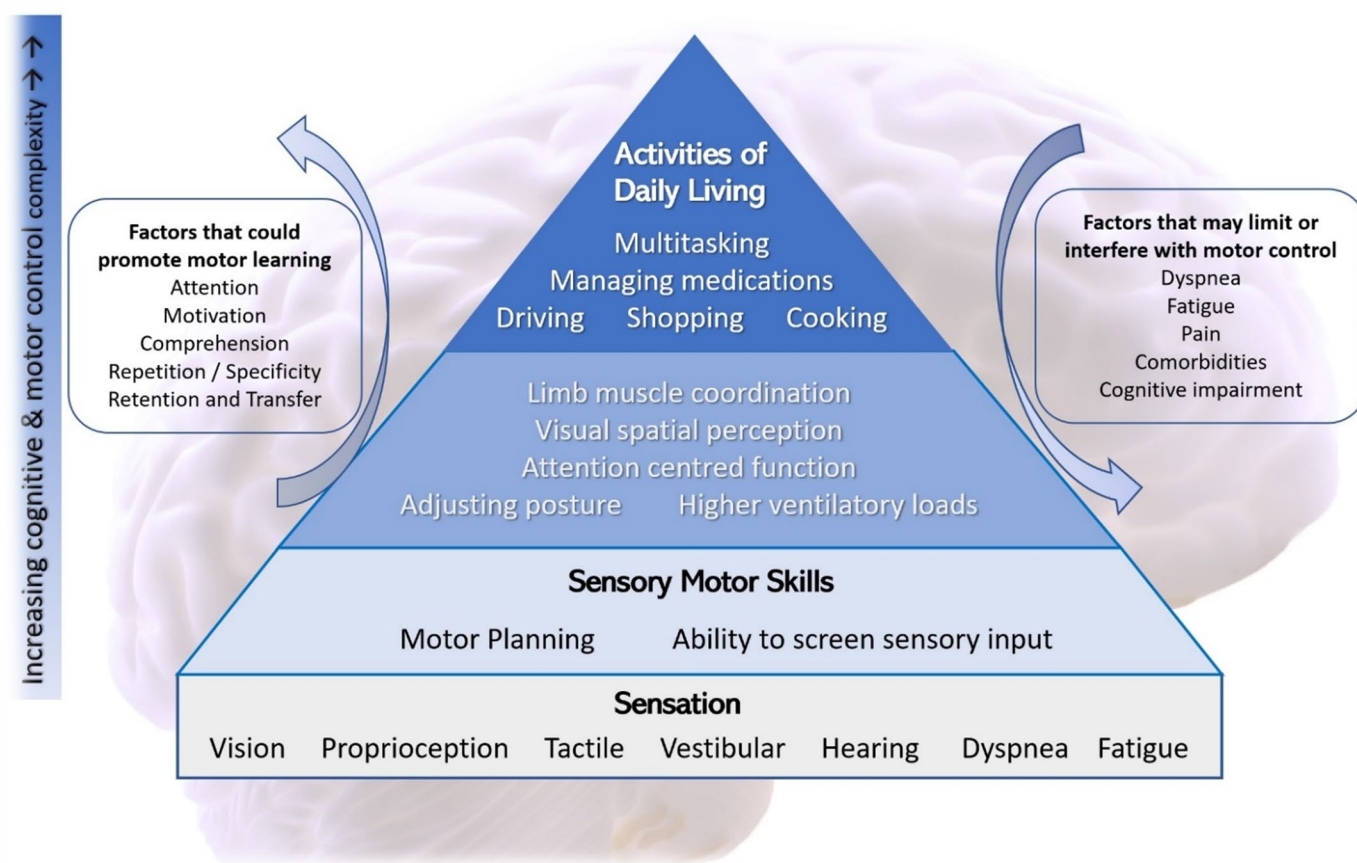


Figure 1: Conceptual pyramid of sensations and motor skills that provide a foundation for more complex tasks. Complex integration of sensory and motor processing is required for many activities of daily living. Moreover, several factors may limit or interfere with motor control. On the other hand, motor control can improve with many training strategies.

Figure taken from Rozenberg D et al, Chest; 166 (4); 2024. Open access article under CC BY-NC-ND license.

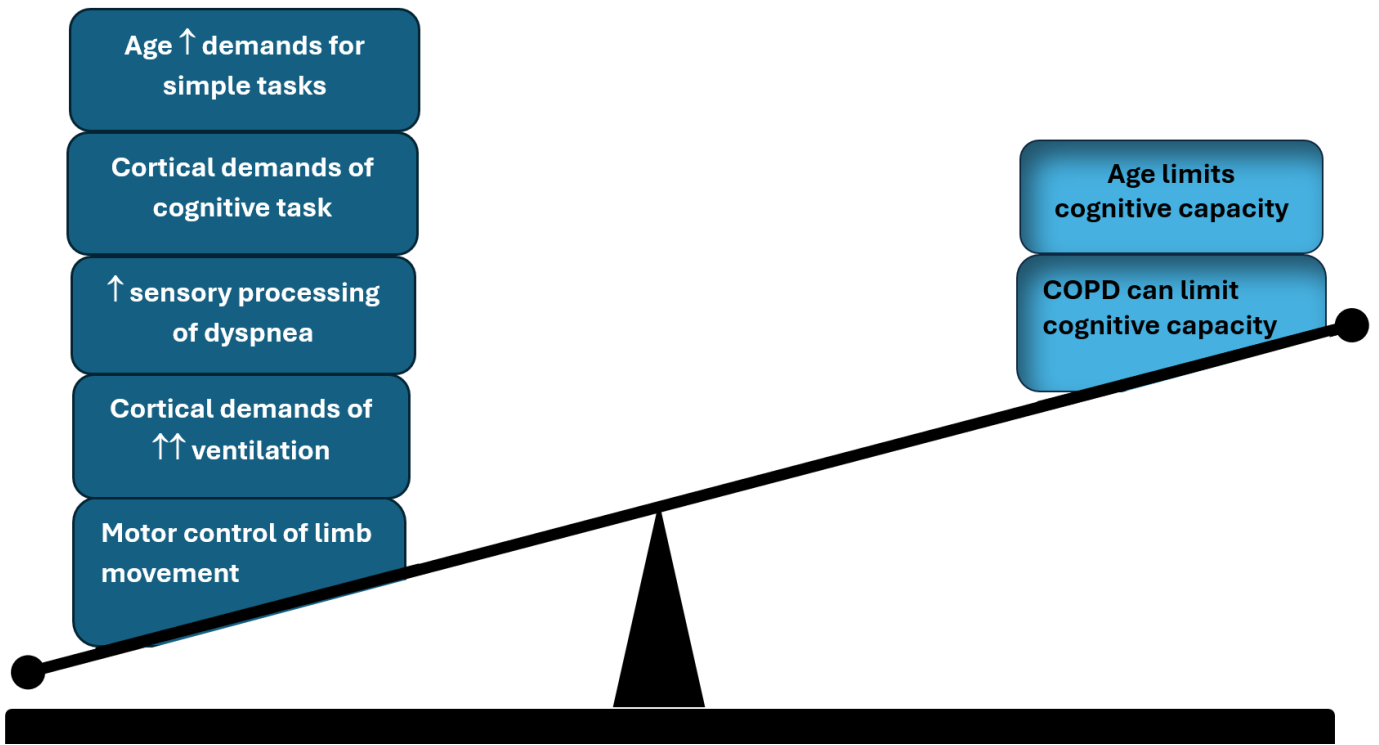


Figure 2: Dual tasking can be limited in COPD because of an imbalance between cognitive demands and cognitive capacity. These factors may be amenable to training or should be considered when approaching ADL.

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