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# LONELINESS AND MOTOR CONTROL: FIELD AND LAB INVESTIGATIONS

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## Abstract

Loneliness has been argued to burden the cognitive system, diverting attentional resources towards the search for social cues. Loneliness has been also linked to impaired motor control, evident in slower walking speeds and compromised postural balance. However, previous studies connecting loneliness with motor control predominantly involved older adults and did not consider the role of cognitive load. This study was designed to explore the relationship between loneliness and motor control in young and middle-aged adults, taking into account cognitive resource availability. In Study 1, 123 participants aged 21-59 underwent field evaluations involving static and dynamic balance tasks within single- and dual-task paradigms, allowing for the calculation of attentional costs on motor control. Levels of Social, Familial, and Romantic loneliness were also assessed. Results indicated that social loneliness predicted increased attentional costs in dynamic balance tasks, suggesting that participants with higher loneliness scores found these tasks more challenging under dual-task conditions. Performance in static balance tasks decreased in relation to romantic loneliness, under both single and dual-task conditions. In Study 2, 59 participants aged 19-44 completed the UCLA loneliness scale and a postural stability assessment using a Tetrax system. Findings revealed a correlation between loneliness and a left-side weight distribution bias, particularly in tasks performed with closed eyes. Altogether, these findings support the right-hemisphere cognitive overload hypothesis of loneliness, offer a detailed examination of how loneliness might interact with motor control mechanisms, and generalize previous findings to young and middle-aged adults.

***Keywords:*** *Loneliness, motor control, static balance, dynamic balance, Tetrax.*

## 1. Introduction and objectives

The association between physical function and mental health, has been gaining attention in health and movement literature. Yet, knowledge about how loneliness impacts aspects of motor control, such as overall physical stability and mobility, remains limited. Loneliness, defined as the subjective feeling of lacking meaningful social connections, is a known risk factor for various health issues (Hawkley et al., 2009). Studies suggest that loneliness can negatively affect balance control mechanisms, potentially due to reduced physical activity leading to muscle weakening and impaired sensory processing (Buchman et al., 2011; Philip et al., 2020).

However, standard motor control assessment methods, like dual-task (DT) performance or accurate postural stability measurement, are rarely used in loneliness research. This gap in methodology limits our understanding of the loneliness-motor control relationship. For example, a study by Rezola-Pardo et al. (2019) found no connection between DT and loneliness, but used DT as an intervention rather than a high cognitive-load assessment condition, thus not conclusively addressing the impact of loneliness on motor control. Our study was aimed to further investigate the association between loneliness and motor control through lab and field studies. We hypothesized that participants with higher loneliness levels will show poorer performance in various motor tasks compared to their less lonely counterparts.

## 2. Method

### 2.1. Materials and procedure

Study 1 consisted of 123 participants aged 21-59 (M=34.20, SD=10.42), sampled in a convenience sampling method and assessed at their homes. Loneliness was examined using the SELSA questionnaire (DiTommaso & Spinner, 1993), which assesses levels of Social, Familial, and Romantic loneliness. Motor

control was assessed using several tasks: a) In the **one foot stance single task**, participants were to stand on non-dominant foot; b) The **one foot stance dual task** was similar to the previous task, with the addition of continuously subtracting 3 from a random three digit number provided by the experimenter; c) In the **gait single task**, participants were to tandem-walk for 2m and back; d) In the **gait dual task**, participants were to do the same, in addition to continuously subtracting 3 from a random three digit number provided by the experimenter. In all motor assessment performance time was measured (in seconds).

Study 2 consisted of 59 participants aged 19-44 (M=26.05, SD=4.43), all physical education students who volunteered to the study. The study was conducted in a laboratory equipped with a Tetrax™ system which assesses postural stability in various conditions (e.g., with eyes open, with closed eyes, etc.) following a strict protocol. Loneliness was assessed using the UCLA questionnaire V3 (Russell, 1996). In addition, Timed Up and Go (TUG) and Trail Making Test (TMT) were assessed.

## 3. Results

In Study 1, attentional costs on motor control were calculated by subtracting single task performance from dual task. Attentional cost and loneliness data were submitted to linear regression analyses, controlling for age, gender, relationship status, and foot dominancy. The analyses revealed that increased attentional costs in dynamic balance tasks was predicted by social loneliness ($B$=4.71, $p$=.008) and romantic loneliness ($B$=2.18, $p$<.001), suggesting that participants with higher levels of loneliness found these tasks more challenging under dual-task conditions. Performance in static balance tasks decreased only in relation to romantic loneliness ($B$=-12.55, $p$=.005) under both single and dual-task conditions.

In Study 2, loneliness and Tetrax data were submitted to Pearson correlation analysis. Findings revealed a correlation between loneliness and a left-side weight distribution bias, particularly in tasks performed with closed eyes (HB B%: $r$=.272, $p$<.05; WDI: $r$=.286, $p$<.05; PO B%: $r$=.275, $p$<.05). TUG and TMT were not associated with loneliness.

## 4. Discussion and conclusions

Overall, our findings support the right-hemisphere cognitive overload hypothesis of loneliness. This hypothesis suggests that loneliness occupies the attentional system, which is regulated by control mechanisms in the right parietal hemisphere, thereby affecting attentional control in general and specifically on the left side of the body. Our data indicated that loneliness was associated with decreased motor performance under increased attentional demand (i.e., during a dual task) and with diminished motor control over the left foot. These findings could be used to enhance our understanding of the impact of loneliness on vulnerable individuals.

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