# The effect of transcranial direct current stimulation on task processing and prioritisation during dual-task gait.

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## Abstract

The relationship between cognition and gait is often explored using a dual-task gait paradigm, which represents the ability to divide cognitive resources during walking. Recent evidence has suggested that the prefrontal cortex is involved in the allocation of cognitive resources during dual-task gait, though its precise role is unclear. Here, we used anodal and cathodal transcranial direct current stimulation (tDCS) to probe the role of the prefrontal cortex in the control of stride time variability (STV), trunk RoM and cognitive task performance during dual-task gait. As task difficulty has been shown to mediate the dual-task cost, we also manipulated walking speed to see if the effects of tDCS on dual-task gait were influenced by walking difficulty. Ten adults performed a serial subtraction task when walking at either preferred walking speed or at 25% of preferred walking speed, before and after receiving tDCS of the left prefrontal cortex. Anodal tDCS reduced STV and the dual-task cost on STV, and improved cognitive task performance. Cathodal tDCS increased STV and appeared to increase the dual-task cost on STV, but did not affect cognitive task performance. There was no effect of tDCS on trunk RoM and the effects of tDCS were not mediated by walking speed. The effect of dual-task gait on stride time variability and cognitive task performance was altered by the application of tDCS, and these effects were polarity dependent. These results highlight the role of the prefrontal cortex in biasing task performance during dual-task gait and indicate that tDCS may be a useful tool for examining the role of the cortex in the control of dual-task gait.

## Keywords

Non-invasive; Cognition; Prefrontal cortex; Stride; Variability;

## Introduction

A growing body of evidence supports a link between gait and cognition. Rather than being an automated task requiring little top down control, the control of gait involves high-level cognitive processes (Woollacott and Shumway-Cook 2002; Yogev-Seligmann et al 2008). The relationship between cognition and gait performance is typically explored a using dual-task (DT) gait paradigm, which probes an individual’s capacity to divide and allocate cognitive resources during walking (Yogev-Seligmann et al 2008; Al-Yahya et al 2011). During DT gait, participants simultaneously perform a cognitively demanding task whilst walking. Changes in walking performance, cognitive task performance, or both, represent competition for shared central resources which are limited in capacity (Huang and Mercer 2001; Woollacott and Shumway-Cook 2002). Both the variability of stride time (STV), which is an indicator of gait automaticity and stability, and trunk motion, which is an indicator of postural control and stability, are frequently used to interpret the role of cognition in the control of gait (Hausdorff 2001; IJmker and Lamoth 2012). Changes in both STV and trunk motion are used to assess fall risk and gait rehabilitation interventions in older and cognitively impaired adults (de Hoon et al 2003; Montero-Odasso et al 2012).

The left prefrontal cortex is has been implicated in the allocation of cognitive resources between two simultaneously performed tasks (Collette et al 2005) and recent evidence from studies using functional near-infrared spectroscopy has revealed that there is increased prefrontal cortex activation during DT gait (Holtzer et al 2011; Doi et al 2013). There is a growing body of research indicating that transcranial direct current stimulation (tDCS) of the prefrontal cortex influences cognitive function (Kuo and Nitsche 2012). tDCS is a non-invasive electrophysiological stimulation technique which elicits polarity dependent effects on the cortex: cortical excitability increases after anodal tDCS and decreases after cathodal tDCS (Stagg and Nitsche 2011). Only one study has used tDCS as an intervention in DT gait: Zhou and colleagues (2014) reported that prefrontal anodal tDCS with a current intensity of 1.5mA reduced the dual-task cost on gait speed and trunk motion. Anodal tDCS was thought to increase the availability of cognitive resources for task performance. However, there was no effect of prefrontal tDCS on STV or cognitive task performance. As a result, the precise role of the prefrontal cortex in the control of DT gait is not clear. During the performance of two simultaneous tasks, the prefrontal cortex is suggested to exert top-down control on task performance by biasing cognitive processing (Miller and Cohen 2001). Therefore it is possible that, rather than increasing cognitive capacity, prefrontal anodal tDCS increased the bias and allocation of cognitive resources to one aspect of DT gait performance, gait speed. If the prefrontal cortex is involved in the bias and prioritisation of aspects of task performance during DT gait, then prefrontal cathodal tDCS, which reduces cortical activity, might be expected to interfere with ongoing bias signals from the prefrontal cortex, resulting in performance decrements in one or both tasks (Vines et al 2006; Johnson et al 2007). Examining the effects of both prefrontal anodal and cathodal tDCS may thus help identify the role of the prefrontal cortex in the control of DT gait.

The effect of tDCS on STV and cognitive task performance may also be influenced by task difficulty. DT gait performance is mediated by the relative difficulty of both the walking and cognitive task, because more difficult motor or cognitive tasks reduce the availability of shared high-level cognitive sources (Huang & Mercer 2001). STV increases during more difficult walking, indicating an increased contribution from high-level resources

(Hausdorff 2005; Kelly et al 2010). In the study by Zhou et al (2014), participants walked at their preferred walking speed whilst performing serial subtractions. As tDCS is suggested to influence the allocation of cognitive resources during dual-task performance (Zhou et al 2014) then the walking speed (i.e. the difficulty of the walking task) may mediate the effect of tDCS on DT gait.

The primary aim of this study was to examine the role of the prefrontal cortex in the control of DT gait using anodal and cathodal tDCS. We hypothesised that prefrontal anodal tDCS would amplify the bias of one task over the other, whilst cathodal tDCS would interfere with usual task bias during DT gait. We also hypothesised that the effects of tDCS would be mediated by walking speed.

## Materials and Methods

### Participants

Ten right handed males (mean ± SD age: 23.0 ± 3.2 years) volunteered to participate in the study. Handedness was assessed using the Edinburgh handedness inventory (Oldfield 1971). Informed consent was obtained from all participants included in the study. Medical contra-indications to tDCS were screened using self-completed health questionnaires. Exclusion criteria for enrolment included epilepsy, surgically implanted materials in the head or neck, known allergies to preparation materials, a history of psychiatric disease or previous neurosurgical procedures. All procedures were conducted in accordance with the declaration of Helsinki and were approved by the local University ethical committee.

### Gait analysis

Temporal gait variables and trunk motion were recorded using a portable gait analysis system which consisted of three body worn sensors, each containing a triaxial accelerometer and gyroscope (OPAL, APDM, Portland, USA). Two sensors were placed on the shank of each leg, anterior and 4cm superior to the malleous process. The third sensor was placed on the lumbar spine, at section L5. The method by which temporal gait parameters are derived from angular accelerations of each shank are described in detail elsewhere (see Salarian et al. 2004). Briefly, temporal gait measures were calculated from shank angular velocity recorded by the gyroscopes on each leg (range ± 2000 °/s, sample rate 128 Hz). Stride time (s) was recorded as the time in seconds between successive heel contacts for the same leg. STV (%) was calculated as the coefficient of variation of stride time. Trunk angular distance (deg) per gait cycle in both the anterior-posterior (AP) and medio-lateral (ML) directions were integrated from the trunk and shank gyroscope data and recorded as trunk range of motion (RoM). The sensors transmitted their data online to a wireless receiver linked to a personal computer running the Mobility Lab software package (APDM, Portland, USA) where the data were filtered and underwent online bias removal. STV and trunk RoM data were analysed offline using Mobility Lab.

### Cognitive task – serial subtraction

Starting from a number between 590-600, participants were required to verbally subtract in sevens for 120s. The starting number for each trial was chosen by using a pseudo-randomisation function in Microsoft Excel (Version 2013, Microsoft Corporation, Redmond, USA). The number of correct responses and errors were recorded using a portable digital dictaphone (UX200, Sony, Tokyo, Japan) and analysed off-line. The ratio of errors to correct answers (error ratio) was then calculated using the following equation:

$$\left(\frac{Number\ of\ errors}{Number\ of\ correct\ answers}\right) \times 100$$

### Transcranial direct current stimulation

Transcranial stimulation was delivered via a programmable battery driven stimulator (HDCkit, Newronika, Milan, Italy). Participants received anodal, cathodal or sham tDCS in a randomised order. The stimulator was programmed by a technical member of staff not involved in the study and both participant and experimenter were blind to the stimulation condition. Both active and reference rubber electrodes were placed in saline soaked sponges. The active electrode was 35cm$^2$ in size and was placed over the left prefrontal cortex at F3 using the 10-20 EEG system. The reference electrode was 72cm$^2$ in size and was placed over the contralateral supra-orbital region. We chose to use a larger reference electrode to reduce current density and stimulation efficacy at this site (Nitsche et al 2008). The applied current was 1.5mA, giving a current density of 0.043mA/cm$^2$ under the active electrode and 0.021mA/cm$^2$ under the reference electrode. Current was ramped up for 15s in all conditions. For the active (anodal and cathodal) conditions, stimulation was applied for 15 minutes. For the sham condition, current was switched off after 30s (Gandiga et al 2006).

## Experimental design

Initially, following familiarisation with experimental procedures, participants' preferred walking speed was determined. Starting at 2.0 km.h$^{-1}$, participants walked on a motorised treadmill (CLST, Life Fitness, Cambridge, UK). Participants were blinded to their walking speed. Walking speed was increased in 0.1 km.h$^{-1}$ increments until the participant indicated that they were walking at their preferred speed. Walking speed was then increased to 6.5 km.h$^{-1}$ and reduced in 0.1 km.h$^{-1}$ increments until participants indicated that they were walking at preferred walking speed. This process was repeated and the mean of the four identified speeds was recorded as each individual's preferred walking speed.

Following familiarisation, each participant then participated in three testing sessions separated by at least 48 hours. The protocol during each session was as follows: initially participants performed the serial subtraction task whilst standing facing a fixation point 2m in front of the treadmill. This served as the single task condition for the cognitive task. Subsequently, participants walked for 240s at both their preferred walking speed and a speed equal to 25% of preferred walking speed, in a counterbalanced order. Participants rested for 30s between each walking speed change, and walked for 30s at the new speed before data collection began. Pilot data from our laboratory (see Appendix) has shown that performing a serial subtraction task whilst walking at a speed equal to 25% of preferred walking speed is perceived as more difficult than performing the same task whilst walking at preferred walking speed. During each four minute stage, participants walked for 120s with no additional task (single task) and for 120s whilst performing the serial subtraction task (dual-task), also in a counterbalanced order. After both walking stages were completed, the participants' received tDCS whilst seated. Participants were asked to sit in silence without performing any other task during the stimulation. After stimulation cessation, the walking protocol was immediately repeated.

## Data Analysis

All data are reported mean $\pm$ SD. We examined the effect of tDCS and walking speed on DT gait and on the dual-task cost on STV, trunk RoM and error ratio. The dual-task cost, a measure of change from single to dual-task conditions (Kelly et al 2010), was calculated for STV and trunk RoM using the following equation:

$$\left(\frac{(Dual\ task\ -Single\ task)}{Single\ task}\right) \times 100 \qquad 118$$

Because an error ratio of zero is possible, the dual-task cost on cognitive task performance was calculated using the following equation:

$$(Dual\ task - Single\ task)$$

The effects of stimulation and walking speed on DT gait were examined using a three way repeated measure ANOVA (stimulation condition [anodal, cathodal and sham] x walking speed [preferred, slow] x time [pre and post stimulation]). Significant effects were followed up using Bonferroni-corrected pairwise comparisons. Non-Gaussian data were normalised using logarithmic and square root transformations (Tabachnick and Fidell 2007). If data remained non-parametric after transformation, the effects of stimulation were analysed at each speed using a two way Freidman's ANOVA with Bonferroni-corrected Wilcoxon signed rank tests follow up. Statistical significance was set at $p<0.05$. Partial eta squared ($\eta p$) was used as a measure of effect size for main and interaction effect sizes and Cohen's $d_{av}$ for within subjects repeated measures ($d$) was used for pairwise comparison effect sizes (Lakens 2013).

## Results

### Gait Analysis

Participants' mean preferred walking speed was 1.2 ± 0.07 m.s$^{-1}$. Mean ± SD number of strides and stride time (s) for each speed (across all three stimulation conditions and times) are presented in Table 1.

Table 1 here

### The effect of tDCS on stride time variability

Table 2 shows the mean STV and trunk Rom during dual-task gait, and the mean dual-task cost on STV and trunk RoM. For STV during DT gait, after logarithmic transformation there was no main effect for stimulation condition ($F_{(2,18)}=0.5$, $p=0.611$, $\eta p=0.053$) or time (pre-post) ($F_{(1,9)}<0.1$, $p=0.990$, $\eta p<0.001$). There was an effect of walking speed on STV, where STV was higher at the slow walking speed ($F_{(1,9)}=505.6$, $p<0.001$, $\eta p=0.983$) There was a significant interaction between stimulation condition and time ($F_{(2,18)}=5.0$, $p=0.019$, $\eta p=0.355$)., Figure 1). Bonferroni corrected pairwise comparisons revealed that STV decreased after anodal tDCS ($p=0.011$, $d=0.1$) and increased after cathodal tDCS ($p=0.029$, $d=0.2$). There was no difference in STV after sham tDCS ($p=0.535$, $d=0.1$). There was no interaction between stimulation condition, walking speed and time ($F_{(2,18)}=1.2$, $p=0.330$, $\eta p=0.116$).

Figure 1 Here

For the dual-task cost on STV, after logarithmic transformation there was no main effect for stimulation condition ($F_{(2,18)}=2.5$, $p=0.112$, $\eta p=0.216$), time (pre-post) ($F_{(1,9)}=1.4$, $p=0.394$, $\eta p<0.001$) or of walking speed ($F_{(1,9)}=0.5$, $p=0.494$, $\eta p=0.053$). There was a significant interaction between stimulation condition and time ($F_{(2,18)}=3.8$, $p=0.041$, $\eta p=0.299$, Figure 2). The dual-task cost on STV was lower after anodal stimulation ($p=0.002$, $d=0.6$) and there was a trend for the dual task cost on STV to be higher after cathodal tDCS ($p=0.063$, $d=0.6$). There was no difference in the dual-task cost on STV after sham stimulation ($p=0.765$, $d=0.1$). Again, there was no interaction between stimulation condition, walking speed and time ($F_{(2,18)}=0.6$, $p=0.578$, $\eta p=0.059$).

Figure 2 here

### The effect of tDCS on trunk RoM

For ML trunk RoM after logarithmic transformation there was no main effect for stimulation condition ($F_{(2,18)}=0.6$, $p=0.578$, $\eta p=0.059$) or time (pre-post) ($F_{(1,9)}<0.1$, $p=0.976$, $\eta p<0.001$). There was an effect of walking speed on ML trunk RoM where trunk RoM was lower at the slow walking speed ($F_{(1,9)}=12.4$, $p=0.006$, $\eta p=0.983$). There was no interaction between stimulation condition and time ($F_{(2,18)}=1.6$, $p=0.238$, $\eta p=0.147$) and no three way interaction between stimulation condition, time and walking speed ($F_{(2,18)}=1.6$, $p=0.225$, $\eta p=0.153$). For AP trunk RoM after logarithmic transformation there was no main effect for stimulation condition ($F_{(2,18)}<0.1$, $p=0.979$, $\eta p=0.002$), time (pre-post) ($F_{(1,9)}=2.9$, $p=0.121$, $\eta p=0.246$) or walking speed

($F_{(1,9)}=4.7$, $p=0.059$, $\eta p=0.342$). There was also no interaction between stimulation and time ($F_{(2,18)}=0.6$, $p=0.577$, $\eta p=0.059$) or between stimulation, time and walking speed ($F_{(2,18)}=0.1$, $p=0.949$, $\eta p=0.006$).

Table 2 here

At the preferred walking speed, there was no interaction between stimulation and time on the dual-task cost on ML trunk RoM ($X^2_{(5)}=1.4$, $p=0.925$) or AP trunk RoM ($X^2_{(5)}=8.4$, p=0.136). At the slow walking speed, there was no significant interaction between stimulation condition and time on the dual-task cost on ML trunk RoM ($X^2_{(5)}=4.8$, $p=0.444$). There was a significant interaction between stimulation condition and time on the dual-task cost on AP trunk RoM ($X^2_{(5)}=11.4$, $p=0.042$) however Bonferroni corrected follow up revealed no statistically significant differences in AP trunk RoM following stimulation (all $p>0.05$).

### The effect of tDCS on cognitive task performance

Table 3. shows the mean ± SD error ratio and dual-task cost on the error ratio. For error ratio during DT gait, after logarithmic transformation there was no main effect for stimulation condition ($F_{(2,18)}=1.8$, $p=0.202$, $\eta p=0.163$, time (pre-post) ($F_{(1,9)}=2.0$, $p=0.194$, $\eta p=0.180$) or walking speed ($F_{(1,9)}=2.3$, $p=0.162$, $\eta p=0.205$). There was an interaction between stimulation condition and time ($F_{(2,18)}=3.9$, $p=0.039$, $\eta p=0.302$, Figure 3). Error ratio was lower after anodal tDCS ($p=0.004$, $d=1.1$). There was no difference in error ratio after cathodal tDCS ($p=0.925$, $d<0.1$) or sham tDCS ($p=0.324$, $d=0.4$). There was no interaction between stimulation condition, time and walking speed ($F_{(2,18)}=0.9$, $p=0.433$, $\eta p=0.089$).

Figure 3 here

For the dual-task cost on error ratio, after logarithmic transformation there was no main effect for stimulation condition ($F_{(2,18)}=1.1$, $p=0.365$, $\eta p=0.106$, time (pre-post) ($F_{(1,9)}=2{,}8$ $p=0.128$, $\eta p=0.238$) or walking speed ($F_{(1,9)}=1.9$, $p=0.197$, $\eta p=0.177$). There was also an interaction between stimulation condition and time ($F_{(2,18)}=4.1$, $p=0.034$., $\eta p=0.313$, Figure 4) where the dual-task cost on error ratio was lower after anodal stimulation ($p=0.006$, $d=0.9$). There was no difference in the dual-task cost on error ratio after cathodal tDCS ($p=0.939$, $d<0.1$) or sham tDCS ($p=0.323$, $d=0.2$). There was no interaction between stimulation condition, time and walking speed ($F_{(2,18)}=0.7$, $p=0.523$, $\eta p=0.069$).

Figure 4 here

Table 3. Here

## Discussion

The primary aim of this study was to investigate the role of the prefrontal cortex in the control of DT gait using transcranial direct current stimulation. Our secondary aim was to see if the effects of tDCS on DT gait were mediated by walking speed. As predicted, anodal tDCS decreased both STV and the dual-task cost on STV, and increased cognitive task performance. Conversely, cathodal tDCS increased STV and there was a trend for cathodal tDCS to increase the dual-task cost on STV. These findings support the suggestion that the prefrontal cortex is involved in the bias and prioritisation of task performance during DT gait. In contrast to our predictions, the effects of tDCS on DT gait were not mediated by walking speed. These findings extend those of Zhou et al (2014) by showing that tDCS affects STV and cognitive task performance during DT gait on a treadmill and help to clarify the role of the prefrontal cortex in the control of dual-task gait.

### The effect of tDCS on dual-task gait

In the present study, anodal tDCS reduced STV and the dual-task cost on STV and improved cognitive task performance. Conversely, cathodal tDCS increased STV and appeared to increase the dual-task cost on STV. These results support the proposal that the prefrontal cortex is involved in the bias and prioritisation of relevant task processes during DT gait. Prefrontal cortex activity increases when multiple cognitive processes compete for cognitive resources, suggesting that the prefrontal cortex is involved in the prioritisation and filtering of relevant ongoing processes to achieve task relevant goals (Miller and Cohen 2001; Milham et al 2003). During DT gait on a treadmill, healthy adults may reduce their STV (Lövdén et al 2008). A reduction in STV represents a reduction in the allocation of cognitive resources to the control of gait (Hausdorff 2005), indicating that during DT gait on a treadmill participants prioritise the allocation of cognitive resources from gait to cognitive task performance (Lövdén et al 2008). In the present study, prefrontal anodal tDCS appears to amplify this effect; further increasing the allocation of cognitive resources away from gait and toward cognitive task performance which leads to a reduced dual-task cost on STV and increased cognitive task performance. Conversely, prefrontal cathodal tDCS increased STV and there was a trend for cathodal tDCS to increase the dual-task cost on STV. It is tempting to interpret the effect of cathodal tDCS here as the opposite of the effect of anodal tDCS: that is, if a reduction in STV after anodal tDCS represents an increase in the allocation of cognitive resources away from gait, then an increase in STV may indicate that cathodal tDCS interferes with the allocation of cognitive resources away from gait toward cognitive task performance. Alternatively, as increased STV has been linked to age and disease related declines in cognitive and prefrontal cortex function (Hausdorff 2005; Allali et al 2010; Beauchet et al 2012), here prefrontal cathodal tDCS may have reduced the availability of cognitive resources during DT gait by reducing prefrontal cortex activity, which led to an increase in STV during DT gait. Although the exact mechanism by which cathodal tDCS affects dual-task gait is unclear, the differing effects of both stimulation types indicate that the prefrontal cortex is involved in the allocation of cognitive resources during dual-task gait.

In the present study, there was no effect of tDCS on trunk RoM. This may suggest that, whilst trunk RoM is affected by dual-task gait (Doi et al 2011), the prefrontal cortex is not involved in the control of trunk RoM during gait. Alternatively, it is possible these data here represent a ceiling effect in the control of trunk RoM in healthy adults. Asai et al (2013) reported age related differences in the control of trunk RoM during DT gait. It is possible that in older adults or clinical populations, there may be greater involvement from high level centres such as the prefrontal cortex and tDCS of the prefrontal cortex may effect trunk RoM in these groups. However, in contrast to the present findings, Zhou et al (2014) reported that anodal tDCS improved postural sway during a standing dual-task, suggesting that tDCS may affect trunk motion in healthy young adults under some circumstances.

Anodal tDCS is suggested to have the potential to be a useful therapeutic tool for gait rehabilitation (Zhou et al 2014) and there is a large and growing body of evidence linking the application of anodal tDCS to improved cognitive functions (Kuo and Nitsche 2012; Kadosh 2013). In the present study, anodal tDCS (further) reduced STV during dual-task gait. Whilst high stride variability is often linked to falls (Hausdorff 2001) very low stride variability may also increase fall risk (Brach et al 2005). Therefore, increased allocation of cognitive resources from gait to cognitive task performance, which leads to a decreased STV, could be detrimental to gait stability and increase fall risk. Therefore, the results of the present study suggest anodal tDCS may not facilitate dual-task gait, as the exploitation of stride variability maybe required for optimum gait performance (Dingwell and Cusumano 2010). Rather, the change in STV reported here only indicates that the prefrontal cortex is involved in the control of dual-task gait. Whether these effects occur during over-ground walking is unclear however, as only Zhou et al (2014) have investigated the effect of anodal tDCS on over-ground DT gait, and found no effect on STV. The relative priority of each task (gait and cognitive) during DT gait may be influenced by the walking condition (Kelly et al 2013) which may explain the disparity between the present results and those of Zhou et al (2014). In support of this suggestion, Simoni et al (2013) previously reported that older adults' dual-task gait and cognitive task performance were influenced by walking modality, and suggested that treadmill and over-ground walking may place different demands on cortical control centres. This disparity may have important implications for practitioners who use treadmills during rehabilitation in an effort to improve over-ground walking. Future studies should compare the involvement of the prefrontal cortex in the control of dual-task gait in both walking modalities.

We chose not to record stimulation sensation or detection data after each trial, in order to reduce the possibly confounding effects of drawing participants' attention to the nature of the stimulation. However, it is possible that the effects reported here may have been influenced by the participants' perceptions during stimulation. We consider this unlikely however, as the current tDCS protocol is reported to be successful in blinding participants to the nature of the stimulation condition (Gandiga et al 2006), even if there were reported differences in the sensations felt in both conditions (Russoa et al 2013). Nonetheless, future studies using tDCS to examine brain function and cognition may want to record whether participants were accurately able to discriminate between active and sham stimulations (Russoa et al 2013) in order to ensure blinding efficacy. Alternatively, a between-participant design could be used to avoid changes in awareness of stimulation sensation confounding subsequent stimulation conditions.

### The influence of walking speed on the effects of tDCS on dual-task gait

Our second aim was to examine whether the effect of tDCS on DT gait was mediated by walking task difficulty, which we increased by reducing walking speed. Task difficulty is a known mediator of the dual-task effect

(Huang and Mercer 2001) however, in contrast to our hypothesis, we found that the effects of tDCS on DT gait were not influenced by walking speed. One possible explanation for this finding is that increasing walking difficulty by decreasing walking speed does not influence prefrontal cortex activity, and the changes to gait during walking at a slow speed maybe dependent on factors other than cognitive function. Under these circumstances, the effects of tDCS of the prefrontal cortex may not be mediated by walking speed.

## Conclusion

In conclusion, here we report that anodal tDCS of the left prefrontal cortex increases the allocation of cognitive resources from gait toward cognitive task performance which occurs during DT gait on a treadmill, whereas cathodal tDCS may have interfered with the allocation of cognitive resources during DT gait performance. These results indicate that the prefrontal cortex may be involved in the allocation and prioritisation of tasks during DT gait. These preliminary data also suggest that tDCS can be used to alter the ability of healthy adults to allocate cognitive resources during dual-task treadmill walking and may help to inform future research examining the effects of tDCS on fall risk and dual-task gait.

Conflict of Interest: The authors declare that they have no conflict of interest.

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