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## Impact of allocentric and egocentric perspectives on far transfer effects following cognitive neurorehabilitation in stroke patients: A randomized control trial

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## ABSTRACT

**Objective:** This study aimed to evaluate the role of egocentric and allocentric perspectives in facilitating far transfer (improvement of emotional state and psychomotor functions) following cognitive training in stroke patients.

**Methods:** In a three-arm, non-blind, randomized clinical trial, 128 patients with acute stroke were randomly allocated to one of the following groups: 1) control, 2) allocentric perspective, or 3) egocentric perspective groups. Each group received a 2-week intervention, with the experimental groups completing an additional 10 sessions. Cognitive function was measured by the Addenbrooke Cognitive Evaluation-III, depression by the Patient Health Questionnaire-9, anxiety by the Generalized Anxiety Disorder-7 scale, and psychomotor function by the Finger Tapping Test.

**Results:** Cognitive training tasks based on allocentric and egocentric perspectives, when combined with conventional rehabilitation, did not yield a statistically significant far transfer effect compared to conventional rehabilitation alone. No significant differences between-groups were observed for changes in anxiety ( $F(2, 111) = .056, p = .945, \eta^2 = .058$ ), depression ( $F(2, 109) = 0.831, p = .160, \eta^2 = .074$ ), or dominant ( $F(2, 111) = 0.059, p = .943, \eta^2 = .001$ ) and non-dominant ( $F(2, 108) = 1.375, p = .257, \eta^2 = .290$ ) psychomotor functions.

**Conclusion:** The incorporation of an allocentric and egocentric perspective based cognitive training tasks in conventional rehabilitation do not provide significantly better improvements in emotional state and psychomotor functions.

The ISRCTN clinical trial registry (<https://doi.org/10.1186/ISRCTN14922230>).

## Introduction

Stroke often leads to cognitive impairments that result in disability and various challenges in daily functioning.<sup>1</sup> These cognitive deficits are frequently accompanied by emotional disturbances such as symptoms of anxiety and depression, as well as motor dysfunction. Therefore, rehabilitation for stroke survivors is of critical importance and should encompass a broad range of functions related to independence and adaptation in daily life.<sup>2</sup> This implies that cognitive neurorehabilitation

interventions that target one function but produce improvements in others – a phenomenon known in the literature as the far transfer effect – could lead to greater rehabilitation outcomes within the same time and resource constraints.

Understanding the mechanisms underlying far transfer is a key area of interest in cognitive rehabilitation research.<sup>3</sup> Studies have shown that cognitive training may result in improvements not only in targeted cognitive domains but also in emotional state and motor functions,<sup>4,5</sup> language,<sup>6</sup> and daily functional abilities.<sup>7</sup> The far transfer effect is

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thought to rely on overlapping brain areas responsible for multiple functions,<sup>8</sup> as well as individual differences such as higher baseline cognitive performance.<sup>9</sup> Etkin and colleagues<sup>10</sup> provided evidence for the neural pathway connections between working memory and emotional regulation, mediated by the interaction between frontal and parietal lobes.<sup>10</sup> Other researchers have suggested that indirect far transfer may occur due to neural network overlap, with activation of the posterior lateral prefrontal cortex resulting in improved emotional and psychomotor functioning.<sup>11,12</sup>

Schaefer et al.<sup>13</sup> emphasized the role of methodological differences in rehabilitation programs, such as the quantity and nature of tasks, in explaining the far transfer effect.<sup>13</sup> One key task feature is the spatial perspective involved in rehabilitation exercises – egocentric versus allocentric.<sup>14</sup> To operationalize these perspectives within the intervention, the present study employed both non-immersive virtual reality (nVR) and immersive virtual reality (iVR). Non-immersive VR was used to support an allocentric, third-person perspective, whereas immersive VR was selected to facilitate an egocentric, first-person perspective.<sup>15</sup> It is important to note that the activation of frontal and parietal brain regions is associated with egocentric perspective processing.<sup>14</sup> Therefore, it can be reasonably hypothesized that cognitive training using egocentric tasks may produce a stronger far transfer effect on emotional functioning compared to allocentric tasks. Selective visual attention is linked to self-monitoring and bodily awareness during visual information processing, particularly in egocentric tasks. This has implications for psychomotor functions, specifically hand–eye coordination.<sup>16</sup> In egocentric tasks, visual information is processed relative to one's own body, whereas in allocentric tasks, it is processed relative to external objects. Thus, it is plausible to hypothesize that visual attention and short-term visual memory tasks based on an egocentric perspective may result in stronger indirect far transfer effects on psychomotor functions.

However, findings in this field are inconsistent. Some studies report that far transfer effects are rarely observed or entirely absent.<sup>17,18</sup> Despite theoretical background and studies showing evidence of far transfer, meta-analyses indicate that the principles underlying its occurrence remain unclear.<sup>18</sup> These mixed findings may be due to the specific characteristics of the interventions employed. Far transfer is more likely to occur when tasks engage multiple functions simultaneously,<sup>7</sup> but the influence of egocentric versus allocentric task perspectives on far transfer remains unexplored.

This paper presents the findings of a study that assessed the effectiveness of rehabilitation programs based on egocentric and allocentric perspectives in enhancing directly trained cognitive functions and evaluating far transfer effects in stroke patients.

The main objective of this research is to evaluate the role of egocentric and allocentric perspectives in facilitating far transfer during short-term visual memory training in stroke patients.

## Methods

A randomized clinical trial with a non-blind design comprising three arms: the control group, the allocentric group, and the egocentric group.

### Sample size

A priori power analysis was performed using G\*Power 3.1 to determine the required sample size. A priori power analysis indicated that a sample size of 128 stroke patients is necessary to achieve 80% statistical power and detect small effect sizes (0.25) in a randomized controlled trial incorporating pre- and post-tests.

### Randomization

Study contained three groups: control, allocentric and egocentric groups. Participants were randomly assigned to one of the three groups by rolling the electronic dice after the enrolment in the study. To

minimize selection bias, the random allocation sequence and the assignment of participants to the intervention were carried out by J. Janavičiūtė-Pužauskė, who was not involved in conducting the pre- or post-assessments. Participants completed both pre-assessment and post-assessment to evaluate changes in cognitive functions. During the interval between these assessments, all participants engaged in a conventional rehabilitation program (that consist of average 5 procedures per day that involve physiotherapy, speech therapy, occupational therapy). Additionally, those in the allocentric and egocentric groups attended ten 30-minute sessions (conducted five times per week over two weeks) of short-term visual memory and selective visual attention training in either the immersive or non-immersive virtual reality environments.

### Recruitment of participants

The randomized clinical trial with a parallel design and its study protocol were registered in the ISRCTN clinical trial registry (<https://doi.org/10.1186/ISRCTN14922230>). The study was approved by the Vilnius Regional Biomedical Research Ethics Committee (No. 2022/2-1408-880). Written informed consent was obtained prior to inclusion. Participants were recruited from February 15, 2022, to April 22, 2025. Post-stroke patients during their rehabilitation at Neurology department of Abromiškės Rehabilitation Hospital who met inclusion criteria and willingly provided written informed consent involved in the study and randomly allocated to one of the three arms. Inclusion criteria were as follows: 1) a confirmed stroke diagnosis less than one year ago, 2) absence of severe cognitive impairment, 3) native Lithuanian speaker, 4) admission to the rehabilitation hospital at least three days prior. Exclusion criteria included: 1) age over 85 years, 2) a history of epilepsy or psychiatric disorders, 3) severe aphasia, 4) presence of unilateral neglect, 5) severe impairment in both hands, 6) other communication or cognitive impairments that could hinder understanding of the tasks or study objectives. During the study, eleven participants dropped out of the study because of the motivation and health issues. Their data was excluded from further analysis. Among them, seven were unable to complete the post-test due to early discharge from the rehabilitation hospital, while four chose to discontinue their participation, citing a lack of motivation.

### Interventions

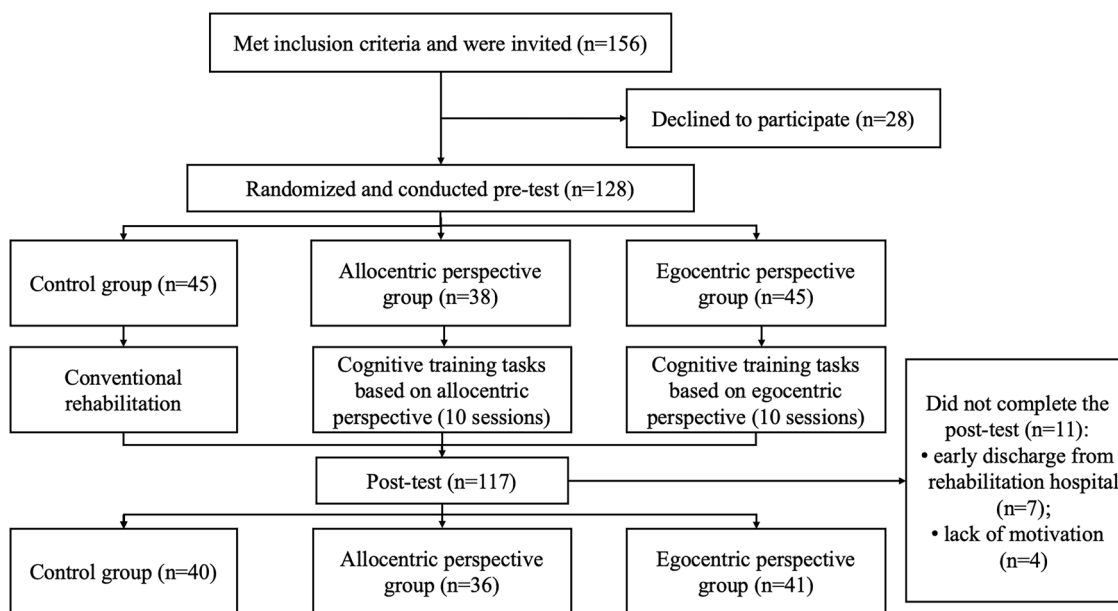
Two tasks were used to train visual short-term memory and selective attention. The first task was to remember the products on the green plate during the limited time (3 seconds per object) and then they appeared on the orange plate among others. The participant is asked to recall the objects and put them back on the green plate. The second task involves remembering the sequence. The participant is asked to remember the objects shown in a particular sequence. For the first time, three of them appear in random order. In both tasks, the difficulty increases after each level is completed twice without mistakes.<sup>19</sup>

To create conditions for engaging allocentric and egocentric frames of reference, nVR, supporting a third-person perspective, and iVR, supporting a first-person perspective, were employed.<sup>15</sup> The tasks were developed using the Unreal Engine 5 game engine and installed on the Samsung Galaxy Tab S8 Plus and an Oculus Quest 2 head-mounted display.

### Study instruments

During the pre-assessment, sociodemographic and clinical data were collected. Sociodemographic details covered sex, age, education, residence, and dominant hand, while clinical information included the type, localization, and stage of the stroke.

During the pre- and post-assessment measurements for near- and far-transfer effects were implemented. Although the near-transfer effect is



**Fig. 1.** Figure presents a detailed flowchart outlining the study design process, including recruitment, randomization, group allocation, interventions, and follow-up. A total of 156 participants were screened for eligibility; 28 declined participation, resulting in 128 participants enrolled in the study. Participants underwent pre-test assessments and were randomly assigned to one of three groups: control ( $n = 45$ ), allocentric perspective training ( $n = 38$ ), or egocentric perspective training ( $n = 45$ ). The control group received conventional rehabilitation. In contrast, the allocentric and egocentric groups each underwent 10 sessions of cognitive training, with the training content based on allocentric or egocentric perspective tasks, respectively. Following the interventions, post-test assessments were completed for 117 participants: 40 in the control group, 36 in the allocentric group, and 41 in the egocentric group. Eleven participants did not complete the post-test: four due to early discharge from the rehabilitation hospital and four due to lack of motivation.

not the focus of this paper, the measurements will be briefly reviewed as the study has had an impact in these areas. The assessment of short-term visual memory was conducted using the Medical College of Georgia Complex Figures.<sup>20</sup> The assessment of attention was conducted using the Trail Making test (TMT) Form A<sup>21</sup> and the Attention subscale of the Addenbrooke Cognitive Evaluation-III (ACE-III).<sup>22</sup> The TMT-A measured selective visual attention.<sup>21</sup> The ACE-III evaluated attention-orientation.<sup>22</sup>

#### Measurements of far transfer effect

Depression symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9).<sup>23</sup> Each statement is rated on a 4-point Likert scale. The maximum possible score is 27. The internal consistency of the scale in the current study is acceptable (Cronbach's  $\alpha = 0.73$ ).

Anxiety symptoms were measured using The Generalized Anxiety Disorder scale-7 (GAD-7).<sup>24</sup> Each item on the scale is scored from 0 to 3 according to the severity of the anxiety experienced in the last two weeks. The overall maximum total score for the scale can be 21. In the present study, the internal consistency of the scale is good (Cronbach  $\alpha = 0.841$ ).

For psychomotor function and lateralization control, the Finger Tapping Test (FTT)<sup>25</sup> was used.

#### Statistical analysis

Statistical analyses were completed using IBM SPSS software (version 22.0). Categorical variables were expressed as frequencies and percentages, while continuous variables were reported as means with standard deviations. The significance level was established at  $p < .05$ . Outliers identified in the dataset were adjusted using winsorization to minimize their impact on the analysis. We conducted an analysis to examine the impact of different perspectives in cognitive rehabilitation training on far-transfer effects over time. Mixed repeated measures ANOVA and ANCOVA were used, controlling for baseline far-transfer

effect scores. The dependent variables included far-transfer effect measures such as depression, anxiety, and psychomotor functions, while the independent variable was the perspective (allocentric or egocentric).

#### Results

A total of 117 post-stroke patients fully participated in the study (Fig. 1).

Participants' average age was 63.01 years (SD = 10.75), and the mean years of education were 13.32 (SD = 1.30). The majority of participants were male ( $N = 79$ ; 68%), and nearly all were right-handed ( $N = 113$ ; 97%). Additionally, two-thirds of the participants had a partner ( $N = 72$ ; 62%) and most lived in urban areas ( $N = 103$ ; 67%). The majority of participants were diagnosed with ischemic stroke ( $N = 104$ ; 89%). Most participants demonstrated cognitive function, higher than the cut-off score, with 70% ( $N = 82$ ) achieving an ACE-III score greater than 75. Additional sociodemographic and clinical characteristics of the participants are presented in Table 1. The groups demonstrated homogeneity in their sociodemographic and clinical profiles except for sex and number of strokes. These variables were controlled in the analysis.

#### The far-transfer effects of the interventions

**Anxiety.** The impact of time on the GAD-7 scores for the entire sample was statistically significant ( $F(1, 113) = 24.159, p = .001, \eta^2 = .176$ ). Repeated measures ANOVA controlled for sex and number of strokes indicated that, changes in the anxiety symptoms did not differ between groups ( $F(2, 111) = .056, p = .945, \eta^2 = .058$ ). However, t-test for dependent samples revealed significant differences between pre-test and post-test on anxiety scores within all three groups (Table 2).

**Depression.** The impact of time on the PHQ-9 scores for the entire sample was statistically significant ( $F(1, 111) = 24.876, p = .001, \eta^2 = .183$ ). Repeated measures ANOVA controlled for sex and number of strokes indicated that, changes in the depression symptoms also did not differ between groups ( $F(2, 109) = 0.831, p = .160, \eta^2 = .074$ ).

**Table 1**  
Sociodemographic and clinical characteristics of the participants.

		Control group (N = 40)	AP group (N = 36)	EP group (N = 41)	Total (N = 117)	Statistical criteria, <i>p</i>
Age (mean ± SD)		64.95 ± 9.51	63.97 ± 12.12	60.27 ± 10.29	63.01 ± 10.75	F(2, 114) = 2.174, <i>p</i> = .118
Sex (%)	Males	28 (70.0)	18 (50.0)	33 (80.5)	79 (67.5)	$\chi^2(2) = 8.295, p = .016$
	Females	12 (30.0)	18 (50.0)	8 (19.5)	38 (32.5)	
Dominant hand (%)	Right-handed	40 (100)	33 (91.7)	40 (97.6)	113 (96.6)	$\chi^2(4) = 4.677, p = .322$
	Left-handed	0	0	1 (2.8)	1 (0.9)	
	Ambidextrous	0	2 (5.6)	1 (2.4)	3 (2.6)	
Residence (%)	City	38 (69.1)	31 (72.1)	34 (59.6)	103 (66.5)	$\chi^2(2) = 1.969, p = .374$
	Village	17 (30.9)	12 (27.9)	23 (40.4)	52 (33.5)	
Years of education (mean ± SD)		13.25 ± 1.28	13.58 ± 1.23	13.15 ± 1.39	13.32 ± 1.30	F(2, 114) = 1.158, <i>p</i> = .318
Marital status (%)	In the romantic relationships	29 (72.5)	18 (50.0)	25 (61.0)	72 (61.5)	$\chi^2(2) = 4.061, p = .131$
	Not in the romantic relationships	11 (27.5)	18 (50.0)	16 (39.0)	45 (38.5)	
Clinical data						
Lesion side (%)	Right sided	23 (57.5)	18 (50.0)	21 (51.2)	62 (53.0)	$\chi^2(4) = 4.911; p = .297$
	Left sided	15 (37.5)	18 (50.0)	20 (48.8)	53 (45.3)	
	Not identified	2 (5.0)	0	0	2 (1.7)	
Stroke type (%)	Ischemic	33 (82.5)	33 (91.7)	38 (92.7)	104 (88.9)	$\chi^2(2) = 2.532; p = .282$
	Haemorrhage	7 (17.5)	3 (8.3)	3 (7.3)	13 (11.1)	
Days after stroke		57.73 ± 80.97	35.78 ± 20.27	44.80 ± 54.63	46.44 ± 58.63	F(2, 114) = 1.361, <i>p</i> = .261
Number of strokes (%)	One	34 (85.0)	27 (75.0)	40 (97.6)	101 (86.3)	$\chi^2(2) = 8.355; p = .015$
	More than one	6 (15.0)	9 (25.0)	1 (2.4)	16 (13.7)	
ACE-III scores	Below 75	15 (37.5%)	8 (22.2%)	12 (29.3%)	35 (29.9%)	$\chi^2(2) = 2.122; p = .346$
	Above 75	25 (62.5%)	28 (77.8%)	29 (70.7%)	82 (70.1%)	

Abbreviations: AP = allocentric group; EP = egocentric group; ACE-III = Addenbrooke's Cognitive Examination III.

However, t-test for dependent samples revealed significant differences between pre-test and post-test on anxiety scores in control and egocentric perspective groups (Table 2).

Psychomotor functions. The impact of time on the FTT-D scores for the entire sample was statistically significant ( $F(1, 113) = 23.297, p = .001, \eta^2 = .171$ ). Repeated measures ANOVA controlled for sex and number of strokes indicated that, changes in the dominant hand psychomotor functions differ between groups ( $F(2, 111) = 0.059, p = .943, \eta^2 = .001$ ). T-test for dependent samples revealed significant differences between pre-test and post-test on dominant hand psychomotor function scores within control and allocentric perspective groups (Table 2).

Additionally, the impact of time on the FTT-N scores for the entire sample was statistically significant ( $F(1, 111) = 11.755, p = .001, \eta^2 = .096$ ). Repeated measures ANOVA controlled for sex and number of strokes indicated that changes in the non-dominant hand psychomotor functions did not differ between groups ( $F(2, 108) = 1.375, p = .257, \eta^2 = .290$ ). T-test for dependent samples revealed significant differences between pre-test and post-test on non-dominant hand psychomotor function scores within control and allocentric perspective groups (Table 2).

## Discussion

This study revealed that selective visual attention and short-term visual memory training tasks based on an allocentric and egocentric perspectives do not cause far-transfer effect. The findings of this study indicate that there were no significant differences between groups in psychomotor function, depression and anxiety symptom changes. Although null findings provide important theoretical and methodological insights that will be discussed.

While fewer studies in the field of cognitive neurorehabilitation have examined the far-transfer effects of cognitive training on psychomotor functioning, evidence from motor neurorehabilitation studies suggests that improvements in cognitive outcomes can follow targeted motor training.<sup>26,27</sup> This theoretical link between cognitive and psychomotor functions has also been supported by previous empirical research.<sup>28,29</sup> Nevertheless, this study results partially contradict the **speed of neural**

**processing theory**, which posits that enhanced psychomotor performance is driven by faster neural signalling in the motor cortex, and that efficient cognitive functioning likewise depends on rapid neural processing.<sup>30,31</sup> However, some findings suggest that only those cognitive functions closely linked to language processing – such as verbal recall – are significantly associated with psychomotor speed.<sup>32</sup> In contrast, the present study focused on training selective visual attention and short-term visual memory, which are not directly related to language abilities. This discrepancy may explain the lack of transfer effects on psychomotor performance observed here.

The results of this study revealed that symptoms of depression and anxiety decreased across all participants, regardless of group assignment. While psychological research frequently highlights a strong association between cognitive functioning and emotional states such as depression and anxiety, this relationship may be less straightforward in post-stroke populations.<sup>33</sup> The present findings, in line with other studies,<sup>34,35</sup> underscore the complexity of emotional changes following stroke and suggest that improvements in mood cannot be attributed solely to specific interventions.

Previous studies have shown that various rehabilitation interventions can produce improvements in emotional well-being among stroke survivors. These include cognitive training,<sup>34</sup> upper limb motor function rehabilitation.<sup>35</sup> Based on these findings, it is plausible to assume that the overall emotional improvement observed in all participants may be attributed to increased functional independence commonly achieved during rehabilitation.<sup>36,37</sup> Therefore, the tasks based on allocentric and egocentric perspectives used in this study may not have provided additional benefit beyond that of conventional rehabilitation in enhancing emotional outcomes to a degree that would result in statistically significant group differences.

Perspective-based cognitive training has been proposed to enhance spatial representation, and it was specifically hypothesized that egocentric training would yield greater improvements in psychomotor functioning and emotional well-being.<sup>16</sup> However, the present findings indicate that any potential benefits of such training may be domain-specific meaning that training cause only near-transfer effects,<sup>38</sup> and that the dose of training provided in this study was not sufficient to

**Table 2**  
Changes in the far-transfer effect measures between and within groups.

Far-transfer effect measures	Groups	Pre-test	Post-test	Statistical criteria, p
Anxiety (GAD-7)	C	3.60 ± 3.51	1.85 ± 2.13	t(39) = 3.325, p = .002
	AP	3.71 ± 3.83	2.00 ± 2.40	t(34) = 3.270, p = .002
	EP	3.37 ± 3.83	2.15 ± 3.00	t(40) = 2.096, p = .042
	*Statistical criteria, p	F(2, 111) = .056, p = .945, $\eta^2 = .058$		
Depression (PHQ-9)	C	4.4 ± 4.07	2.79 ± 2.43	t(38) = 3.328, p = .002
	AP	4.63 ± 3.49	3.23 ± 3.05	t(34) = 2.181, p = .036
	EP	3.75 ± 3.25	2.48 ± 2.70	t(40) = 3.084, p = .004
	*Statistical criteria, p	F(2, 109) = 0.831, p = .160, $\eta^2 = .074$		
Psychomotor functions (dominant hand) (FTT-D)	C	30.08 ± 11.26	33.94 ± 10.82	t(39) = -3.210, p = .003
	AP	30.35 ± 10.89	33.1 ± 10.89	t(34) = -2.637, p = .013
	EP	34.19 ± 9.56	37.48 ± 11.94	t(40) = -2.641, p = .012
	*Statistical criteria, p	F(2, 93) = 0.5142, p = .008, $\eta^2 = .814$		
Psychomotor functions (non-dominant hand) (FTT-N)	C	27.32 ± 9.08	31.4 ± 9.29	t(38) = -3.782, p = .001
	AP	26.69 ± 12.23	28.61 ± 11.56	t(34) = -2.475, p = .018
	EP	32.79 ± 13.68	33.89 ± 12.72	t(39) = -0.737, p = .465
	*Statistical criteria, p	F(2, 108) = 1.375, p = .257, $\eta^2 = .290$		

Note: controlled for sex and number of strokes.

Abbreviations: C = control group; AP = allocentric group; EP = egocentric group; GAD-7 = the Generalized Anxiety Disorder scale-7; PHQ-9 = the Patient Health Questionnaire-9; FTT = the Finger Tapping Test (D = dominant hand; N = non-dominant hand).

elicit far-transfer effects. Within the broader scientific debate on the reliability and feasibility of achieving far-transfer,<sup>18</sup> these results contribute important empirical evidence: ten sessions of allocentric- or egocentric-based cognitive training did not produce measurable improvements in emotional state or psychomotor performance in post-stroke patients. This suggests that perspective-based cognitive interventions, at least in their current form and intensity, may have limited capacity to influence broader functional outcomes beyond the directly trained cognitive domains.

Although the study revealed null results, showing that perspective-based cognitive training does not produce far-transfer effects, several important implications for clinical practice emerge. First, the findings reinforce that conventional multidisciplinary rehabilitation remains central to emotional and physical recovery, as all participants improved regardless of training condition. Second, while cognitive rehabilitation may yield near-transfer effects even after short or low-intensity training, achieving broader far-transfer effects likely requires substantially greater training duration and intensity. These insights can help clinicians set realistic expectations, prioritize evidence-supported interventions, and allocate rehabilitation resources more effectively.

## Limitations

This study has several limitations. One of the major limitations of this study is its non-blinded design. To reduce potential bias, the research team assigned distinct roles; for example, the researcher responsible for recruiting participants and allocating them to groups did not conduct outcome assessments. Nonetheless, achieving full blinding is challenging in studies conducted within rehabilitation hospitals, where treatment environments cannot be tightly controlled as in laboratory settings. This limitation is also related to the randomization procedure, which relied on an electronic dice-rolling method and resulted in unequal group sizes. Future studies should consider using independent and fully automated randomization systems to enhance allocation concealment and overall methodological rigor.

Other limitation is associated with the intensity and duration of the intervention. The intensity and duration of the cognitive training may have been insufficient to produce measurable effects beyond those elicited by conventional rehabilitation practices. It is also important to consider the clinical setting: the study was conducted in a rehabilitation hospital where services primarily target the restoration of motor functions. Therefore, the experimental intervention may not have provided substantial added value beyond the conventional rehabilitation care to elicit significant group differences.

The absence of far-transfer effect may lie in the fact that this study measured only the additional effect of tasks based on allocentric and egocentric perspectives, rather than their isolated effect. In other words, all participants received conventional rehabilitation, and the specific impact of the perspective-based tasks was not evaluated independently from the general effects of rehabilitation. Furthermore, the results can be generalized only to those patients who have suffered a mild stroke and do not have severe cognitive impairments.

## Conclusions

This study demonstrated that selective visual attention and short-term visual memory training tasks based on allocentric and egocentric perspectives did not produce far-transfer effects in stroke patients. Specifically, no statistically significant differences were observed between groups in changes in psychomotor functioning, as well as in symptoms of depression and anxiety. These findings suggest that far-transfer effect after cognitive rehabilitation based on allocentric and egocentric perspectives remains limited.

## Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

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## Authors contributions

All authors wrote the main manuscript text, read and approved the final manuscript.

## CRedit authorship contribution statement

**Jovita Janavičiūtė-Pužauskė:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Raimonda Petrolienė:** Writing – review & editing, Writing – original draft. **Loreta Zajančauskaitė-Staskevičienė:** Writing – review & editing, Writing – original draft. **Andrius Paulauskas:** Software. **Liuda Sinkariova:** Writing – review & editing, Writing – original draft, Supervision, Project administration,

Funding acquisition, Conceptualization.

## Declaration of competing interest

The authors report there are no competing interests to declare

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## Supplementary materials

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