Eye gaze technology use for people with Motor Neurone Disease: A Systematic Review

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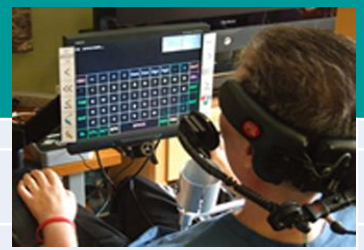


Introduction

Eye gaze technology (EGT) is one of the few viable methods of communication access for people with motor neurone disease (MND).

Alternative and augmentative communication (AAC) options are required to support their rapidly deteriorating communication and physical abilities. EGT enables people with severe physical limitations to access the world around them, socialise, email, surf the internet, control their environment and communicate independently.

Research has shown that EGT can increase independence, communication opportunities and quality of life, however, as a relatively new technology, there is need for more research evidence to provide clarity around the effectiveness of EGT for people with MND to guide SP treatment.

Methods

- Eight electronic databases were searched, chosen for their relevance to the study question: ProQuest, SpeechBITE, Medline, Embase, PubMed, Cinahl, PsychInfo and Cochrane.
- Search Restrictions were applied to filter the results to English, peer reviewed, publication period 1995-2016, adult population (18+ years). Forward and backward citation tracking was conducted for select studies.
- Risk of bias assessment was conducted using the Single Case Experimental Design (SCED) scale (L Tate et al., 2008) to evaluate the quality and level of bias for each study.
- In accordance with the ICF model of health (WHO, 2001), we reviewed the articles in relation to the following areas:

1. Communication impairment and function, specifically relating to changes in speech and accuracy of message transfer
2. Communication activity and participation such as changes in opportunities to communicate, social networking, independence, environmental control, and access to computer functions
3. Overarching quality of life, including changes in wellbeing, mental health and life satisfaction.

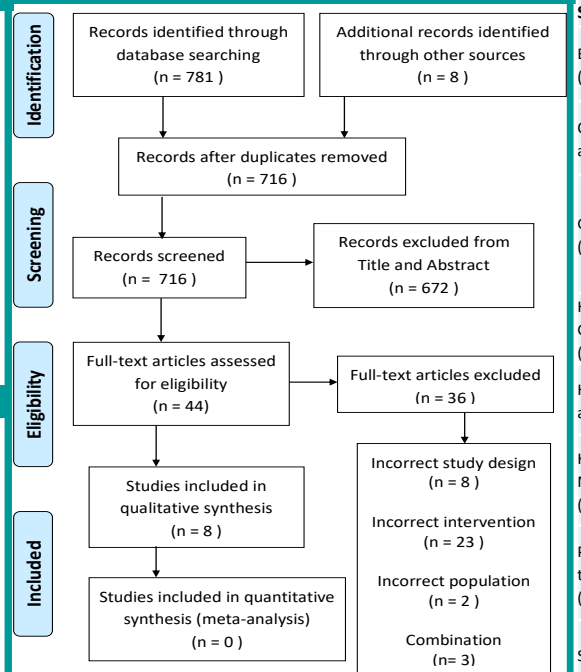
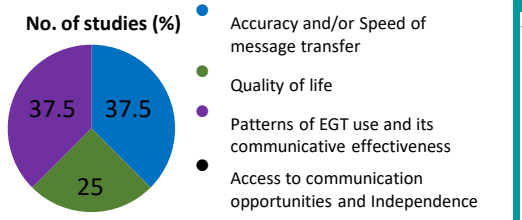


Fig 1: *Method Process- Flowchart of article selection*

Study	Aim/Intervention	Results
Ball et al. (2010)	Evaluate effectiveness EGT in different modes of communication	-EGT successful with limited mobility compared to other AAC options - EGT is a reliable option throughout the course of the disease -93.3% favoured EGT as their primary AAC method
Caligari et al. (2013)	Compare communication ability and quality of life with no device, eye transfer board, and EGT	-Less problems reported by participants using EGT than no device -Moderately positive impact on self-rated quality of life (competence, adaptability, self-esteem) with EGT -Participants rated EGT with strong satisfaction
Gibbons (2010)	Control comparison with single-switch scanning and EGT	-Increased speed of sentence construction (secs), and words per minute with EGT than single-switch scanning -Higher net error rates with EGT than scanning -Higher rates of error for participants with MND than controls -EGT rated as more efficient than scanning by participants with MND and controls (statistically significant) -All participants with MND participants preferred EGT to scanning method
Harris & Goren (2009)	Compare a manual letter board and EGT for speed of message transfer and ease of use	-33.3% participants achieved faster sentence construction with EGT, compared to 66.6% with manual letter board -66.6% reported that the EGT was easier to use
Hwang et al. (2014)	Compare an EGT and a phonetic board relating to quality of life	-Depression scores significantly improved following implementation of EGT -Average QOL scores were higher for EGT than a phonetic board -EGT reduced carer burden
Koole & Mak (2014)	Evaluate the effect of EGT 'hot keys' for turn taking and interlocutor interactions	-EGT facilitated increased complexity and turn taking in conversation interactions -Nil change in perception of fluency of conversation -Conversation with feedback from the use of 'hot keys' was rated as more pleasant, and increased interaction and listening in conversation
Pasqualotto et al. (2015)	Compare Brain-Computer Interfacing and EGT for usability and cognitive workload	-EGT had a significantly higher median information transfer rate than Brain Computer Interface (BCI) -System usability score was significantly higher for EGT than BCI -Cognitive workload was higher for BCI than EGT -The longer the disease duration, the higher the cognitive workload, and lower the usability of BCI, compared with nil change for EGT
Spataro et al. (2014)	Evaluate the usefulness of a EGT and the variables affecting its use	-63.4% used EGT for a median of 420mins per day -Reasons for non-use: gaze tiredness (72.7%); severe oculomotor impairment (18.2%); difficulties with keeping head still (9.1%) -Education level and disease duration had nil effect on use of the EGT; Regular users had a median age 6 years below the occasional/non-user group

Results

Eight studies met the criteria. Notably no studies in the area of EGT have investigated the effectiveness of this type of AAC to improve access to communication opportunities and independence for the MND population.



Reference: L Tate, R., Mcdonald, S., Perdices, M., Togher, L., Schultz, R., & Savage, S. (2008). Rating the methodological quality of Single - subject designs and n-of-1 trials: Introducing the Single-Case Experimental Design (SCED) Scale. *Neuropsychological Rehabilitation, 18*(4), 385-401.

World Health Organization (WHO). (2001). *International Classification of Functioning, Disability and Health: ICF*: World Health Organization.

Conclusion

There is a gap in current evidence focusing on activity participation or social engagement and functional applicability of EGT for people with MND.

However, this review found that EGT:

- Is significantly faster but less accurate than scanning methods
- Is easier but less efficient than a manual letter board
- Reduces depression and improves quality of life
- Provides opportunities for increased complexity and turn taking in conversation Has high user satisfaction
- Is faster and more accurate than a brain-computer interface device

Index

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