

Critical Review:
Is errorless learning more effective than errorful learning in the treatment of anomia for individuals with aphasia?

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This critical review examined the effectiveness of errorless learning when compared to errorful learning in treating anomia for individuals with aphasia. Five studies with case-series designs were investigated. Overall, research found errorless learning to be as effective as errorful learning but not significantly advantageous. Clinical implications are discussed.

Introduction

Anomia refers to a difficulty thinking of the word one wants to say and is a common problem among individuals with aphasia. Traditional anomia therapy has centered on a trial-and-error based approach where subjects are encouraged to independently produce the word at the risk of making errors (Fillingham et al., 2006). For instance, a client may be shown a picture and will be encouraged to guess its name before being supplied with the correct label. This is based on the belief that learning will be better if one is allowed to make mistakes and learn from them.

In contrast to errorful learning, errorless learning is a form of remediation based on the belief that learning will be more effective if the learner is prevented from reinforcing his or her own errors (Fillingham et al., 2003). Therefore, a client will be shown a picture followed immediately by its name, verbally and/or in written form. This belief follows the principle of Hebbian-based learning that states that if two neurons fire together the strength of their synaptic connection will be increased. If an error is made, there will be an increased likelihood of that pattern of neural synapses repeating itself in subsequent occasions. Thus errorless learning would be more advantageous as a rehabilitation approach, as it would prevent reinforcement of incorrect neural pathways (Fillingham et al., 2006).

Errorless learning has already been found to be more effective than errorful learning in the rehabilitation of patients with memory impairments during tasks that involve relearning names of objects and people (Fillingham et al., 2005). This paper questions how effective it would be in anomia therapy for patients with aphasia when compared to the traditional errorful learning.

Objectives

This paper is primarily meant to review current research on the differences between errorless and errorful

treatment for anomia. A secondary objective is to use the evidence obtained to recommend appropriate principles in the management of anomia for individuals with aphasia.

Methods

Search Strategy

Research articles were investigated using the online databases, CINAHL, SCOPUS, PubMed and PsycInfo, along with the search engine Google Scholar. The following search terms were used to find articles: (errorless OR errorful) AND ((anomia) OR (word finding)) AND (aphasia).

Selection Criteria

Articles were included only if they addressed the difference between errorless and errorful learning for anomia, and if they exclusively treated individuals with aphasia. Studies involving only one type of treatment or a combination of errorless and errorful learning were excluded from the review, as a direct comparison of their effects could not be established.

Data Collection

The articles included in the review consist of case series designs (5).

Results

Case series designs do not usually provide evidence that can be readily generalized to the rest of the population due to their sampling limitations. However, they are appropriate if the question refers to a specific pool of individuals (i.e. individuals with aphasia who have word-finding difficulties). In this case, they would also allow experimenters to make within-subject comparisons between errorful and errorless conditions across subjects with a wide range of aphasia severity. Their designs can also incorporate a series approach that

provides replication of results within the same study. The studies examined in this paper are at a level III evidence scale, indicating that they are well-designed quasi-experimental group studies.

Fillingham et al. (2005a, b; 2006) conducted three consecutive studies investigating the difference in therapy outcomes between errorless and errorful treatment for anomia in individuals with aphasia. They recruited eleven participants with word-finding deficits due to central language impairments. Treatment involved errorless and errorful learning over a five week period for each condition. Baseline, immediate post-therapy and follow up assessment measures were administered using non-parametric tests. Results revealed a general improvement in word-finding abilities after both treatments but no significant difference between the errorless or errorful learning conditions that would suggest an advantage of one over the other. After eliminating feedback as a confounding factor they still found that both treatment styles were equivalent in improving naming ability.

Fillingham et al. used appropriate selection criteria that excluded confounding variables (e.g visual, hearing difficulties, agnosia) but still maintained the diversity of deficits prevalent in the aphasic population. They used well-established tests to measure the degree of anomia in their participants and their methods were well-defined for easy replication. While their initial study (2005 a) administered errorless learning followed by errorful learning, cross-over of the two treatments was incorporated into their consecutive studies to avoid order effects. Fillingham et al. had small sample sizes in all their experiments (n=11, 7, 7 respectively) that could impact generalization of results. However, this is an understandable limitation, given the specific population being examined (i.e. aphasic individuals with anomia). Their outcome measures were appropriate since they used non-parametric tools of analysis (i.e. McNemar's test, chi-square) that were suitable for their sample size.

Overall, through valid methods and analysis tools, Fillingham et al. provide compelling evidence of an overall treatment effect with no advantage of one learning style over the other, even when replicating the method twice.

McCossick & Ward (2007) investigated the difference between errorless and errorful learning through four treatment conditions: errorless learning, errorful learning without feedback, errorful learning with feedback and no treatment. Treatment was administered to five participants with anomia due to a stroke. Each treatment condition was applied to a set of pictures that elicited word finding difficulties for a particular

participant. The presentation order of all the pictures was randomized, consequently randomizing the order of the conditions. By the end of the eight-week period of therapy each participant had undergone all four learning styles. Pre, post and follow-up assessments were conducted using parametric measures and found no significant difference between errorful learning with feedback and errorless learning. However, both treatments led to a significant improvement in naming ability. Conversely, errorful learning without feedback was found to have no significant improvement in word finding, suggesting that feedback may be an important factor in treatment outcome.

McCossick & Ward had more stringent selection criteria than Fillingham et al. (2005a, b; 2006). They excluded participants with memory impairment, stating that previous research had already found errorless learning to be beneficial for memory impairment and it would be a confounding factor in the study. While the narrow selection criteria increased the likelihood of accurate results, it resulted in a small sample size (n=5). This limited the ability to generalize the results obtained. McCossick & Ward used appropriate tests to gain participant information and their methods were valid and well-detailed for easy replication. They also randomized the order of treatment conditions to prevent any order effects from occurring. However in terms of analysis, parametric measures used (i.e. ANOVA, paired t-tests) were inappropriate for the small sample size, as they increased the likelihood of inaccurate results. Using nonparametric measures like McNemar's test would have been more ideal to avoid potential skewing of the results.

Overall, due to sound methodology but unsuitable analysis measures, this study provides suggestive evidence of improved naming after either errorful or errorless learning, with no significant difference between the two.

Conroy, Sage and Ralph (2009) further investigated the difference between errorless and errorful learning in noun and verb naming therapy. They hypothesized that errorless learning would be more beneficial to verb naming because they were linguistically more complex and led to an increased vulnerability for errors at either the phonological, morphological, semantic or syntactic levels. Noun and verb targets were chosen for nine anomic participants with aphasia and were grouped either into the errorless or errorful treatment conditions. Both therapies were carried out in all sessions for nouns and verbs. ANOVA analyses revealed a group treatment effect in naming accuracy from baseline to immediate assessment, with a "borderline difference favouring errorless over errorful learning" (Conroy et al., 2009).

McNemar tests used on an individual level revealed a significant improvement from baseline to immediate and follow-up assessments but no significant improvement between the latter two. Regardless of word type there was a general trend among participants of increased naming accuracy with errorless learning over errorful; however, most did not reach significance. When analyzing word type, Conroy et al. found an overall word effect with a group ANOVA, where nouns were more accurately named than verbs. Chi-square tests on individual results supported the group findings.

Conroy et al. appropriately selected participants with well recognized inclusion/exclusion criteria. As with the other studies they had a small sample size (n=9), reducing the ability to generalize results to the rest of the population. This reduction in statistical power could explain finding a trend towards greater improvement in errorless learning but not having it reach significance. Conroy et al.'s methods were well- designed and maintained a reasonable therapy block length by providing both treatment conditions in every session, with the presentation order counterbalanced over both conditions. One weakness lies in their use of parametric tools of analysis. As stated previously, using measures like ANOVA to analyze data with a small sample size like this one could skew the results leading to inaccurate findings. However, contrary to McKossick & Ward's study (2007) nonparametric measures like McNemars test and the chi-square test were also used to analyze the results at an individual level and to compare them with the group ANOVA's results. Therefore, the complementary evidence from both approaches increases the validity of the analysis.

Overall, this study provides moderate individual evidence showing improved treatment outcomes for nouns and verbs using errorless and errorful learning, with no significant difference between the two treatments. Therapy also revealed bigger improvement in nouns than verbs. Group evidence should be interpreted with caution due to inappropriate analyses tools.

Discussion

As reported earlier, the aim of this paper was to examine whether errorless learning was more advantageous than errorful learning in anomia therapy for people with aphasia. Five case studies were reviewed and found suggestive to moderate evidence that errorless learning was as effective as errorful learning, with neither style having an advantage. Small sample sizes were the main methodological concerns for all the studies with a range of 5 to 11 participants. They resulted in low statistical power that could have

explained the lack of finding a significant difference between errorless and errorful treatment outcomes, although one study found a trend favouring errorless treatment. Two out of the five studies used outcome measures that were inappropriate for their sample sizes. All these factors likely affected the reliability of the results and need to be taken into consideration when interpreting the findings.

Despite concerns with methodology, the consistency of the evidence from all the studies suggests that the two learning styles may actually be equivalent for anomia therapy in the aphasic population. Ralph & Fillingham (2007) proposed a framework that explained this lack of difference when compared to findings of errorless learning being advantageous in the population with Alzheimer's Disease who have amnesia. Their basic premise was that people with amnesia know that they have to learn so their learning system is switched on, but their poor memory does not allow them to "code and store representations of the response and stimulus" (Ralph & Fillingham, 2007). By being unable to store representations they would not be able to detect and learn from erroneous ones, and errorful learning would be ineffective. Thus errorless learning would be more beneficial for them. However, people with aphasia would be able to turn on their learning systems and access their stored representations, as long as their attention-executive skills were not too impaired. This would lead to equivalent treatment outcomes for both errorless and errorful learning (See the framework in Ralph & Fillingham, 2007 for more detail).

Ralph & Fillingham (2007) note that more research needs to be done to directly compare errorless and errorful treatment in the two populations (Alzheimer's disease and aphasia) in order to better understand the contradictory evidence on the advantage of errorless learning.

Clinical Implications

Both errorless and errorful treatments brought about effective improvements in anomia for individuals with aphasia with no differences between the two treatment styles. However when choosing the right therapy approach, it is important to consider the client's preferences. Fillingham et al. (2006) reported that all their participants expressed a preference for the errorless method because they found it less frustrating and more rewarding. There was the idea that participants would not attend to objects carefully if they were not required to immediately guess the name (Fillingham et al., 2005), but Fillingham et al.'s studies (2005a,b; 2006) did not support this notion. Errorless learning also presents a few challenges for clinicians, as

it is a passive process and can be tedious for some to administer (Fillingham et al. 2005). However, with current technology errorless learning could be made into a computer-based intervention that could be administered at home (McKossick & Ward, 2007), in turn effectively reducing the work-load of the clinician while increasing the independence of the client. Although the options are many, it is important to remember to always take the client's needs into consideration when choosing the therapy approach to gain maximum treatment benefit.

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