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A rehabilitation programme to increase reading performance in adults with a vision impairment⁴

Abstract

This research attempted to establish the content validity of an experimental rehabilitation programme which was carried out in order to show an increase in reading performance – the *Reading Performance Vision Rehabilitation Programme* (or the RPVRP). The programme was tested on adults with low vision (severe and profound) in the Czech Republic.

The following methods of experimental testing were used: reading speed, number of mistakes, and the ability to use obtained information (pretest, posttest No. 1, posttest No. 2) for evaluating the level of increase in reading skills. Results: Our findings confirm that the experimental *Reading Performance Vision Rehabilitation Programme* significantly influenced the effectivity of using vision potential and increased reading performance in the investigated cases.

Keywords: vision impairment, vision rehabilitation, vision training programme, reading skills, reading performance, adults with vision impairments

Program rehabilitacji realizowany w celu zwiększenia efektywności czytania u dorosłych z uszkodzeniem wzroku

Streszczenie

Celem prezentowanych badań było potwierdzenie skuteczności oraz trafności treściowej eksperymentalnego programu rehabilitacyjnego, który zastosowano w celu usprawnienia efektywności czytania – *Reading Performance Vision Rehabilitation Programme (Efektywność Czytania – Program Rehabilitacji Wzrokowej (w skrócie RPVRP))*. Program został przetestowany w grupie dorosłych osób z uszkodzeniem wzroku w stopniu znacznym i głębokim w Republice Czeskiej.

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W celu oceny stopnia poprawy umiejętności czytania zastosowano eksperymentalne metody służące do oceny: tempa czytania, liczby błędów oraz umiejętności wykorzystania uzyskanych informacji (badanie wstępne, posttest nr 1, posttest nr 2).

Uzyskane wyniki potwierdzają, że program eksperymentalny *Reading Performance Vision Rehabilitation Programme* znacznie wpłynął na skuteczność wykorzystania możliwości wzroku i zwiększył efektywność czytania u badanych osób.

Słowa kluczowe: uszkodzenie wzroku, rehabilitacja wzroku, program treningu wzroku, umiejętności czytania, efektywność czytania, dorośli z uszkodzeniem wzroku

Introduction

Vision is a very complex learning-based process. Visual perception plays a significant role in creating images and concepts, in the development of memory, concentration, thinking and speaking, and also in emotional and volitional areas (Corn 2010). *Visual performance* represents to what extent and how efficiently partial visual learning is used in concrete activities and critical situations (Dickinson 2002). *Visual performance* is defined by environmental conditions, previous experience, and the level of cognitive processes of a particular individual. These factors can be labelled as learning-influenced and they have an impact on the quality of life.

Adults with low vision⁵ represent a large group with many specific needs. A sophisticated approach towards vision rehabilitation can significantly influence both visual performance and the performance potential in other areas as well: a higher effectivity in using vision potential, the feeling of greater comfort while performing visually demanding activities and, subsequently, lessening the deficit of information and increasing self-sufficiency (Balatka, Růžička, Vondruška, Růžičková & Jílek 2004).

As opposed to other developed countries, a complex system of *rehabilitation care for adults with low vision* has not been systematically worked on yet in the Czech Republic. There isn't a sufficient number of available methodical materials in the Czech Republic that focus on skills needed to develop and explore partial visual potential⁶.

General background of the Reading Performance Vision Rehabilitation Programme

The ability to read is considered one of the main human competences and belongs among the social status and freedom of information values. The founding ground for creating an experimental rehabilitation programme aimed at increasing

⁵ According to the World Health Organization (WHO), approximately 70 to 75% of new cases of vision defects appear after reaching the age of 65. With the growing average life span, another statistically significant increase of seniors with vision defects is expected in the next twenty years. Generally speaking, in the case of adults and seniors, there is a prevailing low level of competences to adjust independently and effectively to the arising secondary effects of their vision defect (see Skalická 2007, Moravcová 2004, Jesenský 2002, Dickinson 2002, Lueck 2004, and others).

⁶ The need to revise system solutions has been supported in findings by numerous Czech authors for many years (see Jesenský 2003, Moravcová 2004, Skalická 2007, Růžičková 2006, and others).

reading performance is the fact that reading is generally considered one of the key rehabilitation areas for people with low vision⁷ (Lueck 2004).

Based on research carried out both in Czech and international professional theoretical backgrounds, and drawing from practical experience in longitudinal practice in a rehabilitation centre for adults with visual impairment, an experimental Reading Performance Vision Rehabilitation Programme (RPVRP) was designed⁸. The programme was developed to outline all tools which can aid reaching optimum reading performance in the target group, i.e. adult people with *severe* and *profound* low vision. According to the focus of the programme, the most significant issues include: acquiring the ability to follow individually beneficial eye hygiene rules, learning how to carry out vision performance in the so-called 'eye comfort' conditions, and decreasing the amount of effort put into vision performance and sight work. The RPVRP was prepared and put into practice by an interdisciplinary team of experts (an ophthalmologist, an optometrist, a vision therapist, a teacher specializing in training people with visual impairments, and a psychologist). The programme was recommended by the Ethical Committee of the Teaching Hospital in Hradec Králové (č.j. 200502S03L).

Participants

The experimental group consisted of 10 people ($N = 10$)⁹. The participants were selected from patients of the Department of Ophthalmology at the Hradec Králové Hospital. The participants fulfilled the following criteria:

- their visual acuity was less than 6/18 (0.3) in the better eye with the best correction (ICD-10 Codes 1 & 2);
- they were prescribed an optical device in the 5x to 15x magnifying range or a special optical system by the Department of Ophthalmology at the Hradec Králové Hospital (this kind of optical aid can be obtained solely from this department);
- they had no previous experience with professionally managed rehabilitation training.

Table 1. The description of group participants. Basic Criteria of experimental group ($N = 10$)

Participant	Sex	Age	Visual Acuity	Prescribed an Optical Device	Ability to use Optical Device
A	F	46	0.33	6x	No
B	M	67	0.12	Kepler 6 x 17	Yes
C	F	61	0.17	8x	Yes
D	M	73	0.16	Kepler 6 x 17	Yes
E	F	71	0.015	Galileo 4x	Yes
F	M	54	0.02	Galileo 4x	No
G	F	56	0.01	Kepler PM 6 x 17	No
H	M	60	0.03	12,5x	No
I	F	25	0.2	Hypercorr 4x	Yes
J	F	27	0.15	5x	Yes

⁷ Most patients come to a revision ophthalmologist's surgery wishing to be prescribed a 'reading aid' (Pavličková & Vorlíčková 2001, Moravcová 2004).

⁸ The programme was designed in accordance with the WHO 'Healthy Vision 2010', International Academy for Certification of Vision Rehabilitation and Education Professional ACVERP (USA), Nord Star Vision Group LLC (USA), Lueck 2004, Dickinson 2002.

⁹ A lower number of participants was balanced with combining quantitative and qualitative methods of obtaining, processing, and evaluating outcomes.

Methods

The research was carried out as *empirical mixed research* in the QUAN-QUAL¹⁰ form (Hendl 2005).

Key Research Questions:

1. What is the level of increase in *reading speed* based on the implementation of RPVRP?
2. What is the level of *decrease in the number of mistakes* in reading based on the implementation of RPVRP?
3. What is the level of *increase in information effectiveness* in reading a text based on the implementation of RPVRP?
4. How significant is the share of the technical and functional part of the programme on the overall increase in reading performance?
5. How significant is the share of the educational and training part of the programme on the overall increase in reading performance?

The structure of the programme is based on modern concepts used in andragogy principles as well as on other concepts used in the above mentioned areas (motivation, mental training, etc.). The effectivity of the RPVRP is proved by empirical results.

Quasi-experimental¹¹ research was organized with a single experimental group and verified with a pretest, posttest no. 1 and posttest no. 2.

The pretest was carried out before the start of the programme. It verified the initial level of reading performance according to the following criteria: reading speed, number of mistakes, and ability to use obtained information.

The quantitative posttest measurements were carried out twice. The first posttest verified the level of influence of the technical and functional part of RPVRP on the increase in reading performance. The first measurement took place after the first four lessons. It was aimed at evaluating if the technical devices used while reading with optical aids and in a given environment were used in the best possible manner.

The second one measured the level of influence of the educational and training part of the programme on the change in participants' performance. It was carried out after finishing the programme (after 10 lessons).

Procedure

The research was conducted on ten experimental cases. The RPVRP itself was carried out individually with each of the persons in their place of residence and divided into ten educational and training units (1.5 hours per week) for approximately three months. Training units were supplemented with individual practical tasks.

The RPVRP was strictly divided into two experimental parts: the first one – *technical and functional* and the second one – *educational and training* focused.

¹⁰ QUAN-QUAL research combines selected quantitative and qualitative research methods.

¹¹ Quasi-experimental research is designed for testing one experimental group of participants.

The first one:

1. practical training in using suitable *technical devices* (optical, electronic or non-optical);
2. development of skills needed to use optimum *environmental adjustment for reading* (work surface optimization, lightning, work distance adjustment, etc.);

The second one:

3. development of skills needed to use *special methods and procedures of sight work* (basic techniques like localization, fixation, spotting, tracing, tracking and special techniques like eccentric vision, head movement supervision, reading techniques for limited head or hand motion, and so on); increasing accessibility through visual means; sight hygiene, sight tiredness relaxation, visual information work procedures, text work procedures, and so on.

The research interest concentrated on increasing reading performance in the following experimental criteria: *reading speed*, *number of mistakes*, and *the ability to use obtained information* in both of the two parts of the experimental programme. One of the research goals was to gather information about the relation between each one of the experimental parts and the experimental criteria.

Measurement results

The main results measured in individually observed categories of reading performance are listed as the average value of the obtained results and the effectivity ratio between the two basic parts of the RPVRP (technical and functional part, educational and training part).

1. Measurement Results in the Reading Speed Category (Research Question No. 1)

In connection with the implementation of the programme, the average increase in reading speed in the experimental group was 16.27 words per minute (34.3%). The technical and functional part of the programme was responsible for an increase of 6.96 words per minute (14.7%); the educational and training part caused an increase of 9.31 words per minute (19.6%). An overall performance increase in reading speed was significantly influenced by both parts of the experimental programme, the educational and training part of the programme proved slightly more effective.

Table 2. Statistical Results in the Reading Speed Category

	The Total Sum – Reading Speed (\bar{X} words/min.)	Span ($X_{\max} - X_{\min}$)	The arithmetic mean ($N = 10$)	Effectiveness (%)
\bar{X}_{T_1R}	47.6	88.0–18.5	47.60	100
\bar{X}_{T_2R}	54.4	89.7–29.2	54.45	114.6
\bar{X}_{T_3R}	63.7	100.0–40.0	63.77	134.3
$\bar{X}_{T_{1/2}R}$	69.6	15.2–1.7	6.96	14.7
$\bar{X}_{T_{2/3}R}$	93.1	11.1–2.3	9.31	19.6
$\bar{X}_{T_{1/3}R}$	160.9	34.4–6.3	16.27	34.3

Note:

T_{1R} Results of the average reading speed in the first reading test (pretest);

T_{2R} Results of the average reading speed in the second reading test;

T_{3R} Results of the average reading speed in the third reading test (posttest);

$T_{1/2R}$ Difference in Results achieved in the first and second test (Effectiveness of the first part of the Programme);

$T_{2/3R}$ Difference in Results achieved in the second and third test (Effectiveness of the second part of the Programme);

$T_{1/3R}$ Average difference in Results in the first and third test (overall Effectiveness of the Programme).

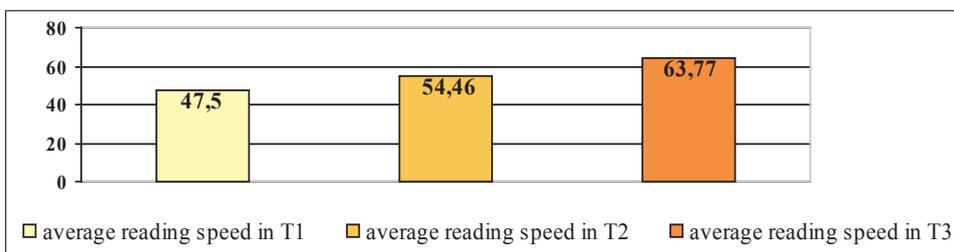


Figure 1. Average increase in reading speed in the experimental set (n = 10).

The results are listed as the average number of words per minute

2. Measurement Results in the Linearity of Reading Category (Research Question No. 2)

Linearity of reading is defined as the average number of mistakes, regressive movements and excessively long pauses in reading. Based on the technical and functional part of the programme, the average number of mistakes decreased by 0.77 mistakes per minute (35.5%). In respect to the educational and training part of the programme, the average number of mistakes decreased by 0.66 mistakes per minute (30.4%). All in all, in connection with the complete programme, the average number of mistakes decreased by 1.43 mistakes per minute (65.9%). The outcomes of the experimental group showed a relation between reading mistakes and the quality of reading conditions. The training part also accounted for a major improvement in reading fluency. The high level of improvement in the linearity of reading illustrates the importance of a professionally managed intervention.

Table 3. Statistical Results in the Linearity of Reading Category in the experimental group

	The Total Sum – number of mistakes per min.	Span ($X_{max} - X_{min}$)	The arithmetic mean (N = 10)	Effectiveness (%)
$\bar{X} T_{1L}$	21.7	7.8–0.7	2.17	100
$\bar{X} T_{2L}$	14.0	4.2–0.5	1.40	64.5
$\bar{X} T_{3L}$	7.4	1.7–0.34	0.74	34.1
$\bar{X} T_{1/2L}$	69.6	3.6– -0.16	0.77	35.5
$\bar{X} T_{2/3L}$	93.1	2.5–0	0.66	30.4
$\bar{X} T_{1/3L}$	160.9	6.1–0.2	1.43	65.9

Note:

T_1L Average Results in Linearity of Reading in the first test (pretest);

T_2L Average Results in Linearity of Reading in the second test;

T_3L Average Results in Linearity of Reading in the third test (posttest);

$T_{1/2}$ L Difference in the average Results achieved in Linearity of Reading in the first and second test (Effectiveness of the first part of the Programme);

$T_{2/3}$ L Difference in the average Results achieved in Linearity of Reading in the second and third test (Effectiveness of the second part of the Programme);

$T_{1/3}$ L Average difference in the Results achieved in the first and third test (overall Effectiveness of the Programme).

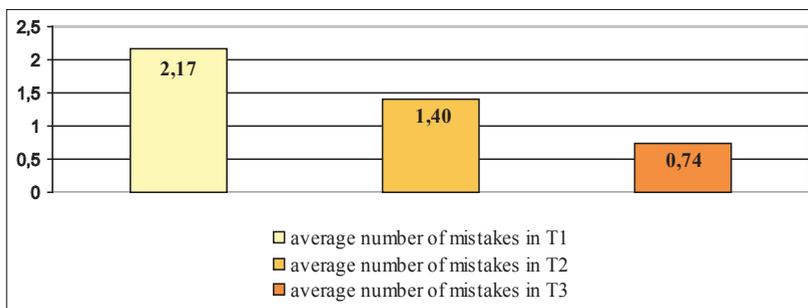


Figure 2. Average level of decrease in the number of mistakes in reading in the experimental group ($n = 10$). The results are listed as the average number of mistakes per minute

3. Measurement Results in the Category of Information Effectiveness of Reading (Research Question No. 3)

Based on the technical and functional part of the programme, the average increase in the number of correctly answered questions was 0.4 (15.4%). Based on the educational and training part of the programme, the average number of correct answers increased by 2.4 (92.3%). All in all, in connection with the complete programme, the experimental group showed an average improvement of 2.8 correct answers (107.7%). The listed research outcomes show a high level of effectivity of the rehabilitation programme for the observed area of reading performance.

Table 4. Statistical Results in the Category of Information Effectiveness of Reading in the experimental group

	The Total Sum – correct answers	Span ($X_{max} - X_{min}$)	The arithmetic mean (N = 10)	Effectiveness (%)
\bar{X}_{T_1O}	26	4–1	2.6	100
\bar{X}_{T_2O}	30	4–2	3.0	115.4
\bar{X}_{T_3O}	54	6–4	5.4	207.7
$\bar{X}_{T_{1/2}O}$	4	1– -1	0.4	15.4
$\bar{X}_{T_{2/3}O}$	24	3–1	2.4	92.3
$\bar{X}_{T_{1/3}O}$	28	4–2	2.8	107.7

Note:

T_1O Average Results in the first test (pretest);

T_2O Average Results in the second test;

T_3O Average Results in the third test (posttest);

$T_{1/2}O$ Difference in the average Results achieved in the first and second test (Effectiveness of the first part of the Programme);

$T_{2/3}O$ Difference in the average Results achieved in the second and third test (Effectiveness of the second part of the Programme);

$T_{1/3}O$ Average difference in the Results achieved in the first and third test (overall Effectiveness of the Programme).

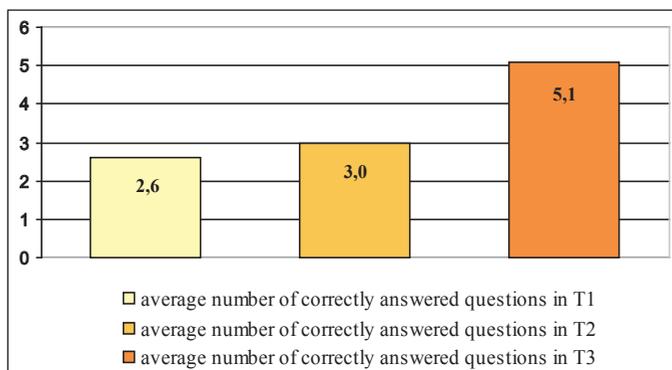


Figure 3. Average level of the increase in information effectiveness in the experimental group (n = 10). The results are listed as the number of correctly answered questions based on the read text

The reading performance increase share – technical and functional part of the programme

As compared to the training part of the programme and depending on condition optimization, the categories of reading speed and linearity of reading showed a slightly lower effectivity. The outcomes in the information effectiveness of the reading category show a less significant dependence on the technical and functional part of the RPVRP. It represents a major part of vision rehabilitation, although it has to be complemented by other factors.

The reading performance increase share – educational and training part of the programme

according to the outcomes, the training part of the programme is crucial for vision rehabilitation. The category of information effectiveness of reading scored the highest results – 71.5%. A high level of improvement in reading speed was scored in the training part of the programme as well. The outcomes in the linearity of reading category were comparable in both parts of the programme. Training represents an essential part of vision rehabilitation.

Conclusions

The research outcomes also point out that Czech adult rehabilitation practice traditionally prefers a technical and functional approach, which does not appear to be based on justifiable foundations.

The research showed the importance of intentional intervention in terms of complex vision rehabilitation in order to increase reading performance in adults with a visual impairment. Both parts of the programme – the technical and functional one and the educational and training focused one – proved effective. Although the rehabilitation process must remain individualised, it can be modelled and structured in order to obtain the best results and can influence the quality of life in the targeted group of adults with low vision.

Recommendations for using the RPVRP in the Czech Republic practice

Based on comparing the obtained results and outcomes, we would like to suggest the following:

1. Concentrate on using and developing a modern concept of the RPVRP for vision rehabilitation of people with a visual impairment.
2. Create educative videos, methodology manuals, and training practice set handbooks to the RPVRP, but also publications in ophthalmological journals and at ophthalmological conferences.
3. Improve information exchange and cooperation between health care and rehabilitation provided by non-governmental institutions in the Czech Republic.
4. Develop rehabilitation workers' skills in using the RPVRP.
5. Verify research outcomes on a larger research sample and implement the RPVRP into rehabilitation practice.

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