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TACTILE INFORMATION AS A FACILITATING ELEMENT IN THE SPATIAL ORIENTATION

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Abstract

The aim of the submitted contribution is to introduce a theoretical basis, practical applications and a research framework in the area of tactile graphics with respect to the field of spatial orientation and individual mobility. The use of tactile graphics represents, among other things, a significant element in the overcoming or at least the mitigation of the information deficit originating due to the restriction or loss of visual perception. Thereby, it also becomes a potential means of increasing the quality of life of an individual with visual impairment. Theoretical knowledge about tactile graphics is embedded in the research framework, the content of which is a primary probe into the applicability of tactile graphics in the field of spatial orientation and individual mobility from the perspective of those with visual impairment and professionals who work with this group. Our intention was to perform an initial probe into the chosen field of interest and to identify the interesting aspects suitable for a follow-up within applied research.

Keywords: Visual impairment, tactile graphics, O&M, tactile maps.

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Corresponding Author: Kateřina Kroupová
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1. Introduction

Tactile graphics intended a priori for persons with visual impairment can represent a significant means of overcoming or reducing the information deficit originating due to restriction or loss of the visual perception. Even in spite of the current preference of information received auditorily, tactile graphics still remain a significant information carrier.

Tactile graphics (typhlographics) consist of graphic images based on embossed lines or low embossed surfaces made for the needs of persons with visual impairment or by these individuals themselves (Jesenký, 1988). In a broader sense, the field of typhlography also includes current 3D print technology, which works with a 3D display rather than simple flat embossing (Voženílek, 2010).

What is key is the function of tactile graphics in terms of improvement and support of the dynamic development of perception. In response to improved perception, the imagination develops - spatial ideas are refined, deepened and extended, as is thinking in terms of integration of the individualities into a whole with respect to exploration of the surrounding world (Finková, Růžičková, & Ludíková, 2007; Barvir, Vondrakova, & Ruzickova, 2018).

Practically, tactile graphics is primarily of benefit to the area of spatial orientation and independent mobility, in particular in terms of tactile plans and maps. Searching for other ways to improve the spatial knowledge and ignite the spatial imagination of persons with visual impairment is an important challenge faced by contemporary society. In this context, there have been a number of research studies oriented on the role of tactile maps in direct application to the practice and implementation of independent mobility and spatial orientation (Picard & Pry, 2009).

1.1. Tactile graphics and their application in research concepts

Wright, Harris and Sticken (2010) presented a review study oriented on the key practical typhlography application – tactile maps and models for persons with visual impairment. The authors declare that tactile maps and models are a substantial part of spatial orientation and independent mobility training (O&M), in particular for two reasons. The ability to scan the visual environment enables intact persons to create cognitive maps for spatial orientation quickly and relatively easily (Sapp as cited in in Wright, Harris, & Sticken, 2010), whereas persons with visual impairment have the options to explore space limited by the tactile field of their white cane (Ungar, Blades, & Spencer, 1998 as cited in Wright, Harris, & Sticken, 2010). Another aspect is the fulfilment of current educational standards, which require demonstration of the corresponding competencies in working with maps – these abilities are required both in pupils and students with visual impairment if they are supposed to achieve the same level as their peers in an inclusive environment (Budd, La Grow as cited in Wright, Harris, & Sticken, 2010).

The authors (2010) confirm that experimental research, even if relatively sporadic, has proved that the use of tactile maps and models can improve symbolic understanding and additional knowledge of O&M concepts.

Budd and La Grow (in Wright, Harris, & Sticken, 2010), within their research, confirmed the importance of inclusion of their tactile maps and models into the O&M training concept, which provide significant benefits for the practice and implementation of spatial orientation. Likewise, Higgins (as cited

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in Wright, Harris, & Sticken, 2010) points out the accessibility of orientation and independent mobility when using tactile maps. Růžičková (2017) also confirms these conclusions.

In the conclusion of the study, the authors (2010) highlight the absence of research focusing on the application of the information acquired through tactile map and plan reading into direct practice. The currently implemented TACR project is based on multisensorial recognition of routes (orientation points and signs) through audio-tactile maps that will be explicitly applied in practical spatial orientation training. It can be assumed that this information, mediated by multi-channel learning, can make O&M training and implementation in persons with visual impairment more efficient (Růžíčková & Vondráková, 2018).

2. Problem Statement

Tactile graphics represent an important means to overcome or at least mitigate the information deficit resulting from the loss of visual perception. The scope of this research is focussed on a primary probe of the applicability of tactile graphics in spatial orientation and independent mobility among professionals and persons with visual impairment.

Following the research aspects of tactile representation outlined above, the key premises of our study focus on the overall approach of persons with visual impairment to the use of tactile representation, the practical applicability of these representations within O&M, and the opinions of the professional public on the graphic representation as well as on the nature of this type of representation. These aspects co-create a total image of current reality in the field of tactile graphics with accent on the application of possibilities within O&M.

3. Research Questions

Based on the study of specialised literature and resources, several key questions arose:

- What is the information benefit of tactile graphics (typhlographics) for persons with visual impairment?
- What is the applicability of tactile graphics (typhlographics) within the area of spatial orientation and independent mobility from the perspective of visually impaired persons?
- What is the information benefit of tactile graphics (typhlographics) in the context of spatial orientation from the perspective of professionals working with people with visual impairment?
- What should the characteristics of tactile representation be, from the perspective of persons with visual impairment and involved professionals?
- Does contemporary society have adequate tactile elements in public space?
- Are tactile graphics (typhlographics) commonly used in everyday activities?
- Do tactile graphics (typhlographics) also fulfil an aesthetic function for persons with visual impairment?

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4. Purpose of the Study

The purpose of the study is to embed theoretical knowledge about tactile graphics into a research framework, the content of which is a primary probe into the applicability of tactile graphics in the field of spatial orientation and individual mobility from the perspective of those with visual impairment and professionals who work with this group. The goal of the research is to create a relatively complex image of the current situation in the field of tactile graphics with an accent on the application scope in O&M in the form of tactile maps and plans. A partial goal is the comparison of the view of individual research participants, which can be a potential source of mutually contradicting information and attitudes.

5. Research Methods

We utilised a quantitative research design that was implemented in form of questionnaire. The primary research set was saturated based on intentional selection and the respondents were selected based on their visual impairment regardless of the degree. The secondary research set was made of professionals working with persons with visual impairment, selected based on their practical experience and active operation in the field of caring for visually impaired persons.

The primary research set consists of 15 respondents across the age spectrum (from adolescence to seniors) with various visual impairments. The secondary research set contains 16 professionals with various practice length, with 60 % of professionals in practice longer than 15 years and only 13.3 % of respondents with special education practice of less than 5 years. These data imply adequate competences for assessment of the area of interest. The professionals' opinions can be considered as highly relevant. A more than half (53.3 %) of the primary set respondents consists of young adults, which we deem desirable, mainly considering the assumed higher need of independence and self-sufficiency (in the access to information, in spatial orientation) and reflecting the modern trends in the area in question. We assume that the heterogeneous age structure can provide interesting variability in the research results. The essential characteristics of the primary research set also include the degree of visual impairment and the time of its origin. Two thirds of the primary research file respondents are persons with congenital severe visual impairment or an impairment which originated at an early age (blindness, residual sight, severe vision impairment), which can be considered as a significant indicator of the research validity.

In the second research set, we were also interested in the qualification structure. The vast majority of the addressed professionals (81.3 %) has the qualification needed to work with visually impaired persons, and in 73.3 % the respondents undertook special education studies focusing on the issues of persons with visual impairment. Moreover, 60 % of the respondents completed a course, training or workshop focusing on tactile graphics for persons with visual impairment.

Respondents from the research sets were administered a questionnaire consisting of open items with space for free association and closed items with scaling. The data collection was implemented through on-line communication – organisations in the territory of the whole Czech Republic were addressed. At the same time, the snowball sampling method was applied, for ensuring sufficient saturation of the research sets.

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The content structure consisted of questions focusing on the area of tactile graphics (typhlography) in compliance with the research targets, with the respondents from all research sets replying to questions with similar focus in order to describe and compare the observed aspects comprehensively and compare them in mutual interaction from all the respondents' points of view.

Within the data analysis, illustrative methods of representation in the form of tables and charts were used. Considering the insufficient saturation of the research sets, it was not possible to test the data statistically; therefore, the interpretation has an a priori descriptive and qualitative nature. A few questions were aimed at providing a free associative space for the most authentic answers – therefore, we will not cross the borders of pure description in the analysis and interpretation and will utilise the methods intended for qualitative research primarily (bunching, contrasting, etc.). Due to the above, it is not possible to generalise the acquired data; therefore, the results will be interpreted predominantly in relation to theory.

6. Findings

Firstly, it should be noted that in the Czech Republic, the research focused on tactile graphics is only sporadic, usually limited to the tactile map area. Within this study, we were striving for a more complex view of the particular area.

The result of our study is a unique complex image of the current reality regarding tactile graphics, intended for persons with visual impairment, with an accent on its information benefit in the field of spatial orientation and independent mobility, from the perspective of the persons involved (persons with visual impairment, professionals working with persons with visual impairment).

In the following part of the text, the data acquired will be sorted and systematised based on the content structure of answers from two respondent groups, relying on the overarching semantic categories. The mutual relationships of individual statements will be presented, with both contrasts and commonalities emphasised, which should result in a complex image illustrating the key aspects of the tactile representation issue for the needs of persons with visual impairment in the Czech Republic.

Table 01. Qualitative analysis (clustering, contrasting)

Overarching semantic category	**Primary research file (person with visual impairment)**	**Secondary research file (professionals working with persons with visual impairment)s**
What does typhlography mean to you (free associations)	Tactile maps (43.8%) Plastic 3D models (25%) Guide line on the pedestrian crossings "Graphics with 3D projection"	Plastic maps (60%) Plastic - tactile images (60%) Relief, embossed lines Aesthetic function, art education Development of a person with visual impairment Educational aids Tactile representations for the blind Braille Art form 3D models "Typhlography contributes not only to the development of knowledge, intelligence and thinking but can also contribute significantly to the development of emotions, enrich a person as an artistic and aesthetic element, as the expression of

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		something beautiful, unearthly (transcending the human)."
Most important tactile information	Braille captions Tactile maps (13.3 %)	Tactile maps and plans (66.7 %) Educational aids (mathematics, chemistry, biology, physics, history, geography) Spatial imagination development – "Information about the layout of objects in space, spatial relations in general, ratio of different object sizes." Guide lines Braille captions Concordance of the tactile information with reality "Any embossments serving for independent mobility of visually impaired persons" "Maps and plans. In a substantial way they help develop ideas about the environment, represent a precondition for independent mobility in the environment."
Typhlography potential	Tactile maps 3D print "In the ZOO" Educational aids Sights and public spaces	Practical life – all the life areas of persons with visual impairment (33,3 %) Means of developing imagination in persons with visual impairment (26.7 %) Spatial orientation and training thereof (maps, plans, models, guide lines, new route practise, public building navigating) (46.7 %) Educational aids Development of hobbies
The most burning absence of tactile information	Typhlocartography (12.5 %) Public space (theatre, public buildings, means of transport, monuments, offices, large shopping centres) (25 %) "I personally would welcome if a person with visual impairment could touch the models of monuments in several towns across CR. Mostly, the plastic models in castles and mansions are fragile and you are not supposed to touch them. They are covered behind the glass to prevent breakage. A visually impaired citizen does not have the opportunity to take a good view of the model like the other people without impairment, which is discriminating. If someone describes the model to you, it is very kind of them but it doesn't provide you with the same information as if you had the opportunity to create your own idea based on these tactile perceptions." "In the places where they are missing"	Application in real life (20 %) Public space (transport, public buildings, offices, museums, health care facilities, exhibitions, shopping centres) (33.3 %) In education (20 %) – "Good typhlography is missing in the teaching of children with visual impairment and social rehabilitation of blind adults." VERSUS "This is usually handled well/satisfactorily in our clients' education." In the leisure time area "I feel like it is missing everywhere in general."
The best example of tactile graphics	Tactile maps (18.8 %) 3D print Building models Tactile rulers Pavement	Tactile maps and plans (60 %) Tactile books (20 %) 3D print Option of printing tactile maps off the Internet "Calendar for blind and mouldings of embossed tree

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	"Model of the school route in Nové Butovice, Prague 5"	leaves" "Plan of the environment with embossed elevation of the buildings or 3D models." "Custom-made graphics, for a particular user, with respect to their experiences, preferences and needs."
What is missing from the embossment?	Complex map of Prague (12.5 %) Crown Jewels London Eye Significant monuments "I would definitely welcome expansion of the number of models of monuments and significant buildings in the Czech Republic. I would also like plastic abstract paintings, with combination of painting and plastic representation of the abstract motives using various objects (zippers, earrings, buttons, natural materials, shells, etc.)."	Town centres (40 %) School and its neighbourhood (13.3 %) Significant monuments Plan of longer route stages in O&M training Relief representation for educational purposes (animals, flowers) (13.3 %) "This is very individual and depends on the need and interests of the particular person" "Spider web, travel to the highest mountain of the world, model of a tick, detail of an eye..." "Personally, I believe that for blind adolescents, it would be interesting/important/beneficial, to have tactile representations of human bodies with emphasis on the sexual traits and their diversity. The best option would be to get to know actual bodies of different types of figures but since this is not realistic, at least in form of modelled figures made of materials as real as possible."

Qualitative analysis revealed dominance of cartographic information in tactile representation, in particular in relation to the mobility and orientation in persons with visual impairment. Apart from tactile maps and 3D printing, specific plans of routes and significant points on the route were also mentioned. The tactile maps were the most dominant element across all the identified semantic categories (associations connected with typhlography, information benefit, typhlography potential, absence of tactile information, best example of typhlography). A direct relationship to spatial orientation is observable within the free association area for information benefits as well as other potential development of typhlography. As regards the absence of tactile information, apart from the tactile maps, the public space was accentuated in general (plans of buildings, significant monuments, offices and other public spaces). From the perspective of the professionals working with visually impaired persons, the role of typhlomaps, plans and 3D models was crucial, and tactile information in general was mentioned in the direct context of the development of spatial imagination. Among other things, the professionals put emphasis on the educational potential of typhlography and its aesthetic dimension. This aspect is suitably illustrated by one of the comments by the professionals: "Even in sighted people, tactile perception in general has a crucial artistic/aesthetic or even emotional meaning (if you realise that the used materials have impact on the human emotional condition in general – there is a difference between constantly touching plastic objects only or objects made of wood, glass, metals, soft fabrics ... etc.)." It is apparent from the typhlography concept (free association area) that the addressed professionals are highly involved and knowledgeable. We believe that this aspect could be, in response to the requirements and level of their special education training, generalisable to the whole professional public.

In terms of involved professionals, the refinement of spatial imagination in particular is an important feature of typhlography. However, 13 % of persons with visual impairment principally disagree with them. This can be placed in the context of total preference and popularity of the auditory channel to

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obtain information in contrast to the more demanding tactile perception. It is apparent and positive from the results that the closest contact with typhlographics is obtained by persons with visual impairment within the domain of education – the professionals expressed agreement/predominant agreement with this assumption, only a marginal disagreement was apparent in the primary research set. More than 73 % of visually impaired persons confirm an insufficient amount of tactile elements in their environment; however, the professionals are convinced about sufficient saturation to a considerable degree – 37.5 % of them consider the amount of tactile elements as sufficient. Everyday use of typhlographics is not confirmed by any single group of respondents; however, the professionals are convinced for the most part about relatively frequent use of tactile information in everyday activities. This corresponds with a somewhat broader conception of typhlographics (basically, any tactile information – e.g. Braille captions, electronic reader labels, tactile elements on keyboards, various types of surfaces, etc.) in the interpretation of professional public. Respondents from both research sets confirm the importance of the aesthetic function of typhlographics. However, almost 19 % of persons with visual impairment do not consider the aesthetic dimension of tactile representations as important. A similar situation was reflected in the question of typhlographics as a source of entertainment. The reason might be entirely individual features and preferences of every individual with visual impairment in terms of rational approach to typhlography. The information benefit of typhlography is quite striking for the whole secondary research set. However, 20 % of respondents with visual impairment did not share this opinion. The same trend was expressed in the question of information deficit compensation and its reduction through tactile elements. Here, we can return to the outlined pitfalls and obstacles in the use of typhlographics – in particular the insufficient development of tactile perception, an inadequate level of spatial imagination and, marginally, anatomic and functional obstacles to tactile perception and inaccessibility of tactile information were also mentioned.

7. Conclusion

When conceiving this study, which is mainly of a pilot nature (only resulting in a primary probe in the chosen sphere of interest), several key research questions and premises arose. In this part of the text, we will evaluate them and try to respond to them under the limited conditions of this study, only interpreting them without generalisation.

We were interested in what the information benefit of tactile graphics (typhlographics) is for persons with visual impairment themselves. The answer to this research question is not fully clear, in particular from the perspective of the users of tactile graphics themselves. On the contrary, the professionals unambiguously declare such a benefit, confirming it even in the question of compensation and reduction of the information deficit caused by restriction or loss of visual perception. From both groups' point of view, the most significant benefit is seen in the area of spatial orientation and independent mobility in terms of refinement of spatial imagination through tactile maps and plans. However, the information transfer also has its limits, which were presented by respondents from both research sets in relative agreement.

Furthermore, we were interested in the usability of tactile graphics (typhlographics) in the area of spatial orientation and independent mobility, in particular from the perspective of both actors involved. In

correspondence with our assumption, typhlographics dominated in the area of spatial orientation, with the role of tactile maps, plans and 3D models being emphasised across a majority of the items examined. Integration of tactile representations into teaching and implementation of spatial orientation was emphasised mainly by the professional public, which was at the same time pointing to typhlographics as a means of development and refinement of spatial imagination.

In fact, we were not expecting a clear-cut answer to the question whether contemporary society has adequate tactile elements in public space. In any case, what was surprising for us was the position of professionals, who evaluate the amount of tactile elements in the environment as sufficient to a great extent.

The use of typhlographics or tactile representations in everyday activities also was not confirmed significantly. This assumption is refuted in particular by the persons with visual impairment themselves. However, this statement is limited by the relatively vaguely determined term of typhlography as well as very low saturation of the research set.

Last but not least, we were interested in the aesthetic dimension of typhlography and its understanding by the persons with visual impairment as well as involved professionals. Even in the intentions of this research question, we do not have a fully clear answer, which in itself is basically a desirable result, predetermining further, more extensive, research.

Our intention was to perform a primary probe into the chosen field of interest and identify the interesting aspects possibly to be explored within a program of applied research. It is apparent that tactile graphics (typhlographics) have a considerable information potential mainly in the area of spatial orientation and independent mobility. The identified aspects can be a suitable guide for conceiving applied research.

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