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Review on the habilitation thesis

by

RNDr. Stanislav Popelka, Ph.D.

on the topic

„The evaluation of cartographic visualization methods and interactive map interfaces through Eye-tracking technology”

Preliminary remarks

In a letter dated February 13, 2025, I was invited to prepare an expert opinion for the Faculty of Science of the Palacky University of Olomouc on Dr. Stanislav Popelka's habilitation thesis. I would like to thank you for the trust you have placed in me.

My assessment is based on a copy of the habilitation thesis submitted to me. I know Dr. Stanislav Popelka personally, but I can also confirm his independence. There have been no joint projects or publications or similar with the candidate to date.

Form of the habilitation

The submitted habilitation thesis is not a monograph, but a cumulative habilitation thesis, in which the already published articles are stapled in chronological order as far as possible. The submitted habilitation thesis comprises eleven articles written by two or more authors. Stanislav Popelka is named as the first author of five articles. One article from 2013 dates back to the time before his doctorate (2015).

On page 32, Mr. Popelka makes transparent which work shares of the respective authors can be assigned to the articles. Here it becomes clear that the articles on which the habilitation thesis is based were published in high-ranking journals, some with high impact factors, e.g. “Int. Journal of Human-

Computer Interaction” (IF 3.4), “Earth Science Informatics” (IF 2.8), and “Cartography and Geographic Information Science” (IF 2.5).

The concrete requirements of the Faculty of Science of the Palacky Universität Olomouc regarding the necessary number, time of publication, quality, first or sole authorship of the publications contained in the cumulative, differentiation from the dissertation topic etc. are not known to the reviewer. It should be noted that 43% of the scope of work that led to the eleven articles submitted can be attributed to Stanislav Popelka himself. In addition to the limited number of first authorships, this somewhat relativizes the weight of the 11 publications that form the core of the habilitation thesis.

However, such a purely quantitative analysis does not allow a meaningful assessment of the qualitative influence that Mr. Popelka had as a co-author on the creation process of the work. Due to his extensive experience in the field of analyzing and evaluating eye-tracking data, it can probably be assumed that he had a disproportionately large influence on the methods used. Mr. Popelka already has numerous other publications to his name, including a Czech-language monograph on eye-tracking technology, and finally an extensive publication together with *Kenneth Holmqvist*, one of the pioneers in the field of eye-tracking technology (Holmqvist et al., 2022). It is somewhat formally irritating that he quotes this article without comment (p.17), because the article had to be retracted by the journal (for reasons that are not further known) on 16 November 2023 (<https://doi.org/10.3758/s13428-021-01762-8>). From my point of view, such articles can be referred to in principle, but in the context of conscientious scientific activities, the associated problems should at least be made transparent in a habilitation thesis.

Evaluation of content

My review does not go into the details of the eleven submitted contributions, as this is based on the assumption that the peer-reviewed review was successful. Rather, the focus is on the theoretical framework, in particular the coherent derivation of hypotheses as well as the summarizing and evaluating consideration of the topics and results.

Mr. Popelka has worked through what he considers to be the relevant aspects of his habilitation thesis in five chapters. He begins with a brief description of the concept on which the habilitation thesis is based. Here he names three overarching (rather broadly defined) target areas into which the eleven articles are to be classified with regard to their questions:

- 1 Evaluation and comparison of cartographic visualization methods,
2. Assessment of interactive map interfaces
3. Design and development of eye-tracking analyses and visualization tools

Stanislav Popelka would like to show how the submitted articles relate to each other. A small chapter on the “Narrative of the Habilitation” also serves this purpose, explaining which questions have led to the chronological development of the contributions since 2013. This makes it clear that the concept structure for the habilitation thesis was created retrospectively. However, Stanislav Popelka deals with this openly: the “selection of the studies was not part of any grand plan aimed specifically at writing the thesis” (p.55).

The focus of his work - unchanged since his doctorate - is the application and evaluation possibilities of the eye-tracking method. In order to prevent the cumulative institution from being merely a rather arbitrary collection of articles on the topic of eye tracking, Stanislav Popelka, has placed a stronger

focus on the eye-tracking-based analysis of interactive map interfaces (Popelka et al. 2022) and, above all, on the innovative development of suitable visualization tools (“ScanGraph, GazePlotter”) (Dolezalová/Popelka 2016, Popelka et al. 2024) (in addition to the eye-tracking-supported evaluation of cartographic visualization methods (Popelka/Brychtová 2013, Opach et al. 2017)). In this way, he succeeds in framing the content and can give the habilitation thesis a more targeted line of research.

Mr. Popelka has written a 21-page introduction (pp. 11-32), which precedes the main section with the already published eleven articles. In chapter “2 Introduction”, he first provides a somewhat detached description of the development of cognitive cartography (with a comprehensible but also one-sided focus on the eye-tracking method), in chapter 2.2 finally a - rather textbook-based - presentation of the technique on which eye-tracking is based, and an overview of what he considers to be the influence of his previous work in cognitive cartography (2.3 “Eye-tracking in cognitive cartography”, pp. 19-23).

Chapter “3 Methods” (pp. 24-31) contains a very detailed description of the eye-tracking technique, which is definitely worth reading, especially for those researchers interested in eye tracking. However, it remains largely unclear what function these chapters have for further (methodological and content-related) answers to the three question areas on which the habilitation thesis is based. The textual transitions or derivations between the chapters and also between paragraphs are sometimes quite abrupt (p. 15). The chapters could be more closely related to each other. Obviously, Stanislav Popelka believes that this is implicit in the presentation of the results in chapter “4 Results”.

Indeed, the chapter “4 Results” contains the two-page summaries of all articles, with the aim of placing them in the thesis narrative. However, the chronological rather than content-based arrangement of the summarized articles makes this task more difficult. Although quite brief, the final chapter “6 Conclusions and Future Work” (pp. 58-62) addresses the classification somewhat more clearly. Here, the author establishes clearer links between the results of the 11 articles and progress, particularly for cognitive cartography. A somewhat more detailed discussion, also with reference back to the theoretical foundations presented in the introduction of the habilitation thesis, would certainly have been even more interesting (e.g. on the limits of eye-tracking for determining causalities). This would probably have exceeded the scope of a cumulative habilitation thesis.

The fact that his work is also recognized in the scientific community is shown by the *Henry Johns Award for the most outstanding paper* (2023) of the British Cartographic Journal for the paper “Verification of Cartographic Communication Models Using Detection of Map Reading Strategies Based on Eye Movement Recording” by Beitlova, Popelka et al. (2023).

Overall, the habilitation thesis submitted by Mr. Popelka shows very clearly that the habilitation candidate has extensive methodological and technical knowledge in the field of eye tracking. Particularly noteworthy are the successes that Mr. Popelka has achieved with the development of suitable visualization tools for data analysis.

Despite some points of criticism, I therefore recommend that the faculty accept the habilitation thesis.