

# Short-Term Effects of Graphical versus Textual Visualisation of Variables on Program Perception

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**Abstract.** The empirical evaluation of program visualisation has been based mostly on observations of long-term effects of the program visualisation tools, while possible short-term effects of the visualisations and their relation to the long-term effects have been elided. In order to study short-term effects of visualisation of variables in a context where the long-term effects are already known, we conducted a controlled experiment, in which we investigated how a person targets her visual attention and what kind of a mental model she constructs, when variables are presented either textually or graphically. The results indicate clear differences in the targeting of visual attention between the visualisation tools: With the graphical tool, the participants targeted their visual attention to variables much more than with the textual tool. With the graphical tool, the increase of visual attention to variables increased the proportion of high-level information in program summaries and decreased the proportion of low-level code-related information.

## 1 Introduction

Learning to program is a difficult task for many students. One reason for this is that programs deal with abstract entities—formal looping constructs, pointers going through arrays etc.—that have little to do with everyday issues. Methods and techniques that help students to better understand and conceptualise these abstract entities and their behavior can be used to enhance learning elementary programming. Visualisations can be used for this purpose, e.g., to illustrate expert programmers' reasoning processes to the novice [1] or to make programming language constructs and program constructs more comprehensible [2, 3].

What, then, should be chosen as the focus of a visualisation, and how it should be presented to the viewer? Variables are central to the comprehension of computer programs. Programs consist of variables, operations on variables, and larger program constructs, such as functions, classes, and modules. In one study [4], information about variables was the most frequent information need type among professional maintenance programmers. Several taxonomies and frameworks [5–9] have been presented to aid designers and evaluators of software visualisation tools and visual programming environments in identifying the essential aspects of visualisations. This information can be utilised in searching answers for the question how information should be presented in



























