

CONCEPTUAL DIFFICULTIES WITH HISTOGRAMS: A REVIEW

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For a first and quick analysis of statistical data, graphical representations such as histograms are widely used (Ben-Zvi & Garfield, 2004). The interpretation of data in histograms, however, is ‘not as easy [...] as it might seem’ (Lem, Onghena, Verschaffel, & Van Dooren, 2014, p. 557). The goal of our review, therefore, is to create an overview of conceptual difficulties with histograms as found in the literature. The research question was: what are the conceptual difficulties with histograms? We define a histogram as a graphical representation with connected bars, one variable of interval or ratio level of measurement on the horizontal, and density or – in the case of equal bin width only – (relative) frequency on the vertical axis. The theoretical framework of big ideas in statistics (e.g., Ben-Zvi & Garfield, 2004) was refined and expanded (Boels, Bakker, Drijvers, & Van Dooren, submitted) and used to classify the conceptual difficulties that were found in the review study.

We searched several databases as for instance Google Scholar and PsycInfo with search terms such as histogram and mistake. In case of too many hits, keywords like MRI were used to exclude irrelevant studies. Over 800 studies were found. After removing doubles, and a check of title, abstract, or full text 53 studies remained.

Most reported difficulties relate to (1) an incorrect notion of what nominal, ordinal, interval and ratio data are, (2) confusing a bar graph and a histogram (e.g., Cooper & Shore, 2010), (3) the incorrect use of measures of centre, or (4) misinterpreting variability (e.g., Lem et al., 2014). Two big ideas in statistics play an important role in these conceptual difficulties: distribution and level of measurement. The results of this review will be used in an explorative eye-tracking study for a more focalised search for the causes of these conceptual difficulties.

References

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