Bayesian data analysis and sequential dependencies in psychophysical research

In psychological research, it makes intuitive sense to examine the data after every participant to avoid needlessly testing participants. Soon after starting a study, most researchers want to know whether the study is likely to yield informative results given the time and financial resources available. But this approach goes against common practice. Typically, studies are designed to test a predetermined number of participants, calculated prior to running the study on the basis of so called 'power analyses'. In psychological research, the data being collected is not intermittently examined. Rather a pre-planned number of participants are tested, and only then are statistical analyses conducted. But, why wait until the end of a sometimes long and costly study before examining the data?

Using Bayesian methods, inferential decisions about whether to stop of continue with a study can be formulated directly after each participant has taken part in the study: interpretation of Bayesian statistics does not depend on whether the sample size was fixed in advance or not. To date, however, only a few psychology studies have used Bayesian methods to intermittently exam the data as they are being collected. Moreover, the few studies that have set-out to assess this approach have done so in a relatively limited manner, opting to stop or continue data collection based on interpretation of Bayes' factors alone.

An objective of the current project is to broaden the scope of Bayesian interim analysis by examining a wider variety of ways of drawing inferential decision about whether to stop or continue data collection, by development and application of so called 'utility' functions. A further aim is to apply Bayesian interim analysis to psychophysical experiments to examine issues concerning time-on-task, and sequential dependencies arising from the dynamic range of stimuli presented in experiments. Application of interim Bayesian analysis and subsequent optional stopping of studies to real psychological research will generate new methodological guidelines for improving the efficiency of psychological science. In turn, empirical findings derived from psychophysical experiments will provide for rigorous experimental assessment of interim Bayesian analysis and a more complete picture of how we dynamically update and use generic information in the comparison and discrimination of visual stimuli.

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