The role of multiple numeric competencies in improving decision making.

Everyday decision making requires the processing of numbers regarding probabilities, costs and benefits. However, many people have difficulties, even when faced with simple numerical problems. It has been shown that statistical numeracy—the ability to understand the concept of probability and statistical information, and use this numerical information efficiently—is strongly related to superior decision making. Interestingly, numeracy may not be a unitary construct. For example, Peters and Bjalkebring (2015) distinguished between multiple numeric competencies (objective numeracy, subjective numeracy, and approximate numeracy) which predict distinct decision outcomes. While objective numeracy is related to performance in mathematical tasks and formal knowledge about mathematical concepts, subjective numeracy is a combination of these objective abilities, math emotions, self-efficacy and the motivation to solve tasks containing numerical information. Approximate numeracy is related to a 'sense of number' – the intuitive ability to perceive and manipulate numerosities, and to map symbolic numbers to magnitudes. The main aim of this project is to experimentally validate the notion of multiple numeric competencies and to provide evidence that approximate numeracy and subjective numeracy can serve as sources of compensatory mechanisms that are potentially helpful in improving decision making among people with low numeracy.

The project will be divided into four research tasks. First, we plan to perform a systematic review of the literature regarding the impact of the three numeric competencies on decision outcomes. We will also perform meta-analyses (a statistical analysis that combines the results of multiple studies) of the following effects: (1) relationships between subjective, objective, and approximate numeracy; (2) relationships between the different numeric competencies and decision outcomes for studies including measures that can be interpreted as indicating quality of decision making; (3) relationships between the different numeric competencies and response latencies in decision tasks.

Second, we aim to test the effectiveness of cognitive training focused on approximate numeracy: mental number line. We will further explore transfer to tasks based on estimation and real-life decision outcomes, and also test the stability of these effects over time (Task 3). Moreover, the effects of mental number line training will be compared with four control conditions: arithmetic training, symbolic number mapping training, non-symbolic approximate number system training, and passive control.

Finally, we plan to design and test interventions that may encourage people with low numeracy to deliberate more on decision problems. These interventions will be based on the idea that making a numerical decision task not look like a classical mathematical problem (e.g., by instructing participants to estimate rather than calculate) might reduce math anxiety and improve self-efficacy, thereby influencing deliberation time and performance in decision tasks in people with low numeracy.