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Principal investigator: Rico Fischer

Adaptive action control requires the dynamic adjustment between complementary control demands. While task-irrelevant stimuli need to be ignored and blocked from being processed in order to prevent interference with task-relevant processing (goal shielding), complete shielding is dysfunctional and even potentially harmful, as it would prevent the individual from monitoring the environment for potentially relevant stimuli (background monitoring) that may signal a change in action goal (e.g., stimuli that imply danger). Instead, a dynamic regulation of these complementary control processes is required, reflecting a tradeoff between antagonistic constraints. This dynamic regulation of cognitive control processes, however, is to date only insufficiently understood.

The present project set out to target this question by asking, how control is regulated to meet the requirements in a dynamically changing environment. We particularly applied a dual-task approach, because dual tasking constitutes a prime example of a control dilemma. It requires an individual to maintain a balance between two antagonistic types of performance optimization, i.e., minimizing between-task interference (by increasing serial task processing) and minimizing mental effort (by allowing for more parallel processing). Flexibly adjusting the degree of more serial versus more parallel dual-task processing to changing task and context requirements reflects high levels of adaptability in dynamic environments.

In the present project we investigated the adjustment of more parallel versus more serial task processing. We claimed that cognitive control parameters in dual tasking are not only determined by voluntary top-down regulation due to task instructions (of how to perform the dual task), but importantly that substantial bottom-up regulation of cognitive control enables the adoption of certain task processing modes. Three study lines were proposed, in which statistical contingencies were manipulated in a context (location)-specific manner (e.g., likelihood of between-task interference). The goal was to demonstrate that these bottom-up features are detected and are capable to trigger associated control states that determine the degree of parallel versus serial task processing.