SFB 378 - Fortsetzungsantrag (4. F rderperiode: 2005, 06, 07) zu
Teilprojekt EM 2 ARC : Aging, Resources and Cognition

EM 2 ARCADE: Aging, **R**esources, **C**ognition **a**nd Error-In**d**uced L**e**arning

Antragsteller: Axel Mecklinger & Jutta Kray (PSYCHOLOGIE)

The main goal of the present project is to examine the role of cognitive control processes during learning and knowledge acquisition. By this, ARCADE intends to continue and extent the project ARC from the previous funding phase. Consistent with the former ARC project cognitive control is considered as a mechanism that adapts and allocates available resources to current tasks. In extension of this view the present project focuses on a particular control process: Error monitoring and its role for error-induced learning. It is generally assumed that error monitoring plays a central role in the development of adaptive behaviour. The existence of an error monitoring system has been inferred from the error-related negativity (ERN), an event-related potential component, elicited when humans commit errors in reaction time tasks. The ERN is assumed to be generated by a negative reinforcement learning signal or by the absence of reward expectancies. On the neuronal level the ERN has been associated with the anterior cingulate cortex. As ERNs are not only elicited by errors but also by negative feedback stimuli i.e. perceived errors, it is assumed that the error monitoring system is not concerned with error commission per se but rather with the more general utilisation of error information to adjust post error performance. Though the relevance of error monitoring for post error adjustment of behaviour is generally acknowledged, the exact mechanisms enabling error induced learning processes as well as their neuronal correlates are not well understood. The present proposal considers error monitoring as a limited resource and aims at specifying the functional and neuronal characteristics of error induced learning processes. It will pursue the following research goals:

1) <u>Aging and error monitoring</u>: Here we examine the extent to which error monitoring as a limited resource is modulated by aging. How does the ability to utilize error information change with age?

2) <u>The role of error monitoring for explicit and implicit learning processes</u>: The high relevance of the ERN for the adjustment of post-error performance raises a number of important issues: Do errors affect explicit and implicit (post-error) learning mechanisms to a similar extent? What is the exact impact of committed and perceived errors on post-error learning mechanisms?

3) <u>The role of expertise in error induced learning:</u> The role of expertise, though considered as highly relevant for perceptual processes, has so far not explicitly addressed in conflict monitoring research. In a first approach it will be examined to what extend good and poorly performing subjects differ in the capability of post-error learning. In a second step, expert groups of various domains (perceptual and motor behaviour) will be examined in domain specific and domain unspecific learning situations.

To achieve these goals an experimental paradigm will be developed that allows to examine committed and perceived errors and their impact on post error learning. Beside performance measures (reaction times and accuracy) the main depended variable of all experimental studies will be the error-related negativity. For selected issues, i.e. localising the neuronal networks underlying error and post-error processing, functional magnetic resonance imaging will be employed.

Planned cooperation within SFB 378

AERA: Expertise and working memory.

ALPHA: Expertise and processing of prosodic information.

Expected Costs:

Number of staff members: 3 BAT IIa/2 positions for PhD students
Number of student researchers: 2 SHK - 19 hours per week

Additional costs: per year: 10 T_
about 4 T_ for payment of participants
about 6 T_ for EEG and laboratory equipment

in 2005: 60 T_ in total.
(New 64 channel EEG amplifier System to replace an older 64 system)

Scientific Publications 1998-2003 (a selection)
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Frensch, P. A., **Kray, J,** & Buchner, A. (2000). Zur Unterscheidung impliziten und expliziten menschlichen Lernens: Historische Kontinuit t eines Irrweges? *Zeitschrift f r Psychologie, 208*, 284-303. (Sonderband Deutschsprachiger Psychologie im 20. Jahrhundert: R ckblick und Ausblick).

Kramer, A. F., & **Kray, J.** (submitted.). Aging and divided attention. To appear: E. Bialystok & F. I. M. Craik (Eds.), *Lifespan cognition: Mechanisms of change*.

Kray, J. (submitted). *Selecting among ambiguous task sets in younger and older adults: The role of task cueing and item-specific learning*.

Kray, J. Eber, J., & Lindenberger, U. (submitted). Age differences in executive functioning across the lifespan: The role of verbalization in task preparation. To appear: Special Issue in *Acta Psychologica*.

Kray, J. & Frensch, P. A. (2002). A view from cognitive psychology: ªg — (G)host in the correlation matrix? In R. J. Sternberg & E. E. Grigorenko (Eds.), *The general factor of intelligence: How general is it?* Mahwah, NJ: Lawrence Erlbaum.

Kray, J. Li, K. Z. H., & Lindenberger, U. (2002). Age-related changes in task-switching components: The role of task uncertainty, *Brain and Cognition, 49*, 363-381.

Kray, J. & Lindenberger, U. (2000). Adult age differences in task switching. *Psychology and Aging, 15*, 126-147.

Lindenberger, U., & **Kray, J.** (in press). Kognitive Entwicklung [Cognitive development]. In S.-H. Filipp & U. M. Staudinger (Eds.), *Entwicklungspsychologie des mittleren und h heren Erwachsenenalters* [Developmental psychology of middle and later adulthood]. G ttingen, Germany: Hogrefe Verlag.