Everyday Activities

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Introduction

Humans perform a wide range of everyday activities (e.g., preparing a meal, setting the table) frequently, and often without conscious thought. Despite the experienced ease with which we perform such activities, their successful completion involves a complex set of abilities and mechanisms. This becomes apparent when considering that even healthy adults exhibit occasional errors (Norman, 1981, e.g., failing to spoon coffee grinds into the filter before switching on the coffee machine) in performing the necessary actions, while mild cognitive impairment may interfere with successful performance of highly familiar everyday activities (Gold, Park, Troyer, & Murphy, 2015).

Successful performance of everyday activities taxes at least the following abilities:

- *Perception*: The environment in which the actions are performed has to be adequately perceived to properly act in it. Among others this comprises the ability to recognize largely occluded objects in cluttered environments (e.g., plates in a stack of plates or objects in a dishwasher).
- *Action Planning*: Everyday activities consist of several actions and the effectiveness and efficiency of performing activities will often depend on the order in which the actions are executed (see coffee making example above). Accordingly, planning one's actions is an important aspect of everyday activity performance.
- *Spatial Reasoning*: Spatial relations of objects to each other and to one's body are crucial for everyday activity. Without knowledge about these relations, locomotion in the environment as well as collecting and properly arranging objects would not be possible.
- *Movement Planning*: Individual (motor) actions require planning to, for example, avoid obstacles, remain in the operational range of one's effectors, and to reduce the chance for mishaps (reaching with a full cup over – instead of around – your laptop is not a good idea)
- *Controlling Action Sequences*: Action sequences not only have to be planned, but also controlled during execution to ensure that no actions are left out, actions are not executed in the wrong order, or that inappropriate (i.e., not part of the plan) actions that are habitual or appropriate given the current state of the environment are avoided.
- *Monitoring and Error Correction*: Given that slips and lapses in action execution occur, monitoring of progress towards the goal and error correction mechanisms are also need to ensure successful action completion.

Considering that the listed abilities constitute research areas in their own right, it seems clear that gaining a (more) comprehensive understanding of everyday activities is an ambitious endeavor. At the same time, everyday activities provide an opportunity to jointly research several cognitive abilities in what Newell (1973) has called *complex tasks*. Everyday activities such as "setting the table" are circumscribed enough to study them in the lab, while being complex enough to require the combination of several cognitive abilities. As such, investigation of everyday activities has the potential to not only foster our understanding of the cognitive processes involved, but also of their interaction and integration.

Gaining a deeper understanding is also of applied relevance. Given the demographic change and an aging society, the number of people unable to perform independently all necessary everyday activities is increasing (e.g., Nicholas & Smith, 2006). A deeper understanding of what drives successful everyday activities, how the underlying mechanisms develop, and how and what in the process may break down with age and cognitive impairment (dementia) can help support those who have trouble with everyday activities in two ways. First, with knowledge about which abilities may decline with age and impairment, specific training regimes can be developed to counter the decline in ability (e.g., Bettcher et al., 2011). Second, support could be given by artificial cognitive agents (e.g., robots) performing or prompting those activities that people are less able to do themselves. Currently available (household) robots are missing the flexibility and versatility to stand in for a human housekeeper (Ersen, Oztop, & Sariel, 2017), and a deeper understanding of the mechanisms that underlie learning and mastery of everyday activities may therefore inform the design of improved artificial agents.

This workshop will assemble six speakers with multidisciplinary backgrounds to discuss (a) the cognitive abilities un-

derlying everyday activities, (b) how these abilities develop ontogenetically, (c) how abilities may break down with cognitive impairment, (d) possible integration of different abilities in the scope of everyday activities, and (e) how insights from (a)-(d) could inform building artificial cognitive agents mastering everyday activities.

Speakers

Speakers have been selected to cover important areas that are relevant to the issues raised in the preceding section. Our speakers combine expertise in abilities involved in everyday activities, how they develop (Kaichi Yanaoka, Satoru Saito), how they may decline with cognitive impairment (Tania Giovannetti), how they may be formalized and integrated in computational models (Falk Lieder, Gregor Schöner, John Laird), and how cognitive principles may be transferred to artificial cognitive agents (John Laird, Gregor Schöner). Talks will address the following topics:

Falk Lieder, MPI Tübingen will present work on *discovering rational planning strategies*. To succeed in everyday life people have to quickly solve complex sequential decision problems with bounded cognitive resources. Lieder and colleagues' resource-rational analysis suggested that people's planning strategies are jointly shaped by these adaptive pressures and the structure of the environment. Lieder will present an automatic method that leverages this principle to predict which planning strategy people are going to use in a given environment and test it in a series of experiments.

Gregor Schöner, Ruhr-Universität Bochum will present *how neural dynamic architectures generate physical and mental acts*. Acting in the real world involves the coordination of perception, cognitive processes, and movement generation. Schöner will discuss how the balance between stability and flexibility that is necessary for successful coordination can be achieved in a framework of neural dynamics.

Kaichi Yanaoka & Satoru Saito, Kyoto University will present work on *the role of executive functions in routine sequential actions in young children*. They will provide an overview of research on executive functions and action control from a developmental perspective before presenting new data on learning and control of routine sequential actions in young children.

John Laird, University of Michigan will present *a cognitive architecture approach to everyday activities*. Laird will explore how the myriad of cognitive capabilities required to perform everyday activities can be supported by an integrated cognitive architecture, drawing examples from research with the Soar architecture. One capability Laird will focus on is Interactive Task Learning — how the cognitive architecture approach can support learning new tasks from natural instruction.

Tania Giovannetti, Temple University will present work on *everyday action in cognitive aging, mild cognitive impairment, and dementia*. Giovannetti will provide an overview of how deterioration of older adults' performance of everyday tasks is related to level and type of cognitive impairment. In doing so, she will also highlight the implications observed difficulties have for understanding the cognitive mechanisms that are required for accurate performance of everyday activities in healthy populations.

Schedule

The workshop is planned as a half-day event. Speakers will be allotted 25 minutes each for their presentations (20 minutes talk + 5 minutes discussion). The workshop will begin with a brief introduction by the organizers followed by the first three talks (Lieder, Schöner, Yanaoka & Saito). After the break, the two remaining talks (Laird, Giovannetti) will be delivered. The organizers will then lead a discussion of all presentations. The workshop will be concluded with a 30 min. poster session. Posters will be solicited by a Call for Posters with rolling acceptance. Poster presenters will be asked to put up their posters before the workshop to allow attendees to begin discussing them during the break.

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