Eberhard Karls University of Tübingen
Department of Psychology
Cognition and Action Lab

Venue

Psychologisches Institut
Schleichstraße 4, 72076 Tübingen

Organizing committee

Markus Janczyk	markus.janczyk@uni-tuebingen.de
Moritz Durst	moritz.durst@psycho.uni-tuebingen.de
Christoph Naefgen	christoph.naefgen@uni-tuebingen.de
Sandra Renas	sandra.renas@psycho.uni-tuebingen.de

Address of Welcome

Dear Participants,
Dear Speakers,

It is a great pleasure for us to have all of you here in Tübingen for the Winter School "Human Action Control: Current Theories and Debates".

We are convinced that we have compiled a great mixture of participants, with various scientific backgrounds and from a variety of countries. Regarding the speakers, we are glad that all speakers we approached were very happy to be part of this event and have confirmed their participation already very early. They are all leading experts in their fields of research, and we are sure that they will provide you with new aspects and insights from which your research can benefit.

If you have any further questions, please approach one of us, and we will do our best to help you!

At this point, we wish you a pleasant stay in Tübingen and helpful and inspiring insights and suggestions concerning your research projects. We very much hope you will consider this event a fruitful experience.

Markus, Christoph, Moritz, and Sandra

	Monday 13/2/2017	Tuesday 14/2/2017	Wednesday 15/2/2017	Thursday 16/2/2017
8.00-8.30 am	**Registration** **Coffee**			
8.30-9.00 am	**Welcome**			
9.00-9.30 am	**Hommel** Integrating perception, action and self: The Theory of Event Coding	**Rosenbaum** Will the science of mental life and behavior finally embrace motor control?	**Franz** Perception vs. Action: What is the overall, functional architecture of the human visual system?	**Mansell** Perceptual Control Theory (PCT): Motor control as the control of perception
9.30-10.00 am				
10.00-10.30 am				
10.30-11.00 am	**Coffee Break**	**Coffee Break**	**Coffee Break**	**Coffee Break**
11.00-11.30 am	**Janczyk** Ideomotor theory and dual-tasking: The role of goal-states for dual-task interference	**Herbort** Anticipatory actions	**Schwarzer** The interplay of perception and action during child development	**Wolpert** Computations in human sensorimotor control
11.30-12.00				
12.00-12.30 pm				
12.30-1.00 pm	**Lunch**	**Lunch**	**Lunch**	**Closing**
1.00-1.30 pm				**Lunch** **Open discussion with experts**
1.30-2.00 pm				
2.00-2.30 pm	**Koch** Ideomotor mappings in the cognitive control of actions and tasks	**Coffee Break** **Poster session**	**Parallel discussion with experts in thematic groups**	
2.30-3.00 pm				
3.00-3.30 pm				
3.30-4.00 pm	**Coffee Break**		**Coffee Break**	
4.00-4.30 pm	**Kunde** Effect-based action control in social contexts	**Proctor** Action selection in physical and cyber environments	**Schenk** The neuropsychology of perception and action	
4.30-5.00 pm				
5.30-6.00 pm				
7.00-9.00 pm	**Dinner: Aspendos**	**Dinner: Neckarmüller**	**Dinner: Africa**	

Note: Lectures, active contributions of participants, breaks, organizational units

1. Program Overview

Monday, February 13

8:00 am	**Registration | Coffee**
8:30 am	**Welcome**
9:00 am	**Bernhard Hommel** Integrating perception, action and self: The Theory of Event Coding
10:30 am	**Coffee Break**
11:00 am	**Markus Janczyk** Ideomotor theory and dual-tasking: The role of goal-states for dual-task interference
12:30 pm	**Lunch**
2:00 pm	**Iring Koch** Ideomotor mappings in the cognitive control of actions and tasks
3:30 pm	**Coffee Break**
4:00 pm	**Wilfried Kunde** Effect-based action control in social contexts
6:00 pm	**End**
7:00 pm	**Dinner: Aspendos**

Tuesday, February 14

9:00 am	**David A. Rosenbaum** Will the science of mental life and behavior finally embrace motor control?
10:30 am	**Coffee Break**
11:00 am	**Oliver Herbort** Anticipatory Actions
12:30 pm	**Lunch**
2:00 pm	**Poster Session | Coffee Break**
4:00 pm	**Robert Proctor** Action selection in physical and cyber environments
6:00 pm	**End**
7:00 pm	**Dinner: Neckarmüller**

Wednesday, February 15

9:00 am	**Volker Franz**
	Perception vs. action: What is the overall, functional architecture of the human visual system?
10:30 am	**Coffee Break**
11:00 am	**Gudrun Schwarzer**
	The interplay of perception and action during child development
12:30 pm	**Lunch**
2:00 pm	**Parallel discussion with experts in thematic groups**
3:30 pm	**Coffee Break**
4:00 pm	**Thomas Schenk**
	The neuropsychology of perception and action
6:00 pm	**End**
7:00 pm	**Dinner: Africa**

Thursday, February 16

9:00 am	**Warren Mansell**
	Perceptual Control Theory (PCT): Motor control as the control of perception
10:30 am	**Coffee Break**
11:00 am	**Daniel Wolpert**
	Computations in human sensorimotor control
12:30 pm	**Closing**
	Lunch / Open discussion with experts

2. General Information

Catering

Coffee breaks

From Monday to Wednesday there will be two coffee breaks each day. The one in the morning will last from 10.30 am until 11.00 am, and the one in the afternoon will last from 3.30 pm until 4.00 pm. On Monday morning there will also be coffee and biscuits available while the registration is in progress. On Tuesday, the coffee break in the afternoon will last from 2.00 pm until 4.00 pm, running in parallel to the poster session.

Lunch breaks

Every lunch break will start at 12.30 pm and will last until 2.00 pm sharp. The Winter School offers sandwiches for lunch. If you are, however, interested in exploring Tübingen or if you would like to have lunch at one of the many restaurants or takeaways nearby, feel free to do so during lunch break. For recommendations and directions on restaurants and takeaways see *6. Guide*.

Dinner

From Monday to Wednesday we have reserved tables for everybody in Tübingen's finest but yet affordable restaurants. Tables are reserved for 7.00 pm. If you would like to join us for dinner please make sure to let us know which menu you choose for each restaurant (please watch out for emails from Sandra Renas and Christoph Naefgen). For further information about the restaurants see *6. Guide*.

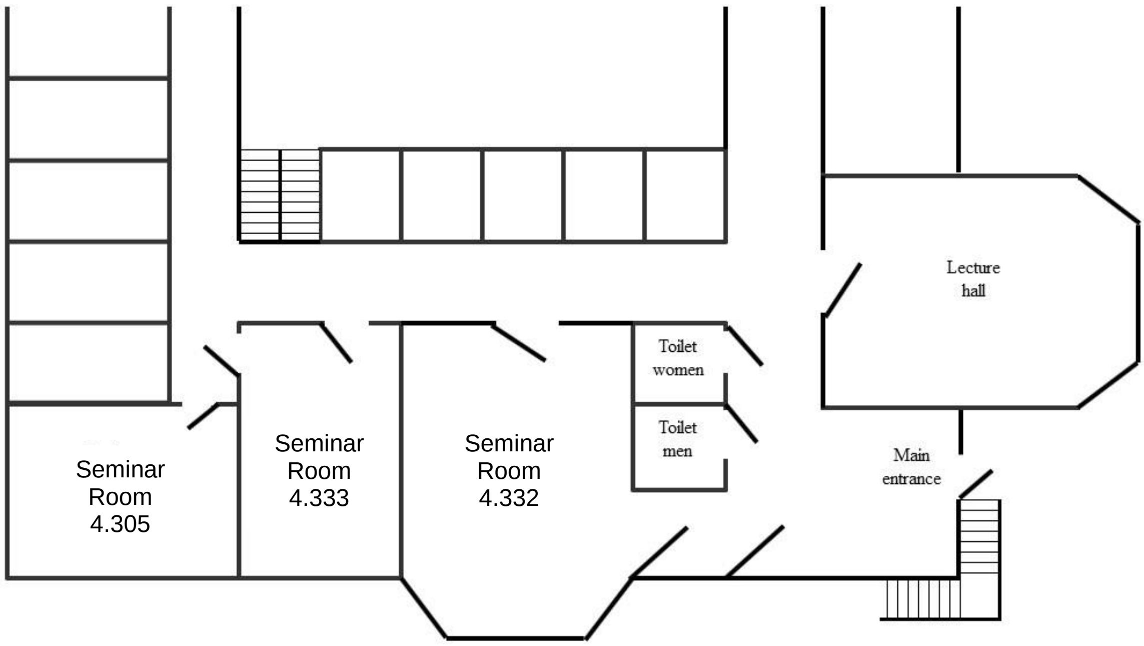
Poster presentation

The poster presentation will take place in the seminar rooms 4.305, 4.333 and 4.332 (see floor plan below).

The poster walls used for the presentation will have the following size: 100 cm (width) × 180 cm (height). Please make sure to print your poster in an appropriate size.

All poster abstracts are listed under *4.2. Poster Session.* Each abstract is labelled with a number. This number also labels the poster wall your poster will be assigned to.

Floor plan



3. Speakers

Volker Franz studied Psychology and Physics at the University of Konstanz (Germany) and at the University of California (San Diego). He did his PhD at the University of Bochum and at the Max-Planck-Institute for Biological Cybernetics in Tübingen (Germany), was a professor for General Psychology at the University of Hamburg, and works since 2016 as a professor for Experimental Cognitive Science at the University of Tübingen. His main research interests are the neuroscience of perception and action, visual illusions and motor behavior, as well as statistics and research methodology.

Oliver Herbort studied Psychology at the University of Würzburg (Germany), where he also received his PhD in 2008. After a stay at the University of Tübingen, he is now a lecturer at the University of Würzburg. His main research interests lie in action control, tool use, and computational models.

Bernhard Hommel studied Psychology at the University of Bielefeld (Germany), from where he also received his PhD. He then worked as a post-doctoral researcher at the Max Planck Institute for Psychological Research, and as off 1999 he is a professor for Cognitive Psychology at the University of Leiden (Netherlands). His research interests include action planning and the interaction with perception, attentional control, the representation of self and others, and creativity.

Markus Janczyk studied Psychology at the Martin Luther University at Halle-Wittenberg (Germany) and at the University of Nevada at Reno (USA). He earned his PhD at Dortmund University of Technology (Germany). Following this, he spent four years at the University of Würzburg (Germany) as a post-doctoral researcher, and since 2014 he is a Junior-Professor for Cognitive Psychology at the Eberhard Karls University of Tübingen (Germany). His research interests include action planning and action selection, multitasking, and working memory.

Iring Koch received his Diploma in Psychology from the University of Frankfurt (Germany), and his PhD from the University of Würzburg (Germany). He then worked as a post-doctoral researcher at the Max Planck Institute for Psychological Research, and as off 2005 he is a professor of Cognitive and Experimental Psychology at the RWTH Aachen University, Aachen (Germany). His main research interests include attention and action planning, multitasking, and implicit learning.

Wilfried Kunde studied Psychology in Hamburg and obtained his PhD from the University of Würzburg (Germany). In 2007 he became a professor at Dortmund University of Technology (Germany). Since 2010 he has been a professor for Cognitive Psychology at the University of Würzburg (Germany). His research interests lie in action control, attention, unconscious cognition, and applied cognitive psychology

Warren Mansell received a PhD at the University of Oxford and a Doctorate in Clinical Psychology at King's College, London. He currently is a Reader at the University of Manchester, where his research is led by Perceptual Control Theory (PCT). He began by applying PCT to inform psychological interventions for a wide range of mental health problems. Now he uses PCT more widely including the fields of motor control and computational modelling.

Robert W. Proctor is a professor at Purdue University (USA) since 1988. He studied psychology in Austin and Arlington (TX, USA), where he also did his PhD. His main research interests are human performance, human factors and human-computer interaction, as well as experimental research methods. Furthermore, much of his research focuses on stimulus-response compatibility effects and response selection.

David A. Rosenbaum studied Psychology in Swarthmore (PA, USA) and in Stanford (CA, USA), where he also did his PhD. Since July 2016 he has been a professor at the University of California, Riverside (USA). His research interests lie in, among other things, human motor control, computational modeling and perceptual-motor integration.

Thomas Schenk studied Psychology at the Universities of Konstanz and Tübingen (Germany), and St. Andrews (Scotland). He did his PhD at the Max Planck Institute for Psychiatry in Munich (Germany), and works as a professor at the LMU Munich since 2015. His main research interests are, among other things, neural processes involved in perception and action, neural mechanisms underlying the spatial control of attention and motion perception, and the treatment of neuropsychological disorders.

Gudrun Schwarzer received her Diploma in Psychology at the University of Marburg and did her PhD at the University of Frankfurt (Germany). Since 2003, she is a professor for Developmental Psychology at the University of Gießen (Germany). Her research interests focus on perceptual, motor, and cognitive development during infancy and childhood and the impact of perceptual-motor skill on the processing of objects and faces.

Daniel Wolpert studied Medical Science at the University of Cambridge, as well as Clinical Medicine at the University of Oxford (England), where he then went on to do his D.Phil. in Physiology. He currently is a professor of Engineering, at the University of Cambridge (England), a Professorial Fellow at Trinity College, a Wellcome Trust Senior Investigator as well as the Royal Society's Noreen Murray Research Professor in Neurobiology. His current research interests include motor planning and optimal control, probabilistic models of sensorimotor control and using robotic and VR interfaces to investigate motor learning and control. For more information see www.wolpertlab.com.

4. Abstracts

4.1 Lectures

Integrating perception, action and self: The Theory of Event Coding

Bernhard Hommel

University of Leiden, NL

This talk gives an introduction into the Theory of Event Coding (TEC), which claims that perception and action are not only based on shared (i.e., sensorimotor) representations but are in some sense one and the same thing. Behavioral and neurocognitive studies will be discussed to show how knowledge about possible action goals and action affordances is acquired in infants, children, and adults, how this knowledge is used to select and control intentional action and to anticipate action outcomes, and how it is neurally represented. Recent extensions also consider the role of cognitive control and the representation of self and other social events.

Ideomotor theory and dual-tasking: The role of goal-states for dual-task interference

Markus Janczyk

University of Tübingen, Germany

In many if not all situations, humans do not only work on a single task, but are engaged in several tasks, that is, they are multi-tasking. In the laboratory, multi-tasking is usually investigated with two tasks, and typically one task suffers in performance compared to when it is carried out alone (dual-task interference).

I will begin the lecture by briefly outlining models of dual-tasking and by showcasing that ideomotor effect anticipation is the capacity-limited process causing dual-task interference. I will then present work showing that no dual-task interference arises if a bodily movement is carried out not as part of an action, that is, without the implication of desired goal-states. In the final part I will argue and demonstrate that parts of (specific) dual-task interference critically depend on the commensurability of action effects, rather than of the effectors with which these effects are produced.

Ideomotor mappings in the cognitive control of actions and tasks

Iring Koch

RWTH Aachen University, Germany

In cognitive psychology, it is a major idea that motor actions are controlled by higher-level representations of task goals and anticipated action outcomes. Such representations are presumably integrated in "task sets," which specify the relevant parameters of task execution. In my presentation, I first focus on the role of effect anticipation in performing single actions, using the so-called response-effect compatibility paradigm. Here, I present data suggesting that effect anticipation can be based on more conceptual codes, but that their influence at the level of single actions is affected by modality-specific factors. In the second part of my presentation, I turn to cognitive control at the level of tasks (or task sets), which can be studied using the task-switching paradigm. I will briefly describe this paradigm and then discuss recent evidence from our lab demonstrating that modality-specific action-effect anticipation has substantial but theoretically neglected influences on performance. Together, these studies show the important role of effect anticipation in the cognitive control of actions and tasks, and they highlight the fact that multimodal multitasking is particularly vulnerable to modality-specific between-task crosstalk.

Effect-based action control in social contexts

Wilfried Kunde

University of Würzburg, Germany

Humans store and retrieve motor actions by codes of the perceptible consequences that these actions consistently produce. What we do, however, has consequences not only in the inanimate environment, but at social partners around us. Sometimes such social consequences are intended, and sometimes they are not, but happen consistently nevertheless. Do such social consequences constrain our action and perception so as consequences in the inanimate environment do I will present some observations suggesting so, thereby supporting the idea of “socio-motor” action control. I will also discuss some peculiarities that should likely be taken into account when studying the impact of social compared to less social action feedback.

Will the science of mental life and behavior finally embrace motor control?

David A. Rosenbaum

University of California, USA

Psychology, the science of mental life and behavior, has curiously ignored motor control, the study of how physical behavior is controlled. An article about this neglect, called the "Cinderella of Psychology," appeared in *American Psychologist* in 2005. In the present talk, I will touch on some of the themes of that article and ask whether psychology has, in the meantime, witnessed, or is likely to witness, a resurgence of interest in motor control. There are signs that it has and will continue to do so, among them the growth of interest in embodiment (though even here, the focus has been more on perception than on action). My main basis for believing that psychology will finally embrace motor control is that the study of motor control provides a special window into the mind, and reliance on the tools of psychology provides a special window into the analysis of the control of physical movement and stability. I will illustrate these principles by describing some research that my colleagues and I have done, focusing on two main topics: (1) The past meets the future; and (2) Apples and oranges.

References

Rosenbaum, D. A. (2005). The Cinderella of psychology: The neglect of motor control in the science of mental life and behavior. *American Psychologist, 60*, 308-317.

Anticipatory actions

Oliver Herbort

University of Würzburg, Germany

Actions are seldom executed in isolation. Rather, they are preceded and followed by other actions and also depend on preceding and following actions. We pay tribute to these interdependencies by acting anticipatorily: Earlier actions are carried out in a fashion that facilitates or even enables subsequent actions. An example is grasp selection for object manipulation. A person grasping an object in order to manipulate it usually selects a grasps that allows the object manipulation to be carried out quickly and with high precision. I will attempt to provide a theoretical outline on how we select grasps for object manipulations. The first part of the task will address why we select specific grasps for specific actions (Marr's computational level). The second part will address the processes involved in selecting a specific grasp (Marr's algorithmic level). It will become apparent that the upcoming object manipulation is only one of many factors that determines grasp selection. The third part will give an outlook on rarely addressed but crucial topics, such as what does it take to act anticipatorily in the first place – and thus extent one's action capabilities.

Action selection in physical and cyber environments

Robert W. Proctor

Purdue University, USA

Action selection has typically been investigated in laboratory settings using relatively simple tasks. General findings are that action selection is influenced significantly by spatial relations between stimuli, responses, and effects. These relations become more complex in built physical environments, such as automobile and airplane cockpits, in which there are multiple frames of reference. Accurate prediction of action selection in such environments requires knowing the relative weightings that the various reference frames receive and people's expectancies about the effects of their actions. In cyber environments, the consequences of actions may differ from those in the physical environment due to there being no concrete frame of reference. With regard to cyber security, the consequences of some risky actions are often not immediately obvious. Therefore, how to address action selection in the cyber environment requires consideration of unique features of that environment.

Perception vs. action: What is the overall, functional architecture of the human visual system?

Volker Franz

University of Tübingen, Germany

This lecture contains two parts: In the first part, I will give a general introduction to the perception vs. action model as proposed by D. Milner and M. Goodale. This famous model posits a certain functional architecture of the visual system, namely that processing of visual information for perception and visual awareness is very different from processing of visual information for the guidance of action. In the second part, I will focus on one important line of evidence that has been put forward for this model: The finding that certain visual illusions affect only perception and visual awareness but not motor behavior. Some researchers describe this finding as meaning that there is a 'motoric zombie' in our brain, such that certain aspect of the visual scene (e.g., the undistorted, physical size of an object) are in principle not accessible to consciousness, albeit calculated for the guidance of action. I will give an overview of our recent research on this topic, including a recent large-scale, international pre-registered report replicating and testing the most influential studies that have been published on this topic. Based on the results of this pre-registered report, we hope to solve the 20-year long debate of whether or not the model is correct for visual illusions and actions or not.

The neuropsychology of perception and action

Thomas Schenk

University of Munich, Germany

The visual brain of primates and humans consists of two systems. These two systems are anatomically distinct and operate functionally in largely independent ways. One, the ventral system, creates a visual representation of the external world, the other, the dorsal system, uses visual information to guide our actions. In support of this model findings from anatomy, physiology, and psychophysics were presented. However the most compelling evidence for this hypothesis comes from the field of Neuropsychology. Milner and Goodale, who introduced the dual-systems hypothesis, regarded the contrasting deficits of patients with visual form agnosia and optic ataxia as the most compelling piece of evidence for their model. Patients with visual form agnosia and patients with unilateral neglect produce near-normal visuomotor behavior despite profound perceptual deficits. Patients with optic ataxia show the opposite behavioral pattern. Milner and Goodale argued that it is hard to explain this double-dissociation unless you assume some form of neuroanatomical division of labor between perception and action. In this talk I wish to present findings from visual form agnosia, unilateral neglect and optic ataxia in an effort to show that it might not be that difficult to account for the neuropsychology of perception and action without adopting the dual-systems hypothesis.

The interplay of perception and action during child development

Gudrun Schwarzer

University of Gießen, Germany

How the relationship between perception and action develops is still a controversial matter. Depending on the theoretical viewpoint it is argued that perceptual skills develop ahead of action skills or vice versa, actions skills develop ahead of perceptual skills. In this lecture I show that there is no clear head start of one of them. I will rather demonstrate how closely even during the first year of life both, action and perception, are linked and mutually supporting each other.

In the first part of the lecture, I focus on the role of action and action experience in the perception of objects during infancy. In a series of experiments, I show how action shapes infants' object perception. In the second part, I concentrate on the role of anticipation and planning in the development of acting on objects. Here, a series of experiments will indicate how the perception of certain object features and the planned action goals control the execution of actions in children at different ages.

All in all, this lecture provides evidence for a close interaction and attunement of perception and action during the first years of life enabling children to consider and process the principal perceptual and action-related characteristics of objects.

Perceptual Control Theory (PCT): Motor control as the control of perception

Warren Mansell

University of Manchester, UK

In 1960, William T. Powers, a control systems engineer, co-authored two papers describing in detail a hierarchical negative feedback architecture that models action as the control of perceptual input. Over subsequent decades, Powers and colleagues constructed functional models of motor control based on the theory, replicating a close match between model performance and participant performance. Most recently, PCT has informed the field of motor control in robotics and neuroscience. Dr Mansell will summarise PCT, describe the key studies to date and introduce work from his own research group that tests the theory. In particular, he will report on studies indicating that (a) response latency could be a consequence of perceptual delay rather than motor delay, (b) task-specific control parameters within a PCT model are idiosyncratic to the individual and can be reliably reassessed after a week, and (c) that perceptual instructions lead to more accurate motor performance compared to motor instructions. The distinctiveness of PCT and its research methodology in relation to other theories of motor control will be emphasised.

Computations in human sensorimotor control

Daniel Wolpert

University of Cambridge, UK

The effortless ease with which humans move our arms, our eyes, even our lips when we speak masks the true complexity of the control processes involved. This is evident when we try to build machines to perform human control tasks. I will review our work on how humans learn to make skilled movements covering motor planning in the framework of optimal feedback control, state estimation, motor prediction and forward models, probabilistic models of learning, including Bayesian and structural learning as well as the role of context in activating motor memories.

4.2 Poster-Session

1

Neural correlates of perceiving audiovisual consequences of voluntary movements

Arikan, B.E., van Kemenade, B.M., Podranski, K., Steinsträter, O., Straube, B., & Kircher, T.

University of Marburg, Germany

It has been demonstrated that sensory consequences of self-generated movements are attenuated. Although attenuation has been observed for different sensory modalities both on a behavioral and neural level, how multisensory action consequences are processed is not clear. We aimed to investigate neural mechanisms involved in the prediction of voluntary movements leading to unimodal vs bimodal sensory consequences. Participants performed active and passive hand movements gripping the handle of a custom-made device inside the scanner while seeing an online video of their hand. Temporal delays were introduced to the video, and participants were asked to detect delays between the movement and video. Data analysis showed reduced activation in areas linked to somatosensory, visual and auditory processing in the active compared to the passive condition, suggesting attenuation for the sensory consequences of voluntary movements, both for unimodal and bimodal consequences. Moreover, activity in the cerebellum seems to be modulated by subjective delay detection performance in active trials, suggesting differential processing in this area for voluntary movements.

2

The impact of visual information in dual-task tracking

Bröker, L.[1], Ewolds, E.[2], Künzell, S.[2], de Oliveira, R.F.[3], & Raab, M.[1,3]

[1]German Sport University of Cologne, Germany

[2] University of Augsburg, Germany

[3] London South Bank University, UK

It was investigated whether the display of advance visual information in a continuous tracking task, which was coupled with an auditory reaction time task (RTT), would help to decrease dual-task costs. It was hypothesized that such information support feedforward control which in turn promotes movement planning and a shift of attention to the auditory RTT, leading to enhanced tracking performance and lower reaction times. As expected tracking performance was worse when simultaneously performed with the auditory task, but there was a significant main effect of visual information on tracking errors. In contrast to our hypothesis reaction times did not improve with advance information. Velocity profiles indicated that participants increase velocity shortly before reacting to sounds which is why we concluded that dual-task interference occurred with response execution of the second task rather than during processing. Future studies should also manipulate auditory predictability (e.g. by arranging the sounds to a predictable sequence).

3

Reward expectancy modulates primary motor cortex excitability depending on action requirements during task preparation

Bundt C.[1], Brass, M., & Notebaert, W.

[1]University of Ghent, Belgium

Action preparation has been associated with transient primary motor cortex (M1) suppression before target onset. This effect has been shown to vary depending on individuals' motivation. It remains unclear, however, whether motivational effects on M1 are contingent upon action preparation. We devised a Go/NoGo cue-target delay paradigm where a reward cue (+1) indicated that participants could receive reward on the coming trial or a neutral cue (+0) indicated they could not receive reward. Corticospinal excitability (CSE) was measured by means of motor TMS and EMG early (100ms) and late (500ms) during the cue-target delay period (600ms). Results showed heightened CSE followed by a sharp decrease for Go trials early after a reward cue compared to a no-reward cue. In contrast, NoGo trials did not show such pattern but tended to show stronger CSE suppression after a reward cue compared to a no-reward cue. These findings suggest that motivational effects on M1 depend on action requirements during task preparation.

4

The EEG index reflects the best and the worst performance in air-pistol shooting

Cheng, M.-Y.[1, 2], Koester, D[1,2], & Schack, T.[1,2]

[1]Cluster of Excellence Cognitive Interaction Technology (CITEC), Bielefeld, Germany
[2]University of Bielefeld, Germany

Lowered cortical activity in the sensorimotor area has been related to increased efficiency on motor programming that is conducive to skilled motor performance. The sensorimotor rhythm (SMR), the frequency band within 12 to 15 Hz at the sensorimotor area, can reflect the activation of this region. Therefore, our study used SMR to investigate the neural efficiency in sports performance. Twenty-four skilled shooters were recruited to fire 40 shots while EEG and shooting accuracy were recorded. The results exhibited that the better performance was related to higher SMR activity during the aiming period, indicating that they reduced the interference from sensorimotor processing to perform better in a more efficient manner. On the contrary, we found a significant reduction in SMR activity in the worst shooting performance. These findings suggest that SMR is a unique EEG index that predicts the quality of air-pistol shooting performance during the aiming period. Applying SMR activity with the neurofeedback training is warranted for future sports performance studies.

5

Information processing during action observation and imitation – memory encoding, retrieval, and the influence from higher cognitive functions

Chiou, S.-C.[1,2], Bläsing, B.[1,2], & Schack, T.[1,2]

[1]Center of Excellence Cognitive Interaction Technology (CITEC), Bielefeld, Germany
[2]University of Bielefeld, Germany

Imitation is the most basic and common way of acquiring motor skills. However, the fundamental mechanism of imitation is still under debate. The computational view suggests that action imitation contains perceptual, conceptual, and motor stages, while the discovery of the so-called mirror neuron system and the action-observation network suggests that imitation is based on an automatic activation of motor representation during action observation. Aside from this controversy, one interesting question evolved from recent studies is how the visuo-perceptual system represents and processes observed movements before either conceptual analysis or motor simulation proposed by computational or motor resonance account, respectively, can be proceeded. In my PhD project, I will focus on the visuo-perceptual process when observing meaningless "dance-like" movements, and try to investigate the relation between memory encoding and retrieval when different intentions, observation-imitation schedules, and movement knowledge are applied.

6

Grasping objects afforded by task characteristic: Motor synergies and object representation

Cienfuegos, M., Essig, K., & Schack, T.

University of Bielefeld, Germany

Task characteristics influence grasp postures when manipulating objects. To examine the differences of how individual objects are manipulated during two classes of tasks, we investigated the hand kinematics and duration of grasping movements directed towards natural objects. The kinematic data was analyzed using principal component analysis (PCA) in order to extract movement synergies and determine invariant movement characteristics for grasping a set of objects on different conditions. Mental representations of grasping movements were also analyzed using a hierarchical sorting paradigm (Structural Dimension Analysis). Results suggests that the grasping movement is influenced by the object task characteristics at an early stage of the movement.

7

Action selection by temporally distal goal-states

Durst, M., Ulrich, R., & Janczyk, M.

University of Tübingen, Germany

In line with ideomotor theory, numerous response-effect compatibility (REC) studies found evidence that action -effects are anticipated prior to action initiation, as indicated by an REC effect: a response is given faster when its effect occurs on the same compared to the opposite side. So far, REC studies only applied contingent effects, i.e., effects occuring immediately after the response was given. However, it may be argued that in everyday life many actions cause effects which do not occur immediately. Additionally, as actions can have more than one effect, desired effects occuring in the future may only be arrived at by achieving fundamental effects first. The present study investigated whether temporally more distal effects are anticipated in order to initiate actions, and how multiple, serially occuring effects are represented. To this end, a spatial REC paradigm was extended in a way that a first contingent effect (that immediately followed the response; E1) was 500 ms later followed by another visual effect (E2). An REC effect was only observed for the temporally more distal effect E2. Taken together, these results indicate that temporally more distal effects are anticipated, and that multiple, serially occurring effects are represented separately rather than as a composite.

8

Delta plots with negative-going slopes as a potential marker of decreasing response activation in masked semantic priming

Ellinghaus, R.[1], & Miller, J.[2]

[1]University of Tübingen, Germany
[2]University of Otago, New Zealand

Delta plots with negative-going slopes (nDPs) reflect the phenomenon that an RT difference between two conditions is greater for relatively fast than for relatively slow responses. This unusual distributional pattern has predominantly been observed in the spatial Simon task, where it has been interpreted as reflecting the selective inhibition of an automatically activated response. Literature suggesting that a similar fading mechanism influences RTs in masked identity priming inspired us to check an analogous semantic priming paradigm for nDPs. Consistent with the findings in other paradigms, two masked semantic priming experiments revealed stronger priming effects for relatively fast than for relatively slow responses, thus reflecting a nDP. These findings are compatible with the ideas that the activation produced by masked semantic primes decreases over the course of a trial, like that of irrelevant spatial information and of masked identity primes, and that nDPs are a general signature of within-trial decreases in response activation across different tasks and paradigms.

9

The influence of predictability on multitask performance

Ewolds, H.[1], Künzell, S.[1], Bröker, L.[2], Raab, M.[2], & de Oliveira, R.F.[3]

[1]University of Augsburg, Germany
[2]German Sport University of Cologne, Germany
[3]London South Bank University

As long as action control is without awareness it may called automatic. For automatic control the situation needs to be predictable. We therefore argue that predictability of a situation is a prerequisite for successful multitasking. In the current study we examined the effects of making a task more predictable by studying performance on a tracking task. Participants tracked a target which describes a path consisting of two random segments, at the start and end, while the middle segment is always identical. An implicit group trained the tracking task unaware of the repeating middle segment while an explicit group did so while informed. In a test block learning of the middle segment and dual-task performance was tested. An auditory go/no-go reaction time task was used as a secondary task. We calculated the root mean square error (RMSE) for tracking performance and reaction times for the auditory task. Results revealed participants in both groups improved during training sessions. Moreover, participants improved more on the repeating middle segment than the random outer segments. Analyses of the test block revealed that performance on trials with a random middle segment was worse compared to trials with a repeating middle segment, both during dual- and single-task conditions. No differences between groups were found. In conclusion, predictability might be an important factor to improve dual-task performance.

10

The role of preparation on modality compatibility effects in task switching

Fintor, E., Stephan, D.N., & Koch, I.

RWTH Aachen University, Germany

Two experiments examined the role of preparation on modality compatibility in task switching. The term modality compatibility refers to the similarity between the stimulus modality and the modality of response-related sensory consequences. Previous research showed evidence for modality compatibility benefits in task switching when participants switch either between two modality compatible tasks (auditory-vocal and visual-manual) or between two modality incompatible tasks (auditory-manual and visual-vocal), but it was also found that this modality compatibility benefit was diminished with long response-stimulus interval (RSI). However, there is no study that investigated the different aspects of preparation in modality compatibility effects on task switching. To this end, in Experiment 1, we varied the RSI and compared the RSI effect between a predictable and an unpredictable task sequence group. In Experiment 2, we manipulated the cue-stimulus interval (CSI). In Experiment 1, we found that performance is generally better with a predictable task sequence, but preparation has an impact on mainly task repetitions. However, this repetition benefit did not differ across modality compatibility conditions. In Experiment 2, we found decreased switch costs with long CSI, but the CSI effect did not modulate the modality compatibility effect. Together, the data suggest that modality compatibility is independent of preparation, suggesting different underlying mechanisms (i.e., structural task-set overlap vs. advance activation of response mappings).

11

Grasping movement (re-)planning interferes with working memory during the maintenance process: An ERP study

Gunduz Can, R.[1,2] , Schack, T.[1,2,3], & Koester, D.[1,2]

[1]University of Bielefeld, Germany
[2]Center of Excellence Cognitive Interaction Technology (CITEC), Bielefeld, Germany
[3] Research Institute for Cognition and Robotics, Bielefeld University, Germany

The present study focuses on the neurophysiological interactions of cognition, specifically working memory, and grasping movements. In particular, we investigated neuro-cognitive costs of implementing a new grasp plan for separate working memory (WM) domains (verbal, visuospatial) and processes (encoding, maintenance, retrieval). In a dual-task paradigm, 35 participants concurrently performed a WM task and grasp-to-place task (grasp a sphere and place it onto either the left or right motor target according to an arrow cue). For 30% of trials, grasping movement had to be re-planned online. This study employed a 2 (WM Task: Verbal vs. visuospatial) x 2 (Grasp Planning: Prepared vs. re-planned) within subject design. Event-related potentials (ERPs) were analyzed separately for encoding, maintenance, retrieval processes. Behavioral analyses showed that the memory performance decreased for both WM tasks when grasp re-planning was required. That is, grasp re-planning interferes with WM in domain-general pattern. ERP analyses showed for maintenance process that prepared trials elicited larger negative slow waves compared to re-planned trials regardless of WM task. That is, maintenance-related ERPs of verbal and visuospatial tasks were equally affected. There was no effect for encoding and retrieval processes. Therefore, ERP findings support the domain-general re-planning interference with WM. More importantly, for the first time, ERP findings show the process-specific (maintenance) re-planning interference at the neurophysiological level. The present study provides a better understanding of neuro-cognitive mechanisms of manual action flexibility, particularly focusing on ERPs during overt movement execution.

12

Deriving hierarchical control structures from real world experience

Hawker, B., & Moore, R.

University of Sheffield, UK

Hierarchical control structures have diversified responses to control problems and made solutions more robust. However, building control structures is often tedious and complicated. The origin of the hierarchies in control structures is poorly understood, with few algorithms that can derive a hierarchical structure from experience. Those that do exist have only been tested on simple, virtual tasks that do not display the complexities of the real world. Furthermore, solutions which require a large amount of training data are restricted to activities with large data sets available increasing the need for real world learning. The Dependency Oriented Framework for Assembling Hierarchies (DOFAH) is a new algorithm based on Perceptual Control Theory's concepts, which allows an agent to derive its own control structure autonomously. DOFAH generates structures from testing the relationships between inputs and outputs, then forms closed loops progressively in an attempt to control each input variable in turn and identifying where control subsystems need to deliver output to in order to close all loops. DOFAH works in real time with real world experience, needing no additional training data to support it.

13

Neural correlates of error processing in a complex motor task – An EEG-study

Joch, M., Hegele, M., Maurer, H., Müller, H., & Maurer, L. K.

University of Gießen, Germany

Neural error processing can be measured by event-related potentials in the EEG. Among these potentials, the ERN is a negative deflection in fronto-central regions that emerges with or shortly after an erroneous motor response, even prior to sensory feedback about the movement outcome such as knowledge of results (KR; Falkenstein et al., 1991; Gehring et al., 1993). The functional significance of the ERN is discussed in light of different aspects of error detection and error processing, all of which include prediction about the movement outcome. The current study strives to quantify the ERN in self-induced errors in a relatively complex motor task where KR is delayed with respect to movement termination allowing to discriminate between error prediction and processing of error KR. 10 participants (4 males; Mage = 22.7 years, SD age = 3.4) performed a semi-virtual goal-oriented throwing task for 1600 trials on 4 days total. They manipulated a real lever to throw a virtual ball displayed on a computer monitor with the aim to hit a virtual target as often as possible. While performing the task, EEG was recorded from 12 scalp electrodes (reference: averaged mastoids). For each subject, the EEG signals were filtered (0.3-20 Hz bandpass), corrected for ocular artifacts and then segmented into epochs from 600 ms before and 1500 ms after ball release of successful trials hitting and error trials missing the target. The grand average of the FCz electrode of all subjects showed a significant negative deflection in error trials relative to hit trials occurring 200-350 ms after ball release, which is 500 ms before KR feedback. The data was analyzed by confidence bands generated using a resampling technique (Rodgers, 1999). Since the negative deflection appeared independent from any visual feedback about movement effect, we suggest that it represents an ERN signal strongly related to error prediction. In order to confirm these interpretations, further experiments are planned.

14

Mobile brain/body imaging (MoBI) of physical interaction with dynamically moving objects

Jungnickel, E., & Gramann, K.

TU Berlin, Germany

The poster captures the results of an oddball experiment requiring responses due to a color change of an object moving on a projection screen. The responses were either a fast button press or a fast and accurate pointing movement towards the moving object. The Mobile Brain/Body Imaging approach using high density mobile EEG synchronized with motion capturing allowed the participants to move freely. It could be shown that the contribution of brain processes, muscle activity and eye movements to the signal can be quantified and the event-related potential component P300 caused by target stimuli can be measured - even during rapid volatile movements. When participants responded by pointing to the stimulus with their right index finger instead of simply pressing a response button their response onsets were shorter and, solely considering the signal generated by brain sources, the P300 amplitude was increased. This encourages the hypothesis that behavioral states influence brain states.

15

Are visuomotor abilities spared in visual neglect? A case study of peripheral pointing

Knights, E., & Rossit, S.

University of East Anglia, UK

Patients with visual neglect demonstrate an inattention to one side of space, but the condition per se is believed to spare the neural mechanisms responsible for visuomotor control. Differently, patients with optic ataxia exhibit clear visuomotor control difficulties, particularly when actions are executed under peripheral vision. Using single-case statistics we examined whether patient D.A., who shows signs of visual neglect, could perform pointing movements to targets viewed in her periphery (and fovea) as accurately as a healthy age-matched control group (N = 13). In line with her lesions that spared regions believed to be responsible for peripheral reaching (and that are typically affected in optic ataxia patients), D.A. pointed to targets appearing in her periphery as accurately as controls with either hand, even when they appeared on her neglected side. It is concluded that visual neglect is not intrinsically linked to optic ataxia and that the condition leaves visuomotor control intact.

16

Validating the variational coupled gaussian process dynamical model

Knopp, B., Velychko, D., & Endres, D.

University of Marburg, Germany

The Variational Coupled Gaussian Process Dynamical Model (vCGPDM) generates movements using a latent dynamical system with associated kinematics mapping for each body part. These dynamical models are coupled in a product-of-experts fashion to allow flexible adjustment of the coupling strength at run time. The vCGPDM learns Movement Primitives (MPs) for every body part. These MPs can then be combined to compose novel movements. The variational treatment introduces Inducing Points (IPs), which parametrize each MP. We show in a psychophysical experiment that a small number of IPs is sufficient to generate perceptually believable human walking movements. Also we are able to compose a novel 'waving while walking' movement by exchanging the upper body dynamics of the vCGPDM.

17

Interdependence of gaze and aiming behavior in natural environments

Kurz, J., Hegele, M., Reiser, M., & Munzert, J.

University of Gießen, Germany

When people engage with goal-directed natural scenes, their gaze behavior is influenced more consistently by task-specific instructions and by task-related locations in the environment than by the salience of the stimulus context.

We examined gaze behavior and performance in a far-aiming task (soccer penalty) and gaze behavior and hand movements in a close-aiming task (grasp and transport movements of water glasses with different filling level). Results for the far-aiming task showed that the gaze is directed almost exclusively toward task-relevant locations and that task specificity can indeed attenuate and even switch off automatic fixations on salient stimuli (the goalkeeper). However, this attenuation depends on the time course of the action. Results for the close-aiming task showed significant differences concerning gaze and movement kinematics for higher filling level. However, these differences occurred especially during the later phases of transport and release.

18

Studying the effect of perceptual cognitive performance in gymnastics

Mack, M.

University of Leipzig, Germany

Sport expertise is defined as the ability to constantly demonstrate superior athletic performance. Although the physical mechanisms are well understood, the perceptual cognitive mechanisms are still less evident. Perceptual cognitive skills refer to the ability to identify the relevant information out of the environment and integrate them with prior knowledge. Effective perceptual performance requires the athletes to focus their attention to the most relevant information. Therefore most crucial for skilled performance is the knowledge of WHERE and WHEN to look and WHAT to expect there. This project tries to get behind this mechanisms in gymnastics with an experimental approach out of four clusters: (1) biomechanical profiling, (2) eye tracking (3) film occlusion and (4) training intervention.

19

Searching for the perceptual origins of the speed-curvature power law

Matic, A., & Gomez-Marin, A.

Instituto de Neurociencias CSIC-UMH, Spain

One of the best-studied characteristics of human motor control, the 2/3 power law between instantaneous speed and local path curvature, has been found in several types of voluntary movements, such as in drawing, walking, eye movements and speech (Lacquaniti et al, 1983; Wann et al, 1988; Tasko et al, 2004, Ivanenko et al 2002). A variety of models have been proposed to explain the law, including centrally planned (Karklinski et al, 2015, Huh et al, 2015) and brain-body interaction models (Schaal et al, 2001; Gribble et al, 1996). Recent experiments have shown different exponents for drawing ellipses in water (Catavitello et al, 2016) as well as in the trajectories of foraging Drosophila larvae (Zago et al, 2016), casting doubts on a purely central planning hypothesis. Since motor output in biological systems is tightly coupled to perceptual inputs that are relevant to the organism (not the experimenter), here we aim to address the problem from the perspective of perceptual control (Powers, 1973), and across species. We have started to investigate the visual and kinesthetic contributions during curve tracing on the screen by introducing incongruities between them. For instance, modifying the horizontal gain between the drawing pad and the computer screen made the ellipses on the screen differ in eccentricity from ellipses drawn by hand. We have found the power law exponent for ellipses drawn by hand to be higher than 2/3 in incongruous situations. We are also investigating the role of fluidity versus accuracy in drawing pure frequency curves, and its development. We are also designing experiments to instruct participants to learn to trace curves and track targets in ways that violate the power law in a predictable way. We believe that studying motor control in the light of perceptual control theory can provide a more comprehensive understanding of the interaction between neural computations, body constraints and environmental contingencies.

20

Motor development and its relation to participation in physical activity in typical development and in individuals with williams syndrome

Mayall, L.[1], D'Souza, H.[2], Esfandi, F.[3], Tolmie, A.[1], & Farran, E.[1]

[1]UCL Institute of Education, London, UK
[2]Birkbeck University of London, UK
[3]Brunel University of London, UK

Williams Syndrome (WS) is a rare neurodevelopmental disorder. We documented the full WS motor profile, and investigated how this relates to involvement in physical activity. Twenty individuals with WS aged 12 to 50 were recruited, and compared to TD children of the same range of motor abilities (aged 4 to 7 years). Individuals with WS demonstrated impaired fine and gross motor abilities (BOT2; Bruininks & Bruininks, 2005). All performed in the below average or well below average zones, and performance was comparable to TD 4-5 year olds and significantly below the TD 6-7 year olds. The WS motor profile was characterized by a particular weakness in balance, and a relative strength in upper limb control. There were also significant positive correlations between both fine and gross motor ability and participation in physical activity in both the WS and TD groups.

21

Effects of age and cognitive control availability on the deactivation of completed intentions

Möschl, M.[1], Fischer, R., Altgassen, M., Burger, K., & Walser, M.

[1]Technical University of Dresden, Germany

Prospective memory denotes the ability to postpone intention execution until the right circumstances are met. Here, we investigated the role of cognitive-control availability on subsequent intention deactivation. To this aim, we induced varying degrees of response-conflict during the processing of no-longer-relevant prospective memory cues. If control availability was crucial for intention deactivation, aftereffects of completed intentions should be most pronounced when cognitive control is taxed (e.g., by high control demands or cognitive aging). In line with our hypothesis, more older than younger adults erroneously repeated a completed intention. However, aftereffects of completed intentions were comparable between no-conflict and high conflict trials (study 1) and under varying control demands (study 2). Overall our findings suggest that, while intention deactivation can be affected by enduring control deficits, it might not rely upon trial-by-trial availability of cognitive control.

22

On the relationship between working memory and the generation of free choices

Naefgen, C., & Janczyk, M.

University of Tübingen, Germany

Free choice tasks are tasks in which two or more equally valid response options per stimulus exist. In investigations on the putative difference between voluntary and stimulus-determined actions, free choice tasks are often used in contrast to forced choice tasks, in which only one response option is considered correct. It has been repeatedly shown that working memory (WM) demands, in random generation tasks (e.g. Baddeley, 1962; for an overview see Wagenaar, 1972), lead to more obvious response patterns (e.g. positive or negative recency biases). The goal of the present study, assuming similarities between free choice and random generation tasks, then was to investigate what role WM plays in the emergence of the very consistently observed response time (RT) difference ($RT_{free} > RT_{forced}$) in a series of three experiments. In Experiment 1 we tested the influence of previous free choice responses on new responses by manipulating the amount of external WM support the participants had (none, three, and seven responses) while performing a free choice task. In Experiments 2 and 3, we theorized that participants compare their given responses to a sequence of responses representative (in the participants' minds) of the instructed response distribution. We then assumed that longer sequences would lead to higher WM demands, which we hypothesized should lead to larger RTs. We manipulated the sequence length by changing the instructed target distribution of responses from the standard 50/50% to different values (Experiment 2: 10% increments from 0% to 100%; Experiment 3: 100%, 80%, 75%, 66%, 60%, 50% and their respective complementary percentages). Preliminary results suggest (a) an influence of WM on the generation of free choice responses in that WM support speeds up response generation and (b) that the assumption of a monotonous increase in working memory load from 50% to 90% target distribution with a sharp drop-off for 100% is untenable.

23

Is the effect of the attentional focus on performance and learning generalizable or dependent on the functionality of the focused movement effect?

Nowak, S., & Müller-Plath, G.

Berlin Institute of Technology, Germany

In several training studies it has been shown that focusing on the movement effect (=external focus) leads to better performance and learning outcomes than focusing on the own body and its movements (=internal focus; for a review see Wulf, 2013). It remains unclear whether these results can be generalized to all kinds of movements (e.g., Künzell, 2007). We are investigating whether the superiority of the external focus is dependent on the functionality of the focused movement effect for the task. In an ongoing experiment healthy participants stand on a Wii Balance Board and are asked to shift their balance according to a predefined shape. Visual information and feedback are presented on a screen in front of them. We manipulate two factors: the attentional focus (by instructions) and the functionality of the movement effect (by the quality of the information on the screen). The preliminary results will be presented and discussed.

24

Can computational models be optimised to individual's tracking movements and accurately simulate their performance after one week?

Parker, M.[1], Tyson, S.[1], Weightman, A.[1], Abbott, B.[2], Emsley, R.[1], & Mansell, W.[1]

[1]University of Manchester, UK
[2]Indiana University – Purdue University Fort Wayne, USA

Computational models of individuals' movements in pursuit tracking tasks demonstrate individual variability in performance and control parameters. However, studies have not investigated whether the parameters of such models are consistent within an individual over time, or whether models show individual-specificity in simulations of tracking performance. In this experiment, 20 healthy adults completed three blocks of 15 trials (one minute each) of pursuit tracking task (Powers, 2008). Blocks 1 and 2 occurred in one session and block 3 occurred one week later. Twenty computational perceptual control theory (PCT) models were optimised to the block 1 data using a least mean squares approach, and validated with data from blocks 2 and 3. We found statistically significant inter-individual variability and intra-individual consistency in parameter estimates over one week. Participants' tracking performances were significantly more accurately simulated by models developed from their own tracking data than by models developed from other participants' data. We conclude that computational models can be optimised to simulate the performance of an individual and discuss implications for motor control theory and application to the field of assistive robotics.

25

A look into the future: Spontaneous anticipatory saccades reflect processes of anticipatory action control

Pfeuffer, C.[1], Kiesel, A.[1], & Huestegge, L.[2]

[1]University of Freiburg, Germany
[2]University of Würzburg, Germany

According to ideomotor theory, human action control uses anticipations of one's own actions' future consequences, that is, action effect anticipations, as a means of triggering actions that will produce desired outcomes. Using the response-effect compatibility paradigm (e.g., Kunde, 2001), we demonstrate that the anticipation of one's own manual actions' future consequences not only triggers appropriate (i.e., instructed) actions, but simultaneously induces spontaneous (uninstructed) anticipatory saccades to the location of future action consequences. In contrast to behavioral response-effect compatibility effects that have been linked to processes of action selection and action planning, our results suggest that these anticipatory saccades serve the function of outcome evaluation, that is, the comparison of expected/intended and observed action outcomes.

26

On the development of a four-person social Simon paradigm

Puffe, L., Dittrich, K., & Klauer, K.C.

University of Freiburg, Germany

Previous studies observed spatial compatibility effects in a Simon task even when the task was shared between two co-actors. Automatic co-representation of the co-actors' action or task is considered to account for this finding. However, recent research suggests an alternative, non-social interpretation: The presence of a co-actor or a salient non-social event might serve as a spatial reference point, allowing for a spatial response coding; inducing response interference. Nonetheless, the particular referencing process and its flexibility reveal some open issues within this account. In a series of experiments, we developed a social Simon paradigm involving four person in order to examine how performance and spatial representations (especially regarding the role of keys, seats and stimulus alignment) might differ in a setting of four participants working jointly on the Social Simon task. Results suggest so far that spatial response coding involving more than two participants is more complex than previously thought.

27

Action effect features, but not anatomical features, determine the backward crosstalk effect: Evidence from crossed-hands experiments.

Renas, S., Durst, M., & Janczyk, M.

University of Tübingen, Germany

The Backward Crosstalk Effect (BCE) indicates that features of Task 2 in a dual-task paradigm influence even Task 1 performance. However, it can be assumed that responses are represented with multiple features in the cognitive system. In this regard, Ideomotor Theory suggests action effects as one central response feature in human action control and an earlier study by Janczyk, Pfister, Hommel, and Kunde (2014, Cognition) already provided some evidence that action effects are a crucial determinant of the BCE. The present study aimed to further investigate which response features are critical for the left/right BCE. Therefore a crossed-hand manipulation was implemented in two experiments to examine if rather the spatial position of the actual response and thus its associated action effects or the body-side of the effectors' anatomical connection determine the BCE. Analyses revealed that even when participants press a left response key with the right hand and vice versa, the usual BCE occurs. These results indicate that the BCE depends on spatial features of the action effect rather than on anatomical features and therefore provide additional support for the contention that action effects have an important influence on the BCE and on action control in general.

28

Infrequently inserted "false" effects of actions and nonactions modulate subsequent behavior in a task-switching paradigm

Röttger, E., & Haider, H.

University of Cologne, Germany

Whenever an action or nonaction is contingently associated with a certain effect, the anticipation of this effect is used to select the respective (non)action (Kühn et al., 2009; Röttger & Haider, 2016). Recently, Saunders and Jentzsch (2012) provided evidence that post-error as well as post-correct task performance was modulated by false external feedback. We hypothesized that if a (non)action leads to an effect other than the expected one "post-correct slowing" should be found. Therefore, we conducted a task-switching experiment. After action- and nonaction-effect associations were established, participants switched randomly between a free-choice go/no-go task and a categorization task. In a small subset of pre-switch-trials (from go/no-go to categorization), false effects were presented. We found larger switch costs after false than after correct effects for go- and no-go responses. This result once again supports the hypothesis that actions and nonactions are selected in the same way (Kühn et al., 2009; Röttger & Haider, 2016).

29

Intentional binding of two effects

Ruess, M.[1], Thomaschke, R.[1], Haering, C.[2], Wenke, D.[3], & Kiesel, A.[1]

[1]University of Freiburg, Germany
[2]University of Würzburg, Germany
[3]PFH University of Applied Sciences Göttingen, Germany

When an action produces an effect, the action is perceived later in time compared to an action without a following effect, and the effect is perceived earlier in time compared to a stimulus without preceding action. Despite numerous studies on this phenomenon – referred to as Intentional Binding effect (IB) – the underlying mechanisms are still not fully understood. Typically, IB is investigated in settings where the action produces just one single effect, whereas in everyday action contexts, it rather causes a sequence of effects before leading to the desired outcome. Therefore, we investigated in four experiments IB of two consecutive effects and observed substantially more IB for a first effect tone compared to a second tone. Interestingly, the second tone yielded stronger IB when it was less delayed. Thus, events occurring later in an unfolding action effect sequence might be less bound to actions than effects following actions directly. This, however, seems rather to be caused by the longer delay of a later occurring effect, instead of the fact, that it is the second one of two effects.

30

Role of motor variability in joint action learning

Sabu, S., Curioni, A., Vesper, C., Sebanz, N., & Knoblich, G.

Central European University, Hungary

Wu et al., 2014, suggests that an individual's natural motor variability can predict the rate at which she learns a motor task. The authors demonstrated that motor learning was faster when individuals exhibit higher variability in their movements, presumably due to exploring a wider space of motor parameters. Thus variability seems to enhance individual motor learning. In joint action, variability reduction is adopted as a coordination strategy for enhancing predictability of one's movement when individuals act together (Vesper et al., 2013). The current study aims at investigating the differential role that variability plays in individual and joint learning, specifically how variability is exploited when individuals learn a motor task jointly with a partner. In a joint sequence learning paradigm, participants learned the motor task jointly with a confederate who is either highly variable or less variable in his movements. The task is set up in such a way that the confederate's movements directly affect the participant's movements. We hypothesize that a partner producing high variability will be advantageous in joint learning: individuals who learn the task with a highly variable partner will learn faster and hence reduce their spatial error rapidly because the variability of the confederate's movement enhances action exploration for the individual.

31

Task sharing reduces crossmodal congruency effects for visual and auditory stimuli

Schweitzer, J.[1], Wesslein, A.-K.[2], & Hesse, F.W.[1 2]

[1]Knowledge Media Research Center Tübingen, Germany
[2]University of Tübingen, Germany

Joint action research investigates the perceptual, cognitive, and motor processes that enable individuals to coordinate their actions during collaboration. A central issue for current theoretical accounts of joint action concerns the degree to which collaborating actors take their partner's perceptions and actions into account when planning their own actions. Previous research demonstrated that sharing a task with a partner can reduce crossmodal congruency effects for visuo-tactile stimuli located within an actor's peripersonal space (Heed, Habets, Sebanz, & Knoblich, 2010). This effect can be attributed to a top-down influence on multisensory integration that causes reduced weighting of those stimuli to which the partner responds. We used an elevation judgment task with auditory (pitch) and visual stimuli (spatial position) to investigate whether a similar effect can be found for this modality combination. Participants classified the elevation of target stimuli presented in one sensory modality (auditory or visual) while ignoring simultaneously appearing distractors in the other sensory modality. On each trial, the auditory and visual stimuli were either congruent or incongruent with regard to their elevation (i.e., pitch and spatial position). Participants performed the elevation judgement task alone or alongside a partner (within-subjects manipulation) who responded to those stimuli presented to the "irrelevant" sensory modality. We expect the presence of a person responding to the distractors to decrease the weight placed on these stimuli, resulting in decreased crossmodal interference for incongruent (compared to congruent) pairs of audiovisual stimuli.

32

Task effects and their integration in the activated task set

Sommer, A., & Lukas, S.

University of Education Weingarten, Germany

Participants executed two judgment tasks (the magnitude or the parity task) either in a voluntary task-switching paradigm or in a cued task-switching paradigm. In the experimental groups a correct response was contingently followed either by a color for the magnitude task or by a tone for the parity task and vice versa. In the control groups action effects occurred at random. If task effects play a crucial role in discriminating between competing task sets, the experimental groups may outperform the control groups in regard to reaction time, error rates and switch costs as shown in Lukas, Philipp, and Koch (2013). If the sensorimotor action control mode differs functionally from the ideomotor action control mode differences should be seen in the consistency effect and in the non-reversal advantage (cf. Hommel & Elsner, 2001) not only on the response level but also on a hierarchically higher task level.

Literature:

Elsner, B., & Hommel, B. (2001). *Journal of Experimental Psychology: Human Perception and Performance, 27,* 220-240.

Lukas, S. Philipp, A. M., & Koch, I. (2013). The influence of action effects in task switching, *Frontiers in Psychology,* 3, 595. doi: 10.3389/fpsyg.2012.00595

33

Apraxia of pantomime does not depend on online visual feedback

Sperber, C.[1], Christensen, A.[1], Ilg, W.[1], Giese, M.A.[1], & Karnath, H.-O.[1,2]

[1]Hertie-Institute for Clinical Brain Research, University of Tübingen, Germany
[2]University of South Carolina, Columbia, USA

Pantomime of tool use is typically affected in patients with apraxia, a cognitive disorder of complex action. In contrast, the corresponding action with a real tool is usually not or only mildly disturbed. This is commonly explained by differences in sensory input. The lack of visual online feedback of the object in pantomime has been hypothesized to play a crucial role. However, the influence of visual feedback has not been systematically studied yet. We investigated ten neurological patients with apraxia of pantomime and ten healthy controls in a task requiring the pantomime of tool use as well as real tool use. Visual feedback was systematically removed at different time points of the action using visual occlusion spectacles that were controlled online based on real-time motion-capturing. Data were analysed qualitatively with rating of videotaped movements and quantitatively by analysis of kinematic data. Both analyses found general differences between pantomime and tool use, with more apractic errors in pantomime. However, visual feedback was not found to affect apractic errors. These findings contradict the hypothesis that apraxia patients pathologically over-rely on visual feedback. Instead, we propose that pantomime of tool use requires cognitive processes that are not necessary for real tool use and independent of visual input.

34

The causal role of the lateral occipital (LO) cortex and anterior intraparietal sulcus (aIPS) in real and pantomimed grasping: An fMRI-guided TMS study

Tonin, D., Romei, V., Lambert, R., Bester, A., Saada, J., & Rossit, S.

University of East Anglia, UK

Milner and Goodale (1995) propose a model of vision that makes a distinction between vision for perception and vision for action. One strong claim of this model is that the visual processing of objects for real grasping depends on dorsal stream areas whereas the processing of objects for pantomimed actions depends on the ventral stream regions. However, and even more that 20 years after its formulation, this claim is largely based on a single-case neuropsychological study: visual form agnosic patient DF can scale her grip aperture to different object sizes during real visually-guided grasping, but her grip scaling is impaired when performing pantomimed grasping in a location adjacent to these same objects. Here we used fMRI-guided transcranial magnetic stimulation (TMS) to shed light on the specific role of the lateral occipital (LO) cortex, a key ventral stream area in object perception, and the anterior intraparietal sulcus (aIPS), a key dorsal stream region in grip scaling, in real and pantomimed grasping. We applied theta burst TMS over left aIPS, left LO or vertex in three separate sessions before 16 participants performed real object grasping and pantomimed grasping in an adjacent location to the presented object. Grasping movements were performed in open loop with the right-hand in response to 3D Efron blocks presented in the right visual field. For real grasping, TMS over aIPS significantly weakened the relationship between object size and grip aperture when compared to TMS over LO and TMS over vertex, whereas TMS over LO had no effects. For pantomimed grasping, TMS over both aIPS and LO considerably reduced the relationship between object size and grip aperture when compared to vertex stimulation. Our results show that while aIPS is causally involved in grip scaling for both real and pantomime grasping, LO is only involved in pantomimed grasping.

35

Efficiency in joint action: Do we make rational decisions when coordinating with others?

Török, G., Sebanz, N., Pomiechowska, B., & Csibra, G.

Central European University, Hungary

In individual motor planning, actors choose and execute optimal motor plans depending on the costs and benefits related to potential outcomes of a given action. Furthermore, from an early age, humans are sensitive to the efficiency of observed joint actions, expecting agents to minimize the aggregate costs invested into an action directed towards a joint goal. Indeed, in joint object manipulation tasks, adults have been found to plan actions by anticipating the end-state of a sequence, and to make efforts to reduce their partner's discomfort. In our study, we tested the hypothesis that, in order to achieve a joint goal, actors maximize the efficiency of their actions on the joint level rather than maximizing only their individual efficiency. We used a dyadic motor coordination game, where the individual and joint costs of movement options were systematically manipulated. Our results suggest that the tendency to choose the individually efficient or inefficient option in neutral trials (with no differences in related joint costs) varied widely across participants. However, in trials where an action could be executed in less and more joint-efficient ways, participants took into account the aggregate costs and acted to maximize the dyad's efficiency, even at the expense of compromising individual efficiency.

36

Dissociating two types of decision strategies in ideomotor free-choice tasks - A mouse-tracking analysis

Vogel, D.[1], Scherbaum, S.[1], & Janczyk, M.[2]

[1]Technichal University of Dresden, Germany
[2]University of Tübingen, Germany

How do we choose the appropriate action to reach a specific goal? According to ideomotor theory, actions are represented by their subsequent effects. This is often tested in free-choice experiments in which participants learn the connection between an action, e.g. a keypress, and an effect, e.g. a tone, and then have to freely choose between actions while the effect is presented. To better understand participants' behaviour in such tasks, we combined an ideomotor experiment with mouse tracking. We identified two distinct groups following different decision strategies: The first group usually made the decision already at the beginning of the trial, irrespective of the yet to be presented stimulus, while the second group decided within the trial, being affected by the presented stimulus more often. This suggests that people use different approaches in free-choice tasks which results in heterogeneous choice patterns and response times. Such differences should be considered in the interpretation of results from free-choice experiments.

37

The influence of instructions and response eccentricity on conceptual congruency effects

Xiong, A., & Proctor, R.W.

Purdue University, USA

People are often faster at performing a reaction task with left and right responses when they are told to use one S-R mapping rather than another. Such S-R congruency effects include the SNARC effect for digit magnitude comparisons, the MARC effect for digit parity judgments, and the Time-Space congruency effect for past-future judgments. We investigated these conceptual congruency effects in 3 experiments with year-number stimuli and different S-R mappings. The response device was placed to the left or right of the participant to examine the influence of response-device placement as well. Results confirm a lack of influence of response-device placement on all 3 effects. The SNARC effect was absent for magnitude comparisons but present for past-future judgments, and left-right response interacted with response-device position for magnitude comparisons and past-future judgments but not parity judgments. These findings illustrate that action selection is a function of the task set provided by instructions.

38

Grasping with immediate and final action goals: A synchronized ERP and eye-tracking study

Yu, L.[1, 2], Koester, D.[1, 2], & Schack, T.[1, 2, 3]

[1]Bielefeld University, Germany
[2]Cluster of Excellence Cognitive Interaction Technology (CITEC), Bielefeld, Germany
[3]Research Institute for Cognition and Robotics (CoR-Lab), Bielefeld, Germany.

Previous studies have shown that neurophysiological activations during action planning and execution during grasping with initial or final action goals. However, the results are still controversial to some extent. Besides, the pre-cues they used are difficult to study goal anticipation, action planning and execution separately. So the present study is going to use separated pre-cues (one emphasizes immediate action goal and the other emphasizes final action goal) to study the difference between anticipating immediate and final goal in grasp and rotation task. EEG and eye movement will be recorded and analyzed synchronously to show those differences in gaze behaviors and neurophysiological activations. Furthermore, this study is trying to find some functional relations between gaze system and motor control system in goal-related actions. The results of this study will help us obtain a better understanding on the neural mechanisms underlying end-state comfort effect in grasping as well.

39

Perceived vividness of imagined movements is associated with the variation of neural pattern within the human motor system

Zabicki, A.[1], de Haas, B.[2], Zentgraf, K.[4], Munzert, J.[1], & Krüger, B.[1]

[1]University of Gießen, Germany
[2]University College London, UK
[4]University of Muenster, Germany;

Imagery in the context of motor actions (i.e., motor imagery) refers to a process where subjects imagine doing a body movement by themselves from first-person-perspective with a strong kinesthetic component. Several studies, have argued that the ability of creating such vivid motor images is an individual as well as a variable feature that can vary within and between subjects. This is underpinned by the notion that inter- as well as intra-individual differences in imagery ability and quality mediate neural activity during MI as group averages. On this background, the aim of the present work is to characterize the nature of the neural representation of motor images and the underlying experienced subjective vividness in different motor regions. More precisely, we applied representational similarity analysis (RSA) to answer the question whether and how the perceived vividness is related to the functional geometry of the respective imagined movements.

5. Attendants & Contact Info

Speakers

Bernhard Hommel	hommel@fsw.leidenuniv.nl
Daniel Wolpert	wolpert@eng.cam.ac.uk
David A. Rosenbaum	david.rosenbaum@ucr.edu
Gudrun Schwarzer	Gudrun.Schwarzer@psychol.uni-giessen.de
Iring Koch	koch@psych.rwth-aachen.de
Markus Janczyk	markus.janczyk@uni-tuebingen.de
Oliver Herbort	oliver.herbort@psychologie.uni-wuerzburg.de
Robert W. Proctor	proctor@psych.purdue.edu
Thomas Schenk	thomas.schenk@psy.lmu.de
Volker Franz	volker.franz@uni-tuebingen.de
Warren Mansell	warren.mansell@manchester.ac.uk
Wilfried Kunde	kunde@psychologie.uni-wuerzburg.de

Participants

Adam Matic	amatic@umh.es
Adam Zabicki	adam.zabicki@sport.uni-giessen.de
Aiping Xiong	xionga@purdue.edu
Angelika Sommer	sommeran@ph-weingarten.de
Belkis Ezgi Arikan	ezgiarik@med.uni-marburg.de
Benjamin Hawker	ben.hawker@sheffield.ac.uk
Benjamin Knopp	knoppbe@staff.uni-marburg.de
Carsten Bundt	bundt.carsten@googlemail.com
Christina Pfeuffer	christina.pfeuffer@psychologie.uni-freiburg.de
Christoph Sperber	christoph.sperber@klinikum.uni-tuebingen.de
Christoph Naefgen	christoph.naefgen@uni-tuebingen.de
Diana Tonin	D.tonin@uea.ac.uk
Diana Vogel	Diana.Vogel@tu-dresden.de
Edina Fintor	edina.fintor@psych.rwth-aachen.de
Ethan Knights	ethan.knights@uea.ac.uk
Eva Röttger	eva.roettger@uni-koeln.de
Evelyn Jungnickel	evelyn.jungnickel@tu-berlin.de
Georgina Török	torok_georgina@phd.ceu.edu
Harald Ewolds	harald.ewolds@sport.uni-augsburg.de
Johannes Kurz	johannes.kurz@sport.uni-giessen.de
Julien Schweitzer	j.schweitzer@iwm-tuebingen.de
Laura Bröker	l.broeker@dshs-koeln.de
Leighanne Mayall	sejjla8@ucl.ac.uk
Lin Yu	lin.yu@uni-bielefeld.de
Lydia Puffe	lydia.puffe@psychologie.uni-freiburg.de
Marcus Möschl	marcus.moeschl@tu-dresden.de
Maximilian Parker	maximilian.parker@manchester.ac.uk
Melanie Mack	melanie.mack@uni-leipzig.de
Michael Joch	michael.joch@sport.uni-giessen.de
Miguel Angel Cienfuegos	miguel.cienfuegos@uni-bielefeld.de
Ming-Yang Cheng	pckobe@gmail.com
Miriam Rueß	ruess@psychologie.uni-freiburg.de
Moritz Durst	moritz.durst@psycho.uni-tuebingen.de
Ruben Ellinghaus	ruben.ellinghaus@uni-tuebingen.de
Rumeysa Gunduz Can	ruemeysa.guenduez@uni-bielefeld.de
Sandra Renas	sandra.renas@psycho.uni-tuebingen.de
Shiau-Chuen Chiou	shiau-chuen.chiou@uni-bielefeld.de
Simily Sabu	Sabu_Simily@phd.ceu.edu
Svetlana Nowak	svetlananowak@googlemail.com

6. Guide

The Winter School takes place at the Department of Psychology (formerly „Alte Frauenklinik") Schleichstraße 4, 72076 Tübingen.

Arrival by bus (see bus schedule)

From the central station to the venue:

- Line 5 (towards WHO Ahornweg): get off at Gmelinstraße; continue by foot

From Hölderlinstraße to city centre / central station:

- Line 5 (towards Derendingen Käppele / Nelkenweg)

Arrival by car

Coming from Stuttgart via the B27:

- Turn right on B28 towards Tübingen city center
- At the „Blaue Brücke" (blue bridge) turn right on Friedrichstr.
- After the traffic-calmed sector turn right on Karlstraße
- Continue depending on desired parking destination (see below)

Car Park (Parkhaus König):

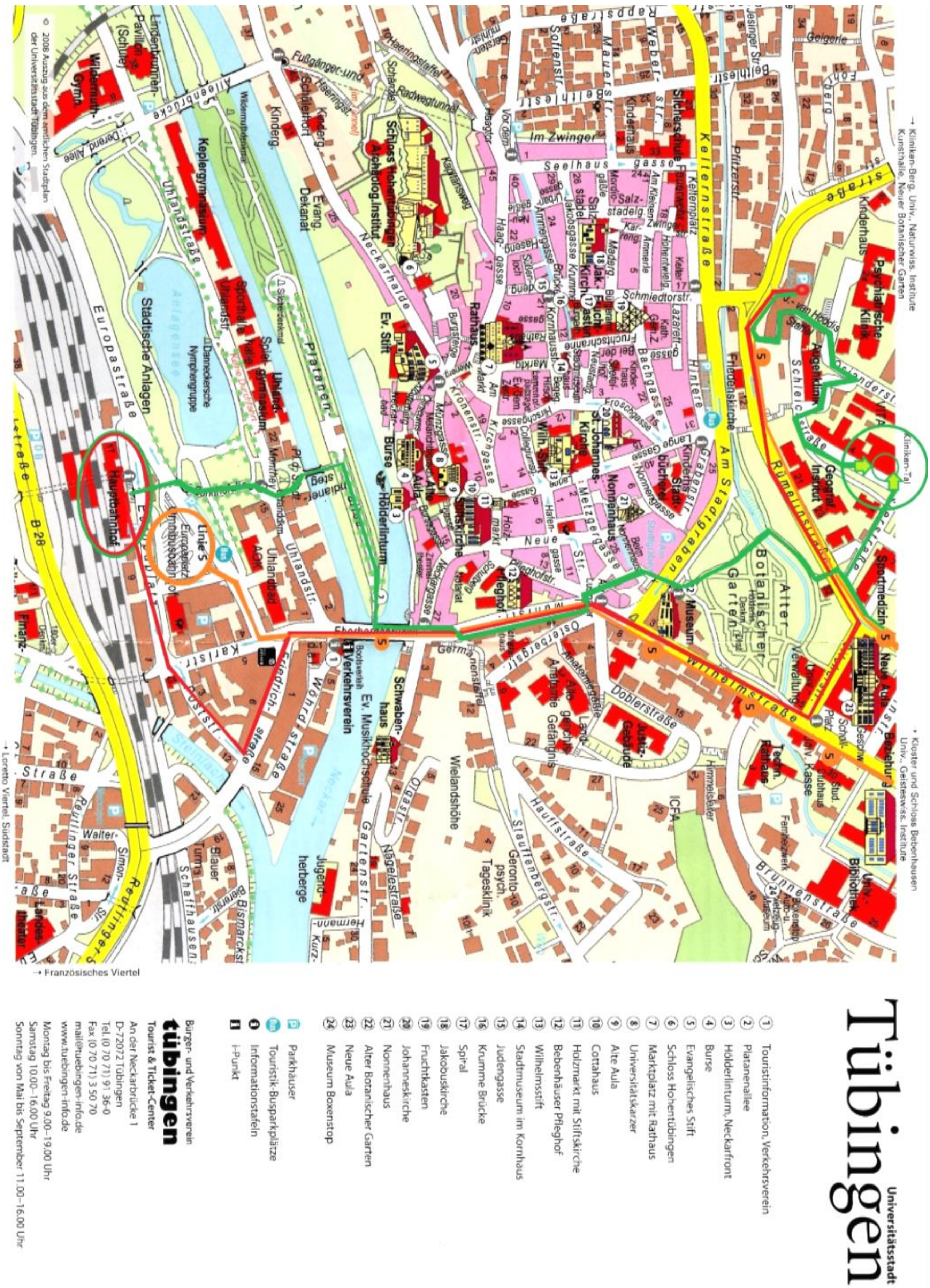
- Turn left on Gmelinstr.
- Turn left on Hölderlinstr.
- Follow Hölderlinstr. for 350m
- The destination is on the right

Parking lot (free of charge; when parking in second row please do not apply the hand brake)

- Continue on Wilhelmstr.
- Follow Wilhelmstraße for 550m
- The destination is on the right

Arrival by taxi

- From central station / Wilhelmstr.


Tübingen
Universitätsstadt
1 Touristinformation, Verkehrsverein
2 Platanenallee
3 Hölderlinturm, Neckarfront
4 Burse
5 Evangelisches Stift
6 Schloss Hohentübingen
7 Marktplatz mit Rathaus
8 Universitätskarzer
9 Alte Aula
10 Cottahaus
11 Holzmarkt mit Stiftskirche
12 Bebenhäuser Pfleghof
13 Wilhelmsstift
14 Stadtmuseum im Kornhaus
15 Judengasse
16 Krumme Brücke
17 Spital
18 Jakobuskirche
19 Fruchtkasten
20 Johanneskirche
21 Nonnenhaus
22 Alter Botanischer Garten
23 Neue Aula
24 Museum Boxenstop
Parkhäuser
Touristik-Busparkplätze
Informationstafeln
i-Punkt
Bürger- und Verkehrsverein
tübingen
Tourist & Ticket-Center
An der Neckarbrücke 1
D-72072 Tübingen
Tel. (0 70 71) 91 36-0
Fax (0 70 71) 3 50 70
mail@tuebingen-info.de
www.tuebingen-info.de
Montag bis Freitag 9.00–19.00 Uhr
Samstag 10.00–16.00 Uhr
Sonntag von Mai bis September 11.00–16.00 Uhr
© 2008 Auszug aus dem amtlichen Stadtplan der Universitätsstadt Tübingen

Restaurants / Takeaways

Ban Mai Thai Restaurant
fresh thai food, rather small portions, lovely staff
Keplerstr. 10

Dönastie
healthy Kebab, excellent vegetarian options, rather expensive
Keplerstr. 8

Kichererbse
healthy, fresh and affordable falafel, great for vegetarians
Metzgergasse 2

Neckarmüller
Local food, nice view of the Neckar
Gartenstr. 4

Saints & Scholars
Irish Pub offering burgers, sandwiches and more
Wilhelmstr. 44

TGF Pizza
classic Pizza takeaway
Keplerstr. 7

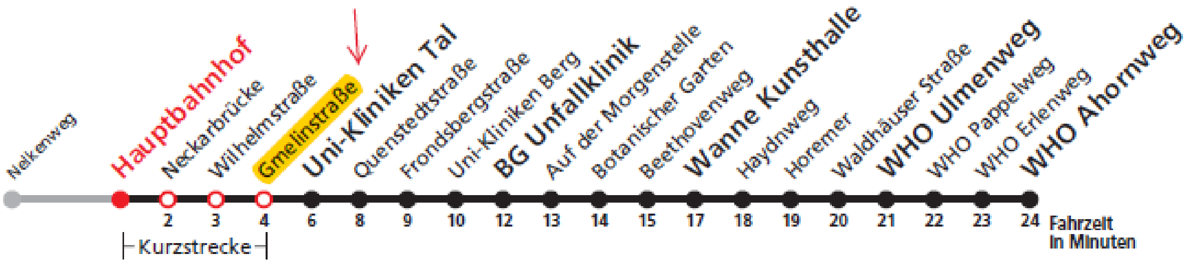
Unckel
affordable Italian restaurant, usually very crowded
Wilhelmstr. 17

Bus schedule from central station

5 Hauptbahnhof → Uni-Kliniken Tal → BG Unfallklinik → Wanne Kunsthalle → WHO Ulmenweg → WHO Ahornweg

swt Stadtwerke Tübingen

get off here



Stadtwerke Tübingen GmbH, Eisenhutstraße 6, 72072 Tübingen
Tel. 07071/157-157, E-Mail: stadtverkehr@swtue.de

Gültig ab 13.12.2015

Uhr	Mo - Fr (Normal)	Mo - Fr (Ferien)	Samstag	Sonn-/Feiertag	Uhr
5	36 56	36	36	36	5
6	06 16 26 36 46 56	01 16 31 46	13 43	13 43	6
7	06 16 26 36 46 56	01 16 31 46	03^{W} 33	03^{W} 33	7
8	06 16 26 36 46 56	01 16 31 46	03 32 47	03^{W} 33	8
9	06 16 26 36 46 56	01 16 31 46	02 17 32 47	03^{W} 33	9
10	06 16 26 36 46 56	01 16 31 46	02 17 32 47	03^{W} 33	10
11	06 16 26 36 46 56	01 16 31 46	02 17 32 47	03^{W} 33	11
12	06 16 26 36 46 56	01 16 31 46	02 17 32 47	03^{W} 18 33 48	12
13	06 16 26 36 46 56	01 16 31 46	02 17 32 47	03^{W} 18 33^{W} 48	13
14	06 16 26 36 46 56	01 16 31 46	02 17 32 47	03^{W} 18 33^{W} 48	14
15	06 16 26 36 46 56	01 16 31 46	02 17 32 47	03^{W} 18 33^{W} 48	15
16	06 16 26 36 46 56	01 16 31 46	02 17 32 47	03^{W} 18 33^{W} 48	16
17	06 16 26 36 46 56	01 16 31 46	02 17 32 47	03^{W} 18 33^{W} 48	17
18	06 16 26 36 46 56	01 16 31 46	02^{A18} 17^{A18} 33$^{W}_{A18}$	03^{W} 33^{W}	18
19	06 16 26 36 46 56	01 16 31 46	03$^{W}_{A18}$ 33$^{W}_{A18}$	03^{W} 33^{W}	19
20	06 16 33^{W} 48	01 16 33^{W} 48	03$^{W}_{A18}$ 33$^{W}_{A18}$	03^{W} 33^{W}	20
21	03^{W} 18 33^{W}	03^{W} 18 33^{W}	03$^{W}_{A18}$ 33$^{W}_{A26}$	03^{W} 33^{W}	21
22	03^{W} 33^{W}	03^{W} 33^{W}	03$^{W}_{A26}$ 33$^{W}_{A26}$	03^{W} 33^{W}	22
23	03^{W} 33	03^{W} 33	03$^{W}_{A26}$ 33^{A26}	03^{W} 33	23
0	03^{W}	03^{W}	03$^{W}_{A26}$	03^{W}	0

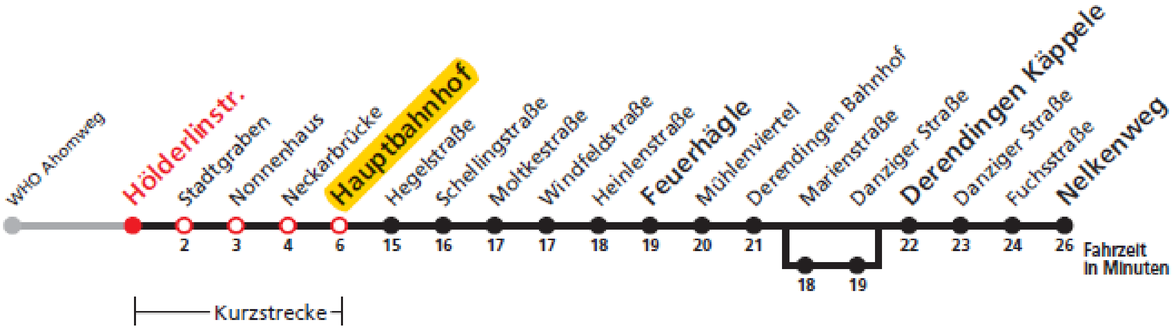
W Weiterfahrt in Waldhäuser Ost Richtung Sand (Linie 2)   A18 nicht 24.12.   A26 nicht 24. und 31.12.

Ferienfahrplan gültig vom 28.12.15 bis 05.01.16, während der Sommerferien 2016 gilt ein Umleitungsfahrplan, der gesondert veröffentlicht wird.

Bus schedule from Hölderlinstr.

5 Hölderlinstr. → Hauptbahnhof → Feuerhägle → Derendingen Käppele → Nelkenweg

swt Stadtwerke Tübingen



Stadtwerke Tübingen GmbH, Eisenhutstraße 6, 72072 Tübingen
Tel. 07071/157-157, E-Mail: stadtverkehr@swtue.de

Gültig ab 13.12.2015

Uhr	Mo - Fr (Normal)	Mo - Fr (Ferien)	Samstag	Sonn-/Feiertag	Uhr
5	24^{A} 44^{A}	24^{A} 44^{A}	46^{A}	46^{A}	5
6	17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{A} 24^{A} 39^{B}_{C} 54^{A}	05^{A}_{R9} 12^{A} 42^{A}	05^{A}_{R9} 12^{A} 42	6
7	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	12^{A} 47	12^{A} 47	7
8	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	17^{A} 39^{B}_{C} 54^{A}	17^{A} 47	8
9	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	17^{A} 47	9
10	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	17^{A} 47	10
11	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	17^{A} 47	11
12	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	17^{A} 47	12
13	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	02^{A} 17 32^{A} 47	13
14	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	02^{A} 17 32^{A} 47	14
15	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	02^{A} 17 32^{A} 47	15
16	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	02^{A} 17 32^{A} 47	16
17	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	02^{A} 17 32^{A} 47	17
18	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{A}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	09^{B}_{C} 24^{A}_{A18} 47^{A18}	02^{A} 17 47	18
19	07^{B}_{C} 17^{A} 27^{A} 37^{B}_{C} 47^{A} 57^{B}_{C}	09^{B}_{C} 24^{A} 39^{B}_{C} 54^{A}	17^{A18} 47^{A18}	17 47	19
20	07^{A} 17 32^{A} 47	09^{B}_{C} 17 32^{A} 47	17^{A18} 47^{A18}	17 47	20
21	02^{A} 17 32^{A} 47	02^{A} 17 32^{A} 47	17^{A26} 47^{A26}	17 47	21
22	02^{A} 17 47	02^{A} 17 47	17^{A26} 47^{A26}	17 47	22
23	26	26	26^{A26}	26	23
0	06^{A}	06^{A}	06^{A}_{A26}	06^{A}	0
1	14^{A}	12^{A}	12^{A}_{A26}	12^{A}	1

A bis Hauptbahnhof
B bis Derendingen Käppele
C bedient von Marienstraße bis Danziger Straße

A18 nicht 24.12.
A26 nicht 24. und 31.12.
R9 Anmeldefahrt, Anmeldung mind. 30 Min. vor Abfahrt, Tel. 07071 / 34 00 0

7. Evening Program

Aspendos, Monday 13/2/2017

The Turkish Restaurant “Aspendos“ is located in the southern area of Tübingen (Reutlinger Straße 24) next to the Landestheater Tübingen. From the city center it is only a 10 minutes walk via the Blaue Brücke (“blue bridge”) and the Reutlinger Straße.

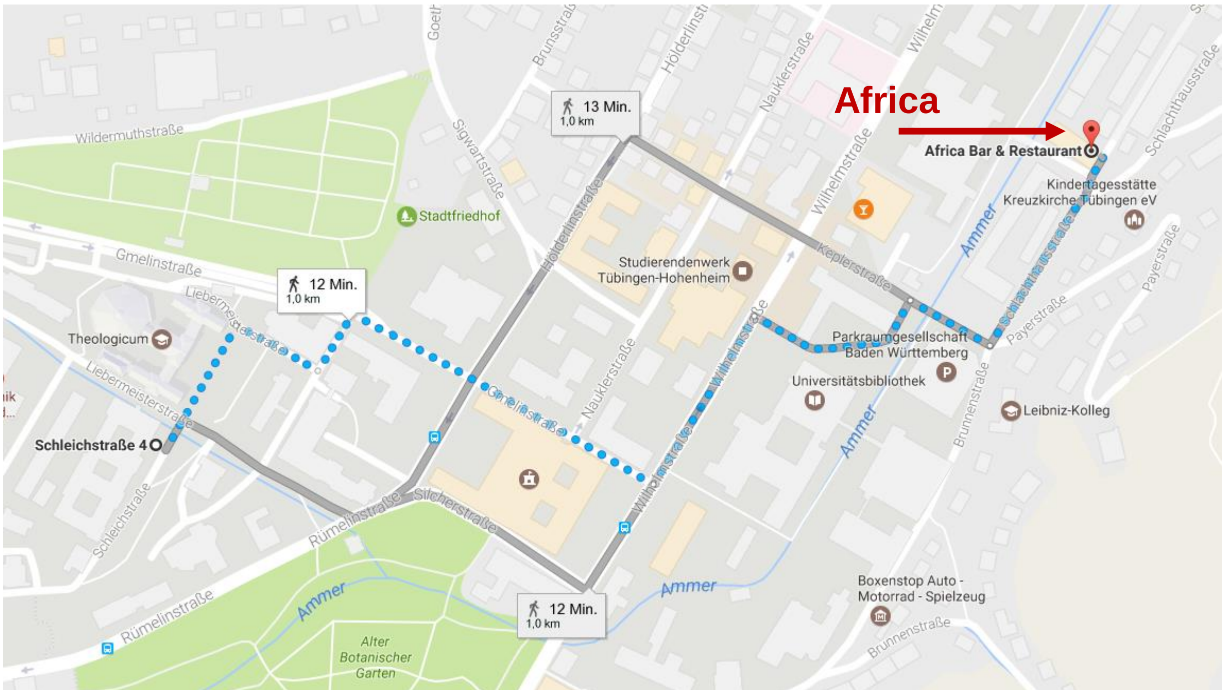
Neckarmüller, Tuesday 14/2/2017

The restaurant and brewery “Neckarmüller“ serves besides traditional Swabian dishes also homebrewed beer. It is located directly at the river Neckar in the city center (Gartenstraße 4) and is therefore easy to find.

Africa, Wednesday 15/2/2017

The Restaurant “Africa” serves dishes from the Ethiopian-Eritrean cuisine. It is near the campus in Schlachthausstraße 9, which is a 10 minutes walk from the venue.


Venue
Schleichstraße 4
Neckarmüller
Gasthausbrauerei Neckarmüller
Aspendos
Aspendos Restaurant
21 Min.
1,6 km
Alter Botanischer Garten
Parkhaus Altstadt-Mitte (Stadtgraben)
Mühlstraße
Gmelinstraße
Silcherstraße
Rümelinstraße
Am Stadtgraben
Ammer
Brunnenstraße
Doblerstraße
Hauffstraße
Stauffenbergstraße
Schwabstraße
Matthias-Koch-Weg
Kleiststraße
Alte Kunst
Rathaus
Stiftskirche
Burgsteige
Hölderlin-Gesellschaft
Gartenstraße
Hermann-Kurz-Straße
Neckarinsel
Uhlandstraße
Wöhrdstraße
Steinlach
Bismarckstraße
Kino Blaue Brücke
Schaffhausenstraße
Anlagenpark
Anlagensee
Europastraße
Tübingen Hbf
Hegelstraße
Fürststraße
Eisenbahnstraße
Landestheater Tübingen
Kaufland


Africa
Africa Bar & Restaurant
Kindertagesstätte Kreuzkirche Tübingen eV
13 Min.
1,0 km
12 Min.
1,0 km
12 Min.
1,0 km
Schleichstraße 4
Wildermuthstraße
Stadtfriedhof
Gmelinstraße
Liebermeisterstraße
Theologicum
Studierendenwerk Tübingen-Hohenheim
Keplerstraße
Wilhelmstraße
Parkraumgesellschaft Baden Württemberg
Universitätsbibliothek
Leibniz-Kolleg
Silcherstraße
Rümelinstraße
Ammer
Alter Botanischer Garten
Boxenstop Auto - Motorrad - Spielzeug
Brunnenstraße
Payerstraße
Nauklerstraße
Hölderlinstraße
Sigwartstraße

8. Thanks!

This event would not have been possible without generous financial support from various sources:

- The main funding comes from the **Zukunftskonzept der Eberhard Karls University of Tübingen** (ZUK 63; Institutional Strategy of the University of Tübingen).
- The **European Society for Cognitive Psychology** (ESCoP) provided funding to support travel costs for participants. If you are not yet a member of the ESCoP, please consider becoming one! The next ESCoP conference takes place from 3rd to 6th of September 2017 in Potsdam, Germany.
- Further support comes from the **Fachgruppe Allgemeine Psychologie** der Deutschen Gesellschaft für Psychologie (DGPS; General Psychology section of the German Psychological Society).

Zukunftskonzept der Universität Tübingen (ZUK 63)
Institutional Strategy of the University of Tübingen

Fachgruppe „Allgemeine Psychologie“ der Deutschen Gesellschaft für Psychologie

European Society for Cognitive Psychology (ESCoP)

We also wish to thank all participants for their interest and contributions to the Winter School, and – of course – all invited speakers. All of them immediately agreed to come to Tübingen for this event when we first contacted them. We very much appreciate your presence in Tübingen!

Finally, thanks go also to Marielle, Pia, and Holger who helped organizing and realizing the Winter School as student assistants in our group.