Leibniz-Institut für Wissensmedien

IWM Summer School:
Multimodality and Knowledge Processes

June 6–8, 2018

Leibniz-Institut für Wissensmedien (IWM)
Schleichstr. 6, 72076 Tübingen

www.iwm-tuebingen.de

LEIBNIZ-INSTITUT FÜR WISSENSMEDIEN

The Leibniz-Institut für Wissensmedien (IWM) analyses how digital technologies can be used to improve knowledge processes. The psychological basic research of the 110 scientists is concerned with practical fields like school and university, knowledge work with digital media, knowledge-based internet use and knowledge transfer in museums. From 2009 till 2016, the IWM together with the University of Tuebingen organised the first Leibniz-ScienceCampus on "Informational Environments", which is continued as follow-up project under the heading "Cognitive Interfaces".

THE LEIBNIZ ASSOCIATION

The Leibniz Association connects 93 independent research institutions that range in focus from the natural, engineering and environmental sciences via economics, spatial and social sciences to the humanities. Leibniz institutes address issues of social, economic and ecological relevance. They conduct knowledge-driven and applied basic research, maintain scientific infrastructure and provide research-based services. The Leibniz Association identifies focus areas for knowledge transfer to policy-makers, academia, business and the public. Leibniz institutions collaborate intensively with universities – in the form of "Leibniz ScienceCampi" (thematic partnerships between university and non-university research institutes), for example – as well as with industry and other partners at home and abroad. They are subject to an independent evaluation procedure that is unparalleled in its transparency. Due to the importance of the institutions for the country as a whole, they are funded jointly by the federation and the federal states.

WELCOME!

The Leibniz-Institut für Wissensmedien (IWM) warmly welcomes you to our Summer School on „Multimodality and Knowledge Processes. The Summer School is jointly organized by Katharina Scheiter's Multiple Representations Lab and Stephan Schwan's Realistic Depictions Lab at the IWM. The main topic of the Summer School will be the interplay of different sensory channels (like vision, sound, haptics) as well as different information modes (like texts, pictures, animations) with respect to perception, cognitive processing, and knowledge acquisition when using different media. These issues will be addressed from various disciplinary perspectives, including learning sciences, experimental psychology, and linguistics.

KATHARINA SCHEITER & STEPHAN SCHWAN

PROGRAM SCHEDULE

WEDNESDAY (JUNE 6)	THURSDAY (JUNE 7)	FRIDAY (JUNE 8)
9:00 – 10:30 Talk *John Bateman:* The analysis of multimodality: Semiotic foundations and consequences for empirical methodology	**9:00 – 10:30** Talk *Neil Cohn:* A cognitive multimodal model of language and communication	**9.00 – 10:30** Talk *Leila Lyons:* Employing embodiment in the design of collaborative exhibits
10:30 – 11:00 **Coffee Break**	**10:30 – 11:00** **Coffee Break**	**10:30 – 11:00** **Coffee Break**
11:00 – 12:30 Talk *Mike Stieff:* Spatial thinking is multimodal	**11:00 – 12:30** Talk *Zacharias Zacharia:* Using physical and virtual labs for experimentation in science education: From theory and research to practice	**11:00 – 13:00** Workshop *Leilah Lyons* (Part I)
12:30 – 13:30 Lunch	**12:30 – 13:30** Lunch	**13:00 – 14:00** Lunch
13:30 – 18:00 **Parallel workshops** *John Bateman /* *Mike Stieff* (Coffee Break: 15:30)	**13:30 – 18:00** **Parallel workshops** *Neil Cohn /* *Nikoletta Xenofontos* (Coffee Break: 15:30)	**14:00 – 16:00** **Workshop** *Leilah Lyons* (Part II)
18:00 – 20:00 Poster session (with buffet)	**18:30 – 20:00** Dinner	

ABSTRACTS AND BIO SKETCHES

JOHN BATEMAN

Bio sketch:

John Bateman (PhD in Artificial Intelligence, Edinburgh) has been professor of applied linguistics in the Faculty of Linguistics and Literary Sciences at the University of Bremen since 1999. His main fields of research range over functional linguistics, semiotics, computational linguistics (particularly natural language generation, discourse and dialogue), formal ontology, and the theory and practice of multimodality. He has published widely in all of these areas, including monographs on multimodality and genre (2008, Palgrave), film (with Karl-Heinrich Schmidt, 2012), text and image (2014, Routledge), and most recently (with Janina Wildfeuer and Tuomo Hiippala) an introductory textbook to the field of multimodality and its study as a whole (2017, de Gruyter).

Talk and workshop:

The analysis of multimodality: semiotic foundations and consequences for empirical methodology

In the 1970s and 1980s multimodality was taken up in extensions of text linguistics and came to constitute a central component of engagements with verbal interaction. Subsequently it has been pursued under a variety of labels and across several largely independent areas, ranging over sociosemiotic approaches to communication, ethnographic and conversation analytic approaches, human-computer interface research, transmedial literary studies, and many more. Parallel to these developments has been the increasing engagement with combinations of modalities found in psychological, cognitive and neurocognitive approaches. Empirical studies apply what is known about perceptual and cognitive processing to explore how people interpret diverse sources of information, integrating distinct forms of internal representation and managing cognitive load across highly limited input channels. Many characterizations of multimodality still then fall between two stools: on the one hand, processing according to distinct sensory channels places important boundary conditions on what is possible while, on the other hand, considerations of semiotic purpose provide the motivation for any materials being shaped for communication at all. Accounts thus must address both theoretical poles but do not always manage this in suitably general ways, forming compromise positions with facets of both. This becomes increasingly problematic when seeking to deal with a broader range of multimodal artifacts and performances. Theories and methods drawn from particular contributing disciplines and are not always applicable to aspects of multimodality lying beyond their own disciplinary orientations. A

more foundational characterization of multimodality as a semiotic phenomenon may offer a solution, anchoring both perceptual and interpretative processes within a common multiperspectival framework. To this end, I first present the general account of multimodality that we have been developing in Bremen over the past ten years, where multimodality is defined semiotically with respect to both materiality and discourse. I then proceed to discussion of examples from diverse media in order to specifically address the question of how empirical methods can both benefit from and contribute to further rounds of theoretical and practical work on multimodal communication. Potential benefits are explored in terms of constructing more focused research hypotheses for empirical investigation, which must then also feedback into and refine theoretical description.

NEIL COHN

Bio Sketch:

Neil Cohn is internationally recognized for his research in linguistics and cognitive neuroscience on the overlap of the structure and cognition of drawings and sequential images with language. His books, *The Visual Language of Comics* (Bloomsbury, 2013) and *The Visual Narrative Reader* (Bloomsbury, 2016), introduce a broad framework for studying visual narratives in the linguistic and cognitive sciences. He received his PhD in Psychology from Tufts University, and is faculty in the Department of Communication and Cognition at Tilburg University in the Netherlands. His work is online at www.visuallanguagelab.com.

Talk: A cognitive multimodal model of language and communication

Natural human communication is multimodal. We pair speech with gestures, use emoji with our texting, and combine writing with drawings and images in places from doodles to comics to advertising. This communication is structurally complex, especially in contexts like visual narratives where grammatical structures organize both the sequential text (syntax) and the sequential images (narrative). Such complexity poses a challenge to theories of multimodality where only a single form uses combinatorial structure (like in co-speech gesture), and also to linguistic models that focus on single modalities. This presentation will outline a cognitive model for addressing this complexity embedded within Jackendoff's (2002) model of a Parallel Architecture of language. I will break down the primary modalities of verbal, bodily, and graphic communication into their constituent parts, and then show that the resulting interactions have systematic characterizations and profiles. Altogether, different types of human expression – speech, gesture, drawings, and multimodal interactions – arise as

emergent activation states out of this broader cognitive architecture. Such an approach can both guide research into multimodal communication and warrant a reconsideration of what constitutes the language system.

Workshop: Narrative grammar

Sequences of images are all around us – from historical scrolls and instruction manuals to film and contemporary comics. Just how do we comprehend these sequences of images? Recent research has shown that the comprehension of visual narratives extends beyond the meaningful relations between images and uses a "narrative grammar" that organizes this semantic information. This structure, based on contemporary construction grammars from linguistics, packages meaning into categorical roles into hierarchic constituents to account for phenomena like long distance dependencies and structural ambiguities. Support for this structure arises from experimental evidence from both behavioral and neurocognitive research. This workshop will teach the basics of analyzing this model of narrative grammar, which is applicable to the analysis of comics, film, discourse, and multimodal narratives across domains.

MIKE STIEFF

Bio Sketch:

Mike Stieff (Ph.D., Northwestern University) is Associate Professor of Learning Sciences and Chemistry at the University of Illinois-Chicago. His research focuses on spatial thinking in science education and the design of learning environments for improving STEM achievement. He is an expert in design and evaluation with a specific focus on secondary and post-secondary STEM curriculum and pedagogy. His current projects explore new theoretical frameworks regarding the role of visualization and diagrammatic reasoning at multiple levels of science instruction and the design of simulations and animations for teaching chemistry.

Talk: Spatial thinking is multimodal

There is relative consensus that spatial thinking plays a central role in science learning and problem solving; however, the ways in which spatial thinking is enacted across STEM disciplines is not uniform. This talk will explore the core features of spatial thinking and how spatial thinking emerges as a multimodal practice that reflect disciplinary norms. With examples from chemistry, geology, and physics, I will illustrate how spatial thinking relies on discipline-specific diagrams and models, imagistic reasoning, and gesture. Through a series of targeted spatial interventions in chemistry, I

will demonstrate how spatial thinking can be improved in the context of conventional curriculum interventions and interactive digital platforms. Across these interventions, I will provide evidence that these tools and processes mediate the relationship between spatial ability constructs and STEM achievement outcomes. Together, these findings raise questions about the utility of targeting spatial ability in service of improving STEM learning and the role of new technologies in the STEM classroom.

Workshop: Designing for spatial thinking

Theories of embodied cognition reject wholly computational models of cognition to assert that cognition is grounded in the human form and supported by motoric action. While research continues to explore the validity of this assertion, learning environments and pedagogies informed by theories of embodied cognition have begun to demonstrate efficacy for improving spatial thinking. This workshop will explore design principles for improving spatial thinking in STEM disciplines with embodied activities. Participants will gain familiarity with design principles for creating learning environments (digital and analog) that employ embodied activity and various methods for evaluating the effectiveness of such environments. Each participant will have the opportunity to develop a design brief using a backwards-design process to identify target components of spatial thinking in a STEM discipline and outline a design brief for facilitating learning.

ZACHARIAS ZACHARIA

Bio Sketch:

Zacharias C. Zacharia is a Professor of Science Education and director of the Research in Science and Technology Education Group at the University of Cyprus. He completed a B.A. in Education at the University of Cyprus (Cyprus), a B.A. in Physics at Rutgers University – New Brunswick (USA), and his graduate studies (M.A., M.Sc., M.Phil and PhD) in Science Education at Columbia University, New York (USA). He has been the (co-) coordinator of several research projects concerning computer supported, inquiry-based learning that received continuous financial support over the years from the European Commission. He was an associate editor for the past six years for the Journal of Research in Science Teaching, and currently an editor of the EURASIA Journal of Mathematics, Science and Technology Education and a member of the editorial board of the Journal of Science Education and Technology and the Journal of Computers in Mathematics and Science Teaching. He is also a reviewer for several major ISI journals.

Talk:

Using physical and virtual labs for experimentation in science education: From theory and research to practice

The purpose of this talk is to present how theory and research has informed practice in using Physical and Virtual labs for Experimentation in Science Education across K-16. Specifically, the talk will reflect on the ongoing debate on using physical and/or virtual labs both from an empirical/research and theoretical standpoint. The theoretical perspectives were drawn from two types of theories, namely embodied cognition and additional (touch) sensory channel, which were associated with the use of physical and virtual manipulatives for learning purposes. The empirical perspectives were drawn from the literature of the domain, which concerned the full text of the publications since 1971 (up until March 2015) across all of the EBSCO databases. The empirical evidence was drawn from two different lines of research. The first line of research involves studies that have focused on comparing physical manipulatives and virtual manipulatives (without the provision of haptic feedback), whereas the second involves studies that have focused on comparing virtual manipulatives with and without the provision of touch sensory (haptic) feedback. Both theories supply strong arguments for providing touch sensory feedback during science experimentation, whereas the empirical research outcomes show that providing touch sensory feedback is not always a prerequisite for learning science through experimentation. Those instances for which touch sensory feedback does appear to be a necessity for learning science through experimentation are identified. Finally, the talk concludes with an example of how this information, both theoretical and empirical, have informed practice. The case of the Go-Lab platform will be presented (www.golabz.eu).

NIKOLETTA XENOFONTOS

Bio Sketch:

Nikoletta Xenofontos is a Researcher of the Research in Science and Technology Education Group at the Department of Education of the University of Cyprus. She completed a B.A. in Education, a M.A. and a PhD in Learning in Natural Sciences, at the University of Cyprus. Her research interests focus on enhancing students' conceptual understanding and acquisition of inquiry skills through the use of inquiry-based learning environments. She is also interested in the use of ICT in Science Education and in developing and assessing learning and teaching materials. She participated in several national and EU funded projects (e.g. SCY, Go-Lab, Ark of Inquiry, Next-Lab). She has published papers in major ISI journals.

Workshop: The Go-Lab sharing and authoring platform

The Go-Lab Sharing and Authoring Platform offers reach resources and innovative learning tools to support Inquiry-Based Science Education in schools. With these tools, students, from 6 to 18 years old, will gain hands-on experience with doing science and will acquire 21st century skills. During the workshop participants will get introduced to the Go-Lab Sharing Platform and explore the available online labs, learning apps and inquiry spaces. The repository of online labs includes remotely operated and virtual laboratories, data sets and analysis tools for Physics, Astronomy, Chemistry, Biology, and other science domains. The repository of apps includes guidance applications that assist students in completing learning processes such as formulating hypotheses, designing experiments, and drawing conclusions. The repository of Inquiry Learning Spaces (ILSs) includes online student environments which have been created by other Go-Lab users. ILSs is a combination of online labs, apps and other learning resources in a structured online student environment, customizable according to specific lesson and students' needs. Participants will also learn how to use the Go-Lab Authoring Platform to create personalized ILSs, to enrich science activities with appealing online experiments and demos. Moreover, they will become members of the Go-Lab Community and learn how to benefit from it when using the Go-Lab Ecosystem.

LEILAH LYONS

Bio Sketch:

Dr. Lyons is an Associate Professor at the University of Illinois at Chicago, where she has a dual appointment in Computer Science and the Learning Sciences departments, and a split appointment with the New York Hall of Science, where she serves as the Director of Digital Learning Research. Her main research interest is in the design and assessment of collaborative digital museum exhibits, and has tested exhibits at the New York Hall of Science, the Brookfield Zoo in Chicago, the Jane Addams Hull House Museum in Chicago, the Exploratorium in San Francisco, and the Ann Arbor Hands on Museum in Michigan. Her work makes use of a wide range of interactive technologies, from various forms of sensing to touch interfaces to mobile devices.

Talk and Workshop: Employing embodiment in the design of collaborative exhibits

Dr. Lyons will discuss the design process for employing embodied interactions within informal learning settings, using several prior exhibits to illustrate the range of ways that exhibits can mediate learner interactions. Dourish (2001) frames "embodied interaction" in terms of the full range of ways humans can be situated within a context: within the body's own sense of itself (proprioception) and its motion (kinesthesia), within the

physical setting of material objects, and within the current social milieu. These three aspects of embodied interactions are reflected by the first two of the three main theses in the field of situated cognition, as described by Robbins & Ayede (2009): (1) *embodiment*, which posits that cognition is rooted not just in the brain but in the body and its sensations, and (2) *embedding*, meaning that cognition exploits structures found in the natural and social environment. The third thesis of situated cognition is (3) *extension*, which examines how cognition can span beyond individual organisms. Collaborative museum exhibits seek to support the *extension* of cognition, by helping museum visitors help each other come to understand the exhibit's content. With the advent of ubiquitous interaction technologies, exhibit designers have more tools for embodying, embedding, and extending the learning of visitors. The embodied exhibit examples Dr. Lyons will cover will span a gamut of topic areas, from environmental science to data literacy to electrical engineering.

The workshop led by Dr. Lyons will engage participants in a hands-on brainstorming and design session, inviting participants to generate ideas for how embodiment could be used to convey otherwise-challenging concepts selected from different STEM (Science, Technology, Engineering, and Math) conceptual domains. Via a guided collaborative paper prototyping process, participants will be given the opportunity to playfully generate ideas for embodied learning experiences, and in so doing, more deeply explore the challenges of employing embodiment in designed learning environments, and the possible roles of different forms of technology for supporting those embodied experiences.


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