

THE COGNITIVE NEUROSCIENCES

Fourth Edition

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PREFACE

It has been 20 years since we first met in Squaw Valley to assess the state of cognitive neuroscience. We have held this meeting three times before and each meeting had its own signature. When the first meeting concluded, we knew we had a vibrant, young field on our hands. As the years passed, our knowledge deepened and slowly and gradually new ideas emerged. With the fourth meeting cognitive neuroscience is busting out all over. Fundamental stances are changing and new ideas are emerging. Everything from the view that individual neurons change their functional role through time to claims that our moral decisions can be tracked in the brain are indicants of the range and excitement of cognitive neuroscience. Fresh air sweeps in and reinvigorates us on the view that we will some day figure out how the brain works its magic and produces the human mind.

It is always in the first two sessions that one finds the contrast in approaches to studying the brain so markedly different. The development and evolution section talks about a dynamic growth pattern that becomes specific and fixed. At the same time those interested in plasticity see the neuronal systems always changing and the dynamics seen in development as continuing for the life of the brain. In our most recent meeting the reports on brain plasticity were more bold than ever before.

The attention session featured a new emphasis on the interactions between reafferent top-down and feed-forward, bottom-up attentional processes. Benefiting from ever-impressive technological advances, the elucidation of attentional mechanisms is proceeding at a dizzying pace. It is refreshing to note that in addition to providing a more comprehensive picture of attentional processes, this exciting new empirical evidence has also verified many central tenets of some of the most longstanding and influential theories in the cognitive neuroscience of attention.

In the motor session, the boundaries of the motor system continued to be pushed further into the realm of cognition. Some have demonstrated the existence of motor-related areas in the parietal lobe that are involved in representing goals of oneself and of others, providing a link for how we may intuitively translate the actions of others into a model of their mental processes. Separate research indicates that areas once thought to have only motor roles actually contain circuits related to executive and limbic function, further complicating the distinction between cognition and motor processes. Perhaps above all else, the work of the motor section suggests that we might be wise to relieve ourselves of the need to make stark distinctions between these two phenomena, at least in higher primates.

Memory research is, paradoxically, providing great insight into how humans imagine future events. Moreover, new models of reconsolidation and retrieval are emerging, and exciting evidence of individual differences in cortical activation patterns during episodic retrieval are forcing a careful reevaluation of central tenets of functional imaging analysis.

The perception session demonstrated the vast potential of Bayesian modeling to provide beneficial descriptions of how the brain performs various functions. But Bayesian modeling

does not hold a monopoly; other theoretical and methodological pioneers are dramatically enhancing our understanding of vision, quite literally from the level of the retina to large-scale networks that connect distributed regions of the cortex. Keeping pace with advances in vision science are exciting findings across the modalities of audition, olfaction, and vestibular function.

Next, we turned our attention to language (and secretly hoped that a few lectures would pass without mention of the word “Bayesian”). The understanding of specific components of language processing is expanding, while exciting parallel studies are examining the genes that may wire our brain in a way that enables language acquisition. But even as we move toward an understanding of how genes and experience sculpt the human brain into a speaking device, the question of who exactly is doing the speaking arises. Fittingly, we transitioned into the session on executive function, where we came across a surprising answer to this question. There does not appear to be a need for a “top” in top-down control; instead, various regions for self-regulation and cognitive control have been identified and their interactions have been modeled in ways that leave the mythical homunculus homeless. As if this were not profound enough, we also learned about an exciting new characterization of resting brain activity, a remarkable advance that has too many implications to list.

Over a week removed from our introduction to theory of mind in the motor session, the emotion and social neuroscience section further demystified the rapidly expanding science of the social brain. New ideas on how our emotions and sense of self inform the ways in which we think about and reflexively understand others continue to evolve, while evidence for the genetic basis of individual variation in affect and, astoundingly, for differences in BOLD activity related to this genetic variation has further shaped the current models of how the emotional brain develops and operates.

As it always does, the conference ended with a bang, featuring two days’ worth of lively discussion on the topic of consciousness. An exciting novel mechanism for how the brain generates the baseline activity necessary to sustain conscious experience was complemented by a bold theoretical attempt to make the problem of qualia a bit more tractable. Between these extremes, others reported suggestive new evidence about the neural basis of visual conscious experience. This session also served as a reminder of how far we had come during those three weeks in Squaw Valley, as topics such as action, emotion, language, and executive function reemerged in the context of examining how such varied processing contributes to the content of conscious experience.

After three weeks of such intense stimulation, it is a testament to the amazing progress unveiled that one somehow leaves Tahoe reinvigorated and enthusiastic to get back into the lab. The past 20 years have seen advances that we could never have anticipated, and, incredibly, the next five or ten hold the potential to continue this exponential progress. The Summer Institute at Tahoe reveals simultaneously the exciting new ideas in the field and the bright minds that are vigorously attacking the persisting mysteries of cognitive neuroscience. It also exposes a talented group of graduate and postdoctoral students to the wonderful breadth and depth of the field. Scanning the room of eager young minds hanging onto the words of the various leaders of the field is truly a sight to behold. It is exhilarating to witness the handing of the baton from one generation to the next. One can only pause, take it all in, smile, and then get back to paying attention to the lecture because the next big idea presented might knock you right out of your seat!

Needless to say, complex events and publications like this work well only if there are dedicated people involved. First, the MIT Press continues to be exceptionally supportive in carrying out high-quality production in a timely manner. Once again my daughter, Marin Gazzaniga, managed the ebb and flow of the manuscripts, playing both good cop and bad cop as the manuscripts moved between authors, section editors, and ultimately the publisher. Marin is a brilliant playwright, actress, and writer in her own right, and all of those skills are required in herding academics to a common goal.

The actual event at Lake Tahoe was managed from the beginning by my assistant, Jayne Rosenblatt. She is always good humored and incredibly dedicated and runs complex events seemingly effortlessly. Finally, these books don't just happen. Peggy Gordon brings it all together into print with a steady hand and professionalism.

Warm thanks and congratulations to all. We will see you all again in five years.

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