Foreword

Intelligent behavior is characterized by the flexible and creative pursuit of endogenously defined goals. It has emerged in humans through the stages of evolution that are manifested in the brains and behaviors of other animals. Intentionality is a key concept by which to link brain dynamics to goal-directed behavior. The archetypal form of intentional behavior is an act of observation through time and space, by which information is sought for the guidance of future action. Sequences of such acts constitute the key desired property of free-roving, semiautonomous devices capable of exploring remote environments that are inhospitable for humans. Intentionality consists of (a) the neurodynamics by which images are created of future states as goals, (b) command sequences by which to act in pursuit of goals, (c) the prediction of changes in sensory input resulting from intended actions (reafference), (d) the evaluation of performance, and (e) modification of the device by itself in learning from the consequences of its intended actions. These principles are well known among psychologists, philosophers, and engineers (e.g., Ashby, 1952; Clark, 1996; Hendriks-Jansen, 1996; Merleau-Ponty, 1945/1962).

What is new is the development of nonlinear mesoscopic brain dynamics (Freeman, 2000) by which to apply complexity theory in order to understand and emulate the construction of meaningful patterns of endogenous activity that implement the action-perception cycle (Merleau-Ponty, 1942/1963) as exemplified by the perceptual process of observation.

The prototypic hardware realization of intelligent behavior is already apparent in certain classes of robots. The chaotic neurodynamics of sensory cortices in pattern recognition is ready for hardware embodiments, which are needed to provide the eyes, noses, and ears of devices for survival and intentional operation—as distinct from autonomous operation in connoting cooperation with the controller—in complex and/or unpredictable environments.

The three salient characteristics of intentionality are (a) intent or directedness toward some future state or goal, (b) wholeness, and (c) unity. These three aspects correspond to the current use of the term in psychology (with the meaning of purpose), in medicine (with the meaning of the mode of healing and integration of the body), and in analytic philosophy (with the meaning of the way in which beliefs and thoughts are connected with or about objects and events in the world, also known as the symbol-grounding problem).

Intent comprises the endogenous initiation, construction, and direction of behavior into the world. It emerges from brains. Humans, animals, and autonomous robots select their own goals, plan their own tactics, and choose when to begin, modify, and stop sequences of action. Humans at least are subjectively aware of themselves acting, but consciousness is not a necessary property of intention. Unity appears in the combining of input from all sensory modalities into gestalts, in the coordination of all parts of the body, both musculoskeletal and autonomic, into adaptive, flexible, yet focused movements. Subjectively, unity appears in the awareness of self and emotion, but again this is not intrinsic to or a requisite for intention. Wholeness is revealed by the orderly changes in the self and its behavior that constitute the development, maturation, and adaptation of the self, within the constraints of its genes or design principles, and its material, social, and industrial environments. Subjectively, wholeness is revealed in the remembrance of self through a lifetime of change, although the influences of accumulated and integrated experience on current behavior are not dependent on recollection and recognition. In brief, simulation of intentionality should be directed toward replicating the mechanisms by which goal states are constructed, approached, and evaluated, and not toward emulating processes of consciousness, awareness, emotion, and so forth in machines.

Chaotic dynamics has proved to be extremely difficult to harness in the service of intelligent machines. Most studies that purport to control chaos either find ways to suppress it and replace it with periodic or quasiperiodic fluctuations, or to lock two or more oscillators into synchrony, sharing a common aperiodic wave form often as an optimal means for encryption and secure transmission. Our aim is to employ chaotic dynamics as the means for creating novel and endogenous space-time patterns, which must be the means to achieve any significant degree of autonomy in devices that must operate far from human guidance, where in order to function they must make up their courses of action as they go along. We know of no other way to approach a solution to the problem of how to introduce creative processes into machines other than to simulate the dynamics we have found in animal brains. To be sure, there are major unsolved problems in this approach, with the chief among them being that we know too little about the dynamics of the limbic system. Hence, we find it necessary to restrict the development of hardware models to the stage of brain-world interaction that we know best, which is the field of perception. In brief, what are the problems in giving eyes, ears, and a nose to a robot so that it might learn about its environment in something like the way that even the simpler animals do by creating hypotheses and testing them through their own actions?

The formation of a worldview by which the device can guide its explorations for the means to reach its goals depends on the integration of the outputs of the several sensory systems in order to form a multisensory percept known as a gestalt. The sequential frames deriving from sampling the environment must then be integrated over time and oriented in space.

It is also clear that such devices were first built by the pioneer of intentional robotics, W. Grey Walter (1953), and are now in advanced development to meet the challenges of extraterrestrial exploration with intentional robots (Huntsberger, 2001; Huntsberger, Tunstel, & Kozma, 2006; Kozma, in press). The proper path of future management will not be by techniques of passive memory installation or of training and aversive conditioning, but by education with the inculcation of desired values determined by the manufacturers that will govern the choices that must by definition be made by the newly intentional and quasi-autonomous mechanical devices.

This book provides both a toolbox and mapping for the exploration of new landscapes of the human technocultural environment.

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