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Intention Awareness in the Nutshell

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Military strategists, like philosophers and cognitive scientists, have struggled with the concept of intention through their extensive study of human behavior. With a mission of bringing security and stability to all aspects of social, economic, and political life, the military, as an organization, has evolved while war undeniably remains an invariant element of human history. Adapting to changes and new demands, the military apparatus created a rich living discipline of structures, processes, technologies, and above all, philosophies and paradigms of thinking. At its core, this discipline seeks to achieve an ideal state of effective and efficient human action.

As problems change, engineering methodology adapts to these changing conditions and creates new solutions. Military engineering techniques have an inherent limit to their capacity because they are based upon a specific philosophical paradigm. A changing perspective and adaptability to new conditions have proven successful methods for finding new solutions. Military philosophers question and analyze conceptual foundations in order to define new paradigms, new methods, and certainly new solutions. The process of philosophical investigation initiates military transformation.

By studying war, Western military philosophers realized that any physical reality is shaped by countless human cognitive realities. These compete to form a given physical space, which is stretched, deformed, and often torn apart. As a paramount competitive human behavior, war brings uncertainties to physical reality, cognitive realities, and to relationships among them.

Bruner, among others, argues that cognitive processes such as problem solving, and planning occur below the threshold of consciousness [Bruner 81]. Anything occurring in the unconscious may be regarded as a form of uncertainty in the cognitive reality. Intentions are relationships between cognitive states and their object or objects [Haugeland 97]. These objects may or may not exist in the physical world, which makes intentions unique relationships. As a buffer for physical action, intentions facilitate the transformation of cognitive processes from cognitive realities into a physical one. Intentions act as an automaton that organizes unconscious processes into a hierarchy of basic conscious components such as situation-action and action-situation trees, a type of decision trees (see [Clemen 96]). Carried out in sequential, and often linear, order, situation-action and action-situation trees occur in a spatiotemporal—and consequently physical—reality. The hierarchical classification of intentions and their basic components as they approach action and interaction in the environment is a linearization necessary to simplify the relation of time to states and actions in a spatiotemporal reality. Awareness of one's intentions therefore lowers the threshold of consciousness by reducing unconscious cognitive processes, particularly reasoning. Reducing cognitive uncertainty can be achieved by such processes as the transformation of intuitive and abductive reasoning - arguably unconscious processes - into inductive or deductive reasoning – conscious processes [Johnson 04]. Plans and planning awareness resulting from internal intention awareness externalize unconscious

processes into conscious ones. The theory of intention awareness as formulated by Newton Howard [Howard 02] claims that:

1) Cognitive uncertainty, and consequently elements of physical uncertainty, occurs because of higher consciousness thresholds.
2) Intentions play an essential role in transforming unconscious processes into conscious processes and physical activities.
3) There are methods to reduce consciousness thresholds by treating the mind as a physical system, thus proposing the Physics of Cognition [Howard 01] as a research agenda.

To gain effective and efficient human behavior conditioned by physical and cognitive uncertainties, the US military has incorporated methods that enhance internal intention awareness. Simple examples include operation orders, decision-making, writing operation plans, rehearsals, and briefbacks. Once mastered, these instill the concept of internal intention awareness - making soldiers aware of their own cognitive processes. Furthermore, these methods propagate a given hierarchy of intentions, which is an expression of normalization deployed by the military as an organization. Such components of military doctrine and their effects directly contribute to reducing cognitive uncertainty. Systems designed to support human action in this context should adopt and carry these uncertainty-reducing elements. As outsiders, system engineers may not realize the subtle significance of these methods and their effects. The disparity between engineering and purpose is an inherent limitation because human activities are comprised of tacit knowledge.

In its most basic form - thinking about thinking mechanisms – the internal theory of intention awareness offers no new insight. The theory's implications on system design, however, remain significant. Influenced by the concept of situation awareness in the last two decades, system design has focused on the spatiotemporal distribution of artifacts. Information systems specifically harnessed for military command, control, communications, and intelligence have exhibited strong spatiotemporal situation awareness while ignoring cognitive aspects, especially intentions [Howard 02].
The paradigm of spatiotemporal-oriented system design is fundamentally incomplete even in the absence of latency in communications. Latency of meaning in real-time communications remains a challenge simply because meaning resides primarily in cognitive realities. Engineering a concept like meaning or more generally, cognitive states and processes, in human support systems proved an exigent endeavor due to abundance, and not scarcity, of cognitive models [Endsley 00]. While some researchers argued that the difficulty in understanding and thus theorizing cognitive processes limits their integration in system design, successful yet primitive techniques implemented in aviation proved promising [Banks 91]. From a theoretical and practical point of view, although these techniques were first implemented in aviation, it is possible to extend the theory in other fields [Hajdukiewicz 99].

The external theory of intention awareness [Howard 02], however, argues that interaction not only reveals patterns of actions and intentions, but also creates intentions and patterns of intentions. This theory is based upon an unconventional view of intentions as emergent products of competitive physical interaction [Gibbs 01]. External intention awareness claims that observing human behavior facilitated by Ethnomethodology allows for:

1) Identifying patterns of actions and intentions,
2) Associating actions and intentions with situations,
3) Formulating situated intentions as they emerge from competitive interaction.

The dominant system implementation of external intention awareness is oriented on reverse engineering action to deduce intentions that guide action. Such a mechanism serves to predict future

actions within given contexts driven delimited intentions. This system design paradigm is essentially described by feedforward control cycles [Albus 01]. However, in adopting a holistic view of intentions as internally formed in cognitive realities and externally created due to physical interaction, action has intentional causes[1] and intentional effects[2]. Action reveals existing guiding intentions and intentions likely to be created. The latter represent key element of external intention awareness. Awareness in this sense requires a non-linear chain of intentions and actions, which presents an impending challenge on system design. In simple terms, differences between these two paradigms can be described as follows:

First Paradigm:
Within the physical sense of time, if intention I_{t_0}, at time t_0 guides action A_{t_1} at time t_1, then by observing A_{t_1} at t_1 one can formulate I_{t_0}. By assuming I_{t_0} and knowing A_{t_1}, one can predict action A_{t_2} at t_2.

Second Paradigm:
In this same sense of time, if intention I_{t_0}, at time t_0 guides action A_{t_1} at time t_1, then observing A_{t_1} at t_1, one can formulate intention I_{t_0} and intention I_{t_1} which is likely to be created at time t_1. Thus, one can predict action A_{t_2} at t_2 based on greater awareness - knowing I_{t_0}, A_{t_1}, and I_{t_1}. Intentions I_{t_0} and I_{t_1} may be related or unrelated.

One may capture the essence of intention awareness and its relationship to spatiotemporal situation awareness by fathoming a game of chess. Each player establishes spatiotemporal awareness by registering the relative physical distribution of pieces on the board. A good player starts monitoring the formation of his own strategies and intentions. The player also develops awareness of their physical expression by a sequence of moves. This formation and awareness of strategies, intentions, and their physical expression constitute internal intention awareness, which guides each player's subsequent moves. Internal intention awareness here also controls one's impulses and surprises by deceiving the opponent. As the game progresses, a good player starts analyzing the opponent's moves. Consequent awareness of the opponent's intentions and strategies helps in choosing future strategies. From experience, a good player can use one's emerging intentions and awareness of opponent emerging intentions to predict future moves. Master chess players integrate actual moves with internal cognitive processes and their opponent's likely cognitive processes to predict a game's evolution. Such cognitive models result from playing many games with many different opponents who use different methodologies. Situation Awareness is reached by combining internal and external intention awareness with spatiotemporal situation awareness.

A chess game demonstrates that colliding cognitive realities reach a climax before creating a physical reality. A sound model of war, chess has all basic principles, as defined by military doctrine: Objective, Offensive, Mass, Economy of Force, Maneuver, Unity of command, Security, Surprise, and Simplicity [FM 100-5]. Chess nevertheless remains a simplistic representation of war because it does not highlight the cooperative nature of human behavior. A non-standard, multi-player version of chess could incorporate this cooperative nature. With five players on each side of the board, for example, each individual player has a limited view of the board that changes over time, and only controls some

[1] Intentions that cause actions.
[2] Intentions that emerge from actions.

of the pieces at any given time. Based on standard rules of chess, rules for this version of the game include:

1. Each player has limited view of the board and this view will change over time.
2. Each player controls the movement of some pieces, not all, this control may change in time.
3. All players have to participate in the game.
4. Each team may organize themselves in any structure they think is suitable. They may communicate with each other in a secured way and unsecured way.
5. All players may have full view of the board but for limited number of times, one time per player, say.
6. Each team has up to five moves before the other team is required to respond.

Game strategies and challenges posed to each player in this context provide a likely representation of competitive human behavior, ranging from cooperation to conflict.

In simple terms, the theory of intention awareness is an integration of internal and external elements in a multi-agent competitive interaction environment, given the unique role of intentions. In a game of chess, adopting spatiotemporal situation awareness only, guarantees that one can play but he will probably lose. While adopting intention awareness only, one may understand the game and still lose.

System efficiency and effectiveness depends on their respective qualities of adopting intentions and rationale. These two aspects have forms and structures revealed in behavioral patterns.

Although intention awareness emerged from military science, it is by no means specific to that discipline. The theory applies to a wider range of human activities – any activity that requires effective and efficient collective human action under conditions that strain behavioral thresholds.

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