Archetypal Patterns of Life for Military Training Simulations

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ABSTRACT

Across societies, cultures, and geographic regions, reoccurring patterns of generalizable human behavior emerge, and within a given sociocultural context, recognizable and reasonably stable patterns of life can be observed, enabling the mental creation of a "baseline" of normal activity. To operate effectively in complex urban contexts, military personnel must be able to recognize local baselines and to use their knowledge of both local and archetypal patterns of life to intuitively identify and respond to anomalies in those baselines.

Enabling personnel to develop these nuanced sociocultural perceptual skills presents several science-and-technology challenges. For instance, available training products may effectively train region-specific competencies or even general cultural awareness, but these programs rarely emphasize archetypal patterns or strategies for identifying anomalies in operational settings. Also, additional work must be conducted to construct appropriate constructive simulations in which to practice these skills; that is, the community must define more computationally grounded principles for integrated, realistic behaviors.

In this paper, we will provide a synthesized overview of the research that informs theories on "Patterns of Life. We also offer a construct definition for the phrase and outline initial thoughts about its training. Then we describe the behavior-representation and behavior-generation gaps that must be resolved before patterns-of-life training simulations can fully address the training need. Finally, we outline our current effort to leverage the integrated academic findings, research-based military training strategies, and next-generation behavioral models to develop a government-owned immersive simulator for training Marines to recognize patterns of life and learn baselining skills.

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INTRODUCTION

This paper describes a unique approach to developing a cultural-general simulation-based training system. First, we review the underlying social science principles in detail, and then we consider how such theories can be translated into actionable computational approaches for modeling entity behavior in the proposed simulator. Our specific simulation focuses on Marine Corps tactical training, but the lessons learned from this exploration should provide broad insights across the military and beyond the Defense sector.

DEMAND SIGNAL

"Knowledge of the cultural terrain can be as important as, and sometimes even more important than, the knowledge of the geographical terrain. This observation acknowledges that the people are, in many respects, the decisive terrain, and that we must study that terrain in the same way that we have always studied the geographical terrain."

– General David H. Petraeus,
Former Commanding General,
Multi-National Force Iraq
(Petraeus, 2009)

Military science and anthropology have had a long, intertwined history. Even millennia ago, Sun Tzu famously cautioned warriors to both know themselves and their opponents. In our more immediate history, cultural studies have played significant roles in World Wars I and II, and the Vietnam conflict, but following Vietnam, the military and the social science community encountered a schism (McFate, 2005).

In part due to failures that occurred during Vietnam, military leaders grew skeptical of the relevance of cultural studies, and the Joint Chiefs of Staff refocused their national-security strategy on conventional warfare, which (they believed) did not require cultural insights. This created several decades of separation between anthropologists and military leaders, fostering a "lack of cultural knowledge in [the United States'] national-security establishment" (McFate, 2005, p. 26). As a result, "when the United States invaded Afghanistan in 2001 and Iraq in 2003, 'culture' was not part of the vocabulary of war" (Davis, 2010).

Recent conflicts, however, have once again thrust the US into unconventional settings, where traditional victory on the battlefield is irrelevant compared with the struggles for power and legitimacy that occur in the diplomatic, informational, and economic spheres of influence. In other words, "the ongoing insurgency in Iraq has served as a wake-up call to the military that adversary culture matters" (McFate, 2005a, p.43; see also U.S. Department of Defense, 2010; Turnley et al., 2012; Selmeski, 2007).

Consequently, the US military has re-embraced cultural studies in an unprecedented way, and military stakeholders now widely acknowledge that personnel must possess keen cultural skills in order to excel in today's—and likely tomorrow's—complex and irregular conflicts. However, despite this clear demand signal, the recent reintegration of military science and anthropological studies has had a rocky road.

Culture-Specific Training

Initially, as the need for cultural "tools" arose, military personnel attempted to address the training gap by themselves. Before a formal cultural training policy even existed in the Army or Marine Corps, individual units began developing ad hoc training materials, such as small pamphlets or "smart cards" (see Figure 1)—but these efforts were scattershot, reactive, and quickly came to be regarded skeptically by deployed warfighters (Davis, 2010; McFarland, 2005).

Figure 1. Culture cards. Photo by Master Sgt. Keith Milks.

Even after the terrorist attacks of 9/11 and subsequent invasion of Afghanistan, "the vast majority of the military, both leaders and troops on the ground, saw culture as either irrelevant to the mission or possibly corrosive of military effectiveness" (Davis 2010). Consequently, the military invested minimal effort in cultural preparedness, instead "recycling old material and hiring contractors to churn out handbooks, compact discs and PowerPoint presentations about Iraq, Arabs and Islam" (Davis, 2010).

These initial forays into modern military cultural training generally shared a stopgap flavor; that is, they focused on "narrow, superficial, short-term responses to specific pressing needs" (Selmeski, 2007; see Table 1 for a more specific summary of the limitations). They emphasized region-specific descriptive facts and figures; generally relied upon static or didactic training approaches, such as pre-deployment briefings or pocket reference guides; and, ultimately, did little to prepare warfighters (e.g., McFarland, 2005).

Table 1. Summary of four culture-specific training limitations for the military community

Gap	Description
1. Quality of Content: Overreliance on a few subject-matter experts (SMEs) and/or out-of-date ethnographic data	Culture-specific training relies heavily upon inputs from individual SMEs and/or data collected through ethnographic observation, both of which have flaws. The SME inputs may be biased, inaccurate, or incomplete (as the military discovered with its recent Iraq, Afghanistan, and Islamic training interventions; see Davis, 2010). Similarly, the observation data rapidly becomes outdated, and it too may suffer from statistical biases or other confounds (Abbe & Halpin, 2010). Hence, overreliance on SMEs and—generally quite-dated—ethnographic data hinders the quality of culture-specific training content.
2. Breadth of Content: Culture-specific training cannot describe all possible cultures that exist within a given region	Wide cultural variations exist within any single country, in regard to ethnic group, religion, region, organization, profession, and so on (Rentsch, Gunderson, Goodwin, & Abbe, 2007); however, even if training developers were so inclined (and often they are not), the training cannot possibly cover all of these nuanced variations. As a result, most culture-specific training groups all people under large-scale categories that ultimately fail to fit anyone. As the military discovered with its Middle Eastern training, "the materials present all Iraqis as essentially the same, thereby lumping together 27 million people of varied educational backgrounds, residential locations, generations, ethnicities, religions and economic incomes, among other differences" (Davis, 2010). At best, such training promotes simplified overgeneralization and, at worst, it provides misleading advice to personnel.
3. Not Actionable: Culture-specific training emphasizes differences between cultures but fails to give personnel knowledge and skills that they can immediately act upon	Culture-specific training conveys declarative knowledge about culturally diverse groups. However, most culture-specific training neither adequately explains the deeper rationale behind observed behaviors nor how to meaningfully apply this knowledge in real-world operations. "Pedagogically, the presentation fails to make clear why the factoids are important" (Davis, 2010). As a result, while culture-specific training has its value, "the common broad representations of culture create an image of static societies and do not prepare members of the military to interact with individuals" (Abbe & Haplin, 2010).
4. Ultimately Not Useful: When used as the sole method of training, region-specific declarative knowledge training does not effectively support personnel	Region-specific training offers narrow generalizations and overly-simplified stereotypes, which have proved problematic across all echelons. As retired-Colonel Maxie McFarland explains, culture-specific training programs "fall far short of generating the tactile understanding necessary for today's complex settings, especially when values and norms are so divergent they clash" (2005). Further, these programs are ineffective when they fail to address personnel's "rigid interpersonal behavior or ethnocentric attitudes" (Abbe & Halpin, 2010). It is not surprising, then, that when a group of Soldiers and Marines were asked, the majority replied that their culture-specific training was "not useful" or that "general education to develop the knowledge and skills related to understanding social structures would be more helpful than the specific cultural awareness training" they had received (Army report cited in McFate, 2005, p. 35).

Culture-General Training

To address the limitations of the didactic, region-specific cultural training efforts, military stakeholders turned to the wide array of existing commercial, academic, and government cultural training programs, designed to support cultural awareness training in other sectors (McFarland, 2005). Such cross-cultural training fosters students' cognitive, affective, and behavioral competencies by exposing them "to a variety of cultural habits, norms, roles, values, and circumstances…which reflect the variations that exist anywhere on earth" (Triandis, 1977, p. 21). These programs generally include training on (1) self-awareness in the context of culture, (2) appreciation of diversity, and (3) general principles about culture (e.g., conscious competency model) that apply around the globe (e.g., Watson, 2010).

For civilian business and leisure travel, there is some evidence that these competencies contribute to intercultural effectiveness, and anecdotal accounts suggest that this training better prepares employees for foreign assignments (e.g., Littrell, et al., 2006; Landis & Brislin, 1996; Morris & Robie, 2001; Black & Mendenhall, 1990; Tung, 1981). Proponents also assert that the "shift toward greater emphasis on generalizable, transferable skill sets, rather than cultural knowledge applicable only in a specific conflict, is a critical component to successfully institutionalizing culture" within the military (Abbe & Halpin, 2010, p. 30).

Many culture-general training packages, however, are intended for international businesspeople or sojourners traveling to other countries. As a result, the training emphasizes longer-term cross-cultural competence, i.e., the development of general behaviors of a "good stranger" (Simmel, 1976), who operates with sensitivity and respect for diverse cultures and who is more concerned with understanding differences than recognizing danger (Abbe & Halpin, 2010). Consequently, despite its utility in other domains, the immediate impact of cultural awareness on military operations has been less obvious. Although empirical research has found some operationally relevant skill sets, such as interpersonal skills, to be responsive to cross-cultural training, most studies do not find clear evidence of enhanced operational performance in cross-cultural settings as a direct result of cross-cultural instruction (e.g., Deshpande & Viswesvaran, 1992; Littrell et al., 2006; Puck et al., 2008; Abbe & Halpin, 2010). "It may be that such cultural self-awareness is a prerequisite for developing other cultural knowledge, but may not contribute directly to intercultural outcomes" (Abbe, Gulick, & Herman, 2008). See Table 2 for a summary of other limitations of culture-general training.

Table 2. Summary of four culture-general training limitations for the military community

Gap	Description
1. Little Evidence of Effectiveness: Empirical data do not clearly support the effectiveness of culture-general military training (when used by itself)	Cross-cultural training has demonstrated benefits; however, the relationship between such training and *applied performance* is less clear (e.g., Puck et al., 2008). Within the military context, in particular, there is little evidence that culture-general programs, alone, directly enhance performance in cross-cultural contexts (e.g., Abbe & Halpin, 2010; Abbe, Gulick, & Herman, 2008)
2. Effects are Moderated: The effectiveness of cross-cultural training is affected by moderating variables, which military personnel may not be able to select for	Numerous moderating variables facilitate the effectiveness of cross-cultural training. These include a variety of individual attributes, cultural toughness, training rigor, timing of training, familial situations, organizational attributes (Litterall et al., 2006, p. 20). Best practices for these moderators, however, have not been aggregated, and even if they had, it is unclear whether military personnel would have the luxury of selecting trainees or training contexts that align with these variables.
3. Not Actionable: Like culture-specific training, culture-general training fails to provide an actionable foundation for military personnel	The interpersonal skills and cultural empathy often gained through culture-general training should not be undervalued; however, these capacities, alone, do not prepare military personnel to take actions in a cross-cultural setting. "An obvious weakness of this method is that it does not necessarily help the trainees to learn anything specific about the host culture(s) in which they will be interacting" (Bhawuk & Brislin, 2000, p. 170).
4. By Itself, Not Useful: When used as the sole method of training, culture-general awareness does not effectively support personnel	The DoD recently outlined 40 cross-cultural learning outcomes that military training programs should address (McDonald et al., 2008). Cultural-general training can meet the objectives involving conceptual knowledge and metacognitive skills. However, many of the more operationally focused skills identified in the report, like sensemaking or complex interpretation, are not met culture-general training alone—nor are they fully met when culture-specific training is also incorporated.

Section Summary

In summary, the military's recent efforts to support cultural training have tended to emphasize culture-specific or culture-general approaches. Both types of cultural knowledge are important but, even when combined, this training leaves gaps in personnel's capabilities (Abbe & Haplin, 2010). Culture-specific training can provide immediate, stopgap declarative knowledge—which has its uses—but this training focuses too narrowly on generalizations and fails to provide sufficiently actionable advice to support complex cross-cultural interchanges. Culture-general knowledge, or the awareness of cultural differences and sensitivity to the ramifications of behavior in light of those differences, is essential; nonetheless, appreciating differences in culture is only the first step toward developing the intercultural competence that would enable a service member to recognize nuanced sociocultural cues, infer their meanings, and apply this knowledge to military operations. Hence, we believe that a "third-leg of the stool" of cultural training is required—something to help personnel integrate their static cultural knowledge and theoretical cross-cultural awareness, and then actively leverage their knowledge, skills, and attitudes to support sociocultural sensemaking. We assert that the missing piece is the study of *patterns of life*.

PATTERNS OF LIFE

"'Most patterns you see, including the ones on sand dunes or fish or tigers or leopards or in the laboratory—even the defects in the patterns—have many universal features,' said Alan Newell, a Regents Professor of Mathematics at the University of Arizona. 'All these different systems exhibit strikingly similar features when it comes to the patterns they form…'"

– Comments from a speech given at the 2011 American Association for the Advancement of Science annual meeting

Across societies, cultures, and geographic regions, reoccurring patterns of generalizable human behavior emerge, and within a given sociocultural context, recognizable and reasonably stable patterns of life can be observed, enabling the mental creation of a "baseline" of normal activity. In conjunction with culture-specific and culture-general knowledge, understanding these archetypal patterns of life, we hypothesize, better prepares personnel to operate effectively in kinetic and nonkinetic cross-cultural settings.

The phrase, "patterns of life" began appearing in the context of cultural studies in military documents around 2008 and has since been used by a variety of military stakeholders, including authors from the Special Forces (e.g., Flynn et al., 2008), Joint (e.g., Carpenter, 2010), Air Force (e.g., AFRL, 2010), Army (e.g., Pinnell, 2009), Navy (Whitmore, 2009), and Marine Corps (e.g., Nasso, 2010) communities.

Despite the apparent pervasiveness of the concept, however, we could not find any formal (nor even informal) definition of the construct. It appears that stakeholders in the military cultural training community have intuitively arrived at the idea that this component of cultural training is necessary, but they have yet to articulate exactly what it involves and how it might be trained. Consequently, we offer the following definition:

> In the context of cultural training, patterns of life are the archetypal emergent properties of a complex sociocultural system.

The subsections below examine the definition further.

Emergent Properties

We use the term *emergent property* to refer to a phenomenon that manifests from, and only becomes observable as a result of, the collective interaction of simpler components (e.g., Lewes, 1875). In other words, an emergent property is the whole that is greater than the sum of its parts. This conceptualization of an emergent property corresponds with its usage in many other disciplines, including philosophy, systems theory, ecology, and Gestalt psychology (to which the above cliché is often attributed).

To better understand the concept, consider chess. A chess game is constrained by the individual parts of the system (e.g., the rules of the game and properties of each piece), but different games unfold in different ways because their outcomes are the result of a complex, dynamical system. Yet, despite the wide range of possible outcomes, the patterns of any single chess game can be described, both qualitatively and quantitatively. Further, the patterns of play across chess games share certain general features that are *ostensive* (i.e., they can be perceived), *coherent* (i.e., they have meaning), and *correlational* (i.e., they have some degree of stability) (Goldstein, 1999; see also Corning, 2002). These are the emergent properties of chess.

Complex System

Emergent properties stem from *complex systems*, which are heterogeneous structures with interconnected parts that exhibit behaviors that are not obviously predictable from the properties of the individual components (e.g., Simon, 1996). This concept is a key tenant of complexi-

ty theory, which suggests that simple dynamical systems can exhibit very complex behaviors and, correspondingly, that underlying any complex system are well-defined processes that govern or generate its behaviors. Yet, while it is easy to describe the processes that initiate the behavior of a complex system, the outcomes of those processes are not wholly derivable *a priori* (e.g., Crutchfield & McNamara, 1987).

Again, consider a chess game. Theorists have thoroughly described the nuances of the game, and computers have defined it in an algorithmic sense. By understanding the interplay of the game's rules and other components, a chess master can excel in the sport and stand a good chance of winning each game. Yet, even Deep Blue (the famous chess-playing computer) cannot completely predict the outcome of any single game, because chess is a complex system. Still, articulation of the system's processes and understanding of its typical emergent properties provides a high degree of insight, which chess masters (of the human or computational varieties) can draw upon to make sense of a game, problem solve, and anticipate their opponents' moves.

Archetypal Patterns

Like the construct *emergent property*, numerous academic disciplines use the term *archetype*; however, in this case, the various researchers fail to agree on its meaning. Rather than engage in a semantic debate on the topic, we simply use the term in its common, definitional sense; i.e., an archetype is prototypical pattern, symbol, or concept. It is a general template from which unique derivatives arise.

Applied to the current topic, we argue that patterns of life fall into archetypal configurations. That is, the emergent properties (mentioned above) can be organized into categories that describe classes of patterns of life that share similar general features, and we expect these same classes will manifest (likely with different nuanced characteristics) across all societies and cultures.

Implications

From this definition, we are further able to draw the following conclusions, which have relevance for military training. Because of the nascence of this area of research, they are described as hypotheses:

Hypothesis$_1$: Patterns of life are structured. We suggest that the emergent properties of patterns of life follow archetypal templates, and further, that these archetypal patterns are structured and relatively stable. This implies that the patterns can be described via a formal classification scheme (e.g., an ontology), which, in turn, will enable theoretical development, computational processing, and corresponding training. Classification would involve describing the features associated with different classes of patterns of life and the relationships among the different categories of patterns.

Hypothesis$_2$: Patterns and anomalies can be modeled. If it is possible to define the processes of a complex sociocultural system, describe the emergent properties of such systems, and articulate an ontological structure of those emergent properties, then it is possible to model these patterns and simulate their dynamic outcomes over time. Thus, simulations of patterns of life could be developed to support a range of activities, from virtual training to constructive mission rehearsal.

Hypothesis$_3$: Codifying patterns of life will enhance training. The human mind's pattern recognition abilities (when properly trained) can sift, connect, and draw meaning out of what seems to be random noise. For example, submarine sonar operators learn to classify and localize ships based on the barest of acoustic signals. Once articulated, we hypothesize that instruction and practice about recognizing patterns of life in sociocultural contexts will give personnel a mental framework that they can use to similarly frame human-terrain problems, address novel challenges, and interpret behaviors across different settings. Thus, by articulating a patterns-of-life theory and operationalizing it for training, we believe we can meaningfully enhance personnel's ability to interact with complex sociocultural contexts (either kinetically or nonkinetically).

Hypothesis$_4$: Anomalies are identifiable. If patterns of life are observable and relatively stable, as research into emergent properties suggests, then anomalies within a given pattern should also be detectable. Further, the process of anomaly pattern recognition should be trainable, and offering this training to personnel should have a direct impact on their operational importance. According to military doctrine, detecting such anomalies helps personnel act more proactively (i.e., "left of bang"), enabling them to better prevent or avoid harm (e.g., Fautua et al., 2010).

Section Summary

In summary, we believe that understanding patterns of life will allow personnel to intuitively recognize the emergent sociocultural patterns with any context and use their skills to support sociocultural sensemaking, the development of mental baselines of normality, anomaly detection, and communication of sociocultural cues (Schatz, Wray, et al., 2012).

Our articulation of this patterns-of-life theory coincides with the classic anthropology academic learning model,

in which instruction does not emphasize *what* anthropologists have discovered but, rather, *how* anthropologists think about what they have learned (Monaghan & Just, 2000). This approach also falls in line with theorists who have argued for the importance of sensemaking processes in cross-cultural adjustment (e.g., Abbe, Gulick, & Herman, 2008; Black et al., 1991; Osland & Bird, 2000), as well as other training methods to enhance personnel's "metacultural awareness" (Johnson & Friedland, 2010). It similarly fits with anthropological theories that suggest core behaviors occur transculturally and correspond with predictable human archetypes (Tomas, 1998; Bhawuk & Brislin, 2000).

Finally, interpretation of these observable patterns goes beyond theoretical culture knowledge or cross-cultural awareness. The patterns-of-life approach provides more actionable tools to personnel. That is, "these processes enable individuals to cope when expectations are violated and to continue learning about a culture over time. An increasingly complex understanding of culture allows one to recognize and make sense of cultural paradoxes—apparent contradictions between cultural values or practices that emerge as one becomes more familiar with a foreign culture" (Osland & Bird, 2000).

EXAMPLES

As a scientific community, we are not yet able to define the formal ontological structure of patterns of life, but theorists have already described various pieces of it. For instance, literature theoreticians have studied archetypal patterns in writing (e.g., Campbell, 1949). A handful of basic, archetypal literary patterns, often called "narrative universals," account for two-thirds of the plots in all narrative tradition (Hogan, 2006). These foundational themes—these patterns of *literary* life—are common across all cultures. Although, each culture may present its own nuanced versions, features of the common themes are discernible worldwide (Bauer, McAdams, & Pals, 2008). Similarly, social scientists have articulated the features of universal social roles (Masolo et al., 2004). These are defined by a number of elements, including "patterns of relationships" (Sowa, 2000), which are observable across societies and cultures.

Within the military domain, researchers have identified universal patterns within counterinsurgency (COIN) operations. The COIN environment is a complex system "with many interdependencies, externalities, and adaptive entities involving both sociocultural and kinetic dynamics" (Flynn, Pottinger, & Batchelor, 2010). Within this system, emergent properties regarding the actors, their relationships, and their social dynamics have been documented. For example, archetypes have been identified, such as the *patron-client network*, *opportunistic insurgent*, and *accidental guerrilla* (Turnley et al., 2012). Further, these generalizations transcend specific cultures (Iraq, Afghanistan, etc.); they describe and predict emergent patterns of life across all insurgent groups (e.g., Turnley et al., 2012; Jager, 2007).

VIRTUAL OBSERVATION PLATFORM

The previous sections did not simply outline academic questions, but rather they laid our foundation for the development a Marine Corps tactical training simulation. The Virtual Observation Platform is an immersive team trainer designed to support experiential learning of perceptual–cognitive skills, including patterns-of-life sensemaking and related communication competencies (see Figure 2). The simulator is intended to facilitate and extend the training delivered via the Marine Corps Combat Hunter program of instruction (for more information on Combat Hunter, see Schatz et al., 2010), which trains personnel in enhanced observation and combat profiling (among other skills).

Figure 2. Artist's conception of the simulator

In the Virtual Observation Platform, Marines will observe a location (e.g., a small town) from a combat outpost, located between 300–1000 meters away. They will have to identify the patterns of activity within the region to establish a baseline, identify anomalies, and, ultimately, to predict deleterious events before they occur (i.e., "left of bang").

Our ongoing theoretical and empirical research involving patterns of life will inform the Virtual Observation Platform directly, and the simulator will incorporate (yet to be developed) instructional principles and assessment metrics related to this area of research. (For more information on the pedagogical elements of the Virtual Observation Platform, see Schatz et al., 2012).

COMPUTATIONAL WAY AHEAD

In order to train Marines to recognize patterns of life from the Virtual Observation Platform, the simulation system must produce a computational manifestation of these patterns in its virtual environment. As the above discussion suggests, validated and practical characterizations of patterns of life are still under development; however, based on existing research and our results to-date, we can begin to consider the computational representation of archetypal patterns of life, which we will implement in the Platform.

Typical Computational Approaches

First, let us briefly consider the standard computational approaches for addressing this sort of challenge. Most simulations that attempt to replicate complex social patterns employ one of two computational methods.

Bottom-up. In this approach, collective behaviors emerge out of the interactions of individual actors or "agents" (Bonabeau, 2002). The agents function independently, developing and acting upon their own beliefs, desires, and goals. They autonomously pursue their objectives and interact with each other as a consequence of their interrelated goals. The resulting behaviors produce patterns of life. For example, if a significant portion of a population of agents were required to travel from their homes outside a large city to its inner core each morning, then a "rush hour" pattern would likely emerge, although no explicit notion of "rush hour" would be encoded in the system.

Top-down. An alternative approach involves using demographic or statistical data to directly encode specific patterns of behavior into a system. In the rush hour example, the system would place a representative number of vehicles on the road at a certain time of day, but the system would not require an individual-level representation of each driver's motivation (i.e., it would not model each character's goals and intents, nor *why* each driver was on the road).

Both of these methods have potential limitations for training patterns of life. The top-down approach requires programmers to directly encode the behaviors that will result in the desired pattern of life, and system developers must anticipate all possible interactions that would influence individual behaviors (e.g., a parade that closes a major thoroughfare). This makes the approach inflexible and less scalable. Additionally, these systems do not encode the underlying causation, which trainees will likely require in order to make sense of the emergent social patterns (Bandura, 1986).

In contrast, bottom-up agent-based systems are *flexible* (each agent has the ability to modify its goals and make new decisions in the light of new information like a road being blocked); *scalable*; and, by design, enable *individual-level observation of causation*, because the action derives from underlying beliefs and intents. The disadvantage of the agent-based approach is that, because its pattern of life are emergent, these systems oftentimes produce outcomes that are undesirable for training, difficult to vary systematically (e.g., to better facilitate trainees' different levels of expertise), or otherwise inappropriate for pedagogical purposes.

A Novel Computational Approach

To best support training, our Virtual Observation Platform will need to incorporate the flexibility, scalability, and transparency of the bottom-up approach along with the pedagogical viability and supervisory control of the top-down method. More specifically, we believe that we can simulate patterns of life by developing a system of interacting agents whose behaviors are governed by a set of rules drawn from scenario, training, and patterns-of-life meta-data. The agents' behaviors will manifest as a result of their various state data, goals, and personal characteristics, as well as information from our ontological definition of possible patterns of life–based behaviors (recall that in $Hypothesis_1$, above, we suggested that these patterns can be captured in such knowledge representations).

Each agent will use probabilistic or fuzzy logic decision-making processes to independently determine its own actions. However, the agents will also be overseen by a controller that monitors the system from the outside and intervenes if the observed, emergent patterns fall beyond the range of desirable outcomes (e.g., if they manifest in undesirable ways or fail to support a scenario's pedagogical goals). When this happens, the controller will dynamically enhance or remove agents' behaviors (or even entire agents). To achieve this, the controller will need to leverage a formalized, quantifiable knowledge representation of patterns of life so that it can mathematically interpret the emergent patterns, identify particular components that are affecting the patterns in specific ways, and then modify these agents to reach more desirable outcomes.

From a mathematical perspective, this approach is not wholly untested. For decades, physicists have been working to quantify a phenomenon called Self-Organized Criticality (SOC). Like our proposed modeling approach for patterns of life, SOC systems can be represented as collections of individual elements with simple local interactions (Bak, Tang & Wiesenfeld, 1987). In addition, the emergent properties of SOC sys-

tems have certain quantifiable features, which can be assessed computationally by using the properties of fractal geometry, 1/f noise equations, and power law distributions. The details of these mathematical approaches are beyond the scope of this paper; the point, here, is simply that mathematical models can be used to determine whether a deterministic chaotic state has been achieved.

There are many documented examples of systems that exhibit SOC behaviors. Examples in physical systems are as diverse as forest fires, shot noise in electronics, and earthquakes in a seismic fault network. In the realm of human interactions, the spread of epidemics (Rhodes et al., 1997), fluctuations of financial market, and severity of wars (Richardson, 1941) have exhibited the scale invariances and other characteristics indicative of SOC patterns. Some recent work has even shown that SOC patterns are detectable in terrorist and insurgent activities (Johnson, 2011).

By relying upon carefully seeded agents and an overseeing controller that employs SOC principles, we believe we can develop an emergent system that acts in semi-predictable ways. If successfully realized, this system will support our $Hypothesis_2$, which suggests that realistic patterns of life can be modeled, and it will allow us to empirically evaluate our $Hypothesis_3$, which asserts that an accurate simulation of patterns of life can effectively support training.

Finally, this approach should also allow us to intentionally insert anomalies (whether they are benign or malignant) into the emergent patterns within the virtual environment, thus addressing our fourth hypothesis. By inserting and manipulating the manifestations of anomalous patterns, trainees will have the opportunity to practice their anomaly detection abilities, sensemaking skills, and other Combat Hunter–related competencies. For instance, if the system generated a realistic rush hour, then the anomaly generation component (drawing from patterns-of-life meta-data and scenario objectives) could insert a potential vehicle-borne improvised explosive device (VBIED) alongside the crowded road. The VBIED would have to exhibit its own unique signature (i.e., its own microcosmic patterns of life) in order to efficaciously support training, and the anomaly's patterns would have to meet the same mathematical standards as the larger pattern of life. Once correctly inserted, however, trainees could practice their observations skills and attempt to identify the threat "left-of-bang."

SUMMARY AND CONCLUSION

In this article, we discussed the importance of military cultural training and highlighted the two common types of such training: culture-specific instruction and culture-general awareness training. Where culture-specific training provides declarative facts about a region, culture-general training develops more conceptual understanding of human behavior. Both of these training approaches, when effectively delivered, can enhance individuals' skills in cross-cultural settings. Unfortunately, even a combination of the best culture-specific and culture-general training leaves some operational gaps; hence, we have proposed an additional training component, called patterns of life.

We hypothesize that archetypal patterns of human behavior can be described, categorized, modeled, and trained. Further, we believe these efforts will have direct, operationally relevant impacts on military personnel's performance in complex sociocultural settings. More specifically, we believe that personnel will be better prepared to operate in complex social contexts if they learn to actively look for sociocultural patterns, identify normal characteristics of the patterns within their areas of operation, and recognize anomalous patterns when they appear.

To support this training, we are developing a simulation-based trainer, called the Virtual Observation Platform. However, more flexible, scalable, and controllable approaches for generating patterns of life are required in order to create accurate and pedagogically viable sociocultural patterns within the virtual environment. We have outlined a possible path toward realizing these complex, realistic, and semi-random patterns for the purposes of training. Our approach integrates bottom-up agent-based modeling with top-down supervisory control, in order to create a dynamically manipulatable, deterministically chaotic system.

Over the next three years, we will continue to refine our theory of patterns of life, as well as the corresponding implementation of that theory in our simulation system. If our hypotheses are supported, then this work will help Marine Corps personnel develop their sociocultural sensemaking, anomaly detection, and cross-cultural perceptual skills.

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