Adaptive Interoperable Models of All Things Based on Human Language

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INTRODUCTION

The ultimate goal of intelligent technologies is to fully understand human speech. Therefore, their ideal models of real things must be based on human language.

We will introduce our Universal Modeling System (UMS) with which we constructed 4,000 models of all things in the dictionary from the sound symbolism of their names. We integrated them in a software system called Readware to test their intelligence, interoperability and relevance. Readware outperformed all global participants in a US government evaluation (TREC Conference, 2000) of question-answering systems. We will present example models from twelve fields (cognition, psychology, biology, sociology, etc.). We hope to openly share UMS with others to create new systems.

BACKGROUND

Due to space restrictions, we will briefly review a representative field of modeling: emotions.

There are four diverging perspectives on emotions (Ruebenstrunk, 2004): *Darwinians* view emotions as evolved phenomena with survival function. They divide emotions into categories of basic emotions such as anger and fear, or suggest emotional dimensions such as arousal and valence (Ekman & Cordaro, 2011; Tomlinson, 2002; Russell, 1980). *Jamesians* believe that emotions always follow bodily changes. *Social-constructivists* view emotions as cultural products that owe their meaning and coherence to learned social rules. *Cognitivists* say that emotions are the product of cognitive appraisal.

Regardless of their perspective, all researchers rely on concepts from *emotional language* as evidence (Fussell, 2002; Ortony, Clore & Collins, 1990). They suggest *semantic universals*—cross-lingual and cross-cultural *concepts*. But languages express emotions differently—concepts (e.g. sadness) don't always map (Shweder, 1994; Goddard, 2002). Some suggest simple terms to define all concepts (Goddard, 2002). Others offer concepts for causes of emotions (e.g. positive/negative reaction).

Since commonality among languages is clearly evident in shared sounds, we looked for concepts associated with sounds—sound symbolism. Researchers either found no consistent sound symbolism (Saussure, 1916), found consistency without precision (Jakobson, 1937; Magnus, 2001), or found partial results (Rhodes & Lawler, 1981). In contrast, our findings were so precise and comprehensive that we developed a universal modeling technique and built 4,000 adaptive interoperable algorithmic models of all things, simply based on the sound symbolism of their names (Adi,

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Ewell, Adi & Vogel, 2009). Moreover, we successfully implemented these models in a top-performing technology with general intelligence (Readware).

A UNIVERSAL MODELING SYSTEM

We will now introduce our modeling technique and its sound-symbolic basis with the help of tables (Adi, 2007; Adi, Ewell, Vogel, Payton & Hippchen, in press). We focused our search for sound symbolism on Arabic because, unlike other languages, its sounds and words remained unchanged for 1,400 years. For example, *anger* stems from German *ärger* (=annoyance), *anxiety* stems from German *angst* (=fear).

Table 1 basically says that each of the 28 Arabic sounds (consonants) symbolizes a universal two-dimensional process concept: an *interaction type* and a *process type*. There are four interaction types: *closed-self, open-self, closed-others,* and *open-others.* There are three *elementary* process types, *assignment, manifestation,* and *containment*, and four *compound* process types that consist of their combinations. For example, the sound *"fa"* (Column 2 of Row 5 in Table 1) symbolizes interaction type "open-self" and process type "manifestation." We say that *"fa"* symbolizes "open-self manifestation."

Table 1 shows that Arabic sound symbols form a complete and consistent multi-dimensional symmetry system of universal process concepts. We have verified that this system applies to many sounds in many words of twenty languages.

The rows of Table 1 are arranged in descending order of *process nimbleness*. Table 2a&b list the rules which determine inter-process control based on nimbleness. Using Table 1 and Table 2a&b, the sound structure of any Arabic *word root* can be mechanically converted into a *General Algorithmic Model* (GAM) that represents the flow of general types of interactions among general types of processes.

If we replace every *general concept* in a GAM with a *specific concept* (Table 3 and Table 4a&b), we obtain a *Specific Algorithmic Model* (SAM). Each process/interaction type (GAM concept) represents an infinite number of specific concepts, i.e. every GAM represents countless SAMs. However, the *Universal Modeling System* (UMS) translates each GAM into one SAM or a few SAMs based on specific concepts that are pinpointed by *muhkam* expressions.

A *muhkam* expression is any text from an old book which is generally accepted as the ultimate reference for the proper use of Arabic (*Al-Qur'an*, 1992). Each such expression explains each word root (=GAM) it contains by pointing to specific interactions among specific processes (=SAM). It does so through grammar and choice of words.

Models (SAMs) created with UMS, such as those listed in the following sections, are adaptive. They evolve through implementation experience and by revisiting UMS, which thus acts as a tool for learning, research and discovery. Models are stated verbally, *formatted like term definitions*, and interspersed with GAM concepts in parentheses. The Arabic word root follows its English meaning in parentheses, along with the appropriate formula from Table 2a & b, whereby the names of Arabic sounds are used instead of f, X, Y, etc. This formula identifies a GAM template in Table 2a & b. Root sounds with strikethrough (~~*ya*~~, ~~*hamza*~~, ~~*waw*~~) are ignored because they are dropped in some word forms. Template numbers are stated the first time

Table 1. Symbolism of Arabic sounds, arranged in descending order of process nimbleness

Process Type \ Interaction Type	Closed-Self	Open-Self	Closed-Others	Open-Others
Assignment	*ya*	*hamza*	*waw*	*ha*
Assignment of Manifestation	*ra*	*lam*	*ba*	*ta*
Assignment of Containment	*seen*	*zay*	*ssad*	*tha*
Assignment & Manifestation of Containment	*hha*	*sheen*	*geem*	*zza*
Manifestation	*meem*	*fa*	*dal*	*thal*
Manifestation of Containment	*kaf*	*ddad*	*tta*	*kha*
Containment	*'ain*	*noon*	*qaf*	*ghain*

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