

Evolution of an Empathetic Digital Entity: Phase One

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Abstract

This demonstration highlights the first of seven segments designed to develop a digital entity that will possess the potential for human empathy. The experiences in the first phase of the digital entity Zoe (Zero-One Entity) parallel a subset of learning and development activities encountered by human beings during their first nine months of existence. A website has been created to provide a window to observe Zoe's experiences and action selection process in order to make her basic learning observable, cumulative, and evolutionary. The human observer is invited to influence her action selection by setting the intensity of Zoe's digital personality traits such as assertiveness, reasoning ability, and disposition. Actions generate body-based and emotive-based feelings which are stored in memory structures. Significantly, these structures serve as a foundation for later stages of learning, understanding and reasoning.

Introduction

This demonstration introduces a computer-coded environment that illustrates the basic experiences of a "digital infant" named Zoe[®] (an acronym for Zero-One Entity). The computer simulation environment is coded in Amzi Prolog[®]. A window into the simulation coordinate space is provided on a website found at <http://www.zoedigital.com> to make her basic learning process observable, cumulative and evolutionary. The use of graphics, audio, chromodynamics (color impact on physical and emotional responses), and animation are included to help the web visitor understand, observe, and participate in the digital infant's learning development. The website is coded in C#, ASP.NET[®], Javascript and HTML. The visual graphics that display Zoe's actions are coded in Flash after being designed using Adobe Creative Suite[®] software.

Description

Zoe's evolution utilizes three primary components interacting in Prolog code to produce a computer entity capable of learning, developing, and responding to humans in a non-static, non-hard coded manner. The first two

components are based on feelings she acquires in her digital world and the third is based on the variable settings of predetermined personality traits.

The first primary component is body-based feelings (Greene and Kozak 1990; Kozak 1994) emanating from the force and path of movement. Body-based feelings are acquired directly from her simulated movements. As an example, the action of pushing and pulling of her limbs include differing intensities of resistance and enablement. These acts of movement and their force encounters are recorded in memory structures for later utilization.

The second primary component is emotive-based feelings ranging from contentment and security to the polar opposites of stress and frustration. These feelings are determined by the action performed and their respective intensities are driven by specific personality traits. These traits include: assertiveness, reasoning, impetus, sensory awareness, and disposition. For the website and demonstration purposes, the author will use the umbrella term dDNA to identify these personality traits.

dDNA is an acronym for digital DNA and is the third primary component. Its use in this research is based on a growing consensus in the field of psychology that our genes are an important element in setting a course for individual human behavior (Carson and Rothstein 2002; Clark and Grunstein 2000; Hamer and Copeland 1998). Those tendencies such as aggression, various moods, different attitudes, and certain aspects of intelligence are believed to be DNA-based and affect human learning. Similarly Zoe's digital traits influence her interaction with, and reaction to, her world. Different selections of dDNA qualities result in different experiences and thus different stored memory structures. It is the dDNA design element which allows the viewer to become Zoe's co-creator, specifically because it is the viewer who ranks the intensity levels of the five different dDNA personality traits.

Zoe's uniqueness may be attributed to the form her actions take in response to digital opportunities and choices presented to her. Interacting digital body-based and emotive-based feelings, in accordance with her dDNA values, create and store memories within Prolog code that guide rather than hard-wire her selection of future actions.

Candidate actions are placed on a blackboard structure where present feelings vote approvals for appropriate actions. But the voting process is not predetermined, not straightforward, nor is it static, nor is it totally random. It is, however, predictable and random enough to parallel the behavior one might expect of a human with similar DNA traits.

The underlying technology that drives this process is described in significant detail in a forthcoming article submission for journal review. However, two examples from a number of possible combinations are provided below to illuminate how the dDNA influences Zoe's behavior.

The first example assumes the web participant set Zoe's dDNA personality traits as follows: a high degree of aggression, a strong drive, an above average reasoning ability plus sensory awareness, and an average disposition. Such dDNA settings insure that Zoe will eventually exert the effort required to accomplish a number of different body-based tasks such as sitting up, stretching her arms, and focusing even though it may take her several attempts. The repeated attempts reflect the aggressive, driven nature that will tolerate a relatively high pain threshold due to Zoe's dDNA settings. This aggressive, driven nature in turn gives rise to emotive-based feelings of increasing frustration each time Zoe fails at an attempted action. As her frustration level increases so will her desire to successfully perform this action. Since the dDNA settings also reflect a high degree of reasoning ability, emotive-based feelings of boredom and curiosity increase as novel experiences decrease. To decide and select her next response within the Prolog code, possible candidate actions are listed on a blackboard type structure and her feelings contribute approval votes to appropriate actions. Feelings of boredom and curiosity will vote approval for actions not recently nor successfully executed. As a further example the feeling of frustration will vote approval for those actions where recent attempts at execution have failed. The quantity of votes contributed by a feeling is proportional to the respective intensity of the feeling.

The second example assumes the web observer selected dDNA characteristics that reflect a very lethargic and passive entity with a low pain threshold. Such dDNA settings would promote very different emotive-based feelings relative to the first example delineated above. These emotive-based feelings would include intense discomfort, internal stress and a strong propensity to cry. If her reasoning ability trait was low, then her emotive-based feelings of curiosity and boredom would also remain relatively low. She would not effectively seek novel action as she did in the previous example. Due to her high degree of lethargy and passivity, she would not exert significant effort. Furthermore, her low threshold for pain will cause her to cry most of the time, distracting her from alternate action. In fact, with these dDNA settings and resulting prevalence of emotive-based feelings of stress, discomfort,

and crying, Zoe may never attempt to sit up. Unlike the more aggressive Zoe in the first example, if the lethargic Zoe tries and fails she will almost never try again. Thus, feelings of intense discomfort, stress and crying will vote for very different actions than will the feelings of intense frustration and boredom discussed in the previous example.

Conclusion

This demonstration highlights the first of seven segments in Zoe's growth and development. It is entitled "Infant" and is the digital equivalent to the first nine months of human development (Berk 2000). Which actions Zoe performs and in what sequence depends largely upon the dDNA settings initialized by the demonstration observer. While the actual actions performed are predictable for a particular combination of dDNA values, they are not predetermined and in fact do vary slightly for different simulation runs of the same combination, which is characteristic behavior of a human being as well. Explicit details regarding this demonstration and explanation of additional aspects have been prepared in an article to be submitted soon for journal review.

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