Subjective Experience Divided And Conquered

Ana Pasztor
Florida International University, School of Computer Science,
University Park, Miami, FL 33199
phone: (305)348-2019, fax: (305)348-3549, e-mail: pasztora@cs.fiu.edu

March 26, 1997

1 Introduction

This paper grew out of my paper Qualia Decomposed (Pasztor, 1996), presented at the Toward a Science of Consciousness 1996 conference in Tucson, Arizona. I was surprised at and pleased with the response I got, and this, together with all discussions and presentations at the conference, reinforced me in my belief that there is an urgent need not only in Philosophy, but also in Cognitive Science in general, for a **new view of subjective experience**.

My *goal* in this paper is to provide such a new view by bringing together different existing models.

Having studied Neuro-Linguistic Programming (NLP henceforth), an epistemological model of human communication, I am puzzled by the distinction between the Easy Problem (questions about the workings of the brain), and the Hard Problem (the problem of qualia or the intrinsic first-person character of subjective experience) suggested by David Chalmers. I find myself siding with Dennett, who believes that a third-person study of people's conscious experiences is quite possible, and therefore qualia, the properties of conscious subjective experience, don't exist - at least not in the way they are traditionally characterized as *ineffable* (i.e. undescribable), *intrinsic* (as opposed to relational), "which seems to imply *inter alia* that they are somehow atomic and unanalysable," and *private* (Dennett 1988). (I disagree with Dennett, however, that qualia are not *directly or immediately apprehensible in consciousness*).

Based mostly on the NLP model and Damasio's (1994) neuroscientific and psychological results, observations and hypotheses on subjective experience, particularly on the distinctive role of emotions and feelings, in section 2 I will offer an analysis of the structure of subjective experience - its basic building blocks or atoms (which I will call *vertical units*), their properties (like e.g., *submodalities*), and how they are linked together by way of *anchoring* into more complex units (which I will call *horizontal units*).

In section 3 I will talk about "conquering" subjective experience, i.e. how we can access and apprehend our own subjective experiences, describe them to others (at least to the extent that our limited vocabulary allows us to do so), and identify others' subjective experiences by recognizing and attending to the physiological and linguistic cues they communicate continuously to us. This section is largely based on the NLP-model.

NLP has evolved from the work of family therapist Virginia Satir, Gestalt therapy founder Fritz Perls, hypnotherapist Milton Erickson, anthropologist Gregory Bateson, and many others. It was originated by Richard Bandler and John Grinder for the purpose of making explicit and replicating successful strategies of people.

Besides its philosophical significance in eliminating the gap between the Easy and the Hard Problem of consciousness, "dividing and conquering" subjective experience, as presented in this paper, has numerous practical applications as well. In section 4 I will present some of these in Education, Design, and Intelligent Systems.

In section 5 I will present some basic experimental research done in NLP, calling for further experimental work to turn Dennett's views, as well as the hypotheses and claims of NLP and Damasio (1994) presented here, into facts.

In section 6 I will conclude by posing some of the numerous questions related to the study of subjective experience and its neural correlates which I would like to see answered by workers in various fields of Cognitive Science.

2 Subjective Experience Divided: Vertical and Horizontal Units of Subjective Experience

According to Damasio (1994), at each moment in time our subjective experience is represented by what he calls an "image": a visual image, i.e. an internal picture, an auditory image, i.e. sounds, discrete or analog, a kinesthetic image, i.e. a feeling, an internal smell or taste, or, a combination of these, called *synesthesia*.

When we perceive, we form "images of varied sensory modalities," which Damasio (1994) calls "*perceptual images.*" But when we remember or make plans, we also make "images, regardless of whether they are made up mostly of shapes, colors, movements, tones, or spoken or unspoken words." Damasio calls them "*recalled images.*"

So our subjective experiences are manifested (consciously or unconsciously) in our sensory systems: visually, auditorily, kinesthetically (for the sake of simplicity, I include here external and internal feelings, as well as taste and smell). Let us denote them by V,A, and K, respectively,

Many people argue that they don't think in images, but rather in words or abstract symbols. But "most of the words we use in our inner speech, before speaking or writing a sentence, exist as auditory or visual images in our consciousness. If they did not become images, however fleetingly, they would not be anything we could know. This is true even for those topographically organized representations that are not attended to in the clear light of consciousness, but are activated covertly" (Damasio 1994).

Damasio (1994) goes as far as to require as an essential condition for having a mind the ability to form internal (visual, auditory, olfactory etc.) images, and to order them in the process we call thought. His view is that "having a mind means that an organism forms neural representations which can become images, be manipulated in a process called thought, and eventually influence behaviour by helping predict the future, plan accordingly, and choose the next action."

Searle (1992), in listing "A dozen structural features [...] of normal, everyday consciousness," and talking about unity of consciousness, says:

> Conscious [and, I argue, all mental] states [...] come to us as part of a unified sequence. I do not just have an experience of a toothache and also a visual experience of the couch that is situated a few feet from me and of roses that are sticking out from the vase on my right, in the way that I happen to have on a striped shirt at that same time as I have on dark blue socks. The crucial difference is this: I have my experiences of the rose, the couch, and the toothache all as experiences that are part of one and the same conscious event. Unity exists in at least two dimensions, which, continuing the spatial metaphors, I will call 'horizontal,' and 'vertical.' Horizontal unity is the organization of conscious experiences through short stretches of time [...] Vertical unity is a matter of the simultaneous awareness of all the diverse features of any conscious state, as illustrated by my example of the couch, the toothache, and the rose.

Let us now take a closer look at both the vertical and horizontal unity Searle talks about.

2.1 Vertical Units of our Subjective Experience

Using the (NLP) notation introduced above, the elements of our subjective experience which are responsible for the vertical unity that Searle is talking about - I will call them *vertical units* of our experience - can be denoted (see Markova, 1992) by, say,

$$\begin{pmatrix} V \\ A \\ K \end{pmatrix} :$$

At each moment in time our subjective experience is manifested/represented through the three modalities V,A, and K, where the top one denotes the representational modality we attend to most consciously at that moment, like visual in the above example - e.g., when we concentrate on the shape of the rose, and the bottom one is that which we attend to least consciously at that moment, like kinesthetic in this case - e.g., the feeling of my body sitting in this chair.

Sometimes we may have a synesthesia of two or more representations (e.g., see the smell), in which case we can fuse together two representations (e.g. V/K).

In mainstream NLP only the most dominant modality of the vertical unit is taken into consideration, a practice which I will also follow below, even though one should not ignore the modalities which are less dominant or which we are less conscious of at the given moment, as they might act as our true decision making agents, like in the case of Damasio's somatic markers, and determine the successor of the unit in question - see below. When I follow the mainstream NLP practice just explained, I will refer to the vertical units simply as (sensory - as opposed to Damasio's dispositional) *representations*.

From Galin's (1994) comments on Mangan's (1993) interpretation of William James' concepts of *nucleus and fringe awareness*, it seems to me that perhaps the top element in a vertical unit of our experience at a time point t is the nucleus, while the bottom two are the fringe, in which all the information is packed which is needed at time point t, but which surmounts the capacity of our awareness.

The great importance of the kinesthetic component of each state/vertical unit, especially of the physical aspects of this component, is best explained in Damasio's (1994) "somatic-marker hypothesis." He creates an imaginary scenario, which calls for sudden decision making. "The brain of a normal, intelligent, and educated adult reacts to the situation by rapidly creating scenarios of possible response options *and* related outcomes. To our consciousness, the scenarios are made of multiple imaginary scenes, not really a smooth film, but rather pictorial flashes of key images in those scenes, jump cut from one frame to another, in quick juxtapositions." (Please note the qualities of the images — c.f. below, where I discuss submodalities.) The mind excites "your consciousness in a show too rich for you to encompass fully. Even in this caricature you will recognize the sort of quandary we face most every day. How do you resolve this impasse? How do you sort out the questions inherent in the images before your mind's eye?" You follow your "gut feelings," or your "feeling or rightness" (Galin, 1994), which mark your images and are felt in your body, hence the name "somatic-marker."

The kinesthetic component is continuosly present - in form of "feelings of emotions" (the latter being the changes in body states triggered by the mind states representing our present subjective experience), or in form of "background feelings," which correspond to our "body states prevailing *between* emotions" (Damasio 1994). The latter contribute to our moods, to our proprioception, introception (visceral sense) - in general to our "sense of being."

2.2 Properties of Sensory Representations/Vertical Units

2.2.1 Submodalities

Each representational modality is designed to 'perceive' certain basic qualities of the experience it represents. These include characteristics such as color, brightness, contrast, focus, size, location, movement etc. for the visual modality; tonality, pitch, melody, volume, tempo etc. for the auditory modality; and intensity, temperature, pressure, etc. for the kinesthetic modality. These qualities are called *submodalities* in NLP, since they are sub-components of each of the representational modalities.

Submodalities play an important role in determining the *meaning of our experiences*. For example, think of a pleasant experience you had. Now slowly change sub-modalities of your memory like (visual:) the color, the brightness, the focus, the size, the movement etc.; (auditory:) the pitch, the melody, the rhythm etc.; (kinesthetic:) the movement, the duration, the speed, the tempo etc. Notice whether and how each change in sub-modality changes the meaning of your memory. Another example: when asked to describe the cognitive processes involved in e.g. *anticipating* versus *hoping* for an event, most people report that in anticipating they have steady images of the event, while in hoping they experience a mental flipping back and forth between images of the event they were hoping to happen and images of the events they did *not* want to happen. By holding still the image of the event hoped for, they experienced anticipation instead of hope. Similarly, it is impossible to maintain an emotion of impatience and at the same time experience a slow *tempo*.

In view of these submodalities, somatic-markers are those *components* of our kinesthetic representations, which, I argue, are our real decision making agents.

According to Damasio (1994), in perception, (complex) sensory information gets into the association cortex through early sensory cortices, where it forms topographically mapped representations. He reports that R.B.H.Tootell has shown using neuroanatomical imaging techniques, that there are structural similarities between an external stimulus and the pattern of brain activity in the early cortices generated by that stimulus. This includes the patterns of body representation of external stimuli in somatosensory cortices.

Recalled mental images arise in the same early sensory cortices in which the original perceptual images were formed. They are the result of "transient synchronous activation of neural firing patterns," which also result in a topographically mapped representation. For example, "if you were to inspect the patterns of activity occurring in that somebody's early visual cortices, within about a hundred milliseconds after the convergence zones for Aunt Maggie's face fired back, you probably would be able to see patterns of activity that had some relation to the geography of Aunt Maggie's face. There would be *consistency* between what you knew of her face, and the pattern of activity you would find in the early visual cortical circuitry of somebody who knew her too and was thinking of her" (Damasio 1994).

Damasio (1994) believes that topographically organized representations needed to experience recalled images are constructed "under the command of acquired *dispositional* neural patterns" or representations stored elsewhere in the brain. "Hidden behind those images," he says, "never or rarely knowable by us, there are indeed numerous processes that guide the generation and deployment of those images in space and time. Those processes utilize rules and strategies embodied in dispositional representations. They are *essential* for our thinking but are not a *content* of our thoughts."

However, it is obvious that *we can change recalled images at will.* We can change the modality, as well as the submodalities of those images. So I can not agree with Damasio that processes used to manipulate images in time and space are mostly unknown to us or can not become the content of our thought. This is a very important point in understanding how to "conquer" our subjective experience - see section 4.

I also disagree with Damasio (1994) that recalled images are "faint" compared with perceptual images. As an example, let us look at Nikola Tesla's powerful visualization processes, as revealed by himself in an interview in 1919 (Dilts, 1994):

> In my boyhood I suffered from a peculiar affliction due to the appearance of images, often accompanied by strong flashes of light, which marred the sight of real objects and interfered with my thought and action. They were pictures of things and scenes which I had already seen, never of those I imagined. When a word was spoken to me the image of the object it designated would present itself vividly to my vision and sometimes I was quite unable to distinguish whether what I saw was tangible or not. This caused me great discomfort and anxiety...
>
> To give an idea of my distress, suppose that I had witnessed a funeral or some such nerve-racking spectacle. Then, inevitably, in the stillness of night, a vivid picture of the scene could thrust itself before my eyes and persist despite all my effort to banish it. Sometimes it would even remain fixed in space though I pushed my hand through it.

As a "remedy" to his problem, Tesla learned to "make excursions beyond the limits of the small world of which" he had knowledge, and he found that the new places and people he traveled to in his mind "were just as dear" to him "as those in actual life and not a bit less intense in their manifestation."

Of course children's mental imagery is very vivid as well, so that they sometimes have a hard time telling apart imagination from reality. But in our culture, by the time we grow up, we don't know how to use our imagination any more quite as well - we are told not to daydream, so that we can "cope" better with reality.

Most feelings, which, by the way, belong in the category of recalled images, can be overwhelmingly powerful in virtue of the submodalities of the thoughts they trigger or accompany them. "As an example, the cognitive mode which accompanies a feeling of elation permits the rapid generation of multiple images such that the associative process is richer and associations are made to a larger variety of cues available in the images under scrutiny. The images are not attended for long. The ensuing wealth promotes ease of inference, which may become overinclusive. This cognitive mode is accompanied by an enhancement of motor efficiency and even disinhibition, as well as an increase in appetite and exploratory behaviours. The extreme of this cognitive mode can be found in manic states" (Damasio 1994).

How do we actually tell apart reality from imagination, in other words perceptual images from recalled images? According to Bandler and MacDonald (1988), it is the submodalities that help us do so - each person has a "reality strategy" which tells them (mostly on an unconscious level) what kind of submodalities go with perceptual images and what kind with recalled images.

2.2.2 Orientation and Other Properties

A sensory representation or image R also has **orientation**, which can be *external* (R^e) - this is the case for perceptual images, or *internal* (R^i) - this is the case for Damasio's recalled images. Internal representations can be *remembered* (R^r) or *constructed* (R^c). Auditory representations can also be *digital* (A_d), like in the case of words, or analog, like in the case of music.

> Another general feature of each modality is that it can occur under the aspect of pleasant or unpleasant, and the way in which it is pleasant/unpleasant is in general specific to the modality (Searle, 1992).

Obviously it is not the images/sensory representations that are **pleasant or unpleasant**, but our feelings associated to them in response: "By dint of juxtaposition, body images give to other images a *quality* of goodness or badness, of pleasure or pain. I see feelings as having a truly privileged status. [...] feelings have a say on how the rest of the brain and cognition go about their business" (Damasio 1994).

Positive (pleasant) kinesthetic representations are denoted by K^+, while negative (unpleasant) ones by K^-.

Each sensory representation or vertical unit has an **effect**. For example, one effect could be the function to generate or input a sensory representation, or to change or test/evaluate some part of our experience.

2.3 Anchors: Linking Vertical Units

In trying to prove that qualia in the traditional sense don't exist, Dennett (1988) writes:

> [...] if it is admitted that one's attitudes towards, or reactions to, experiences are in any way and in any degree constitutive of their experiential qualities, so that a change in reactivity *amounts to* or *guarantees* a change in the property, then those properties, those 'qualitative or phenomenal features,' cease to be 'intrinsic' properties and in fact become paradigmatically extrinsic, relational properties.

In this section I will argue that one's reactions to an experience constitute the *subjective meaning* of that experience, and as such, can not be separated from the experience. This meaning, in turn, determines our subsequent subjective experience. So the present vertical unit/representation serves, according to the NLP model, as *anchor* for the next vertical unit/representation. For example, I hear X's name (A_d^e), this triggers my remembering X's face (V^r), close up, somewhat distorted, and pinkish red, which, in turn, triggers a negative feeling (K^-). Alternatively, I also could hear someone say X's name (A_d^e) in a really small, squeaky "Mickey Mouse" voice, which would perhaps trigger a small visual image of X against some background (V^i), which, in turn might trigger a feeling of unease(K^-).

In NLP *anchoring* refers to the phenomenon of any vertical unit/representation triggering another representation, vertical unit, or a sequence of representations or vertical units. According to (Dilts *et al.* 1980), "A basic assumption behind anchoring is that all experiences are represented as gestalts of sensory information [...] Whenever any portion of a particular experience or 4-tuple [vertical unit] is reintroduced, other portions of that experience will be reproduced to some degree. Any portion of a particular experience, then may be used as an anchor to access another portion of the experience."

The *link* from a representation or vertical unit of our experience at a time point *t* to a representation or vertical unit of our experience at a time point *t+1* is established through anchoring. Anchoring is basically a cognitive extension of the stimulus-response process of behaviorism. An anchor represents perceptual or recalled sensory information which was the original stimulus to the experience associated to the stimulus. The creation of an anchor, as well as its association to a response happens through learning and depends on various complex subjective, social, cultural and other factors also captured in Searle's (1992) notion of the Background.

Looking at the neural basis of subjective experience, Damasio (1994) offers a refined view of the NLP view of anchoring, whereby feelings, although being "just as cognitive as any other perceptual image," are part of every response and play a distinctive role as such. I will present this view below.

As we have said previously, subjective experience of an event is expressed as mental images, be they verbal or nonverbal. These images are constructed "under the guidance of dispositional representations held in distributed manner over a large number of higher-order association cortices" (Damasio 1994), and serve as an anchor in the NLP-sense to our response to (i.e. the meaning of) the represented experience. According to Damasio's hypotheses, this response consists of three parts:

1. Acquired prefrontal dispositional representations, which "embody knowledge pertaining to how certain types of situations usually have been paired [i.e. anchored] with certain emotional responses, in your individual experience" respond to the processing of images in an automatic manner.

2. This response then is signaled to the amygdala and anterior cingulate, where dispositional representations in turn respond by causing an "emotional body state," which includes a state of the viscera "most commonly associated with the type of triggering" event, physiological cues like "facial expression and body posture" (see next section) - an expression of the the state of the motor system, chemical actions of the endocrine and peptide systems, and activation of certain neurotransmitter nuclei in the brain.

3. The "emotional body state," or simply emotion, is being signaled back to the brain through nerve terminals, resulting in feeling your emotional states, which, according to Damasio (1994), means becoming conscious of them. This, he says, "offers you *flexibility of response based on the particular history of your interactions with the environment.*"

Feelings, according to Damasio (1994), are of two kinds: background feelings and feelings of emotions. Emotions on the other hand, are primary - those which we experience early in life, and secondary -

those which we experience later in life. Anchoring then is manifested in "*secondary emotions* which occur once we begin experiencing feelings and forming *systematic connections between categories of objects and situations, on the one hand, and primary emotions, on the other*" (Damasio (1994).

In conclusion, Damasio (1994) offers a view according to which each sensory representation of an experience triggers an emotion, which, in turn, triggers a feeling of that emotion. "That process of continuos monitoring" he says, "that experience of what your body is doing *while* thoughts about specific contents roll by, is the essence of what I call a feeling. [...] *the essence of feeling an emotion is the experience of such changes in juxtaposition to the mental images that initiated the cycle.*"

As mentioned before, according to Damasio (1994)'s theory, somatic markers are our true decision making devices. They are created during our life through anchoring. Like all of our other responses to internal and external stimuli, they are "acquired by experience, under the control of an internal preference system and under the influence of and external set of circumstances which include not only entities and events with which the organism must interact, but also social conventions and ethical rules."

Our internal preference system consists of "mostly innate regulatory dispositions, posed to ensure survival of the organism."

The external set of circumstances on the other hand, consists of the context in which we live: "the entities, physical environment, and events relative to which individuals must act; possible options for action; possible future outcomes for those actions; and the punishment or reward that accompanies a certain option, both immediately and in deferred time, as outcomes of the opted action unfold".

Anchoring then can be defined as the "interaction between an internal preference system and sets of external circumstances," a process by which stimuli "become automatically marked".

According to the NLP model, anchoring can be changed, this being the key to creating new and desired subjective experiences. This represents the most important step towards conquering subjective experience. There are many techniques to change anchoring, and for their discussion I refer the reader to (Dilts *et al.*, 1980).

2.4 Horizontal Units of our Subjective Experience

Coming now back to Searle's *horizontal unity* of consciousness, this is achieved by sequences of representations or vertical units which have consolidated into behavioral units, called strategies (Dilts *et al.*, 1980), and which have been connected through anchoring. I will illustrate this concept by way of some examples.

Analyzing a letter Mozart wrote in 1789 describing his strategy for composing music, Dilts (1994) outlines the first, most basic stage in this strategy as follows:

> Mozart's composition process seems to begin from a positive, congruent kinesthetic feeling state combined with some kind of physical movement $[K^+/K^e]$. Internal feelings $[K^i]$ arise from this state which produce sounds or tones through a natural overlap between the kinesthetic and auditory senses $(K \rightarrow A^i)$. This linking is known as a *"synesthesia."* If these sounds fit with or reinforce the positive feeling state $[K^+]$ they are hummed (K^e/A^e) and retained in memory, otherwise they are discarded.

The following are two contrasting spelling strategies: a typical visual, and a typical phonetic strategy (c.f. Dilts *et al.*, 1980).

A typical visual speller will hear a word (A_d^e), construct a visual image of the letters of the word (V^c), and then test whether this image "looks right or not" (K^+ or K^- - somatic markers). The latter happens by comparing the constructed visual image against the remembered visual image of the word as seen before (V^r). If the two images are congruent, a positive feeling is generated, otherwise a negative one, in which case the speller will perhaps pronounce the word (A_d) and proceed to construct another visual image (V^c) etc.

A typical phonetic speller will pronounce the word first (A_d^c) and test whether it "sounds right or not" (K^+ or K^- - somatic markers). This happens by comparing the constructed auditory image against the remembered auditory image of the word as heard originally (A_d^r). If the two auditory images are congruent, a positive feeling is generated, otherwise a negative one, in which case the speller will perhaps repeat "sounding out" the word (A_d) or parts of it (aloud or internally) and then test again this pronunciation against the original one etc. The feelings of rightness or wrongness may be accompanied by words like "That's it" or "That's wrong" (A_d).

Combining the NLP model with Damasio's (1994) views, let us now try to summarize the essence of subjective experience - how it comes about, and how it is organized:
Internal and external stimuli are "brought in at the early sensory cortices" and manifested as "collection of triggering and evaluative images." By way of anchoring, acquired and innate dispositions are activated. These, in turn, trigger two basic processes: 1. the changes in body state or emotions we talked about before, and which then are signaled back to the brain as feelings, and 2. the release of selective neurotransmitters in sets of nuclei in the brain stem and basal forebrain.

"The result of the neurotransmitter responses is a change in the speed at which images are formed, discarded, attended, evoked, as well as a change in the style [submodalities] of the reasoning operated on those images." In other words, the result of the second process is a "particular style and level of efficiency of cognitive process which" *accompanies* the changes in body state or emotions and their manifestations as feelings. As an example Damasio (1994) contrasts the cognitive processes accompanying the feeling of elation with the cognitive mode which accompanies sadness: "it is characterized by slowness of image evocation, poor association in response to fewer clues, narrower and less efficient inferences, overconcentration on the same images, usually those which maintain the negative emotional response. This cognitive state is accompanied by motor inhibition and in general by a reduction in appetite and exploratory behaviors. The extreme of this cognitive mode can be found in depression."

Putting it all together, our images/vertical units are "glued" together by way of anchoring. Anchors trigger our responses as described above. These responses are organized in sequences of images/vertical units called strategies, which have "become consolidated into a functional unit of behaviour such that it is typically executed below the threshold of consciousness" (Dilts *et al.*, 1980). In Damasio's (1994) words, "[w]e can acquire strategies for reasoning and decision making; and we can select a motor response from the menu available in our brain, or formulate a new motor response, a willed, deliberated composition of actions, which can range from pounding on a table, to hugging a child, to writing a letter to the editor, or to playing Mozart on the piano".

Before I now turn to the issue of conquering subjective experience, let us briefly return to the question of horizontal unity of thought which was raised by Searle (1992) and which was first addressed at the beginning of this section in a quote.

Damasio (1994) offers an answer through his somatic-marker hypothesis. "What else happens when somatic markers, overtly or covertly, do their biasing job? What happens in your brain so that the images over which you reason are sustained over the necessary time intervals?" asks he, thus rephrasing Searle's question. First, he says, "[i]mages corresponding to myriad options for action and myriad possible outcomes are activated and keep being brought into focus. The language counterpart of those entities and scenes, the words and sentences that narrate what your mind sees and hears, is there too, vying for the spotlight." Then, referring to these images, he goes on to say that "[t]he process of knowledge display is possible only if two conditions are met. First, one must be able to draw on mechanisms of *basic attention*, which permit the maintenance of a mental image in consciousness to the relative exclusion of others. [...] Second, one must have a mechanism of *basic working memory*, which holds separate images for a relatively 'extended' period of hundreds to thousands of milliseconds (from tenths of a second to a number of consecutive seconds). This means that the brain reiterates over time the topographically organized representations supporting those separate images."

As to "what drives basic attention and working memory?" he has no doubt that "it can only be *basic value*, the collection of basic preferences inherent in biological regulation." He even goes as far as proposing "that a somatic state, negative or positive, caused by the appearance of a given representation, operates not only as a *marker for the value of what is represented, but also as a booster for continued working memory and attention..*"

3 Conquering Subjective Experience

> [...] far from being directly or immediately apprehensible properties of our experience, they [qualia] are properties whose changes or constancies are either entirely beyond our ken, or inferrable (at best) from 'third-person' examinations of our behavioural and physiological reaction patterns [...] (Dennett 1988)

In the previous sections I have presented a model of the structure of subjective experience. In this section I will argue that changes and constancies in this structure are not at all "beyond our ken," but, just as Dennett suggests, *recognizable* by way of behavioural and physiological cues. Perhaps they are even *directly observable* and measurable through the topography of their sensory representation we talked about in the previous section.

Sequences of images go by so very fast, that people usually are not aware of them. If you ask someone who had pizza for lunch "How do you know that you didn't have quiche for lunch?" they will often say "Because I remember," but they will rarely say something like "The qualities (submodalities) of the images involving the pizza are different from those involving the quiche, and according to my reality strategy it is obvious I had pizza." But introspection with awareness of the images which make up our subjective experiences can be learned and taught, and reveals a very rich structure of these experiences, which we used to think of as being atomic.

Dennett (1988) seems to agree:

> This putative grainlessness, I hypothesize, is nothing but a sort of functional invariability: it is close kin to what Pylyshyn (1980,1984) calls *cognitive impenetrability* [...] so what counts for an individual as the simple or atomic properties of experienced items is subject to variation with training [...]
> Consider the results of 'educating' the palate of a wine-taster, or 'ear training' for musicians. What had been 'atomic' or 'unanalysable' becomes noticeably compound and describable [...]

Responding to visceral, external, or mental stimuli, our brain causes changes in our body states, i.e. emotions (hunger, fear, anger etc). These changes of body states or emotions, are signaled back to the brain. These signals are, as I mentioned before, what Damasio (1994) calls "feeling of the emotion," which bring our emotions into our consciousness. "Why complicate matter and bring consciousness into this process, if there is already a means to respond adaptively at an automated level," asks Damasio (1994). "The answer is that consciousness buys an enlarged protection policy. [...] In short, feeling your emotional states, which is to say being conscious of emotions, offers you *flexibility of response based on the particular history of your interactions with the environment.*"

Feeling our emotions allows us to change any of the factors that caused it, and which we have control over: the representational modality of the event that triggered it, the submodalities of the representation, or its link to our experience, and hence our response to it.

Examples range from trivial, like changing position in response of feeling pain or eating when feeling hungry, to more subtle, like realizing (this takes the kind of training Dennett (1988) was talking about) that roses make you feel sad because their image triggers the image of the funeral of a loved one, and as a result changing this link, i.e. the anchor. As to *how* to change anchors - there are numerous techniques which have been used successfully in NLP - see e.g. (Dilts *et al.*, 1980).

Notice expressions like "roses make me feel sad," or "he frustrates me," or "his look hurts me," etc. People have a tendency to identify the stimulus with their response to it, leaving out the intermediate step of representation of the stimulus and realizing that they have a choice as to how to respond to that representation. This choice is of course based on being aware and understanding the structure of our own stimulus-response cycles, i.e. our own subjective experience.

Our strategies, i.e. the representational modalities we use to represent our experiences, their orientation, submodalities, effects, and the links between them (anchors), are the "programs" we use to go through our lives. Certain programs are more suitable for certain tasks than others.

Another way to put it is using a metaphor borrowed from (Cameron-Bandler & Gordon & Lebeau, 1985): we humans are most sophisticated computers, which, alas, come to this world without manuals. So it is entirely up to us to figure out how we work, particularly which software to use or not to use for a given task. Some people have the good fortune to be using programs which are optimal for certain tasks (Boden, 1990; Weisberg, 1988; Dilts, 1994).

Once strategies, be they learning or otherwise, become cognitively penetrable and disclosed, they become "programmable, hence subject to change" (Gardner, 1985). Both representational modalities, with their orientations, submodalities, and effects, as well as their links, can be changed, as extensively explained and demonstrated by Dilts *et al.* (1980), the goal being to acquire strategies which have proved to be the most effective in achieving desired tasks. First, however, such strategies need to be elicited. In what follows I will discuss means by which to recognize and understand *other* people's ("third person's") subjective experiences.

The elements of the NLP model I presented in the previous section deal primarily with cognitive processes. As we saw before, these processes cause "changes in body state - those in skin color, body posture, and facial expression, for instance - [which] are actually perceptible to and external observer. (Indeed, the etymology of the word nicely suggests an external direction, from the body: *emotion* signifies literally 'movement out')" (Damasio 1994). "These physical reactions are important for the teaching or development of certain mental processes as well as for the external observation and confirmation of them. The primary behavioral elements involved [...] are:

- **B**ody Posture.
- **A**ccessing Cues.
- **G**estures.
- **E**ye Movements.
- **L**anguage Patterns." (Dilts & Dilts & Epstein, 1991)

Here are some examples from (Dilts & Dilts & Epstein, 1991):

Leaning back with head and shoulders up or rounded, shallow breathing indicate the use of visual, *body leaning forward, head cocked, shoulders back, arms folded* indicate the use of auditory, while *head and shoulders down, deep breathing* indicate the use of kinesthetic representations.

According to Dilts & Dilts & Epstein (1991), "When people are thinking, they cue or trigger certain types of representations in a number of different ways including: breathing rate, non-verbal 'grunts and groans,' facial expressions, snapping their fingers, scratching their heads, and so on. Some of these are idiosyncratic to the individual and need to be 'calibrated' to the particular person. Many of these cues, however, are associated to particular sensory processes."

High shallow breathing, squinting eyes, voice higher pitch and faster tempo are some visual, *diaphragmatic breathing, knitted brow, fluctuating voice tone and tempo* are some auditory, while *deep abdominal breathing, deep breathy voice in a slower tempo* are some kinesthetic cues or triggers.

According to the NLP model, eye movement is not at all random. There are patterns in our eye movement, which, like other physiological patterns mentioned above, reveal the structure of our subjective experience. For details see (Dilts & Dilts & Epstein, 1991). NLP's claim about eye movement has been subject to numerous experiments in the 80s, but no conclusive results have been achieved (see next section). Since this is a topic of utter importance not only to philosophy and psychology, but also to areas of AI such as building believable intelligent agents (Bates, 1994), or Participatory Design (Beyer & Holtzblatt, 1995) - see section 4, I would like to urge the research community to continue the experiments of the 80's with the modifications suggested by Einspruch & Forman (1985) - see section 5.

Regarding gestures, "People will often touch, point or use gestures indicating the sense organ they are using to think with" (Dilts & Dilts & Epstein, 1991). Thus *touching or pointing to the eyes; gestures made above eye level* indicate the use of the visual, *pointing toward or gesturing near the* *ears; touching the mouth or jaw* indicate the use of the auditory, and *touching the chest and stomach area; gestures made below the neck* indicate the use of the kinesthetic modality.

Most of the trouble in human communication, I believe, comes from our failure to use the enormous wealth of both non-verbal and verbal cues to our subjective experience in a conscious and systematic way. While on an unconscious level we respond to a lot of cues, and while artists such as Walt Disney know how to use these cues to express their heros' subjective experiences, I have not yet encountered a systematic compilations of these cues in any academic publication. As far as research on these cues goes, there is some on gestures, for example, for the purpose of computer animation (see (Cassell *et al.*, 1994); (Bates, 1994) and references therein). In addition, very few researchers take linguistic metaphors seriously (Lakoff, 1987).

Besides using cues, one can use questions to elicit a person's subjective experiences. Taking introspection and self-report seriously, Bandler and MacDonald (1988) have implemented a table of *submodality distinctions* in each representational modality, accompanied by possible questions that can be used to elicit the respective distinction. Below is a sample. (Each submodality distinction is followed by some questions to elicit that distinction.)

(**Visual**:) Color/black and white (Is it in color or black and white? Is it full color spectrum? Are the colors vivid or washed out?); Brightness (In that context, is it brighter or darker than normal?); Focus (Is the image sharp in focus or is it fuzzy?); Texture (Is the image smooth or rough textured?) Detail (Are there foreground and background details? Do you see the details as part of a whole or do you have to shift focus to see them?); Size (How big is the picture? - ask for specific, estimated size, like 11" x 14"); Distance (How far away is the image? - again, ask for specific, estimated distance, like 6'); *Movement* within the image (Is it a movie or a still picture? How rapid is the movement: faster or slower than normal?); *Movement* of the image (Is the image stable? What direction does it move in? How fast is it moving?); Orientation (Is the picture tilted?); Associated/dissociated (Do you see yourself or do you see the events as if you were there?), etc.

(**Auditory**:) Location (Do you hear it from the inside or from the outside? Where does the sound (voice) originate?); Pitch (Is it high-pitched or low-pitched? Is the pitch higher or lower than normal?); Volume (How loud is it?); Tempo (Is it fast or slow?); Rhythm (Does it have a beat or a cadence?); Duration (Is it continuous or intermittent?), etc.

(**Kinesthetic**:) Quality (How would you describe the body sensation: tingling, warm, cold, relaxed, tense, knotted, diffused?); Intensity (How strong is the sensation?); Location (Where do you feel it in your body?); Movement (Is there movement in the sensation? Is the movement continuous or does it come in waves?); Direction (Where does the sensation start? How does it get from the place of origin to the place where you are most aware of it?); Speed (Is it a slow steady progression or does it move in a rush?), etc.

In the NLP model presented in this paper, metaphors used by people to express their subjective experiences are understood as cues to the strategies and submodality distinctions they are using. "People tend to speak in predicate sets (verbs, adverbs and adjectives) that specify the representational systems they are attending to consciously and that provide information about the sub-modality distinctions they are making." (Bandler & MacDonald, 1988)

Below is a sample of such verbal cues (c.f. Bandler & MacDonald, 1988).

VISUAL

Things were blown out of proportion.
My job seems overwhelming.
Life is so drab.
I need some distance from it.
He's had a colorful past.
That throws a little more light on it.
It all seems so hazy.
I don't know, it just flashed on me.
When you said that I just saw red.
That brightens up my day.
Well, when you frame it that way, yes.
She has a sunny disposition.
That hits too close to home for comfort.
I need to bring things more into perspective.
It just appears flat and meaningless.
I'm glad we see eye to eye.
Everything keeps spinning around and I can't seem to focus on one thing.
It's too vague even to consider.
It's off in the left field somewhere.
The image is etched in my memory.
I just can't see myself being able to do that.
He's got me up on a pedestal.
She cut him down to size.
I'm moving in the right direction.
I can't face it.
It's not a black and white world.
This is top priority.
Let's look at the big picture.

AUDITORY

The right decision was screaming at me.
She gives me too much static.
It's just a whisper.
If I nag myself long enough, I'll do it.
There is too much discord in our relationship.
I hate that whining part of myself.
Got you, loud and clear.
We need to orchestrate our vacation.
It came to a screeching halt.
I keep telling myself, "You can't do anything right."
It's too off-beat.

KINESTHETIC

It's got a slimy feel to it.
He's hot.

She's a cold fish.
Whenever I hear that, my stomach knots up.
The pressure is off.
The whole thing weighed on my mind.
I'm off center, like everything is out of kilter.
I'm trying to balance one against the other.
Yeah, I feel up to it.

As I have mentioned in the previous section, Damasio (1994) reports that R.B.H.Tootell has shown using neuroanatomical imaging techniques, that there are structural similarities between an external stimulus and the pattern of brain activity in the early cortices generated by that stimulus. This includes the patterns of body representation of external stimuli in somatosensory cortices. This suggests that besides inferring, as Dennett (1988) said, third person experiences through linguistic and physiological cues, one day, in the not so distant future, we will be able to observe subjective experiences by analyzing the patterns of brain activity generating our mental images.

4 Applications

As an important criterion for evaluating any cognitive model, Thagard (1996) proposes practical applicability in Education, Design, and Intelligent Systems. In this section I will mention some applications of the model of subjective experience presented earlier in these three areas.

Education: Number 7 of *Communications of ACM* vol. 37, is dedicated to Intelligent Agents. All contributing authors agree that there is a need for agents with common sense, agents capable of learning (see e.g., Mitchell *et al.*, 1993; Maes, 1993). In an interview therein - see (Rieken, 1994), Minsky notes:

> The problem with this, of course, is that we still don't have suitable learning techniques. Lenat and I agree in the view that in order to learn as a person does, one will need to begin with a considerable body of built-in knowledge about a variety of effective ways to learn. The problem is we have not done enough research yet to know how to do this.

In order to acquire the "knowledge about a variety of effective ways to learn," we need to study various *learning strategies,* successful or unsuccessful. The model I presented above allows us to do just that. Here is an example.

Diane Lutzinger, a teacher trainer, gives the following account of a student's unsuccessful vs. successful strategies (Lutzinger, 1991).

> When Jason came to Diane Siegel for help, the first step was to find out the specific behaviors he used in class. For example, Jason would listen to the teacher explain a history lesson, then he'd have a little conversation in his head that went like this: 'This is stupid. Why do I need to know the date of this battle or the name of that treaty? I'll never remember it anyway. The teacher is so boring!' Without being aware of it, Jason would then feel bad about the lesson, the teacher and himself.

> Feeling bad, he would shut down his attention to what was going on in class, and the cycle would continue its downward spiral.

In contrast, here is Jason's football strategy:

> The coach would describe the play. Jason listened and imagined the formations and tactics as he remembered them from 'chalk talk' when the coach drew figures on the board. His internal conversations went more like this, 'I know this play. I can see which player will run out for the pass and which blockers will move forward to assist. I'm able to do this play. I'm excited. Let's get 'em!

Jason's history strategy is "listen, self talk, feel bad, loop back to listen," while his football strategy is "listen, picture, self-talk, feel good" (Lutzinger, 1991).

Design: The structure of subjective experience and its cues play a very important role in knowledge acquisition for knowledge-based systems, in particular in what is called Participatory Design (Namioka & Schuler, 1993; see also Lenart & Pasztor, 1995), where an excellent communication between all participants in the design process is highly critical. It also plays an important role in modeling creativity (Boden, 1990; Weisberg, 1988; Dilts, 1994).

As an example for the latter, I will mention a creativity strategy developed by Dilts (1994). Dilts modeled it after Walt Disney's strategy to create his animated movies with his team. The strategy is best described as a loop which goes from a dreamer phase to an implementation phase to a critique phase and back to a dreamer phase etc., until the critic in the critique phase is satisfied. The phases are clearly separated so they do not "contaminate" each other (have you ever experienced the voice of an internal critic while you were trying to come up with an idea?), moreover, each phase builds upon and improves the previous one.

When I first watched this strategy being demonstrated, I realized that most of my attempts to be creative failed or were so excruciatingly hard because my inner critic (self-talk) interfered as soon as my dreamer started to dream (mostly visual images), or, if I managed to finish my dream, my critic would not let me move on to implementation. Ever since I realized this, and if I am aware of the critic not waiting for its turn, I kindly remind it to wait and let the dreamer and implementor finish first.

Intelligent Systems: As far as *Intelligent Systems* go, particularly Intelligent Agents, the applications are numerous.

Intelligent agents have to communicate effectively with their users, as well as with each other. *Rapport* with a partner is the key to effective communication, and can be achieved by closely observing and responding adequately to *verbal and non-verbal cues* to how the partner experiences the world. Maes (1993) talks about *trust* (i.e. how we can "guarantee the user feels comfortable delegating tasks to an agent") as a main problem "to be solved when building software agents." Mitchel *et al.* (1993) agree that "user acceptance will depend on customizing the personal assistant to the particular habits and interests of the user." Trust and user acceptance, on the other hand, begin with believability of the agents. "Emotion is one of the primary means to achieve this believability, this illusion of life, because it helps us know that characters really care about what happens in the world, that they truly have desires (Bates, 1993)."

> Cues to our experience are the "regularities and recurrent patterns" Maes (1993) talks about when she says "the interface agent learns by continuously 'looking over the shoulder' of the user as the user is performing actions," the goal being to *find and automate* these cues.

5 Basic Research: Past and Future

NLP provides a model of human communication that fares excellently when tested using general criteria for evaluating cognitive theories, such as representational and computational power, psychological and neurological plausibility, and practical applicability - see (Thagard, 1996).

And yet, so far, there has been virtually no connection made to cognitive science. A few years ago Christine Lisetti and I have completed a study of 49 papers written on the NLP model. Most papers were written in the 80s. The findings of 16 of these papers were negative or questioning, while the findings of the others were positive. However, the negative or questioning findings were mostly based on experiments which were conducted improperly. The following comments of Einspruch and Forman (1985) give a very accurate analysis of these experiments, as well as suggestions on how proper experiments could be conducted. To better understand the comments, it is necessary to mention that in the 80's NLP was still almost exclusively being applied in therapy.

> There is a growing body of empirical literature on NLP. A review of this literature by Sharpley1984 failed to consider a number of methodological errors. In the present article the authors identify six categories of design and methodological errors contained in the 39 empirical studies of NLP documented through April 1984. These categories include:
> a) lack of understanding of the concepts of pattern recognition and inadequate control of context
> b) unfamiliarity with NLP as an approach to therapy
> c) lack of familiarity with the NLP "meta-model" of linguistic communication
> d) failure to consider the role of stimulus-response associations
> e) inadequate interviewer training and definitions of rapport, and
> f) logical mistakes.

Einspruch and Forman (1985) conclude:

> It is very difficult to understand the NLP framework from the perspective of traditional counseling models; it is much *more appropriate to approach it from the framework of mathematics, biology, or cybernetics.* [...] NLP is a complex model requiring extensive training before a practitioner may legitimately undertake a study of this nature. A number of **modifications** could be made to improve designs of research conducted on NLP.

They then go on to list these modifications.

In this paper I have touched upon various aspects of subjective experience: vertical units, anchoring, horizontal units, their accessibility in ourselves and others etc. These aspects lie at the heart of a unified study of consciousness. If nothing else, NLP offers a wide variety of working hypotheses which are worth verifying in properly conducted research.

In discussing a unified theory of consciousness, Galin (1993) says: "He [Flanagan(1993)] concluded that a scientific and unified theory of consciousness is possible, but that what it will look like depends on who you let contribute to it. For a complete theory he suggests that the cognitive functional analysts, the neurobiologists, and those interested in phenomenology (subjective experience) should all be invited. In addition to cognitive psychology and neuroscience, he says, 'give phenomenology its due. Listen carefully to what individuals have to say about how things seem.' But at this meeting there has been enormous resistance to talking about subjective experience, even though we are supposed to have outgrown the Behaviorists' restriction to external observation and their edict forbidding introspection. [...] Well, first-person experience is politically correct now; what is the reason that we still are not talking about it?"

Galin (1993) suggests that one reason for this is a lack in "fundamental cognitive tools for the task", a lack in taxonomy and in "consensus on the constructs or terminology with which to characterize its richness."

NLP provides a host of fundamental cognitive tools for studying subjective experiences, but it still needs to be incorporated into empirical research. I agree completely with Galin (1993) when he says "Research on subjective experience is like sex; everybody is terribly interested in it but does not want to be caught in public doing it. Could it be that this area of research contains something so personal, so intimate, that we have trouble looking at it directly? Let's peek."

6 Some Further Questions and Conclusion

Regarding unification with other areas of consciousness study, I have many questions which I would like to see answered by people in other areas of consciousness study or cognitive science in general. Here is a sample:

- What are the general patterns, if any, in the relationship between submodalities and emotions they generate? (E.g. how universal is it that a face seen internally close up, in color etc. will generate stronger emotions than one seen internally from far away, in black and white etc.?) What are the cultural, social etc. patterns?

- How do changes in physiology and language patterns influence our subjective experience/strategies?

-How are (involuntary) physical cues (especially eye movement) 'wired' to internal representations of experience? In other words, what are the neural correlates of such cues?

-What are the submodalities of blind, deaf, mute etc. people, or of people who loose proprioception - see The Disembodied Lady in (Sacks 1987) - compared to normal people?

-How seriously can and should we take the use of metaphors in language? Are people really telling us something about their subjective experience?

-Is it possible to predict submodalities from, say, PET scans or other brain mapping/imaging? I am referring here to the experiment performed by Roger Tootell described by Damasio (1994). Tootell presented a stimulus to an animal and discovered that the shape of the stimulus was remarkably consistent with the shape of the neural activity pattern in one of the layers of the primary visual cortex of the animal. Damasio adds that: "both words and arbitrary symbols are based on topographically organized representations and can become images. Most of the words we use in our inner speech, before speaking or writing a sentence, exist as auditory or visual images in our consciousness."

7 References

Bandler, Richard & MacDonald, Will (1988). *An Insider's Guide to Sub-Modalities.* Meta Publications.

Bates, J. (1994). Agents and Creativity, *Communications of the ACM*, 37(7), 122–125.

Beyer, H.R. & Holtzblatt, K. (1995). Apprenticing with the Customer. *Communications of ACM*, 38(5), 45-52.

Boden, M.A. (1990). *The Creative Mind: Myths and Mechanisms.* Basic Books.

Cameron–Bandler, Leslie & Gordon, David & Lebeau, Michael (1985). *The Emprint Method. A Guide to Reproducing Competence.* Moab, Utah: Real People Press.

Cassell, Justine & Stone, Matthew & Douville, Brett & Prevost, Scott & Achorn, Brett & Steedman, Mark & Badler, Norm & Pelachaud, Catherine (1994). Modeling the Interaction between Speech and Gesture. In Ashwin Ram & Kurt Eiselt (Eds.), *Proceedings of the Sixteenth Annual Conference of the Cognitive Science Society, Atlanta, Georgia, August 1994*, (pg. 153).

Damasio, Antonio R. (1994). *Descartes' Error.* Grosset/Putnam.

Dennett, Daniel C. (1988). Quining qualia. In Marcel, A.J. & Bisiach, E. (Eds.), *Consciousness in Contemporary Science*, pp. 42-77. Oxford: Clarendon Press.

Dilts, R.B. (1994). *Strategies of Genius.* Meta Publications.

Dilts, R.B. & Dilts, R.W. & Epstein, T. (1994) *Tools for Dreamers; Strategies for Creativity and the Structure of Innovation.* Meta Publications.

Dilts, R. & Grinder, J. & Bandler, R. & Bandler, L. & Delosier, J. (1980). *Neuro-Linguistic Programming: Volume I, The study of the Structure of Subjective Experience.*, Cupertino, Calif.: Meta Publications.

Einspruch, E. L. & Forman, B. D. (1985). Observations Concerning Research Literature on Neuro–Linguistic Programming. *Journal of Counseling Psychology*, 32(4), 589–596.

Flanagan, O. (1993) Prospects for a unified theory of consciousness. In Cohen, Jonathan & Schooler, Jonathan (Eds.), *Scientific Approaches to Consciousness: 25th Carnegie Symposium on Cognition, May 20-22, 1993.* Hillsdale, NJ: Erlbaum.

Galin, David (1993). What is the Difference between a Duck?, In Cohen, Jonathan & Schooler, Jonathan (Eds.), *Scientific Approaches to Consciousness: 25th Carnegie Symposioum on Cognition, May 20-22, 1993.* Hillsdale, NJ: Erlbaum.

Galin, David (1994). The Structure of Awareness: Contemporary Applications of William James' Forgotten Concept of 'The Fringe.' *Journal of Mind and Behavior*, 15(4), 375-400.

Gardner, Howard (1985). *The Mind's New Science.* Basic Books.

Lakoff, George (1987). *Women, Fire, and Dangerous Things.* The University of Chicago Press.

Lenart, M. & Pasztor, A. (1995). The Chunking Engine: Closing the Gap Between Formal and Informal Design Specifications. *Proceedings of the Eighth International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems, June 6-9, Melbourne, Australia.* Gordon and Breach Science Publisher.

Lutzinger, Diane (1991). Smart Stuff. 'Maps' of Learning. *Anchor Point* June '91, 14 - 16.

Maes, P. (1994) Agents and Creativity. *Communications of the ACM*, 37(7), 31–146

Markova, Dawna (1992). *How your child is smart: a life changing approach to learning.* San Bernadino, CA : R. Reginald ; Borgo Press.

Mitchell, T. & Caruana, R. & Freitag, D. & McDermott, J. & Zabowski, D. (1994). Experience with a Learning Personal Assistant. *Communications of the ACM*, 37(7), 81-91.

Namioka, A. & Schuler, D. (1993). *Participatory Design: Principles and Practice.* Hillsday, NJ: Erlbaum.

Pasztor, A. (1996). Qualia Decomposed. *Consciousness Research Abstracts: Toward a Science of Consciousness 1996 (Special volume of Journal of Consciousness Studies* (pg. 41). Imprint Academic.

Rieken, D. (1994). A Conversation with Marvin Minsky about Agents, *Communications of the ACM*, 37(7), 23–29.

Sacks, Oliver (1987). The Man who mistook his wife for a Hat, and Other Clinical Tales. Harper Perennial.

Searle, John, R. (1992). *The Rediscovery of the Mind.* MIT Press.

Sharpley, C. (1984). Predicate Matching in NLP: A Review of Research on the Preferred Representational System. *Journal of Counseling Psychology*, 2(31), 238–248.

Thagard, Paul. (1996). *Mind. Introduction to Cognitive Science.* The MIT Press.

Weisberg, R.W. (1988). Problem Solving and Creativity. In Sternberg, R.J. (Ed.), *The Nature of Creativity.* Cambridge University Press.