How to Access and Transform the Unconscious for Cultural Development

Matthias Rauterberg(✉)

Eindhoven University of Technology, Eindhoven, The Netherlands
g.w.m.rauterberg@tue.nl

Abstract. For the future development of cultural technology, access to the cultural foundations of these culture carriers is necessary. One established theory of this cultural foundation is the collective unconsciousness with archetypes as building blocks. A methodological challenge is adequate access to these unconscious layers of the human mind. Recent research in neuroscience contributes in ways to determine the minimally conscious state. Combining these neuroscience results with the upcoming development of brain/body-computer interfaces enables us to envision new ways to establish interactions among culture carriers like humans and their cultural determinations. First, we present an overview of the known ways to get access to conscious layers, and then we discuss the potential of upcoming approaches. New technology enables us to develop new types of interfaces which are directly connected to brain/body processes. Next to direct brain connections, we introduce and discuss the possibilities of tapping into other physiological processes, especially processes of the autonomous nervous system. Finally, we are presenting and discussing the theoretical implications of the architecture of the human mind and the interfaces between all components of the conscious and unconscious parts. Potential access to the five unconscious layers of the human mind can enable new types of cultural developments.

Keywords: Archetype · Bio-signals · Brain/body computer interface · Collective unconsciousness · Consciousness · Culture · Interface technology

1 Introduction

The history of human-computer interaction (HCI) is rich and complex, and I have already summarized some of the major identified paradigms: (1) personal computing, (2) cooperative computing, (3) social computing, and now (4) cultural computing [1]. Originally HCI research was about ergonomics in man-machine interaction [2] and the emergence of the personal computing paradigm. In the 80s, HCI was investigating media-rich computing with the paradigm of networked computer-mediated interaction. Interactive multimedia was the focus of research and development. More recently, HCI was about the social computing paradigm with community-mediated interaction [3]. The HCI community investigated applications such as computer-supported cooperative work and the internet. With mobile, portable, and ubiquitous technology, HCI is looking at more personalized and intimate interaction with positive experiences [4].

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Several concepts have emerged in recent years for the future directions of HCI: ubiquitous, nomadic, mixed-reality computing, and so on. In general, all these new directions have some common properties: (1) the disappearing computer; (2) the ease of use and positive experience, and (3) the building of communities. Hence, I am exploring new ways for a novel direction in human-computer interaction named 'cultural computing', which aims to provide a new medium for cultural translation and unconscious metamorphosis [5].

In essence, cultural computing integrates verbal and nonverbal information, which proposes an emerging research area in "which computers can improve the exchange of cultural information by using cultural models" [6, p. 2]. This new field utilizes the behavior and lifestyles of humans in each culture to share common or peculiar aspects of different cultures. "At a more advanced level, culture could be viewed as an amalgamation of potentially related and relatively durable societal characteristics that describe an identifiable human population, such as a nation or ethnic group" [7, p. 17]. According to Minkov [7] all existing theories and concepts of culture can be categorized as follows: (C1) culture as mental programming or software of the mind (e.g. [8]); (C2) the sum of all created artifacts by individuals and residing outside them (e.g. art objects, clothing, work instruments, residential constructions, etc.); (C3) culture consists of all conventional patterns (i.e. all thoughts, activities, and artifacts passed on from generation to generation); (C4) culture as a set of shared meanings encoded into the norms that constitute them; (C5) culture as a collection of individual values, beliefs, attitudes, even aspects of personality, and aggregated to the societal level; and finally (C6) culture as a pure human construct completely bounded by the measurement methods. I can agree with all six categories because they just express the complexity by emphasizing different perspectives. I think these different views do not compete nor contradict but complement each other; different research communities have their specific preferences (computer scientists prefer C1, ethnographers C2, anthropologists C3 and/or C4, culturologists C5, and operationalists C6). To reduce this complexity and focus our research the interesting question is: Are there different aspects that all cultures have in common?

In sum, cultural constituents can be found on a personal, societal, and even universal layer. The universal aspects of culture are captured in the 'collective unconsciousness' (CU) as Jung defined [9, p. 42]: "The collective unconscious is a part of the psyche which can be negatively distinguished from a personal unconscious by the fact that it does not, like the latter, owe its existence to personal experience and consequently is not a personal acquisition. While the personal unconscious is made up essentially of contents which have at one time been conscious but which have disappeared from consciousness through having been forgotten or repressed, the contents of the collective unconscious have never been in consciousness, and therefore have never been individually acquired, but owe their existence exclusively to heredity. Whereas the personal unconscious consists for the most part of *complexes*, the content of the collective unconscious is made up essentially of *archetypes*." One of the central research questions is now how to get access to this CU and how to influence/transform it (if at all possible)? Before I can provide preliminary answers to these two questions, I have to discuss state of the art around 'consciousness'.

2 The Conscious-Non-conscious Dimension

Consciousness is *sentience* or *awareness* of internal and external existence. Despite millennia of analyses, definitions, explanations, and debates by philosophers and scientists, consciousness remains puzzling and controversial, being a very familiar but also a mysterious aspect of our life [10]. Perhaps the only widely agreed notion about the topic is the assumption that it exists [11]. Opinions differ about what exactly needs to be studied and explained as consciousness. Sometimes, it is synonymous with the mind, and at other times, an aspect of it. In the past, it was one's *inner life*, the world of introspection, of private thought, imagination, and volition [12]. Today, it often includes attention, cognition, experience, feeling, intuition, or perception [13]. It may be awareness, awareness of awareness, or self-awareness. There might be different levels or orders of consciousness, or different kinds of consciousness, or just one kind with different features [14]. Other questions include whether only humans are conscious, all animals, or even the whole universe. The disparate range of research, notions, and speculations raises doubts about whether the right questions are being asked [15].

Examples of the range of descriptions, definitions, or explanations are broad and diverse: (i) simple wakefulness, one's sense of selfhood or soul explored by introspectively *looking within*; (ii) being a metaphorical *stream* of contents, or being a mental state, mental event or mental process of the brain; (iii) having qualia and subjectivity; (iv) being the 'something that it is like' to 'have' or 'be' it; (v) being the *inner theatre* or the executive control system of the mind; and many more. As Crane put it: "The standard philosophical picture of the propositional attitudes [of the unconsciousness; added by author] is a mixture of important truths—the functionalist truisms about their dispositional profile, the ideas of direction of fit and representational content—and some unrealistic and misguided dogmas, such as relations to propositions, the pursuit of a compositional semantics for intentional states, or for sentences in a language of thought" [16, p. 20].

Plenty of evidence for unconscious processing has been accumulated in research areas of perceptual, affective, semantic, motor, and self-regulatory processes. "A variety of methods have been used, including subliminal priming, in which normal participants are presented with stimulus material for such short duration that it cannot be consciously perceived, and supraliminal manipulations, in which participants are aware of the stimulus material (e.g., scrambled sentences, hidden rules) but unaware of how it affects them. Evidence for unconscious processing is obtained if such manipulations reliably affect perception, feelings, judgments, or behavior in spite of participants' reported unawareness. Further evidence for unconscious processing comes from studies on patients with brain lesions… Some of these lesions appear to wipe out aspects of conscious processing while leaving intact lower-order unconscious processes of which patients are completely unaware" [17, p. 198].

2.1 Historical Approaches

At of the end of the 19th century when psychology emerged out of philosophy as a scientific discipline, most psychologists were interested in *consciousness*. They sought to examine the structure and elements of their thoughts and subjective experiences through

introspective analysis. However, within a few decades, the introspective method was discredited, and introspective descriptions were rejected as scientific evidence. Psychology turned away from studies of individuals' descriptions of their thoughts and first-hand experiences and focused on observations of how other adults performed tasks in the laboratory [18].

The rejection of introspection made the study of thinking come to a virtual halt until the 1950s, when technological innovations such as the computer lead to the emergence of cognitive and information-processing theories of psychological phenomena [19]. In the new research approach to the study of thought processes, subjects were asked to *think aloud* (see also talk-aloud, teach-aloud, concurrent verbalization), leading to a new type of verbal reports of thinking that differed from the earlier introspective methods and became the core method of protocol analysis.

The cognitive revolution in the 1960s renewed interest in higher-level cognitive processes and the way how thinking allowed individuals to generate solutions to novel tasks. Cognitive theories described how individuals could apply acquired knowledge and procedures to novel problems, such as mental multiplication of any combination of two 2-digit numbers. Information processing theories proposed computational models that could reproduce the observable aspects of human performance on well-defined tasks through the application of explicit procedures.

2.2 Modern Approaches

The recent developments in cognitive science also support an information processing view of the brain and bodily processes [20]. Investigations of the function of consciousness in human information processing have focused mainly on two questions: (1) where consciousness enters the information processing sequence and (2) how conscious processing differs from pre-, sub-, and un-conscious processing. Input analysis is thought to be initially pre-conscious, pre-attentive, fast, involuntary, and automatic. This is followed by conscious, focal-attentive analysis, which is relatively slow, voluntary, and flexible [21]. It is argued that simple, familiar stimuli can be identified preconsciously, but conscious processing is needed to identify complex novel stimuli. Conscious processing has also been thought to be necessary for choice, learning and memory, and the organization of complex, novel responses, particularly those requiring planning, reflection, or creativity. Dijksterhuis and Nordgren presented a theory about human thought named the *unconscious-thought theory* [22]. This theory distinguishes between two modes of thought, conscious and unconscious, and is applicable to decision making, impression formation, attitude formation, and change, problem-solving, and creativity. Conscious and unconscious thoughts have different characteristics, and these different characteristics make each mode preferable under different circumstances. Contrary to popular belief, decisions about simple issues can be better tackled by conscious thought, whereas decisions about complex matters can be better approached with unconscious thought. This is a strong argument for the higher computational power of the unconscious than the conscious mode.

According to Sleigh, Warnaby, and Tracey [23], *selfhood* is linked to brain processes that enable the experience of a person as a distinct entity with being capable of agency. The presented framework incorporates a continuum of both non-conscious

and conscious self-related information processing and includes a hierarchy of components, such as *awareness of existence* (core self), *embodied self* (sentience), *executive self* (agency/volition), and various other *higher-order cognitive processes*. Consciousness relates to *selfhood* but is not the same; understanding the processes required for selfhood can explain the partial consciousness states seen in anesthesia.

3 Approaches for Access to Mental Content

Two definitions have been the most prominent in the history of mind science called 'psychology' [18]. First, psychology is the *science of mind*: psychical processes are regarded as phenomena from which it is possible to infer the nature of an underlying metaphysical mind-substance. Second, psychology is the *science of inner experience*: "psychical processes are here looked upon as belonging to a specific form of experience, which is readily distinguished by the fact that its contents are known through 'introspection', or the 'inner sense' as it has been called to distinguish it from sense-perception through the outer senses" [24, p. 1]. Since Descartes from the seventeens century, we can assume to have guaranteed private access to our inner experience; "*I am thinking therefore I exist*, *was so secure and certain* that it could not be shaken by any of the most extravagant suppositions of the skeptics, I judged that I could accept it without scruple, as the first principle of the philosophy I was seeking" [25, p. 28]. This introspection was and still is the prime source of philosophical considerations. The emerging discipline of psychology [12, 24] tried to overcome this *exclusiveness* of introspection by objectifying the findings [18]: from *introspection* to *extrospection*!

Although I fully agree with Descartes' "cogito ergo sum", we must be very careful in accepting any introspective reports from a first-person perspective as a reliable and truthful source allowing to generalize the outcomes [26]. "On the one hand, thinking of mindfulness meditation as inner observation of a private mental realm feeds the internalist tendency in cognitive neuroscience to model mindfulness as a kind of mental activity instantiated in neural networks inside the head and visible through brain imaging tools such as electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI). This approach runs the risk of confusing the biological conditions for mindfulness with mindfulness itself, which, as classically described, consists of the integrated exercise of a whole host of cognitive and bodily skills in situated and ethically directed action. On the other hand, thinking of meditation as the enactment of situated mind-body states and behaviors requires us to distinguish clearly between the causally enabling conditions for mindfulness, which include neural systems but are not limited to them, and the cognitive processes that constitute mindfulness as a meaningful form of human experience and that cannot be fully understood unless described phenomenologically. This is one way in which thinking through the enactive approach returns us to the phenomenology of lived experience as a necessary complement to scientific investigation" [27, pp. xxv–xxvi].

The question remains, can we really gain insight into the psyche and mind without whatever kind of introspection? In this respect, *radical behaviorism* [18] finally failed when the upcoming research in artificial intelligence demanded such kind of detailed insights into our minds [28]. Recognition of the growing significance of knowledge-based computing systems has put attention on processes of knowledge acquisition and

transfer. Commercial application of expert systems was being impeded by the *knowledge-engineering bottleneck* and has led to the development of rapid prototyping tools [29]. After reviewing the historical arguments from the radical behaviorism against the use of introspection, Lieberman concluded "that most either is invalid or no longer possess their original force, so the benefits from a wider use of introspection now seem likely to outweigh the possible costs" [30, p. 319]. Although strict behaviorism declined in the 1960s and 1970s, "its main replacement, *cognitivist functionalism* (which treats functionally defined internal cognitive processes as central to psychological inquiry), generally continued to share behaviorism's disdain of introspective methods" [31, p. 24].

3.1 Introspection

Following Valsiner [32, p. 61], the move from Wundt's word association experiments to the change of accepting the validity of *inner observation* was the main contribution of the "Würzburg tradition" of Oswald Külpe, Karl Bühler, and others (1894 to the 1910s). Important method innovations were: (1) the *centrality* of the method of introspection of the "Würzburg School" of the early twentieth century, (2) the "Second Leipzig School's methods of *Aktualgenese* expanded into idiographic *microgenesis*, (3) the *thinking aloud* methods from Otto Selz and Karl Duncker to contemporary cognitive science, and (4) Frederic Bartlett's method of *repeated reproduction* with its contemporary extension into conversational repeated. Also, Piaget's *clinical method* in his study of children's reasoning processes belongs to the same group of methods which all sharing the notion that the person is an active constructor of one's psychological phenomena and has adequate but exclusive access to one's own inner constructions and complexes.

Introspection is used in contemporary research as a means of investigating one's own currently ongoing, or perhaps very recently past, mental states or processes. We can learn about our own mind in the same way we learn about others' minds, e.g., by asking good friends and family members for feedback about ourselves, by observing our own facial expressions (looking in a mirror), by examining readouts of brain activity through a clinical expert, by noting patterns of past behavior through diaries, by mindfulness/awareness meditation [27], etc. It's generally accepted that we can learn about our mind introspectively, in a private and exclusive way that no one else can. But what exactly is introspection? No simple definition is widely agreed upon beyond the fact of immediate, private, and conscious experience. Hofmann and Wilson [17, p. 204] "define introspection as a conscious mental activity by which attention is directed toward one's own phenomenal sensations and experiences in an attempt to form a self-referential proposition about these experiences with the use of inferential rules."

Introspection is a key concept in epistemology since introspective knowledge is often thought to be particularly secure, maybe even immune to skeptical doubt. Introspective knowledge is also often held to be more immediate or direct than sensory knowledge through extrospection. Both putative features of introspection have been cited in support of the idea that introspective knowledge can serve as a ground or foundation for other sorts of knowledge.

3.2 Extrospection

Extrospection is introspection turned outward—from the experiencer. Its process is thus like that of introspection, and it is constructive of the knowledge of the object of extrospection. The three techniques in extrospection are [32]: (1) interview, (2) questionnaire, and (3) experiment. However, all answers about internal states (e.g., emotions) from the investigated subjects – although externally observable through extrospection by the investigator – are finally based on introspective impressions. That was the main motivation to overcome the resistance against introspection and justify why these kinds of data are valid input for research. The milestone book of Ericsson and Simon on protocol analysis tried exactly this [33]. In this book, the authors argued that under certain conditions, verbal data based on introspective impressions could indeed be treated as reliable and valid data. Till today 'design cognition' "refers to the mental processes and representations involved in designing and has been a significant area of interest since the emergence of design research in the 1960s. The field now faces significant challenges moving into the future, with the major change required to overcome stagnation in research topics and methodologies" [34, p. 1].

Protocol analysis is a rigorous methodology for eliciting verbal reports of thought sequences as a valid source of data on thinking [33]. The central assumption of protocol analysis is that it is possible to instruct subjects to verbalize their thoughts in a manner that does not alter the sequence of thoughts mediating the completion of a task and can therefore be accepted as valid data on thinking. Based on their theoretical analysis, Ericsson and Simon [33] argued that the closest connection between thinking and verbal reports is found when subjects verbalize thoughts generated during task completion and problem-solving, resp. When subjects are asked to *think aloud*, some of their verbalizations seem to correspond to merely vocalizing 'inner speech,' which would otherwise have remained inaudible. Non-verbal thoughts can also be often given verbal expression by brief labels and referents.

Task analysis specifies the range of alternative procedures that people could use, considering their prior knowledge of facts and procedures, to generate correct answers to a task. The choice of alternative procedures participants use to generate the answer can be inferred by the time needed and verbal reports of their thoughts during problem-solving. In conclusion, the theoretical and methodological controversies about verbal reports have never cast doubt on people's ability to recall part of their thought sequences. The controversies have centered around efforts to go beyond the sequence of thoughts, to analyze their detailed structure through *introspection*, and infer the processes controlling the generation of new thoughts. In fact, all major theoretical frameworks concerned with thinking have advocated the use of verbally reported sequences of thoughts. However, it would be very useful to have an objective manner to describe and analyze problem-solving processes without the necessity of introspections.

Decades ago, I developed a theoretical framework to conceptualize a measure of behavior complexity (BC), system complexity (SC) and task complexity (TC) [35]. From this framework cognitive complexity (CC) is derived as $CC = SC + TC - BC$. In an empirical study to investigate different measures of cognitive complexity, six beginners and six experts solved four different tasks with a commercially available interactive database management software. Our special program the *automatic mental*

model evaluator (AMME) was developed to analyze the empirically recorded logfile data during the interactive sessions [36]. I collected 48 (= (6 + 6)*4) complete logfiles which represented all task solving processes in an objective manner. The automatic analysis allowed me to analyze all these logfiles in a reasonable amount of time and run inferential statistics on the outcomes. Without such automatic support, it needs several days or even weeks to analyze just *one* logfile [37]. Four different approaches from the literature to measuring complexity in a quantitative way were considered and discussed to validate a measure of cognitive complexity based on observed behavioral data. The application of our four selected metrics was compared and statistically tested against the empirical results of the experiment. The complexity metric of McCabe proved to be the most effective and plausible measure for cognitive complexity. One of the astonishing results of my research approach was the discovery and measurement of the *knowledge about unsuccessful* behavior [38].

This kind of knowledge is not - or almost not - introspectively accessible but can now be indirectly measured through observed behavior. Also, Ericsson and Simon acknowledged that not every aspect of the mind can be investigated by introspection only: "Automation means that intermediate steps are carried out without being interpreted, and without their inputs and outputs using STM [Short Term Memory; added by the author]. The automation of performance is therefore quite analogous to executing a computer algorithm is compiled instead of interpretive mode. Automation (and compiling) have two important consequences. They greatly speed up the process (typically, by order of magnitude), and they make the intermediate products unavailable to STM, hence unavailable also for verbal reports" [33, p. 15].

3.3 Bio-signal Sensing

The automatic sensing of bio-signals (e.g., ECG, EEG, facial expression, NIRS, prosody, skin conductivity, step counter; see at [39]) opens the door to new applications and new types of feedback about the inner states of a person. Affective computing is the research area focusing on such topics [40]. Picard discovered that emotions play an essential role in decision making, perception, learning, and a variety of other cognitive functions and are not limited to art, entertainment, and social interaction. Hence, measuring emotions became an important research challenge. It is amazing how measuring *honest signals* can provide predictions about unconscious human decision-making. Using a specially developed *sociometer*, Pentland and his group have conducted many experiments relating human signaling and patterns of interaction to behavioral outcomes. They have found "that they can use the sociometer measurements to accurately predict outcomes in situations such as negotiations, dating, selling, bluffing, and other critical human activities" [41, p. 111]. Further on, I will only discuss in more detail two interesting and important topics: (1) pain measurement and (2) measuring archetypes.

Accurate pain measurement is a key for the management of chronic pain. Although in clinical practice, the *golden standards* of pain measurement are self-reported scales [42], the reliability and validity of such self-reports remain unclear. Unfortunately, "the reliability of these subjective methods could be easily affected by patients' physiological and psychological status, as well as the assessors' predispositions. Therefore, objective pain assessment has attracted substantial attention recently. Previous studies of functional

magnetic resonance imaging (fMRI) revealed that certain cortices and subcortical areas are commonly activated in subjects suffering from pain. Dynamic pain connectome analysis also found various alterations of neural network connectivity that are correlated with the severity of clinical pain symptoms. Electroencephalograph (EEG) demonstrated suppressed spontaneous oscillations during pain experience. Spectral power and coherence analysis of EEG also identified signatures of different types of chronic pain. Furthermore, fMRI and EEG can visualize objective brain activities modulated by analgesics in a mechanism-based way, thus bridging the gaps between animal studies and clinical trials. Using fMRI and EEG, researchers are able to predict therapeutic efficacy and identify personalized optimal first-line regimens. In the future, the emergence of magnetic resonance spectroscopy and cell labeling in MRI would encourage the investigation on metabolic and cellular pain biomarkers. The incorporation of machine learning algorithms with neuroimaging or behavior analysis could further enhance the specificity and accuracy of objective pain assessments" [43, p. 1].

In the study of Ivonin et al. [44], conscious and unconscious traces related to archetypal experiences have been investigated. In their study with 36 subjects, they examined the effects of experiencing conglomerations of unconscious emotions associated with various archetypes on the participants' introspective reports and patterns of physiological activations. Their hypothesis for this experiment was that physiological data might predict archetypes more precisely than introspective reports due to the implicit nature of archetypal experiences. Introspective reports were collected using the Self-Assessment Manikin (SAM) technique. Physiological measures included cardiovascular, electrodermal, respiratory responses, and skin temperature of the subjects. The subjects were stimulated to feel four archetypal experiences and four explicit emotions by means of film clips. The data relating to the explicit emotions served as a reference in the analysis of archetypal experiences. Their findings indicated that while prediction models trained on the collected physiological data could recognize the archetypal experiences with an accuracy of 55 percent, similar models built based on the SAM data demonstrated performance of only 33 percent. Statistical tests enabled them to confirm that physiological observations are better suited for observation of implicit psychological constructs like archetypes than introspective reports.

4 Cognitive Architectures and Consciousness

In this chapter, I will discuss only two approaches to the cognitive architecture of the human's mind: for historical reasons, Freud's concept, and the most popular modern version of Kahneman. However, I am fully aware of all the many other famous concepts and established approaches, like ACT-R [45], Soar [46], and CLARION [47]; for a historical overview, see [48]. While ACT-R and Soar avoid addressing unconscious mental processes, CLARION has implemented this important distinction.

4.1 Freud's Cognitive Architecture

In response to the unstructured ambiguity and conflicting uses of the term 'the unconscious mind', Freud introduced the structured model of ego psychology (id, ego, superego) in the essay *Beyond the Pleasure Principle* (1920) and elaborated, refined, and made

that model formal in the essay *The Ego and the Id* (1923). The main modules in Freud's cognitive architecture are (1) id, (2) ego, and (3) super-ego (see Fig. 1). These concepts are describing distinct, interacting 'agents' in the 'psychic apparatus'. These three agents are theoretical constructs that describe the activities and interactions of a person's mind. In this model of the psyche, the id is the set of uncoordinated instinctual desires; the super-ego plays the critical and moralizing role; and the ego is the organized, realistic agent that mediates, between the instinctual desires of the id and the critical super-ego; Freud explained that: "The functional importance of the ego is manifested in the fact that, normally, control over the approaches to motility devolves upon it. Thus, in its relation to the id, [the ego] is like a man on horseback, who has to hold in check the superior strength of the horse; with this difference, that the rider tries to do so with his own strength, while the ego uses borrowed forces. The analogy may be carried a little further. Often, a rider, if he is not to be parted from his horse, is obliged to guide [the horse] where it wants to go; so, in the same way, the ego is in the habit of transforming the id's will into action, as if it were its own." [49, p. 3960].

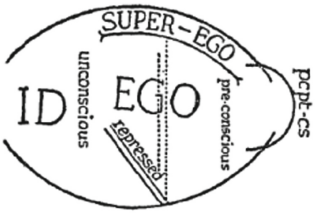

Fig. 1. High-level cognitive architecture according to Freud (adapted from [50, p. 111]) (remark: 'pcpt-cs' means 'perception – conscious')

The existence of the *super-ego* is observable in how people experience norms and values such as guilty and bad, shameful and weak, and feel compelled to do certain things in a rightful manner. Freud described "the general character of harshness and cruelty exhibited by the [ego] ideal—its dictatorial 'Thou shalt'" [49, p. 3989]; hence, in the psychology of the ego, Freud hypothesized different levels of ego ideal or super-ego development with greater ideals: "… nor must it be forgotten that a child has a different estimate of his parents at different periods of his life. At the time at which the Oedipus complex gives place to the super-ego, they are something quite magnificent; but later, they lose much of this. Identifications then come about with these later parents as well, and indeed they regularly make important contributions to the formation of character; but in that case, they only affect the ego; they no longer influence the super-ego, which has been determined by the earliest parental images." [50, p. 64].

The earlier in the child's development, the greater the estimate of parental power; thus, when the child is in rivalry with the parental imago, the child then feels the dictatorial *Thou shalt*, which is the manifest power that the imago represents on four levels: (i) the auto-erotic, (ii) the narcissistic, (iii) the anal, and (iv) the phallic. Those different levels of mental development, and their relations to parental images, correspond to specific id forms of aggression and affection; thus, aggressive and destructive desires animate the myths in the fantasies and repressions of patients in all cultures.

4.2 Kahneman's Cognitive Architecture

The distinction between unconscious intuition and conscious reasoning has been a topic of intensive research in the past. In particular, the differences between the two modes of thought have been addressed in attempts to organize seemingly contradictory results in studies of the judgment under uncertainty. Today there is agreement on the characteristics that distinguish the two types of cognitive processes, which Kahneman [51] labeled system 1 (intuition) and system 2 (reasoning). The well-known scheme of Kahneman is a high-level cognitive architecture and summarizes these characteristics: (i) the operations of system 1 are fast, automatic, effortless, associative, and difficult to control or modify; (ii) the operations of system 2 are slower, serial, effortful, and deliberately controlled; they are relatively flexible and potentially rule-governed (see Fig. 2).

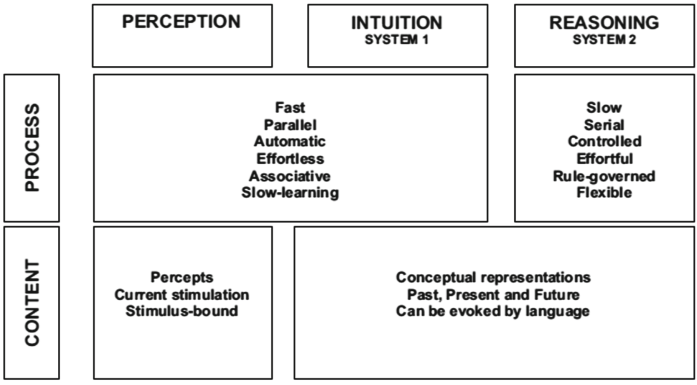

Fig. 2. High-level cognitive architecture according to Kahneman (adapted from [21, p. 451])

4.3 Communication Between Modules

We know that the non- and un-conscious mind do the largest part of the brain's work [52], but we do not know exactly how all of it gets done, and it is an active subject of study. For example, one major area of research is how emotions take shape in the unconscious [53]. Information is stored associatively in the brain, which is largely bundles of pathways of association and usually responsive to activation when needed [54]. A lot of concepts and frameworks about emotions are already available. In one of my papers, I argued for a new holistic view of the relation between the unconscious and the conscious information processing part of our brain [55]. And "there are reasons to believe that, psychologically, emotion is the collective outcome of operations throughout a cognitive system" [53, p. 6].

If we assume that emotions are perceived as important aspects in relation to other cognitive functions, then we could go so far as to conceptualize emotions as the appearance of the results of these unconscious cognitive processes to our consciousness. This is an internal perception loop about the own mental and bodily states. If we assume further that the information processing capacity of the unconscious is several magnitudes higher than the conscious, and both systems are somehow separate systems, we must answer the question of how these two systems communicate with each other. An elegant solution is that emotions can play this role as the 'voice of the unconscious' in telling the conscious the solutions found in a high dimensional non-, un-, and sub-conscious mind space. But these emotions are not only to inform the conscious internally, they also communicate to the social context around us. Our non-verbal body language is also part of the emotional expression space for the adjustment of social relations.

Hofmann and Wilson described a framework of a global workspace that leads to three different zones of consciousness [17, pp. 203–204]: The *first zone* (non-consciousness) includes the class of information that is forever impervious to consciousness because it is part of lower-order subroutines that cannot per se share their contents in the common communication protocol because of a lack of neural connectivity with the workspace. This first zone may be referred to as the realm of non-conscious processing in the strict sense. Even consciously not accessible, non-conscious modular processing can be the source of both processing outputs from the following zone-2 and of behavioral output.

The *second zone* (phenomenal consciousness) is given by the subclass of higher-order processing outputs from modular subsystems that has the potential to be recruited into the workspace but does not (currently) gain access to it, either because it is too weakly represented or because it does not receive top-down attentional amplification. The phenomenal consciousness of zone two may encompass a vast range of sensations and experiences, including perceptions, feelings, and other bodily sensations such as pain that people are having without being aware (in the sense of knowing) that they are having. Importantly, the information represented in this way may, under certain conditions (i.e., attentional amplification), become fully consciously accessible and gain the status of the third zone.

The *third zone* (full consciousness) is reserved for the elite information that has passed the gates of selective attention and, therefore, has become recruited into the global workspace. As part of the global workspace, it becomes accessible to a large range of different processing modules, including long-term memory, self-processing units, and speech production centers that translate the information into a propositional format. Experience has been tagged as such and becomes the object of higher-order thoughts directed at it. Access consciousness, therefore, refers to informational contents that people are aware of in the sense of knowing. These mental contents can be communicated in the form of propositional statements about oneself and the world.

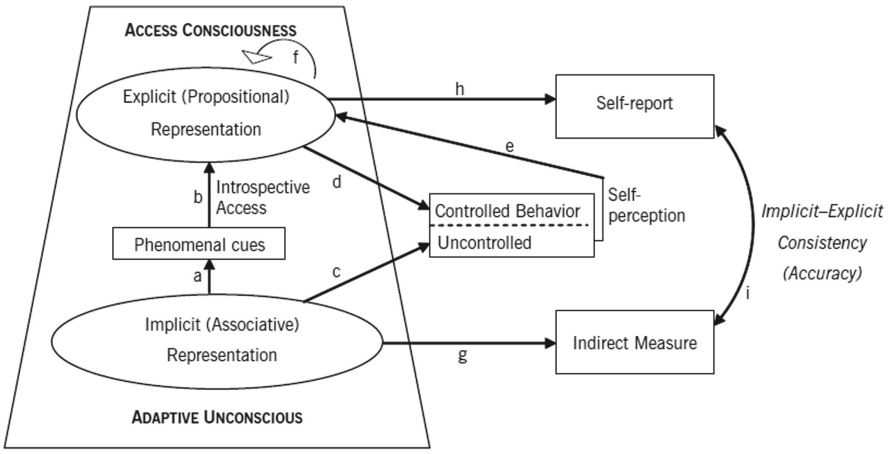

Fig. 3. A self-inference model for implicit–explicit consistency and accuracy (adapted from [17, p. 207])

According to the model of Hofmann and Wilson (see Fig. 3), "accurate explicit representations of implicit representations depend on whether valid phenomenal or behavioral cues are available (path a or path c, respectively) and whether these cues are detected (paths b and e, respectively). Furthermore, accuracy as assessed by implicit–explicit consistency (i) can be impaired by additional information integration or invalidation processes (arrow f) and by poor measurement (paths g and h)" [17, p. 207].

5 Influencing Consciousness

In specifying the general methods employed to produce *altered states of consciousness*, Ludwig [56] emphasized that there is some overlap among the various. For the sake of classification, Ludwig has categorized the various methods on the basis of certain variables or combinations of variables that appear to play a major role in the production of these altered states of consciousness: (1) Reduction of exteroceptive stimulation and/or motor activity; (2) increase of exteroceptive stimulation and/or motor activity and/ or emotion; (3) increased alertness or mental involvement; (4) decreased alertness or relaxation of critical faculties; and (5) presence of somato-psychological factors. All these five categories can be achieved, created or induced by different approaches: amnesia, anesthesia, brainwashing, coma, deprivation, dreaming, drugs, exercises, hypnosis, meditation, neurosis, pain, psychosis, rituals, sex, sleep, torture, trance, tribal ceremonies, etc. Most altered states of consciousness can be described and characterized as: (i) alterations in thinking, (ii) disturbed time sense, (iii) loss of control, (iv) change in emotional expression, (v) change of own body image, (vi) perceptual distortions, (vii) change in meaning or significance, (viii) sense of the ineffable, (ix) feelings of rejuvenation, and (x) hyper-suggestibility [56, pp. 15–18].

***Anesthesia and Other Drugs*:** As an interesting example, anesthesia reversibly alters consciousness without shutting down the brain globally [57]. Depending on the anesthetic agent and dose, different consciousness states can be produced, including a complete absence of subjective experience (sub- or un-conscious states), a conscious experience without perception of the environment (called disconnected consciousness, e.g., during dreaming), or episodes of oriented consciousness with awareness of the environment (called connected consciousness). Each of these three consciousness states may potentially be followed by explicit or implicit memory reports of the patient after the anesthesia procedure. Many other drugs have a strong impact on mental states [58].

Hypnosis: Hypnosis can be defined as "a social interaction in which one person, designated the subject, responds to suggestions offered by another person, designated the hypnotist, for experiences involving alterations in perception, memory, and voluntary action. These experiences and their accompanying behaviors are associated with a subjective conviction bordering on delusion, and involuntariness bordering on compulsion" [59, p. 385]. The characteristics of a hypnotic state include (i) a redistribution of attention to an inward focus, (ii) a reduction of a critical judgment and reality check, (iii) a suspension of forward planning, (iv) an increased suggestibility, (v) heightened imagery or involvement in fantasy, and (vi) a hypnotic role behavior [60, pp. 3–4].

Priming: Priming is a phenomenon whereby exposure to one stimulus influences [positively or negatively] a response to a subsequent stimulus without conscious guidance or intention. The experiments of Bargh and Pietromonaco showed "that social categories can be primed passively by presenting the priming information *outside* of the subject's awareness" [61, p. 446]. E.g., the word *doctor* is recognized more quickly following the word *nurse* than following the word *bread*. priming can be affective, associative, conceptual, negative, perceptual, positive, repetitive, or semantic. Research has yet to firmly establish the duration of priming effects, yet their onset can be almost instantaneous. Priming works most effectively when the two stimuli are in the same perceptual modality. Priming also occurs between modalities or between semantically related words such as *doctor* and *nurse.* For further details, see [62] and [63].

Rituals: A ritual is a sequence of activities involving gestures, words, actions, or objects, performed in a sequestered place and according to a set sequence. Rituals can be prescribed by the traditions of a community, including a religious one. Rituals are characterized by invariance, formalism, performance, rule-governance, sacral symbolism, and traditionalism. Rituals are known for all human societies and cultures. They include not only the worship rites and sacraments of organized religions and cults but also rites of passage, atonement and purification rites, oaths of allegiance, dedication ceremonies, coronations and presidential inaugurations, marriages, funerals, and more [64]. Ritual studies provide several conflicting definitions of this concept. One is that a ritual is an outsider's category for a set of actions that seems irrational, non-contiguous, or illogical. The term *ritual* can also be used by an insider as an acknowledgment that this activity is such by the uninitiated onlooker. In psychology, the term *ritual* can be used in a technical sense for a repetitive behavior systematically used by a person to neutralize or prevent anxiety, bad luck, religious ceremonies, etc. Overall, rituals are highly automated cultural activities in a historically determined context of use.

6 Interface Technologies

Here I discuss only technical solutions that are based on sensors of inner states or contain cultural content to influence such inner states and might contribute to altered states of consciousness.

6.1 Feedback Systems

The design work of Neidlinger includes NeurotiQ as a brain animating fashion that illuminates and maps brain states with color. "The NeurotiQ Spa is an experiential journey for a group to embody their minds, be led in a mindful-yoga meditation class, and then receive a visualization of brain activity as a takeaway. SENSOREE™ therapeutic bio-media is technology to read the body and translate it to visual and tactile languages. We worked with the Muse™ Brain Sensing Headband to identify activity levels and brainwave frequency patterns from the user's mind. Then, we animated this information visually on the NeurotiQ headpiece" [65].

Among other feedback systems, Neidlinger designed a visualization for the feeling of awe. People in awe start to appreciate their sense of selfhood as less separate and more interrelated to the larger existence. "AWElectric is a novel wearable tactile interface that enhances the feeling of awe and shares the feeling with another. The biometric inflatable 3D print fabric amplifies the feeling of goosebumps by mimicking the ripple of skin, as well as the Audio Tactile fabric that creates a tickle to invoke the feeling of goosebumps." [66, p. 322].

6.2 Interactive Systems

To introduce the technical solutions, I focus on three projects: (i) bio-signals from our brain and (ii) two interactive installations based on cultural content. Cultural computing is not only integrating cultural aspects into the interaction with a product but also allowing the user to experience an interaction that is closely related to the core aspects of his/her own culture. As such, it is important to understand one's cultural determinants and how to render them during the interaction.

***Brain-Computer Interface*:** "Brain–computer interfaces (BCIs) are systems that translate a measure of a user's brain activity into messages or commands for an interactive application. A typical example of a BCI is a system that enables a user to move a ball on a computer screen toward the left or toward the right by imagining left- or right-hand movement, respectively. The very term BCI was coined in the 1970s, and since then, interest and research efforts in BCIs have grown tremendously, with possibly hundreds of laboratories around the world studying this topic. This has resulted in a very large number of paradigms, methods, concepts, and applications of such technology" [67, p. 1]. Consumer-grade electroencephalogram and BCI systems, such as Neurosky (www.neurosky.com), Emotiv (www.emotiv.com), or other devices, are increasingly used. Many commercial BCI systems come with ready-to-use algorithms to detect mental states such as attention, emotions, or meditation [68]. The handbook from Nam, Nijholt, and Lotte

provides an overview and tutorials of the multiple and rich facets of BCIs and their applications.

ZENetic Computer: The ZENetic computer from Tosa is an interactive tabletop installation as a means of cultural translation using scientific methods to represent essential aspects of Japanese culture based on Zen. "Using images—deriving from Buddhism and other Asian concepts, Sansui (landscape) paintings, poetry, and kimonos—that have not heretofore been the focus of computing, the authors project the style of communication developed by Zen schools over hundreds of years into an exotic computing world that users can explore. Through encounters with Zen koans and haiku, the user is constantly and sharply forced to confirm his or her self-awareness for the purposes of the story. There is no one right answer to be found anywhere" [69, p. 205].

***ALICE Project*:** We addressed individually and collectively the cultural determinants of the Western culture in our ALICE project. Based on the narrative 'Alice Adventures in Wonderland', we have built a mixed reality installation to provide and investigate cultural user experiences. Alice's adventures happen in a world of paradox, the absurd, and the improbable. The key aspects of *Alice in Wonderland* are: (1) a nonlinear, nonconstant time flow, (2) a distortion of experience in space and with other characters, and (3) a counterintuitive, commonsense defying heuristics. The ALICE installation consisted of six consecutive stages, like a theme park attraction. The visitor moved individually and alone through them, one after the other [70].

In her quest, Alice had to go through surreal locations and events. The user in the role of Alice will go through an interactive experience and for example, at the very beginning getting bored in a park scene. Our investigation addressed the sequential arousal and interdependencies of two drives: boredom and curiosity. Based on the literature, we introduced general design guidelines for arousing boredom and explain how boredom can result in curiosity. We designed a park environment with the entrance to the rabbit hole. Effectively arousing boredom can be demonstrated in our experiment. Based on the experimental results, we redesigned the park environment. In a second experiment effectively, arousing curiosity was shown so that the sequence of events (e.g., the appearance of the 'White rabbit' robot) had a significant positive influence on the arousal of curiosity and on triggering and guiding intended user behavior [71]. Later the user meets a Caterpillar, who questions the participant's whereabouts of his/her *self-concept*. To determine the effect of this experience, we used a method that measures changes in a person's implicit self-concept. We predict that the experience will have an unconscious effect on individual metamorphosis. Using the 'implicit association test' (IAT), we could find a significant effect in the hypothesized direction [72].

7 Conclusion

Our brain, heart, and other organs are permanently active, even when we are asleep. The brain just changes the state of consciousness at different situations. In clinical practice, we can determine such levels; e.g., the *Rancho Los Amigos Scale* is an ordinal scale of recovery of function from traumatic brain injury and consists of eight ranks: (1) no response (coma); (2) generalized response (vegetative state); (3) localized response; (4)

confused-agitated; (5) confused, inappropriate, non-agitated; (6) confused-appropriate; (7) automatic-appropriate; (8) purposeful-appropriate [73]. Although this scale is one approach to measure levels of consciousness, it does not provide any deeper insight into the structure of consciousness. This scale is primarily based on observable behavioral response patterns. Unfortunately, more recent investigations do not provide useful additions [74].

Based on all the discussed literature above, I introduce the five-level model of consciousness (see Table 1). Level-0 describes all bodily activities which are not at all available through introspection (e.g., automated motoric behavior); level-1 is the unconscious part of our mind that needs special techniques (e.g. hypnosis) to get access to; level-2 is the sub-conscious part that we can access indirectly through free association or when we remember dreams, etc.; level-3 is the pre-conscious part that we can easily directly and indirectly control through our attention [75]; level-4 is our direct and immediate conscious experience. The difference between level-4 and level-3 can be described by an analogy: level-4 is like a torch and lights up the spot of our conscious, while level-3 is the whole 'dark' area where we can direct the torch beam to.

Table 1. The five different levels of consciousness.

Level	Description	Introspective access possible	External support required
0 - non-conscious	All bodily processes unavailable by any kind of introspective method	No, only by neuro-scientific methods	Yes, indirectly
1 - un-conscious	All indirectly available content and operations of the mind below the level of conscious awareness	No, e.g. by hypnosis	Yes, directly
2 - sub-conscious	All mental content to be only indirectly available	Yes, indirectly by free association	Partially
3 - pre-conscious	All mental content to be available by explicit attention allocation	Yes, by own extra effort	No but possible, e.g. priming
4 - conscious	Direct conscious experience	Yes, normal flow	No

Overall, our whole body, including our brain, is not only permanently active but also of huge information processing capacity. The cultural content is mainly embedded in level-1, if not also in level-0. It remains unclear where to place the collective unconscious of Jung exactly [76]. Emotions can be interpreted as messages from the unconsciousness to our consciousness.

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