



# Research and Applications of Qualia – The Unit of Subjective Experience

Kamlendu Kumar Pandey, Veena Jokhakar

**Abstract:** *This paper performs a detail study on the present state of research in the study of mind-body problem that is termed as 'qualia' or the 'phenomenal experience'. The term 'qualia' (singular: quale) in Latin has continued to exist in philosophical discussions of the epistemological status of sensory experience, an essential problem of western philosophy. Consciousness has been studied in vast interdisciplinary fields like humanities, sciences, philosophy, academicians, musicians, computer science, physicalism and many more. Further we also talk about how experts talk in terms of mental illness to tackle the problem of mental disorderliness in the civilization. We in this paper discuss about the inception of philosophy up to the present state with all the description of various stages of evolution in sciences and study on the consciousness in various fields.*

**Keywords :** *Qualia, Subjective Experience, Artificial Intelligence, Consciousness.*

## I. INTRODUCTION

According to literature, there are two words, qualia and quale used for plural and singular forms respectively. Understanding clearly about what consciousness is, how it is shaped, assessed, or recognized [1] would help to comprehend who are we, how the universe is perceived by us or may be even what is the perspective of life[2].

Scientists and Philosophers have been trying to understand the phenomenon of consciousness and its nature since ages. The two terms consciousness and qualia have been coined for the same. Consciousness is how it feels to have a subjective experience of any anything and qualia is individual component of the subject experience. This has been a study since philosophy and science has existed. Anything that is visible can be deducted by sense of sight, and anything that can't be seen but still can be understood in some form is qualia. The various subject and fields like sociology, anthropology, science i.e. health science, computer science and neuroscience all have been studying the same in individual perspective.

Qualia can be properties of conscious familiarities that add to composition of what it is to undergo and that goes beyond the well-designed and the "plain" intentional. By the "plain" intended character of a rational condition, it means the premeditated nature that the state can share with some nonconscious state.

It is also taken as nonconscious states can be intentional. For instance, a subliminal perception can most probably be "intentionally directed" towards, or "concerning" objects and features in the surroundings. If any portion of the intentionality of a conscious perception can be had by a subliminal perception, that intentionality is "plain"[3]. Free will is seen as extending from easy sensory experiences to compound subjective constructions resulting in the clear work out of mindful will. The experience between these two limits includes instinctively occurring mental filling, unintentional perceptual knowledge, memory retrievals, and problem solving including feedback of mindful contents. Now there are two factors, one the presence or absence of intention (psychologically defined) and the other the complexity of the cognitive construction involved [4]. Similarly when a fruit is checked for it being ripe or rotten depends on its smell and taste rather than the knowledge of how is known to be this is perceptual knowledge that is acquired through senses.

Consciousness encompasses the fields of psychology, biology, physics, as well as epistemology and philosophy with an growing need of interdisciplinary hard work and swap over of ideas. The intricacy of the hitch and the width of concerned fields of awareness recommend the need for an unbiased approach, able to keep away from any involuntarily prejudicial, dogmatic stance, based on one's formation and beliefs. It also prevents one to correctly talk about the entire theme contained by the space of an article. Qualia are confidential mindful experience of which the connected mind-set can be reported to other people. Further, we can consider every incident is an false impression where every smallest particle in the universe be it a blue sky, or a hot plate or a splendid poem or a conscious agent. This apprehension is primarily evident in the case of digital computers, where the machines are competent of extrapolating all the world's objects from strings of binary digits. Doesn't it seem to experience a face in a bunch of zeroes and ones a huge delusion, in particular while another device executes a song on the same set of inputs!!

The paper has been organized as follows: Section II describes explanation of , Section III discusses the related work, Section IV States the future scopes & applications.

## II. UNDERSTANDING QUALIA IN VARIOUS PERSPECTIVES

Since the dawn of human civilization there has been a quest to find answers to some fundamental questions regarding the existence. "Why the creation exist?", "Who made it?", "What is the basic component of being?" and finally "What exactly makes us experience all this?". Every generation and civilization has tried to answer these questions using the resources, knowledge, and beliefs.

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The quest of answering the questions gave rise to various philosophies, religions, belief systems, traditions, cultures and finally the sciences. It has been a long journey since then. We shall focus on the ways which applied deep wisdom and intellect to answer these questions.

The answer to the question that “What makes us experience all this” is answered in two distinct knowledge postulates. The first one is the Philosophy of panpsychism and the later is the philosophy of reductionalism. Although both were quite serious in answering this question which involved deep investigation of facts, and cutting edge analysis, the two hardly met each other and more ever evasive about each other. One side ancient Indian Vedic awaiting philosophy focused on an omnipresent, existential and eternal consciousness or awareness as the witness and subject which possess first person experience by interpreting the memories and sensations from mind-body complex. On the other side there is a philosophy of reductionalism which rejects this idea and presses that the awareness is nothing but the biproduct of interaction of nervous system and brain. These philosophies are not localized as both of them prevailed in every part of the world. Panpsychism in some parts with a simplistic understanding morphed into religions. The reductionist way gave ways to go on with the experimental-observational-interpretational way of establishing the fact. These two ways of dealing with problem of consciousness led to the famous term called “Hard Problem of Consciousness” aka David Charlmes [20].

The Qualia is the sub domain of the field of consciousness which tries to define the first person experience in some qualitative or quantitative way as “What is it like to experience <something>”. The world qualia is being now used by many disciplines like philosophy, psychology, neuro sciences and computer science. Qualia is one of the most debatable term regarding its occurrence and origin and since long researchers have working upon it. Some first person experiences can be qualified as qualia are categorized as understand [21] (Haugeland 1985, pp. 230–235).

Perception based experiences: like experience involved in seeing red, hearing a harmonium, tasting coffee, smelling the tea, handling a piece of silk.

Physical Sensations in Body, for example, feeling pain, feeling an itch, feeling, craving for food, having a back ache, feeling hot, feeling sleepy, having orgasm etc.

Passions or Emotions, like feeling delighted, lust, fear, love, feeling agrieved, being jealous, regretfulness.

Mood based experiences, as, feeling elated, depressed, calm, bored, tense, miserable, shocked, and apathetical.

Researchers like [22] Galen Strawson (1984) claimed that understanding of sentences and the feeling outcome due to this can also be qualifies as qualia. Non only this he extended the domain of qualia to sudden arousal of thoughts without any sensory perception as also to be qualified as qualia (p. 196). Even spoken words with native connotations and lexis also arouse qualia experience[23] [Horgan and Tienson (2002).]. Although how to take them in account as far as scientific and research is concerned is a big question. So many researchers are not in view to keep them under qualia.

Qualia is seen by different perspectives by researchers having diametrically opposite beliefs regarding qualia some of the arguments are given as under

### A.Functionalism

Functionalism denies any irreducibility and ponders on the view that qualia are the product of brain-nueron correlates and a certain sensory input under identical boundary condition will yield the same qualia. So, it is like a functional computer program of Deep Neural Networks where the final outcomes will be judged by a look up table to make classification, decision and the reaction. There is no unknown awareness or consiousness to make somenody feel the way he feels. This argument has been successfully and mercilessly crushed by researchers [20][30] (Block, Lycan 1987 Chalmers 1996) [ by Inverted Spectrum and Absent Qualia Analysis (China-body problem).

### B.Qualia and the Explanatory gap

This is a grave issue with qualia. No matter how much introspection you do it is difficult to find the root cause of first person experiences. The Upnishads (Indian Philosophical texts) beautifully described it as “I am that and so are you and so is everything”. It is just like finding yourself assuming that you are lost! So you are never going to find it out unless realising that you are that. The reductionalist too face the same issue . Right from the sense organs, sense perception, neural node firing, neural transmissions, brain centres are all but elctromagnetic impulses. How these impulses convert into first person experience is still elusive. This explanatory gap leads to the hard problem of consciousness. The famous “explanatory gap” for qualia is mentioned in [31](Levine 1983, 2000). Some claim the explanatory gap is unbridgeable, and the right inference to draw from it is that a corresponding gap occurs in the world. In [32][20], it is stated that, Experiences and feelings have irreducibly subjective, non-physical qualities [32][20]. Others insists that the gap does not detract from a purely physicalist view of experiences and feelings. It shows rather some physical qualities or states are irreducibly subjective entities [33] (Searle 1992).

### C.Qualia as intrinsic and non representational property

Now this is something which makes the entire work difficult for scientific researchers and takes the qualia in the realms of philosopy. Although representations have a strong argument against it belief that the final outcome of neural corelates somehow create a representation and with a huge look up table the first person experiences are created, however none has provided the real basis of the lookup table. Some argue that the images and their corresponing experiences keep on being stored in the memory which serve as the basis of lookup table. This argument has been quashed by Block’s inverted earth example [24] as having an earth where all the colours are inverted even then the first person experience is not changed. Some researchers argue that the qualia are teleological in character and so they may not be intrinsic. This does not apply to the random thoughts and past memories which may arise without any sensory input. The memories travel in a random chain one memory giving rise to the another and some times has completely imaginary or hallucinational phenomenon have first person experiences so the argument of being teleological does not stand here.

Dretske 1995 paper regarding the swampman problem also cites the same issue[34].

#### D. Qualia as Relational

Campbell(2009) [35], the realists tried to establish that there is no requirement of ego to understand or analyse the first person experience but these experiences and phenomenal and depend of lot of factors including time, space, object, memory, experiences, education and environment. Every one may have different subjective experience as these relational factors are different for different subjects. If we systematize everything with modern day scientific understanding than it is not a difficult nut to crack, however they have no practical way to formalise this and develop any realistic theory on qualia, like there was no explanation for hallucinations and dream experiences.

The researchers in field of Artificial intelligence and robotics are exploring this area of qualia in the relational way. Lot of work has been done in the area of information processing, Set theories, Information System theories, converting this into a NP-hard or Np-complete problems.

#### E. Does Qualia applies to human beings only?

Do the earthworm have qualia? What about plants ? What kind of qualia do they have?. If qualia is to be understood, a comprehensive theory needs to be developed which can be generalised or narrowed down to any biological or even non-biological species. The Indian philosophies like upnishads and vedas come as big rescue here which consider awareness as pan-universal entity like space. This awareness can express itself and generate qualias by by finding the right instruments and environments. It can be compared with analogy of electricity that although electricity can be supplied to any object but it will express itself only when the object or instrument is capable of utilizing it in a meaningful functional way. So all living organisms and non living objects vary in the instrumental make up. Where human being has got a highly evolved sensory-neuro-brain-intellect system, the organisms like earthworm possess a minimum neuro system just for its survival, the sensory and intellect system is minimal so even the consciousness is there the qualia generated is minimal for the survival of earthworm. The plants lack any any intellect or memory system but just a simple physiological response mechanism to respond to any external factor. There is hardly any change of qualia generation even by the presence of awareness. This makes qualia an interesting topic of research where current cross-disciplinary knowledge can be utilised to study qualia.

#### F. Galelian and Non-Galelian Qualia

Par Sundstrom (2014) [36] analysed qualia in the perspective of Galelian and Non-Galelian philosophy. In Galelian Philosophy the qualia occur in the mind and have no relation with the properties observed in the object as different person or organisms develop different qualias for an objective experience. The colour of rose is red because your mind says so, rose has nothing to do with red colour. The Galelian says that whatever it is if your mind says red then it is the truth . No need to disseminate it but accept it as truth. This philosophy is the actual driver of scientific research of quantities and states rather than qualities and perception. This separated qualia or consciousness studies from the field of science and believed that the research of

qualia as just philosophical brain storming. The non Galelian view was much in conformance with the vedic view where every thing different from self was negated and qualia is considered to be over and above realms of mind, matter, environment and intellect. Author rely more on Galelian view and agree that science should enter into this field field of qualia with better instruments of knowledge and explore it a multi-disciplinary and multi-dimensional research rather than writing it off. You can't escape from truth any longer and we need to venture into the fields scientifically.

#### G. Qualia to be treated as outcome of Integrated Information

The research disciplines like physics, neuroscience and computer science rely heavily on the fact that qualia is the outcome of integrated information in multivariate function of our nervous system and is generally a state of mind which is regarded as a subjective experience. Lot of research is going on in this direction.

David Balduzzi, Giulio Tononi (2009) [37] in their paper presents a geometry of integrated information and analysis technique to figure out qualia generated by various influences and factors As per the authors, A space called as Qualia space- denoted as (Q) is having an axis that is responsible to contain the active form (possible state) of a complex. In (Q) each part of mechanism specifies or points to the related sub states. Arrows between the (q) denote the information relationship. Altogether these arrows finally depict a quale- a shape that completely illustrates the quality of a mindful state.

$\Phi$ — denotes the height of the shape while — is the quantity of consciousness along with the experience.

This informational relationship that becomes irreducible to their component relationships, specified with concepts and modes basically termed as Entanglement measure.

They created a set of connections and these connections were finally arranged into lattice of directed graphs with factors, impulses, neuron potentials, firing order, intensity etc. Considering the entanglement of all factors the comeout with probabilistic arrow of quale.

Qualia research institute a US-based research groups firmly believe that qualia or subjective experience is deterministic problem can be solved by working on better technologies in neuroscience, mathematics and data science in realms and in agreement with the philosophy.

There is no need to mystify qualia and the strategy they claim to adopt is identifying phenomenological natural kinds, building a naturalized theory of epistemology, and working through issues of identity. Secondly , by applying the theoretical criteria to expand and unify existing neuroscience models in order to identify better ways to measure subjective experiences.

They are right now working on Valence Realism, Symmetry theories of feelings, algorithms on psychedelic states, seed ontologies , hyperbolic geometry of experiences, denying functionalism and explaining phenomenal time with implicit causal structures in networks of local bindings.



### III. LITERATURE REVIEW

#### A. Philosophical Aspect

What Is It Like to Be a Bat? Manifestation on what it is like to be a bat may lead us to the winding up that there are facts that are not expressed in a human language in the truth of suggestion.

Thus, the presence of these facts can be forced to be recognized without being able to place or realize them [7] [5].

Philosophers have been pondering for if there is something more to perceptual experience than what is presented by that skill—its representational content (or, simply, ‘content’).

The outlook that denies that there is any such thing more is sometimes called the intentional theory of perception (Harman 1990). They believe that there is more about perceptual states than their ‘content’, such as, what are the felt qualities of perceptual experiences. They state that Intuitions are less clear in the sphere of visual experience.

Like the experts [5] state an example of two trees on the same road at a distance of 100m and 200m. While it is to judge the height of the two trees, it appears to be same.

In that view, the visual field's properties are not part of the perceptual state's representational material (Peacocke 1983).

A second thought highlighted is that perceptual states seem to symbolize the surroundings in a much more fine-grained style than a perceiver holds the concepts for. Taking an example sometimes the colors we see are more varied and subtly different from each other than we have concepts for.

A third factor highlighted by the experts is the desire to relate to link the conceptual nature of thought with the contents of the computational states by the computational theory of vision. The computational theory of vision state some of the content of a visual state in expressions of various mathematical concepts, but perceivers don't need to possess those concepts in order to see.

Authors also further talk about a scenario that is a representation of the way the physical space around the perceiver is filled. It is specified by making out within a perceiver-relative edge of positional locations of object plane and the evident properties.

Finally it is assumed that the scenario itself, rather than any mental representation, is part of the content of the perceptual state, and that it captures how the human race seems to the perceiver independently of the perceiver's conceptual resources (Peacocke 1992).

A third question about perceptual content has focused on the computational theory of vision, David Marr (1945–80) presented. (In philosophical jargon, externalism is committed to wide content whereas individualism is committed only to narrow content.) The debate about computational vision has been chased largely matter of the broader reflection about what cognitive theory states (Burge 1996) about mental content.

Philosophical aspect in [6] is explained as qualia as debate had given a way of examination of the nature of the representational content of perceptual states (see Villanueva 1996). The notion that opposes that there is anything more is called as intentional theory or mental state of perception (Harman 1990) where ‘intentional’ refers to what a mental state is about). On the intentional view, once the objects and properties in the scene perceived are specified, the content

of the perceptual state has been exhausted. The qualia freak denies the intentional theory. It is believed that there is more to perceptual states than their content, namely, the felt qualities of perceptual experiences.

Consider orgasms again. The author robustly believes that there is nothing more perceptual states than their content as felt qualities of perceptual experience. It is further explained that felt qualities do not seem to beat the realm of visual experience. So institutions are foggy, this is on the context of particular physiological process happening in one's body.

In the realm of visual experience, intuitions are less clear. Assume if one is standing on a road on which there are two trees of the same height, one tree at distance of 100 meters and the second at 200 meters. There may be judgment of two trees to be of the same height, it is also evident to me that the nearer tree takes up more space in my visual field. Since experience cannot correctly represent the trees both as equal in size and as different in size, it has been recommended that there is an entity, the visual field itself, that is the bearer of the latter aspect of the experience: the trees are represented as being the same size but appear in the visual field to have different sizes. So, two orders of properties are there: those of the visual field and their sister properties in the external world. In this context, the visual field properties are not the representative substance of perceptual state (Peacocke 1983). One such contemplation is the epistemological view that conceptual thought has to be based in something that is nonconceptual (see Sedivy 1996).

The other consideration mentions that perceptual states seem to represent the environment in a much more fine-grained fashion than a perceiver has the concepts for. For example, it is sometimes thought that the colors we see are more different and subtly different from each other than we have concepts for.

A third consideration is the wish to related the conceptual nature of thought with the contents of the computational states posited by the computational theory of vision. The computational theory of vision describes some of the content of a visual state in terms of various mathematical concepts, but perceivers do not have to possess those concepts in order to see.

Another way of implementing so is by means of scenarios. A scenario is a representation of the way the physical space around the perceiver is filled. It is identified within a perceiver-relative frame of reference the locations of object surfaces and their visible properties. The scenario itself is part of the content of the perceptual state, and it captures how the world looks to the perceiver independently of the perceiver's conceptual resources (Peacocke 1992).

David Marr (1945–80) has given stress on perceptual content focusing on the computational theory of vision. Theorists have argued on the contents of computational states for whether the contents of computational states have to make essential reference to the outside world or can be fully specified in terms of the perceiver's states unaccompanied. The former represents the externalism and the latter the version of internalism/individualism.

(In philosophical jargon, externalism is dedicated to broad content whereas individualism is dedicated only to narrow content.)

## B. Musical Aspect-

The authors of [8] state that in this paper; have taken a serious look at the notion of musical qualia. The authors' main goal is to contribute to a more affluent understanding of what musical experience entails, they represent arguments that go further than the sole domain of music, involving critical neuroscience, Gestalt psychology, and philosophy of mind.

The reason certainly is, because music spans such a wide range of human activity, it offers a rich pragmatic context where theories of cognition may be put to the test.

Indeed, the embodied musical perspective we've begun to supply here tries to rethink "inner" and "outer" dichotomies; to check mortal, setting, mind and world, not as basic duality however rather as deeply continuous with one another - as, in fact, a part of identical dynamic system, dynamic intersection of brain, body, and world. The author says that's our expertise of reality isn't assumed to be captivated with th or preconious conditions of brain mechanism, but rather on embodied (inter)activity, then human agency and also the distinctive relative histories of people, groups, and environments return to the fore as organic of consciousness. Again, this appearance on the far side the passive, inputoutput, cause and response framework assumed by several normal approaches to mind, light the active and artistic, the self and world-making potentials of the human mind. In sensible contexts, this could open the approach for brand new ways that of considering the connection between sound property and learning (Schiavio & Cummins, 2015; van der Schyff, 2015), rehabilitation (Schiavio & Altenmüller, 2015), however we have a tendency to hear and perceive the sonic worlds we have a tendency to inhabit (Schafer, 1986; Wilson & Brown, 2012), as however we have a tendency to imagine and construct the acoustic environments and "sounding objects" we digest and thru (Blessner & Salter, 2007; Laurence Sterne, 2003). Authors in [9] state that music is always considered in subjective aspects, primarily such as its emotional tone. But it is mostly denied by contemporary philosophers. Using music as an example, this stated paper has explored the structure of qualitative experience, demonstrating that it is multi-layer emergent, non-compositional, enacted, and situation dependent, among other non-Cartesian properties.

## C. Computer Science View

Turing Test based qualia, a major research executed by authors [10] state basically a Turing machine is a mathematical model of calculation that defines an theoretical machine, which manipulates over symbols on a strip of tape as per a table of rules. Based on this any algorithm can be constructed by ignoring the limitation of finite memory. The authors of the paper [10] examine the chance of a Alan Mathison Turing take a look at supposed to reply the question of whether or not a process unit may be a real subject of acutely aware expertise. Even the proverbial difficulties near the 'other minds problem' in philosophy, we have a tendency to usually believe that different citizenry square measure acutely aware. that the Alan Mathison Turing makes an attempt to shield this original take a look at (2T) in terms of operational parity with the proof at our disposal within the case of attributing understanding and consciousness to different humans. supported an equivalent,

the author argues that the conversation-based 2T is way too weak, and it should rescale to the total linguistic and robotic standards of the full Alan Mathison Turing take a look at (3T).

it's proverbial that by direct person contact that the human central system is capable of supporting the wealthy and varied field of qualitative displays related to traditional psychological feature activities involved as per the authors within the involved analysis. And it definitely appeared as if these displays participate during a crucial role in human mental lives. A vital observation by Van Gulick's position, viz., that every one of the relevant handing out roles in each humans and robots in essence manifest itself strictly in terms of A-awareness while not P-consciousness, it appears that P-conscious states aren't really necessary for explaining noticeable human behaviour and also the attendant psychological feature processes. This highlights the restrictions of Alan Mathison Turing take a look at Approach to such queries, since the take a look at is intended as associate imitation game, and humans square measure the unreal target. therefore the Q3T automaton is intended to behave as if it had subjective, qualitative inner experiences indistinguishable from those of a personality's. However, if human qualia square measure the merchandise of our specific internal structure (either physical-physiological or functional-computational), and if the automaton is considerably totally different during this respect, then the likelihood is open that the automaton may be P-conscious and however fail the take a look at, just because its ensuing qualitative experiences square measure considerably totally different. Experience shown by the authors in [11] have seen downside in the matter of consciousness as a tough problem that has been discharged as associate illusion. They show that show in their work that that computers square measure capable of experiencing. The authors square measure specifying 2 ways in which illusions and acutely awareness may match along to provide a conscious agent: associate agent is real associated is experiencing an illusion. This explains qualia and also the agent itself is real. associate agent is real associated has associate illusion within which another agent experiences an illusion. Self – consciousness is formed by Self-identifying with such associate agent. A stream of episodes corresponds to a a sequence of such episodes and also the illusional agent itself isn't real. you're associate illusion experiencing associate illusion.

Work done by Y. Mizuno ; S. Kato ; A. Mutoh ; H. Itoh in [12] propose a brand new activity model supported the construct of "meme" and "qualia" for multi-agent system. They later enforced the model for cultural transmission by playing multi-agent simulation. They made artificial society whereby agents behave for food objects together. acculturation is transmitted by associate agent, object to eat and preference as a culture to others. This established a cultural transmissions within the artificial society.

Raúl Arrabales et.al in [13] argue that a proper definite on or a practical characterization of a synthetic qualia is needed so as to line up legitimate engineering principles for synthetic phenomenology (SP).

The authors have explored current trends in MC(Machine Consciousness) and SP from the perspective of artificial qualia, that attempts to identify key traits that could contribute to a practical characterization of the concept. It was focused on potential implementations of artificial qualia as a means to provide a new interdisciplinary tool for research on natural and artificial cognition.

Lauren ROMEO et. al in [14] have worked for acquiring lexical information by relying on a number of contexts to contribute information for classification. In an unsupervised clustering task in their work, they propose the use of automatically obtained FORMAL role descriptors as features used to portray nouns from the same lexical semantic class together. They have dealt with three lexical semantic classes (HUMAN, LOCATION and EVENT) in English. Their work shows that its possible to discriminate between elements from different lexical semantic classes using only FORMAL role information. Further they have also employed filtering and bootstrapping strategy in extracting FORMAL role descriptors that proved to minimize effects of sparse data and noise in their task.

#### IV. CURRENT APPLICATIONS AND FUTURE RESEARCH

##### A.Current Applications

The aspect of qualia in terms of qualia computing technically has also been experimented in various applications. Few of them have been described here further.

Many experts like Roman V. Yampolskiy [11] go after the benefits of analysis and problems with conscious machines and implications of such potential on future of computing, machine rights and artificial intelligence security. Phenomenology is classically one of the areas where development in natural sciences that is much more difficult and that can be extra beneficial with artificial systems. It is more exigent in the area of natural sciences where AI-inspired biology can sometimes provide very useful clues to heighten research. Intellectuals in [15] have worked on captchas , a one of the major research area of work. They take captchas as challenge-response tests that are used in many online systems to check on attacks by automated bots. Avatar Captchas are a recently-proposed alternative in which users are asked to organize between human faces and computer-generated avatar faces, and have been shown to be secure if bots employ random guessing. They have tested a variety of modern object recognition and machine learning approaches on the problem of avatar versus human face classification. Their rearch shows that a bot can successfully solve Avatar Captchas as repeatedly as humans can. These experiments put forward that this high performance is caused more by biases in the facial datasets used by Avatar Captchas and not by a fundamental flaw in the concept itself, but yet their results show the difficulty in creating Captcha tasks that are immune to automatic solution.

Authors of [16] have worked over deep convolution neural networks (DCNNs) and bird's-eye videos of natural scenes on Hallucination Machine. Distorted states of consciousness, like psychotic or pharmacologically-induced hallucinations, provided a tool to look at the system underlying aware perception. The phenomenological properties of those states area unit troublesome to isolate by

experimentation from alternative a lot of general physiological and psychological feature effects of hallucinogenic substances or insane conditions. They represented a tool, that they referred to as because the Hallucination Machine. It comprised of novel combination of 2 commanding technologies: one being deep convolutional neural networks (DCNNs) and also the alternative bird's-eye videos of natural scenes, viewed immersive through a head-mounted show (panoramic VR). thus they were able to simulate visual unreal experiences in an exceedingly biologically plausible and ecologically valid method. at the start they show that the system induces visual philosophical system qualitatively kind of like classical psychedelics and within the second experiment they that simulated hallucinations don't evoke the temporal distortion unremarkably related to altered states. Ultimately, the Hallucination Machine offers a valuable new technique for simulating altered philosophical system while not directly sterilization the underlying neurobiology. User expertise as explored by specialists in [16] is majorly wedged by customized services to result the amount of user satisfaction. adjustive user interfaces square measure most of the approaches providing customized services . the main focus of those approaches is restricted to specific domains instead of a generalized approach applicable to each domain. The paper [16] proposes a website and device-independent model-based adjustive user interfacing methodology. The methodology is depends on the analysis of user context and user expertise (UX).

It's enforced as an adjustive UI/UX authoring (A-UI/UX-A) tool; a system capable of adapting interface supported the employment of discourse factors, likes user disabilities, environmental factors (e.g. light-weight level, background level, and location) and also the use of device, at runtime exploitation the variation rules devised for rendering the tailored interface.

To validate effectiveness of the projected A-UI/UX-A tool and methodology, user-centric and applied mathematics analysis strategies square measure used. The results show that the projected methodology outperforms the prevailing approaches in adapting user interfaces by utilizing the users context and knowledge. On the grounds of physiology, authors of [17] R. Ward et.al contribute as physiological indicators of arousal are known to be sensitive to mental events such as positive and negative emotion, changes in attention and changes in workload.

Hence human physiology is suggested to be used in evaluation of software usability. For the same two approaches have been adopted (i) cto compare different arousal levels under different circumstances’s physiological readings across periods of time to indicate, and (ii) physiological changes in response to specific events occurring in seconds(short-term). The authors explore the model within the context of a web-related task. Various social context of a person comes along with Mobile devices with wherever they are and whatever they are doing. With this mobile devices are in seen to be in an ideal position to capture various aspects of social phenomena. Following the concept, the authors have designed and implemented SociaXensor,



an extensible toolkit that exploits h/w sensors, s/w sensors and s/w capabilities of contemporary mobile devices like PDAs and smartphones to capture objective data about human behavior and social context like proximity and communication as well as objective data usage about usage and user experience like needs, frustrations and feelings as experimented in authors in [18].

Further the human-kind is now making computers as conscious like a human –being as explained by authors in [19]. In machine consciousness, a computational model of qualia is highly desirable. Many researchers have proposed framework that supports qualia in machines by implementing a model with three computational areas (i.e., the sub conceptual, conceptual, and linguistic areas). But there are a number of critics of the machine consciousness project dispute this possibility. For instance, Searle, in his Chinese room objection, argues that however complicated a computational system is, it can by no means show intentionality; thus, would also fail to exhibit consciousness or any of its varieties. Specifically, the three-stage artificial qualia model has been formulated in Searle's worries in the Chinese room. Hence the authors could see that the individual doing all the translations in the room could recognize the three areas in the proposed framework. They hence demonstrate the actualization of self-consciousness in machines.

**B. Further Research in Qualia**

Looking the various disciplines in which qualia research is going on, it can lead to understand many aspect of human behaviour, technology, commercial usage, mathematics, neuro science, information technology, artificial intelligence, robotics etc. We here point towards the arrow of ongoing possibility of research in many areas.

**1. Valance Realism**

Study of pain and pleasure as subjective experience can lead to a happier world. Michael Edward Johnson in his work "Principia Qualia"[38]. The author presents a critical study of Integrated Information theory and its variant and finds out the loop holes in all. In order to come up with a universal Information theory with mature and focussed multidisciplinary approach. The valance in the ultimate goal of life mentioned in all texts. To understand this problem of subjective experience can do a lot to humanity as whole. The goal of study is how to maximize the valance by understanding and manipulating qualia.

**2. Seed Ontologies**

This seeks combination of various principles to study qualia and arrange them in an ontological order. This involves Karlton's Free energy principle (FEP), Selen Atasoy's Connectome-Specific harmonic Waves (CSHW), Symmetry theory of Valance (STV) to be combined arranged in systematic manner along with Integrated information theory (IIT) and develop a theory as ecosystem of thinking. This reasearch can lead to a bring out the simulations of human behaviour in different stimulus.

**3. Neuro Sciences**

Human brain is the most complicated thing perceived ever. If we link qualia with neuro functions and correlates than neurological inputs become very important. Understand new brain centres for information processing, look up tables,

memory retrieval, incidence storage mechanism, cognition centres, contemplation correlates, brain waves (alpha, beta and gama), intuition mechanism centre etc. The neuro science is still in its cradle in this areas. Not its fault, it was because qualia was never in the realms of neuro science. Neuro science till now was for curing diseases and medical efficacy of well being. But extending its reach to the qualia science can lead us to under the real purpose of life and well being.

**4. Computer Sciences and Deep Learning**

Finally everything comes on this table. What ever data you generate, what ever theories you adopt. Without the help of computational processing with the help of computer science, nothing really can work out. Computer Science and Information technology has their own realms of data science and deep learning techniques which roughly simulates the stimulus processing in brain. More emphasis is now given on practical ways Machine Learning, Deep Learning which involves Neural Networks, Adversarial Neural Networks, Convolutional Neural Networks and Sequential Neural Networks. The Techniques of Decision trees and Forests are maturing everyday. With the exponential raise in memory storage, processing power, nano technology, Intenet of Things, this branch offers a lot of promise to simulate and undertand qualia. Efforts are there to create virtual humanoids, androids, Thinking Robots, intention driven objects, Emotion Recognition, hallography etc can lead to an entirely virtual world capable of influence life of the real world.

**V. RESULTS**

It is clear from the current reasearch areas in qualia that it's applications are useful in various field. We observe this science as still developing area and it needs multi-disciplinary expertise and approach. As various filed like Neuro science, Mathematics, computer science, philosophy, music, psychology are concerned we found that application of qualia science can bring an unexpected rise in the quality of the outcome in the research which is going in current context. If systematically studied It can bring a change in the quality of life of every individual The results can be tabulated as various aspects of qualia and how it is applicable in various fields.

**Table 1. Qualia Properties and its applicabilitions in various fields**

A – Applicable                      NA – Not Applicable

Qualia Properties	Applicability in various fields					
	Com p Sc.	Neur oSc.	Psyc holo gy	Educa tion	Math emati cs	Mu sic
Explanatory Gap	A	A	A	NA	NA	A
Intrinsc Nature	A	A	A	A	A	A
Non Representational	NA	NA	A	A	NA	A



Relational	A	A	A	A	A	A
Functional	A	A	NA	A	A	NA
Valance	NA	NA	A	A	NA	A
Ontological	A	A	A	A	A	A

VI. CONCLUSION

The paper is an effort to understand and delve into a new area of research in Qualia Science. This areas has been studied in all the perspectives and the time lines. Various supporting and conflicting theories of qualia are presented and analysed to bring out the crux of it. Studies of qualia in the field of psychology, neuroscience, computer science, music etc have been explored to see that how a full fledge and integrated discipline of Qualia can be developed. A lot of possibilities lie in the research and application that can change the entire view of human understanding, bussiness, hospitality, analysis techniques and ultimately can offer some some solutions to long standing questions of human civilization.

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