Salvador Dali, the centenary of whose birth we celebrate this year, was apparently a man of many contradictions. He began as a classicist and remained one. He admired classical works more than modern ones and indeed saw Surrealistic dimensions in the work of dramatists such as Corneille. The work of Vermeer and Velasquez mesmerised him all his life. There are frequent allusions in his writings and paintings to past masters such as Goya (Soft Construction with Boiled Beans: Premonitions of Civil War (1936, Philadelphia Museum of Art), Piero della Francesca (Portrait of Frau Isabel Styler-Tas, 1945) and Jean-Louis Meissonier. But this attachment to classicism was neither slavish nor imitative. His own work, even when it drew heavily on classical masters and traditions, was nothing if not innovative. To him, being steeped in classicism was useful only if one could exploit it to create a new, radically different approach. Dali’s dislike for the incorporation of an un-modernized, un-innovative past in art is evident in his disdain for works that drew upon the past alone, as when he chided his friend, the poet Frederico Garcia Lorca, for living in the past and not putting the present in the Romancero gitano, thereby expressing perhaps a more general regret that the past did not co-exist with the present in art. For him, the past determined the present which, in turn, predicted the future. In fact, one can easily read contradictory currents not only in his art but in his conduct as well. He became a member of the Surrealist movement, and flirted with communism, both of them movements that disowned the past. Yet he turned against both, and they against him. The Surrealists in particular accused him of being an outmoded “counter-revolutionary”, a man of deep Catholic principles whose only object was to draw as well as the great classical masters. Even in spite of his revolutionary tendency, he espoused capitalism fervently, enjoying the
company of the rich and the famous – like Helena Rubinstein whose portrait he painted (*Helena Rubinstein’s Head Emerging from a Rocky Cliff*, 1943). Dali, the revolutionary man with apparently blatant communist tendencies, sympathies and friends showed the world how one can join and then exploit the hard nosed men of capitalism.

Such apparent contradictions constituted an essential part of Dali’s psychological make-up. Given his somewhat flamboyant personality, these contradictions may have been, and no doubt are, thought of as the characteristic of one who will bend with the wind, seeking his fortune wherever it is most accessible. There may be truth in such suppositions. Yet there is a critical period of his work, stretching roughly between 1929 and 1938, when these apparent contradictions, constituting an integral part of his personality, are expressed explicitly in his paintings. This is the period in which he exploited with some passion what he referred to as his “paranoiac-critical” technique. The very use of the term suggests a deep delve into his psychic constitution, and indeed he was not a little influenced by psychiatric texts, among them those of Freud and Kraepelin. But was the “paranoiac-critical” technique one with which he was giving formal expression, in painting, to his contradictory personality, or was it more simply that he was using the capacities of the visual brain to perceive two or more images in a single painting, which he subsequently interpreted as a delve into the sub-conscious? Indeed, were not the contradictions that people have read into his enigmatic personality merely an amplification of a basic and well-developed neural mechanism that enables the brain to give more than one interpretation to the same phenomenon, to see its different sides, a necessity that is imposed on it in its knowledge-seeking role?

I am inclined to the view that Dali actually accepted contradictions because he did not consider them to be contradictions, but rather the inevitable consequence of our psychological make-up, which I interpret to be the constitution of our brains. A root cause of his gradual
detachment from the Surrealist movement headed by André Breton lies in a difference in outlook between him and the Surrealists, as Dawn Ades has convincingly argued. The Surrealists objected to relegating everything that could not be properly accounted for in terms of objective reality to the world of superstition. They believed that what was commonly called superstition was in fact part of reality. They encouraged automatism in works of art to express that other, subconscious, reality that is not subject to control by higher cognitive faculties. This way, they believed, the artist can probe more deeply into another world, one that is not readily accessible because it lies in the unconscious, but one that is nevertheless a fundamental constituent of the human psyche and therefore of reality. Naturally enough, they adopted Sigmund Freud, the master of the unconscious, as their patron. Freud did not return the compliment, referring to them contemptuously, in a letter to Stefan Zweig, “as complete fools (let us say 95%, as with alcohol)”. The ultimate stated aim of the Surrealists may have been to include in the world of our experience and hence in consciousness what is not easily or readily accessible in daily life. But included in their agenda was a more general and grander aim, that of changing the world. Dali, by contrast, wanted to maintain the apparent contradiction, or opposition, between the rational and the irrational, not merge one into the other. Himself a posturer and a poseur, he probably saw clearly enough that the grand agenda of the Surrealists, that of changing the world by changing man’s consciousness itself, was nothing more than some kind of grandiose and rather aimless posturing, as its aims could not be achieved. Although once accused by the Surrealists to have, unlike them of course, a somewhat limited vision, in that his field of action related to painting alone and did not include a recipe for changing the world, Dali’s vision was probably the more realistic, even in spite of its contradictions. Moreover, it was not restricted to painting. He accepted the inevitability of evil in general and war in particular, without supposing that he could change the attitude to either. This constitutes perhaps one reason why he stayed aloof of politics and found the endless squabbles between the Surrealists and the communists, and especially the French Communist Party, distasteful and distracting and perhaps even
meaningless. His aim, unlike that of the Surrealists, was rather to acknowledge the fact that we can perceive the world in very different ways and try to find a solution of sorts for the apparent perceptual confusion and systematize it. His view was closer to that of Piero di Cosimo and Leonardo Da Vinci, who argued that one should not only look at the whole picture but also at the details which can reveal an alternative picture. During an important period of his life he tried to incorporate this doctrine into his paintings.

Dali, too, of course, had another agenda but one quite remote from that of the Surrealists. He imagined that by this approach he could delve deeply into the subconscious and understand it, that he could represent on canvas deep-seated and haunting sexual and emotional disturbances to which he was prey and which could be traced back to his childhood. An artist friend of mine recounted to me how, on a visit to London, he accompanied Dali to buy a diving suit. When asked by the salesman how deep he wanted to descend, Dali replied “To the subconscious”. This attempt is apparently characteristic of his paintings, which are liberally peppered with disturbed sexual imagery and childhood recollections, constituting a rich field for a Freudian analysis. This is no doubt true, but I would like to suggest that, at least during an important phase of his work, stretching roughly between 1929 and 1938, he actually used a very widespread and stable neural mechanism – the capacity to see different images in the same stimulus – and dressed it up in fancy language to suggest that it communicated a great deal more. I will illustrate this by discussing the sources of ambiguity in the brain.

**Ambiguity and the Brain**

Ambiguity is defined in the dictionaries as “vagueness” and “uncertainty”. The neurobiological definition of it that I have given elsewhere is exactly the opposite: that ambiguity is certainty but the certainty of many different interpretations, each one of which is
sovereign at any given moment in time. Consequently, there is no correct answer or resolution because all answers (percepts) are equally plausible.

I have argued elsewhere that ambiguity, which is commonly a characteristic of great art, is not something that the artist invents on canvas. It is rather a potential of the brain that the artist exploits, sometimes to powerful effect, as was indeed the case with Dali. Some of Dali’s output in the period I am considering reveals the potential of the brain in this regard and are worth studying in trying to understand the logic of the visual brain.

**The Brain as Knowledge-Acquiring System**

The first step in doing so is to accept the obvious statement that one of the primordial functions of the brain is to acquire knowledge. In general, the brain is interested in acquiring knowledge about the permanent, essential and non-changing characteristic of objects, surfaces and situations, when the information reaching it is never constant from moment to moment. To be able to disengage itself from the ever-changing conditions in which it views objects and surfaces, the brain must apply concepts to the incoming signals. Immanuel Kant was right when he asserted in the *Critique of Pure Reason* that “sensations without concepts are blind”. But the brain, in seeking knowledge about the visual world, is also confronted with situations that are unstable and therefore are, by necessity, open perceptually to more than one interpretation. Confronted with such conditions, the brain could find itself in a precarious situation if it could not allow for alternative interpretations. Hence, in neural terms, a strong stability is built into the capacity to perceive images unstably, to give alternative interpretations, a capacity that cannot be easily changed, as Dali well understood. Perceptually, there is therefore a continuum from the stable image, for which there is only one interpretation no matter how it is viewed, and the unstable image which remains permanently unstable, no matter how much one may want to force
the percept in one direction. Dali used both, but it is only the latter that interests me in this article.

**Knowledge of the Stable Visual World**

Colour vision provides an excellent example of the stable image. The colour of a surface remains much the same regardless of the illuminant in which the surface is viewed. A green leaf looks green when viewed at noon on a cloudy or sunny day, or when viewed at dawn or dusk. If one were to measure the wavelength composition of the light reflected from the leaf in these different conditions, one would find huge variations. There are even conditions, as at dawn and dusk, when the green leaf may reflect a lot more red than green light and still look green. It is as if the brain has disengaged itself from the physical reality to assign a constant colour to a surface. This property, called colour constancy, has puzzled scientists for a long time. Some, like Herman von Helmholtz assumed that the brain “knows” that the leaf should be green and therefore discounts the illuminant through a process vaguely defined as the “unconscious inference”. Others like Ewald Hering imagined that we see the leaf as green because our memory tells us. Edwin Land, on the other hand, tried to account for colour constancy by supposing that it is a straightforward computational process applied to the incoming signals. The basis of that computation is a comparison of the wavelength composition of the light reflected from a surface (in our example, the green leaf) and from its surrounds. Whatever amount of red light the leaf may reflect, the surround will always reflect more, given the relatively poor efficiency of a green surface for reflecting red light, and there will be a ratio for the amount of red light reflected from the surface and from its surrounds which never changes. Other non-changing ratios will be established for light of other wavebands. These ratios are taken by the brain and the result of this ratio-taking process is the construction of colour by the brain. Light, being electromagnetic radiation, has no colour; it is only the brain that endows a surface with colours through the comparisons outlined above.
We may say that this ratio-taking operation is an inherited brain concept applied by the brain to the incoming signals. Significantly, imaging experiments show that when humans look at coloured surfaces, activity in their brain is restricted to the colour centre, the V4 complex. There is no apparent involvement of brain centres traditionally associated with higher cognitive functions such as learning, memory and judgment. This is so even when subjects view a multi-coloured composition designed in such a way that the wavelength composition of the light coming from every part changes continually without changing the perceived colour, thus simulating in the laboratory real-life conditions. This makes it likely that the inherited concept applied to visual signals to generate colours is not widely distributed in the brain but localised to a relatively small part of it, in the colour centre itself.

Colour, the result of this ratio-taking operation, is the visual language that the brain has developed to characterize certain physical properties of objects and properties, namely their capacity for reflecting light of any given waveband, compared to the capacity of their surrounds for reflecting light of the same waveband. It is a highly stable system for acquiring knowledge about a certain attribute of the visual world; it is not easy to deceive and almost impossible to disrupt unless of course there is a lesions that destroys the colour centre.

Much the same is true of the virtual triangles of Kanizsa (Figure 1). There may be many ways of completing the gaps in this figure but the only plausible way is to draw an “imaginary” straight line to link it with the straight edges. This too is the result of the application of a brain concept, in this instance one which is built into the response properties of cells. Physiological evidence shows that some orientation selective cells in the brain are capable of responding not only to a straight line of their preferred orientation but to a virtual line of the same orientation (Figure 1). The interpretation that the brain gives to the Kanizsa figure is thus the only
physiologically plausible one; here the interpretation is dictated and indeed trapped by the physiological properties of cells. Once again, imaging evidence shows that, when subjects perceive such illusory figures, activity is restricted to the visual areas that contain cells which respond to virtual lines and also in visual areas that are engaged during the perception of forms; no activity is found in areas traditionally associated with higher cognitive functions. The notion that we interpret the figure as a triangle because we somehow have prior knowledge about it is not supported out by these experiments.

![The Kanizsa triangle.](image)

**Figure 1.** The Kanizsa triangle.

*The Beginnings of Ambiguity*

The Kanizsa triangle shown in Figure 1 is but one step from the Kanizsa cube illustrated in **Figure 2**. Here we see the real beginnings of ambiguity. For, quite unlike the Kanizsa triangle, where only one interpretation is possible, the Kanizsa cube allows of three interpretations in the sense that the face of the cube can be in one of three recessional planes: in the plane of the paper, towards the viewer or away.
It is interesting at this point to consider a fundamental feature of the organization of the visual brain, namely its functional specialization. This refers to the fact that different attributes of the visual scene are processed in geographically distinct areas of the visual brain. There are many specializations in the visual brain, including a specialization for colour, form, motion, faces, facial expressions and many more will no doubt be discovered in the future. In the context of the Kanizsa cube described above, whatever the recessional plane that is perceived at any one moment, one presumes that the cube itself is always processed by the same visual area, a visual area specialized for the processing of forms. It is plausible to suppose that the areas involved are V3 and V3A, two visual areas in which the majority of cells are responsive to lines of specific orientation and in which there are cells that respond to stimuli at the plane of fixation, away from it, or in front of it. Based on this assumption, one can conjecture that there is a certain instability in the responses of the cells and that when the near cells are excited, the other two are inhibited and vice versa. An important point here is that, as with colour vision, there is no need for an appeal to higher cognitive factors; one could envisage that the entire machinery underlying this instability is confined to a single set of areas, without the necessity for involving cortical regions thought to be specialized for higher cognitive functions.
There is another critical feature of the Kanizsa cube illustrated in Figure 2, namely that one can only be conscious of one of the recessional planes at any given moment, that one recessional plane is sovereign at any given time. This fact, of primordial importance, naturally raises the equally important but unresolved question of what determines the perceptual change from one state to another.

The Kanizsa cube and other unstable figures like it can be accounted for by an instability within one area, without having to invoke higher cognitive factors. A more complex example is provided by the Rubin vase (Figure 3, Left). Here the alternate percepts are those of two faces or a vase, but not of the two at the same exact time. Faces and vases are, however, processed by two distinct though contiguous regions of the brains. Hence, the change from a face to a vase implies the alternate activation of one area and de-activation of the other. It is almost certain that this change-over is controlled by third areas. This represents a stage in which activity in a given visual area is opened up to influences from other areas. This effectively means that influences of many kinds – memory, experience – can be used to sway the interpretation in one direction or another, though once again, only one interpretation is sovereign at any given moment. There is here an interpretational OR gate – either one OR the other, but not both. This is the brain system that Dali used so effectively in his paintings, especially during the so-called “paranoiac-critical” period.
The Stability of Unstable Images

We may note that the approach that Dali used would not have worked had it not been for a critical neural feature, namely that the brain’s system for maintaining this instability is itself highly stable. If, through no knowledge or experience or preference, the interpretation of an unstable image could be resolved into a single interpretation, to the exclusion of all others, then the work of Dali referred to here would lose much of its significance. This can be illustrated by the following two examples.

Figure 3. Bi-stable figure: vase/faces

Figure 4. (Left) Bi-stable figure: wife/mother-in-law. (Right) An attempt to dis-ambiguate the same figure. Despite the spectacles and eyeshades to stabilize the perception of the "mother-in-law," the figure remains unstable.

In the Rubin vase one can try to force the interpretation in one direction by having two actual faces instead of outlines (Figure 3, Right). But, even under these conditions, the instability remains. Or take the wife and mother-in-law bi-stable figure, where the alternate percepts are those of a young woman or an old lady (Figure 4, Left). Attempts to force the interpretation in one direction only, for example by providing the old woman with spectacles, cannot efface the alternative percept (Figure 4, Right). Hence, the brain’s unstable system, the one that allows of more than one interpretation, is itself highly stable.
“Paranoiac-Critical” or Merely Unstable Images?

It is worth viewing the work of Dali’s “paranoiac-critical” period against this background, and far better to look at the paintings themselves than at what he said of them. His description of the “paranoiac-critical” method was based on his belief in the “delirium of images” which was confusing. But this confusion, according to him, could be “systematized” through the “paranoiac-critical” approach. A good example of the product of this approach is in the painting entitled *The Slave Market* (1940 Salvador Dali Museum, St. Petersburg, Florida) (Figure 5). In this work one can perceive, successively, several images without much effort: an arch, which becomes the forehead of Voltaire, two central figures whose faces and clothes transmute into the face of Voltaire. The darkened cheeks of Voltaire can also be viewed as part of the clothing of the two central figures under the arch or their white collars can constitute the area under his eyes.

![The Slave Market](image)

**Figure 5.** *The Slave Market* (1940 Salvador Dali Museum, St. Petersburg, Florida)

It is noteworthy that, here as elsewhere during his “paranoiac-critical” period, Dali did not so much introduce a new technique into painting – which had been known before and had
been commented on by Leonardo Da Vinci – as to take it to higher levels of complexity and introduce multiple images on one canvas. Other interesting examples of his work during this period are provided by *The Endless Game* (1938, in a private collection) (Figure 6) and *The Invisible Sleeper, Horse, Lion* (1930, private collection) (Figure 7) both of which provide the possibility of multiple interpretations. These examples can be multiplied but, in all, Dali is using the capacity of the brain to read multiple interpretations into a single picture, a capacity that is totally stable in its instability and part of the knowledge-acquiring system of the brain.

![The Endless Enigma](image)

**Figure 6.** *The Endless Enigma* (1938, in a private collection)
Like others in the Surrealist movement (of which he was an official member for a time), Dali made extensive use of psycho-analytic literature and believed his work to be related to deep-seated psychological problems, of repression, of masochism, of sexual instability and much else besides. He explained that the “paranoiac-critical” approach constituted a study of “the critical and systematic objectification of delirious associations and interpretations”. His paintings do indeed contain many elements that one can loosely refer to as psycho-analytic and I do not mean to imply that the paintings of the period that I am discussing are to be understood solely in terms of brain mechanisms of perceptual instability. But perceptual instability is central to them. *The Metamorphosis of Narcissus* (1937, Tate Gallery, London) (Figure 8) may conjure up a psycho-sexual imagery but it does so obviously and explicitly. Perhaps much more interesting from the point of view of “systematizing confusion” is the instability of the central image which becomes alternately a hand that holds an egg with a narcissus flower or the figure of the youth Narcissus contemplating his beauty, but not the two simultaneously. In the background are even more explicit sexual images that do not metamorphose, of what he described as a “heterosexual group” in “preliminary expectation”. In producing this work, he may have been right to suppose
that he was producing “images which provisionally are neither explicable nor reducible by the
system of logical intuition or by the rational mechanisms”, but probably wrong to suppose that
the central characteristic of these works constituted an assault on the unconscious. In this
approach, he was simply using a well-developed brain mechanism which is related to its
knowledge-acquiring function. André Breton described this work as “concocting entertainments
at the level of crossword puzzles”. It is a pity that he phrased his descriptions in what now reads
as pejorative terms, for these “crossword puzzles” are especially interesting from a neuroesthetic
point of view, since it is important to learn how, in neural terms, one image can edge itself into a
momentary conscious experience while edging the alternative out, also momentarily. Sigmund
Freud, more shrewdly, is reported to have said to Dali, when they met in London: “It is not the
unconscious I seek in your pictures, but the conscious…your mystery is manifested throughout.
The picture is but a mechanism to reveal it”. In a letter to Stefan Zweig, he added, “It would
indeed be interesting to investigate analytically how he came to create that picture…”. For
Freud, presumably these enigmatic creations of Dali contained little that lent itself to a deep
psycho-analytic delve into the subconscious, of the sort that he had seen and analysed in
Leonardo’s Virgin, Jesus and St. Anne. The latter, unlike Dali’s work, contains no explicit sexual
imagery yet Freud had managed to discuss it in terms of Leonardo’s childhood and his sexual
orientation.
It is indeed through the use of creations such as these, as well as others, that neuroesthetics aims to study the neural mechanisms underlying the continual shift in attention, and with it the continual shift in consciousness that is so manifest in Dali’s “paranoiac-critical” period.

We can speculate a little further and ask whether there is any relationship between the approach used by Dali and his more general, apparently contradictory, personality. In general, it may be said that, once the brain develops a capacity that is successful in seeking knowledge, it does not restrict that capacity to a single system only. The capacity to give different interpretations is a valuable one and its generalization effectively means that we can interpret much in different ways, and not only in the field of vision. This may be confusing, it may lead to delirious states, but any attempt to systematize it must surely rely on the extraordinary capacity of the brain to acquire knowledge. That capacity gives the brain itself two alternatives, which may themselves seem contradictory but form part of a continuous whole. On the one hand is certain, unchanging knowledge, as in the example of colour vision. At the other extreme is
knowledge that is only certain momentarily and fades to give way to an alternate interpretation, a
capacity that is not restricted to vision. At a certain, possibly even simplistic, level of
observation, Dali’s “paranoiac-critical” method merely represented on canvas this essential
capacity of the brain, which not being restricted to vision, seems to have been characteristic of
Dali’s entire personality as well, as it is indeed, to varied extents, of so many others.

In preparing this essay, I have consulted several books on Salvador Dali but relied mainly
on Dali by Dawn Ades, Thames and Hudson, London 1982. I have also made heavy use of my
article entitled Ambiguity in Art and in the Brain, published in Consciousness and Cognition,
2003.

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