AESTHETICS, COGNITION AND CREATIVITY

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A thesis submitted for the degree of Doctor of Philosophy of The Australian National University
Top: Zero-Crossings and the Raw Primal Sketch. (From Marr, 1982, p.59)

Bottom: A capital from the Mosque Cathedral of Cordoba, Spain. 785AD
This thesis is solely the result of my own original work.

Candidates signature:  

Jennifer Anne McMahon

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Abstract

In this thesis I construct what I call an Interactive Theory of Beauty which attempts to change the way we think about beauty and aesthetic form. I begin by uncovering certain discrepancies between the features characterizing the traditional concept of beauty and those features seen to characterize the phenomenology of beauty. I then uncover the underlying mistaken assumption about beauty which gives rise to these discrepancies. The mistaken assumption is that beauty is an objective property in the object. I present an alternative assumption about beauty. I hypothesize that beauty is a relational property of beautiful objects; that is, it is a property of being such that human perceptual processing of it will employ certain specific principles of whose operations the object makes us dimly aware. The experience of beauty, then, is an awareness of a certain aspect in the perceptual processing of the beautiful object. Hence beauty is neither purely subjective nor purely objective, but a relational property existing in the object by virtue of there being certain processes involved in the perceptual system of the perceiver. I map out this hypothesis in terms of a computational model of perception. I argue for this hypothesis by demonstrating its explanatory power. I show how the discrepancies I have identified as existing between the traditional concept of beauty and the phenomenology of beauty, are resolved. That is, I employ my central hypothesis to explain how beauty can be simultaneously universal and subjective; an experience of the aesthetic form of the object which can, in some cases, supervene on representational content; and a property which is experienced as inferred from more basic properties, but at the same time, experienced as an ineffable property. I demonstrate how this theory applies to visual beauty and I suggest that my central idea could be extended to account for musical beauty and possibly beauty through touch, particularly in nonsighted persons.
The Interactive Theory of Beauty also accounts for the instrumentality of beauty, which is a feature of scientific and mathematical beauty, in a way which also serves as an explanation for, what can best be described as, the feeling of clarity which characterizes the subjective response to beauty. Hence, the central idea of this thesis explains scientific and mathematical beauty in a way which points to the similarities between intellectual and artistic beauty and results in a unified theory of beauty. If my central hypothesis is correct, and if I am right in the way I have employed it to explain artistic, scientific and mathematical beauty, then the Interactive Theory of Beauty explains the experience of beauty in a way which may offer useful insights into the nature of creativity in all fields of enquiry.


Introduction

This thesis constructs a theory of beauty which provides us with a new way of thinking about beauty. A new way of thinking about beauty is needed, because the features identified through a conceptual analysis of the traditional concept of beauty reveal certain inconsistencies with the features identified as characterizing the phenomenology of beauty. For example, judgments of beauty are understood to be universal (for the reasons discussed in I.3.1) and yet the experience of beauty evokes a subjective response (see I.3.2). Beauty is considered to be a relational property which resides in the form of the object and yet in some cases, the representational content ¹ seems to figure in the experience of beauty (see I.4). Judgments of beauty are defended as though beauty is a property inferred from more basic properties and yet, the inability to express these more basic properties in terms of sufficient conditions might suggest that beauty is an ineffable property.² As a basic property is an ineffable property, there seems to be a contradiction between beauty being inferred from more basic properties and beauty being ineffable (see I.5).

Most theories of beauty deal with these inconsistencies by limiting what is recognized and acknowledged about the phenomenology of beauty. I present Kant’s conclusion regarding what counts towards beauty in an object as a classic example of this, particularly seeing that the crux of his theory can be understood to point to an alternative conclusion to the one he adopts (see I.4.2). My approach, on the other hand, is to find the worm that is infecting the apples. I will argue that the culprit is the assumption that beauty is an objective property existing independently in the object.

We have clung to this assumption because it has seemed that the only alternative was to reduce beauty to a personal response or preference: that is, to

¹ 'Representational content' is employed here to mean what the object is recognized to be, or, in the case of artworks, what objects are depicted in/by the artwork.

² An ineffable property is understood in this thesis to mean a property which cannot be expressed in terms of stateable sufficient conditions (see I.5).
assume that beauty exists solely in the head and so is all just a matter of arbitrary taste. There is another alternative though. The alternative is the subject of this thesis.

This is how I proceed to uncover the alternative. I identify the combination of features resulting from an analysis of the concept of beauty and those features that characterize an experience of beauty and show how they have been misconstrued, due to the assumption that beauty is an objective property in the object. I then ask, given that beauty is not an objective property, what kind of property would explain the features of beauty in a way which would resolve the inconsistencies between the features of beauty identified above? I argue that if beauty is understood as an interactive property, a property that neither exists solely in the object nor solely in the mind, but is instead a relational property of beautiful objects, then we could explain the features of beauty in such a way that the inconsistencies identified above, are resolved.

For example, features like universality and subjectivity would be compatible, if the experience of beauty was constituted by an experience of a particular aspect of perceptual processing in the course of perceiving certain objects: that is, if the aspect was universal and evoked a characteristic response (necessary but not sufficient conditions for the experience of beauty). A likely candidate for such an aspect would be the processes that underlie a particular, universal perceptual operation. That is, the experience of beauty might be constituted by an experience of certain processes, or rules of operation, if you like, which underlie a particular level of perceptual operations, even though we would not normally be aware that this was in fact the source of the experience. With this hypothesis in mind, I then demonstrate how the features of the experience of beauty can be construed in experiential terms, as a subjective universal response (experienced as a feeling which can best be described as a feeling of clarity) to the aesthetic form of the object. I demonstrate that the aesthetic form supervenes on the content of the object, content being either or both, the perceptual and conceptual information derived from the perception of the
object. Furthermore, it is demonstrated how beauty can be experienced as both a lawful (complex, defendable) and ineffable property of the object, without inherent contradiction. These features which characterize our experience of beauty are taken to be the key features of beauty. Such a way of thinking about beauty also allows us to be quite clear on which experiences constitute an experience of beauty, and which experiences merely sometimes accompany the experience of beauty. I address this and the above issues in chapter one.

I am suggesting then, that we can think of beauty as a relational property of beautiful objects: that it is a property of being such that human perceptual processing of it will employ certain processes of whose operations the object makes us dimly aware. The experience of beauty, then, would be constituted by an experience of perceptual processes which underlie a particular perceptual operation. I construe the experience of beauty in this way with a particular kind of perceptual theory in mind: the kind of model of perception which identifies levels of operations and underlying processes (rules of operation): that is, a computational theory of perception. In particular I adopt David Marr’s theory of vision as my paradigm theory of perception. However, an Interactive Theory of Beauty does not necessarily depend on Marr’s theory being correct. Marr’s theory is very congenial to explaining what is involved in an experience of beauty along the lines of an Interactive Theory of Beauty. However, as long as perception can be understood to involve certain features, then an Interactive Theory of Beauty could still be supported. In chapter two, I begin by discussing an alternative to Marr’s model. I then proceed to reason that if the experience of beauty is the experience of perceptual processes underlying a certain perceptual operation (a necessary but not sufficient condition of the experience of beauty) and if the experience of beauty is constituted by the perception of aesthetic form, then the first condition for an Interactive Theory of Beauty is that there can be understood to be a level of perceptual operations responsible for the construction of perceptual form, which are underpinned by inbuilt processes. In chapter three, it is further reasoned that if the experience of beauty is universal and if the experience of beauty can be understood to
be an experience of a certain process underlying the construction of perceptual form, then this particular process must be able to be understood to be accessible and universal. These are the second and third conditions respectively. I refer to these conditions as the three conditions of an Interactive Theory of Beauty.

Establishing that the three conditions are satisfied by Marr's theory involves in the case of the first condition, an analysis of the ascending levels of internal operations involved in visual perception according to Marr's model of vision. I focus on the operations involved at each level and for underlying processes I focus on what, according to Marr, are assumptions which underpin these operations. This is to ascertain whether, according to Marr, there is a level of perceptual processing which underpins the operations involved in the construction of perceptual form. I find that, in Marr's model, there is such a level.

In the case of the second and third conditions, I find the nearest I can get to determining whether it is feasible to assume that the processes underlying the construction of perceptual form would be accessible and universal, is to first examine the likelihood of the percept itself, the perceptual form, being accessible and universal. In the case of its accessibility, I discuss what is at stake, philosophically, in positing that an interlevel of perception (a level prior to object recognition) is accessible (see 3.2.1). Then I argue in favour of this possibility. Apart from an isolated statement regarding our subjective awareness of an early level of perceptual processing, the most informative discussion Marr provides of this possibility is in his discussion of what levels of operations certain artists focus upon in their work. I develop this essential idea, arguing that one should accept that interlevels of perception are accessible because of the explanatory power of doing so. Its explanatory power includes an explanation for certain drawing techniques used to improve one's ability to draw realistically and an explanation for the exceptional realistic drawing ability in some autistics which, if correct, illuminates and refines the mainstream explanation provided by cognitive scientists for the nuclear impairments associated with autism (3.2.2). This explanation for the exceptional drawing ability in autistics, draws upon evidence
which suggests some additional features of visual processing which are not explicit in Marr's model. These additional features suggest a way of envisaging the process which underlies the construction of perceptual form in such a way that we can extend the explanation of visual beauty to other perceptual modules and to higher processes (see 3.2.2, 4.3 and Chapter Seven).

The subject of the universality of certain interlevels of the perceptual system, broaches the issue of the modularity of input systems a la Jerry Fodor and the notion of theory-laden perception as opposed to neutral, and hence universal, perception. I argue that the construction of perceptual form is universal by presenting the sources of information on vision which Marr drew upon himself to suggest that perceptual form is constructed from information that enters the system through the specialized perceptual channels and hence without the kind of theory-ladenness that threatens universality (3.3.2). In such cases virtually the only theory involved in the construction of perceptual form is implicit theory which can be assumed to be universal, as opposed to explicit theory which is not (see 3.3.1). Regarding the second condition of an Interactive Theory of Beauty, if perceptual form was accessible, then we would be closer to the possibility that the processes underlying its construction were accessible. Regarding the third condition, if perceptual form is universal, this does suggest that the processes underlying its construction are universal. However, my main argument in favour of the processes underlying the construction of perceptual form being accessible and universal, is the explanatory power of this assumption with regard to the experience of beauty.

In chapters four and five, I explain the explanatory power of this theory of beauty which I call an Interactive Theory of Beauty. In chapter four, I examine the kind of processes in some detail that, according to Marr, underlie the construction of perceptual form. I analyse two examples of visual art, namely sculptures by Henry Moore and Constantin Brancusi, to see whether my central idea adequately explains the way in which we perceive aesthetic form in these sculptures. In particular, I examine whether the explanation suggested in 2.7 regarding what it is about the way
certain objects are perceived that prompts our experience of the processes which underlie the construction of perceptual form, is consistent with the phenomenology of the experience of visual beauty (4.2.3). I then consider whether equivalent explanations for the beauty of other perceptual modes, such as for musical beauty, captures the phenomenology of such cases of beauty (4.3).

In chapter five I continue this examination of the explanatory power of my theory, only in more general form. I return to the features identified in chapter one as characterizing the experience of beauty and give a fuller account of how these features can be construed in a way that captures the full import of the phenomenology of beauty. In addition, I explain some further aspects associated with the experience of beauty, which further demonstrates the explanatory power of my central idea. That is, I suggest a possible explanation for aesthetic ideas, which, as discussed in chapter one (1.6), is distinct from that which constitutes the experience of beauty, although it often accompanies an experience of beauty (5.5). This additional explanation requires some embroidery of Marr's model, which I provide by drawing on Kant's notion of aesthetic ideas (from his Critique of Judgment) and on certain selected theories of metaphor. Then, I look at still other aspects associated with beauty, such as aesthetic perception and the perception of ugliness, and I suggest how they can be explained, employing the central idea of this thesis.

Regarding the implications of this theory of beauty, there are many. For example, in presenting this theory I reason that a perceptual theory, if it is to explain beauty, must satisfy certain conditions. If my theory is right, it has a number of implications for perceptual theory which in turn resonate with issues in cognitive science. However, I only discuss these issues in as much as I need to clarify what is needed for, and implied by, my hypothesis. The philosophical implications that I will discuss in some detail, are those related to aesthetics. While there are many subsidiary issues which are touched upon that relate to aesthetics, I mainly focus on the implications that my thesis has for how we think about the relation of aesthetic
form to representational content, and the relevance of this relation for certain cases of beauty. I explore the phenomenology of the relation between aesthetic form and representational content through an analysis of my perception of a painting by the seventeenth century Dutch painter, Jan Vermeer (6.2). I offer an explanation for this phenomenology (6.3-6.5) to demonstrate that an Interactive Theory of Beauty can account for such cases of aesthetic form. I also explain how it is that one can acknowledge this relationship between aesthetic form and representational content, without threatening the claim that judgments of beauty are universal (6.6), given that the universality of judgments of beauty have been understood in the past to depend on the fact that beauty resides in the form of the object.

That a relation between aesthetic form and representational content exists is of philosophical interest because it validates the experience of beauty, that we arguably have, in phenomena other than artworks and nature. In chapter seven, for example, I explore the possibility that scientific and mathematical beauty are genuine cases of beauty. I offer an explanation for these cases of beauty that accounts for the instrumentality of such beauty in a way which, instead of isolating it as a different kind of beauty (which is what one might expect), highlights the similarities between the nature of intellectual and artistic beauty.

In acknowledging that representational content can play a role in the experience of beauty, the central hypothesis of this thesis has the potential to bring the experience of beauty back onto centre stage in philosophical aesthetics as an interesting and relevant subject of enquiry. Furthermore, the explanation I provide for the instrumentality of intellectual beauty (7.6), not only draws the various aspects of an Interactive Theory of Beauty together, but suggests, in addition, that computational theories of creativity might benefit from a study of the processes involved in the experience of beauty and their relation to cognition.
Chapter 1 An Interactive Theory of Beauty

the rays of the noumenal world filtering through the phenomenal world ...

(Zimmerman, 1968)

1.1 The Concept of Beauty

In the above quote, Robert Zimmerman is referring to the aesthetic experience according to Immanuel Kant. The noumenal world is the world as it objectively is, independent of our perceptions of it: the world as we can never know it. The phenomenal world is the world as it appears to us: we can only know the world through the constraints imposed by our perceptual apparatus. However, according to Kant, the aesthetic experience allows us to glimpse something of the noumenal world. This idea reflects something of the 'otherworldly' feel to the aesthetic experience: the 'hard to characterize' quality of beauty.

This peculiar quality of our experience of beauty is reflected in the explanations given of beauty throughout history. For example, in ancient times, beauty was interpreted as connecting the perceiver with a consciousness or a state of being which existed beyond the material world. According to Plato, beauty, though instantiated in objects, was a transcendent entity. The phenomenology of beauty, as evidenced in the following passage from Plato, highlights that paradox of beauty which still preoccupies contemporary philosophers and theorists. The paradox is that the perception of beauty, though apparently the perception of a property of particular objects, at the same time feels as though it is a recognition of some greater truth about the nature of things: a truth already known a priori by the perceiver. Plato expresses it thus:
The soul is awestricken and shudders at the sight of the beautiful, for it feels that something is evoked in it that was not imparted to it from without by the senses, but has always been already laid down there in the deeply unconscious region (Phaedrus, '250).

In medieval times, the perception of beauty facilitated self-transcendence; a feeling of being in harmony with others or something beyond the self (in Eco, 1988, p.28). In this way, the experience of beauty connected the individual to the divine. However, against this universal subjective response to beauty, was the objective nature of beauty. According to Plato (and Aristotle), beauty was manifested in objects as an organic unity. According to Thomas Aquinas, beauty manifested itself in objects and events as an order and harmony.

Hence, the modern construal of the problem of beauty as involving an antinomy caused by the apparent subjectivity and universality of beauty was already emerging in the work of ancient and medieval thinkers. That is, it was recognized that the experience of beauty involved a certain type of response and a certain type of stimulus. The stimulus evoked a perceptual harmony and order because of the constitution of its parts. By the medieval period, the response to this perceptual harmony and order was already being characterized as a pure and disinterested pleasure (see Eco, 1988, p.17).

The true nature of beauty was a central philosophical question in eighteenth century philosophy. The ideas on the subject developed in the eighteenth century, are most notably represented by David Hume in his *A Treatise of Human Nature* (1739-40) and his *Of the Standard of Taste* (1757), and by Kant in his *Critique of Judgment* (1790). Three ideas which these works share, and which are particularly characteristic of the way the notion of beauty was formulated during this period, are that (i) beauty is

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1 There were a number of attitudes to beauty still prevalent last century and detectable this century in the work of various commentators and theorists which continued some of these early traditions in spirit but lacked their rigour in detail. For example, the English critic and art theorist John Ruskin (1819-1900) defined beauty in opposition to both the sensual and the intellectual as involving a more heightened or spiritual type of awareness; the philosopher R.G Collingwood dissociated beauty from that which simply amused or gave pleasure (1938, pp.96-97); and various commentators have treated beauty as a value symmetrical to the moral, while still others have suggested links between beauty and moral feeling (see Crawford, 1974, pp.146-147). Against this tradition, there were those who described beauty as utilitarian. According to Peter Fuller, utilitarianism proclaimed that the beauty of an object, person, creature or idea, 'was a derivative of its fitness, or functional and practical aptness' (1988, p.45).
understood as quite distinct from the good, the true, or the utilitarian (with which it had been associated during the medieval period); (ii) the perceiving subject is an essential element in the notion of beauty; and (iii) beauty is ultimately associated with a particular perceptual act of a particular type of object, usually an art object or an object of nature. However, Hume and Kant emphasize different aspects of the interaction between the perceiver and the object judged to be beautiful. According to Hume, the perception of beauty involves a certain response on the part of the perceiver which is conditional on the perceiver having a sense of beauty. However, the actual identification of beauty takes the form of a description of the properties of the object. According to Hume:

Beauty is such an order and constitution of parts as either by the primary constitution of our nature, by custom, or by caprice is fitted to give a pleasure and satisfaction to the soul (1739-40, Book 2, Part 1, section 8).

According to Kant, certain objects provide the appropriate stimulus for the experience of beauty, while others do not. However, Kant focuses mainly on the perceptual and/or cognitive conditions that would be necessary to account for the features that he reasons characterize a judgment of beauty. For example, from considering the sort of pleasurable response evoked by a judgment of beauty, and comparing it to the pleasurable responses evoked by the agreeable and the good, he concluded that the pleasure evoked by a judgment of beauty was disinterested: this he referred to as aesthetic pleasure. He reasoned that the basis of a disinterested pleasure must be universal as no personal grounds come into it. This led into his speculation regarding the origins of the universality of judgments of beauty. Kant claimed that this aspect of beauty 'revealed to him a property of the cognitive power which without this analysis would have remained unknown' (CoFJ, Ch.8, '214). This property is:
the way of presenting \{which occurs\}\(^1\) in a judgment of taste [judgment of beauty] is to have subjective universal communicability without presupposing a determinate concept; hence this subjective universal communicability can be nothing but \{that of\} the mental state in which we are when imagination and understanding are in free play [insofar as they harmonize with each other as required for cognition in general]. For we are conscious that this subjective relation suitable for cognition in general must hold just as much for everyone, and hence be just as universally communicable, as any determinate cognition, since cognition always rests on that relation as its subjective condition (Cof J, Ch.9, '218).

While both Hume and Kant emphasize different aspects in the perception of beauty, they both recognize that the experience of beauty involves an interaction between the perceiver and the object.

The followers of the theories of Hume and Kant have not always appreciated the subtlety of the relation between the object perceived to be beautiful and the perceiver. In twentieth century philosophical aesthetics, theories of beauty have, by and large, been hampered by an inability to break the deadlock that thinking about beauty as an objective or subjective property has clasped over our attempts to understand the nature of beauty.

1.2 The Task Ahead

In this chapter I uncover the assumptions that underlie the theories of beauty which have dominated philosophical aesthetics this century and, in turn, argue that these assumptions are wrong. My aim in doing so is to clear the way for an alternative theory of beauty.

I follow a similar procedure to Kant. That is, I establish what seem to me to be the characteristic features of beauty through a conceptual analysis of the concept of beauty and an analysis of the phenomenology of our experience of beauty. Then, within the framework of a contemporary theory of perception, I consider what sort of processes would account for these features of beauty.

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\(^1\) These brackets are inserted by Werner Pluhar) whose translation of Kant's third critique I use. He uses them to insert his own clarifications of the text. The other brackets are used around insertions made by me to clarify points.
I proceed by examining what I identify as three apparent dichotomies which have dominated discussions about beauty in philosophical aesthetics during this century. These apparent dichotomies are evidenced in the way that certain features of beauty have been seen as opposed. By examining the assumptions on which these apparent dichotomies are based, I find that they centre on the notion that beauty is an objective property existing in the object. I argue that while there is a tension between the features identified as characterizing the concept of beauty and the phenomenology of beauty, they are all aspects of beauty that have a complementary relationship in an Interactive Theory of Beauty.

The assumptions that I identify as those on which the false dichotomies are based, are sometimes expressed explicitly and sometimes more implicitly, acting rather like unquestioned general assumptions that inform more specific discussions about beauty. These assumptions all stem from the assumption underlying what I identify as the first dichotomy: the subject/object dichotomy. This dichotomy arises from the assumption that beauty must be a property that either resides in the object or in the mind. Form/content represents the second dichotomy. It stems from the assumption that aesthetic form refers only to the structure or design of the object, necessarily to the exclusion of a consideration of the representational content of an object. Lawfulness/ineffability represents the third dichotomy. The assumption at the base of this dichotomy is an example of an implicit assumption. In particular, it is evidenced in discussions about the validity or otherwise of the critical reasons used to defend judgments of beauty and, more broadly, in discussions about the nature of beauty. The assumption is that if we defend judgments of beauty by treating it as a property that depends on other properties, or a property that can be inferred from the presence of other properties (which I call a lawful property), it follows that beauty must be able to be defined by or reduced to sufficient conditions, by which I mean nontrivial, experiential, stateable, sufficient conditions. It is assumed that if it cannot be reduced to sufficient conditions (in other words, if it is an ineffable property), then it is not a property that can be defended by inferring its presence from the presence of other
properties. Therefore, if beauty is an objective property existing independently in the object, then, either beauty is lawful, or it is ineffable, but it cannot be both.

It is argued in this chapter that the first dichotomy can be resolved if the experience of beauty is thought of in terms of an interactive process between the object and the perceiver. The second dichotomy can be resolved if aesthetic form is thought of as the experience of (an apperception of) an interlevel of perceptual processing. The resolution of the third dichotomy depends on showing how beauty can be experienced as both a property that depends on the presence of more fundamental properties (a lawful property) and a property that cannot be defined by sufficient conditions (an ineffable property). This is done by explaining that the experience of beauty is an experience of certain ineffable processes involved in perception, that manifest themselves in a law-like way in the perception of certain properties in the object.

In each of the following sections, I discuss each of these dichotomies in turn. It is then suggested how an approach to the experience of beauty as an interactive process between object and perceiver, replaces the assumptions that give rise to these dichotomies and results in a reconstrual of the elements of these three dichotomies, in such a way that they become complementary aspects of beauty. These complementary aspects of beauty are the key features of the experience of beauty in my interactive theory.

Before concluding this chapter, I discuss an issue which often clouds discussions of beauty. That is, in section 1.6, I differentiate between what constitutes the experience of beauty and what merely accompanies the experience of beauty. In order to illustrate this point, I draw upon certain other theories of beauty: not those theories to which I referred at the beginning of this chapter as mistaken, but theories which can be interpreted as precursors to an Interactive Theory of Beauty. I include this section in order to stress that the key features of beauty uncovered in this chapter account only for what constitutes beauty and the experience of beauty, and not, in addition, those experiences which might often accompany the experience of beauty.
1.3 The Subjectivity/Objectivity Dichotomy

In this section, I outline the most extreme positions taken on the subjectivity and objectivity of judgments of beauty. These represent the ossification of the views which dominated eighteenth century discussions about beauty. Hume and Kant emphasized the interaction between the object and the perceiver, such that while certain characteristics in the object typically gave rise to a judgment of beauty, it depended on certain conditions pertaining in the perceiver. Kant's theory of aesthetic judgment is a theory about the nature of these conditions. However, no matter how many times theories are put forth to present the more subtle nature of beauty as a dynamic interaction between object and perceiver, still we allow the idea that beauty is an objective property in the object to cloud our thinking about beauty, which locks us back into the kind of problems associated with the objectivist and subjectivist positions. After outlining the problems associated with these two positions, I will show how there is a way of construing the nature of beauty such that we avoid talking and thinking about beauty as though it exists either in the object or in the mind. In doing so we can transcend the problems which arise from the subjective/objective dichotomy.

1.3.1 The aesthetic objectivist

The objectivist position in relation to beauty is that beauty is a property existing in the object independently of its effect upon human beings. Hence beauty might exist in a natural object without a mind ever knowing that it exists there. Even in artworks, beauty could exist independently of anyone ever knowing that it exists there. The objectivist position suggests, in principle, that an artist could create a beautiful work without knowing it to be such.

The objectivist view can be understood as a rejection of the view that all beauty is nothing but a personal preference: an idea or pleasure in the mind. This aspect of the objectivist's view recommends it, in my view. However, once we understand beauty as a property of an object independent of the perceiver, then we ignore the fact
that judgments of beauty entail a particular kind of response on the part of the perceiver. For example, approval and personal involvement are an essential part of the experience of beauty. That something is 'beautiful but unlikable', or 'beautiful but ineffective', contravenes the experience of beauty. The experience of beauty is partly constituted by a certain favourable personal response which the objectivist view fails to account for. If someone claimed that they thought something, say, Greenaway's movies, were beautiful but horrible, or that some scenery was beautiful but left them cold, I would judge their employment of the term 'beauty' in these cases to be mistaken. Perhaps they were confusing formal attractiveness with beauty (see 7.5).

Clive Bell's idea that beauty is significant form which he construes as an objective property in the object (1914) is an example of an objectivist theory of beauty. However, the theories of beauty developed in the twentieth century are not all explicitly either objectivist or subjectivist. Even so, theorists all tend, in my view, to lock themselves into contradictions which stem from the idea that beauty is either in the object or in the mind. For example, Mary Mothersill (1984) divides all aesthetic theories into either pro-theory or anti-theory. She identifies these two groups according to their position towards two theses which she argues are the cornerstones of any aesthetic theory. These are (First Thesis) that there are no principles of beauty; and (Second Thesis) that there are genuine judgments of beauty. She, along with all the theorists she discusses, interprets (FT) as asserting that principles of beauty are properties in the object which are necessary and sufficient to an object being beautiful. She says the pro-theorists (such as Monroe Beardsley and C.I.Lewis) believe that there are such principles but that we haven't discovered them yet. She claims that the anti-theorists (such as W.E. Kennick, S. Hampshire and J.A Passmore) believe that there are no such principles. The assumption underlying both groups, as Mothersill rightly points out, is that to accept the first thesis (FT) as true, means that there can be no definition of beauty and hence no aesthetic theory, apart from that it is a purely subjective matter. Hence the pro-theorists cling to denying FT while anti-theorists like Kennick claim the problem is that traditional aesthetics must rest on a mistake because
either FT is wrong and you have aesthetic theory or FT is right and there can be no aesthetic theory, neither of which is satisfactory. Mothersill distances herself from both groups, rejecting the assumption underlying their attitude to the first thesis by pointing out that while

aesthetic theory ... requires definitions and principles ... there is no reason to suppose that the principles must be principles of taste; and the supposition that the definitions of art or beauty that philosophers have advanced are designed to promulgate principles of taste appears simply to be false (1984, p.143).

Mothersill still understands FT as construed by the pro and anti-theorists in order to illustrate her position. That is, she argues that there can be principles of beauty which can constitute an aesthetic theory without these principles being prescriptive. However, this is not what is meant by ‘principles’ in her FT. In her FT, ‘principles’ refer to ‘good-making’ features in the object. She argues that in this sense, there are no principles of beauty. Now I agree with Mothersill on this point and I address this issue in the third dichotomy in 1.5.1, as a matter of reconciling the ineffable nature of principles of beauty with their lawfulness. However, Mothersill does not present any examples of principles which are not good-making features in the object. She argues that any new aesthetic theory needs to resolve the contradiction between FT (as it is construed by the pro and anti-theorists) and ST. She argues that the assumption that FT and ST are inconsistent must be false and she hints at how this might be by suggesting, as seen in the quote above, that the principles of beauty need not be the kind that lead to prescriptions. However, when Mothersill discusses examples of principles of taste her discussion centres around properties of the object or what she sometimes calls, ‘good-making features’ of the object. For example, she discusses Beardsley’s examples of good-making features such as grandeur of imagery (p.119); the golden section (pp.130-131); she draws an analogy with the good-making features of apples (p.136); and she continually refers back to Beethoven’s Op.59, No.1, attempting to identify features in it which might account for the aesthetic pleasure that it gives her (p.350 and throughout). Now, it is important to point out that she discusses
these examples to show how FT must be right because of the impossibility of identifying principles of beauty in the prescriptive sense. Yet, though she states that principles needn’t be of this kind (the kind that eventuate in criteria that constrain or support judgments of taste, p.135) she does not provide examples of any alternatives. Her only discussion of principles treats them as objective properties in the object. While Mothersill recognizes explicitly that beauty is not an objective property in the object (exemplified in FT) and at the same time that there are genuine judgments of beauty (ST), she cannot escape talking about beauty as though it is an objective property of the object.

Mothersill’s position is that we can accept FT and still have an aesthetic theory, because we can identify principles or define beauty in a way which is not prescriptive. She writes: ‘a definition is “enlightening” to the extent that it serves to bring into focus what has been latent in our use of the concept but heretofore non-articulate’ (p.139). The role of a definition of beauty, then, need not be to provide standards of measuring beauty. The consequences of FT, she says, are that there are neither laws nor principles of taste; no critical features or good-making characteristics. According to Mothersill, the challenge for an aesthetic theory is to find a way of reconciling this fact with the second thesis; that there are genuine aesthetic judgments. Mothersill’s identification of what is needed in an aesthetic theory is enlightening and perceptive. The aesthetic theory I expound in this thesis does reconcile FT and ST as construed by Mothersill. However, in order to arrive at this reconciliation, the focus needs to be on where, if you like, beauty is located. My argument with Mothersill’s construal of the problem is that it does not go deeply enough into the kind of assumptions which give rise to the tension between FT and ST in the first place. Mothersill does not address this. By categorizing all theorists, instead, according to their positions in relation to FT, she does not go far enough in identifying the mistaken assumption underlying the problems in aesthetic theory. The mistaken assumption is that beauty is either in the object or in the mind, the former tending to dominate aestheticians’ thinking about beauty. This is exemplified in Mothersill’s own inability
to talk about beauty as other than located within properties in the object, even though it is clear that she doesn’t believe beauty to be an objective property in the object. The objectivist view implicitly pervades aesthetic theory and prevents any advance in our thinking about beauty.

FT is construed as based on the assumption that principles of beauty amount to objective properties in the object. Mothersill explicitly denies that this is the case (see the quote above) but while suggesting that there might be kinds of principles other than objective ones, she does not provide any examples of what these might be like. And the reason she cannot do this is because as evidenced in her discussions about beauty, she cannot escape the objectivist position.

The objectivist view leads to the necessity of characterizing beauty in ways that are contradicted by the phenomenology of beauty, as evidenced in the second two dichotomies, discussed below. I will show in later sections, how adopting the objectivist position gives rise to the form/content dichotomy when enquiring into the nature of beauty, and how both the objectivist and subjectivist views can lead to the assumptions underlying the third dichotomy which can hamper any attempt to clarify the nature of beauty. The objectivist position, then, will not do.

1.3.2 The aesthetic subjectivist

The subjectivist view is that beauty is a property of being the object of appreciation in this or that person and not a property which anything possesses in its own right. In this case, the class of beautiful things has nothing at all in common except the fact of being appreciated and when we say that something is beautiful we mean simply that it is related to some human being in the sense of being the object of his or her act of appreciation.¹

¹ This way of characterizing the aesthetic subjectivist position is based on Osborne’s turn of phrase, (1952), pp.61-62
Plates 1 & 2: Michelangelo Tomb of Lorenzo De’Medici 1524-32

Top: Plate 1 Lorenzo De’Medici Dusk and Dawn

Bottom: Plate 2 Giuliano De’Medici Night and Day
The subjectivist position recommends itself to us by its recognition that the perception of beauty evokes a characteristic feeling or response. However, it does not account for the way in which we defend judgments of beauty (discussed in 1.5.2). If beauty were no more than just a personal response, the judgment 'that is beautiful' would be on a par with a personal preference like 'that is delicious'. However, while our personal preferences do not seem to require any defence, judgments of beauty do. For example, if your companion expresses a preference for a food you dislike, there is no sense trying to ascertain which of you is right. However, if your companion recognizes beauty in an object which you feel indifferent to, you might well conclude that your companion perceives qualities that you have missed, or that you had perceived voiding features that your companion had missed. In other words, you act from the assumption that whether or not the object is beautiful is an objective matter. Hence, we employ the concept of beauty as if it simultaneously referred to an objective property in the object and a personal response.

1.3.3 Solution to the first dichotomy

An Interactive Theory of Beauty, is one in which beauty is neither purely subjective nor purely objective, but is a relational property existing in the object by virtue of there being certain processes involved in the perceptual apparatus of the perceiver of which the perceiver becomes aware in the course of perceiving beautiful objects.¹

My claim is that certain key aspects of both the objectivist and subjectivist positions would be accommodated if the nature of the relation between the perceiver and the object experienced as beautiful, during the experience of beauty, evoked an ideal kind of emotional response which was universal, or virtually universal, to our species. That is, a judgment of beauty on such terms would demand inter-subjective agreement and justification, without the drawback of failing to account for the importance of the characteristic personal response evoked by beauty.

¹ Eventually 'object' comes to be defined quite broadly in this thesis: see 4.3 and chapter seven.
That the perception of beauty evokes an ideal emotional response which is universal to our species demands some explanation regarding the basis of this universality. My suggestion will be that the experience of beauty involves an experience of a certain process which underlies a certain level of perceptual operations. It is suggested in the following two sections that such an account of beauty would resolve the second and third dichotomies also. This account of beauty is the subject of this thesis.

1.4 The Form/Content Dichotomy

1.4.1 The problem

As mentioned above, the objectivist position breeds a number of further assumptions involving erroneous notions regarding the nature of beauty. When the phenomenology of beauty is interpreted from the objectivist's position, aesthetic form is assumed to equate with the design or structure of the object. Representational content is then construed as quite separate from aesthetic form: as though one can perceive aesthetic form without any consideration or engagement in representational content. In relation to beauty, this results in form being construed in opposition to content. That is, the idea that content is relevant to the experience of beauty, is taken as inconsistent with the idea that the form of the object is wherein beauty lies. In order to show why this construal of the relation of aesthetic form to content is wrong, I will first analyze its two elements one by one.

The meaning of the term 'form', when it is understood as separate from content, is usually a conflation of that property which is the design or structure of the object with that which we refer to as the aesthetic form of the object. While in some cases, we refer to the aesthetic form of the object as its design or structure, it is important to differentiate between the two for reasons that will become clear throughout this and the following chapters. A pivotal point of an Interactive Theory of Beauty is that aesthetic form should be thought of as an aspect of the percept of the object rather than as an objective property in the object. And the experience of the
process underlying the construction of this aesthetic form, constitutes beauty. The difference between the design of the object and the aesthetic form of the object will become clearer throughout the remainder of this chapter.

Now to the second element of this dichotomy. The meaning of the term 'content' is usually equated with what I have been calling representational content, as if this is the only content that the perception of the object conveys. It is understood as separate and complementary to aesthetic form and refers to what the object is (a lamp, say), and, in the case of artworks, in addition, what meaning it conveys. Having construed all of the elements of the object as either falling within one of the two mutually exclusive but complementary categories, namely form or content, any particular property, such as the way beauty is construed, can only, then, be a member of the form category or the content category. The objectivist usually identifies the form of the object as the relevant aspect of the object in a judgment of beauty. The objectivist usually argues that a commitment to some degree of universality in judgments of beauty, demands that beauty reside in the form of the object. Form is taken as the more universally interpreted aspect of the object. On the other hand, what is taken to be represented, which is exclusively how content is understood, involves interpretation influenced by personal biases, experience, interests, desires and so on, and hence would be likely to evoke the kind of personal interest seen to be incompatible with a universal judgment. This approach to form and content comes unstuck in three different types of example:

An example of type 1 are the photographs of Mapplethorpe. Certain of these photographs, it is argued by their detractors, are obscene and should be censored. The opposing side argues that beauty is to be found in the form of the works, for which the content should be deemed simply a vehicle because it is employed in the service of aesthetic form. That is, they argue that the nature of the content cannot preclude a work from being judged beautiful. Furthermore, they imply that when it comes to judging artworks as art, the content is only relevant to the extent that it gives rise to aesthetic form. If representational content gives rise to aesthetic form,
then it is not entirely separate from or irrelevant to aesthetic form. Also, the response of the detractors might suggest that some responses to the nature of the representational content might prevent the perception of aesthetic form. That is, perhaps there are cases in which a consideration of the representational content of the artwork actually prevents us from judging art according to aesthetic form.

These latter cases are those in which the representational content engages our attention in a way which militates against the perception of aesthetic form. In these cases we cannot, and in fact it may seem inappropriate to, disregard the meaning conveyed by the work, to judge it in terms of aesthetic form. This suggests that the perception of aesthetic form rests on or follows on from an engagement with what is conveyed by the work. The idea that beauty is in the form of the work and that the nature of the representational content is irrelevant to the perception of beauty, does not fully capture the phenomenology as evidenced in this example.

Type 2 are cases such as abstract art works or music without words which on this carving up of the elements of the object, have no content.

An example of type 3 is the Tomb of Lorenzo de Medici by Michelangelo (see Plates 1 & 2), in which aesthetic form is related to representational content in a much stronger and more direct way. Here is an account of the sculpture, by Garry Hagberg, in which aesthetic form is shown to depend on the relations that arise between and among the perceptual and representational elements of the artwork:

Above the sarcophagus on one side of the room we find a statue of a robust, active Medici. On the opposite wall, above the other sarcophagus, is a restful, contemplative Medici. And upon each of the sarcophagi are two reclining statues, representing morning and evening, and day and night. It is, in short, a room of distinctions and contrasts, and these contrasts are balanced within the room. Opposing or contrasting forces are placed in such a way that they counteract each other; any individual sub-section of the overall work, for instance, either wall taken separately, remains unbalanced. The whole form, however, is perfectly balanced, and is - once one sees the formal organization - restfully resolved. But the perception of this form, the 'abstraction' of the formal design of the room, is dependent upon the ... content or subject-matter, specifically, of active and contemplative, morning and evening, waking and sleeping, and so on (1984, p.335).
In this example, the relationships arising between the representational elements depicted in the work cannot be separated from the relationships arising between the structural elements of the work. Phenomenologically, they combine in the aesthetic form arising from the work.

The objectivist position does not account for the fact that in some cases, the nature of the representational content can prevent the perception of aesthetic form, that content can be defined other than representational content, and that the representational content of certain works or actions can and sometimes does figure prominently in experiences of beauty. Hence, not only the relation between form and content is more complex than theories of beauty based on an objectivist’s view of form and content would allow, but also what constitutes form and content is more complex than what is necessitated by the objectivist position.

A theory of beauty which is based on the view that form and content are two separate properties existing independently of each other, and from the perceiver, in the object, cannot account for these three types of aesthetic form. Hence, the form/content issue when envisaged within an objectivist view, has clouded and hampered enquiries into the nature of beauty. However, an Interactive Theory of Beauty can account for these three types of aesthetic form, as I will demonstrate.

1.4.2 Solution to the second dichotomy

The solution to this problem needs to take in a number of issues. These issues include: the nature of content, the various ways in which aesthetic form is experienced in relation to this content, and the particular influence of Kant’s notion of beauty on contemporary theories of beauty in which beauty is understood to be in the design of the object. After interpreting these issues, I then show how an Interactive Theory of Beauty solves these inconsistencies and contradictions by construing the relation between aesthetic form and content as one of supervenience.
The first step in accounting for the three types of aesthetic form identified above is to recognize that the content of an object consists of more than is usually allowed in traditional aesthetics. For example, as noted above, if content is thought of as representational content, then abstract works have no content. But of course they do have content even if the information conveyed does not result in the recognition of objects or events. Now, if we think of content as the content of the percept of the object rather than as the content of the object, then we can include perceptual information\(^1\) in the idea of content. In order to grasp this distinction, we need to think in terms of the perceptual processes involved in perceiving the object which precede those processes involved in recognizing the object as a particular thing. The latter is equivalent to what the objectivist thinks of as the content of the object, but the former draws our attention to another element in the content. That is, the first stage in processing would be equivalent to the level at which the perceptual information is conveyed: the second would be equivalent to the level at which this information is interpreted as a representation of something. These two stages of mental processing, then, reflect the two categories of content. I am suggesting, then, that we now think of content as not necessarily what the artwork represents but as also including the perceptual information conveyed by the work. Thus, when an artwork does not convey the type of information which can be interpreted as certain particular objects, we can still refer to the perceptual information conveyed as content. Hence we can now talk of perceptual content and representational content. Thinking of content in this way, which an Interactive Theory of Beauty allows, paves the way for a more focused differentiation between the three types of aesthetic form, as we will see below.

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\(^1\) By perceptual information, in the case of visual art works I mean, the lines, shapes, forms, tones and textures in the work. On the level of computational theories of vision (introduced in chapter 2), perceptual information refers to the zero-crossings, the bars, blobs etc of the primal sketch; the distance of each point from the viewer and information about surfaces in the 2\&1/2D-sketch; and the information about the three dimensional object in the 3D-model description. Later I refer to this as perceptual content.
There is one more point to be made before I can present a more detailed account of the three types of aesthetic form. The first stage of processing, which is the level equivalent to perceptual content, automatically moves into the second stage, the level equivalent to representational content (I will explain below under aesthetic form type B, what this involves when an artwork has no representational content). To become conscious of perceptual content, one needs to suspend the representational content after it has been processed. The perception of aesthetic form involves focusing on the first stage, the perceptual content.

*Three types of aesthetic form*

Now, with the additional category of content in hand, and its relation to the other category of content established, the three types of aesthetic form, which is how I refer to the three ways in which aesthetic form can relate to representational content, can be accounted for:

A. Example: the Mapplethorpe photographs. The representational content is registered and then suspended to allow one to focus on the perceptual content conveyed by the object. The aesthetic form then arises from this perceptual content. Conversely, this would also suggest an explanation for why certain representational contents prevent us from perceiving the aesthetic form of some objects. In some cases of type A, we may be unable to suspend the engagement in the representational content because it evokes such a strong emotional involvement.¹

B. Example: abstract artworks, music without words. The object does not present representational content and so perceptual processing is arrested at the first stage, the level of processing equivalent to the perceptual content, from which arises the aesthetic form. Of course, we would need to have first recognized the object as an artwork or as something we would perceive as an artwork before attending to the

¹ Furthermore, there might be cases in which it would be immoral to disregard the literally interpreted content for the sake of aesthetic form.
artwork's perceptual content in this way. This would mean that initially the representation of the object would be processed: that is, initially we would recognize that the object was an artwork, or an object that would be perceived as an artwork. Having done so, one could then proceed to attend to the object's perceptual content by reperceiving the object. The need to reperceive the object is necessary because it is unlikely that perceptual processing would be arrested at the first stage of processing automatically without the perceiver having first decided to focus in this way (the perception of nature may present an exception but I leave the discussion of this possibility to 5.3.2). If an object did not provide the right information for the processing of representational content (object recognition), one would normally still classify it in some way, even if this resulted in an 'unrecognizable object' classification. So an artwork presents two levels of representational content: what the object is (an artwork) and what the object conveys (its message or theme). I discuss this distinction in more detail in 5.3. For now it is sufficient to say that type B aesthetic form are those cases in which an artwork does not convey representational content, and once having recognized the object as an artwork, we reperceive the object, arresting perceptual processing at the first stage of processing which is the level equivalent to the perceptual content. The aesthetic form then arises from this perceptual content.

C. Example: the Michelangelo sculpture discussed above. It is as if the relationships which arise between the combination of concepts conveyed by the representational content, mimic the relationships within the aesthetic form which arises from the perceptual content, and hence the aesthetic form is experienced as arising from a total engagement with the object.

The accounts above of the three possible types of relation between the aesthetic form and the representational content of the object, will be referred to hereon as type A, B or C aesthetic form. They are meant to represent exhaustive and exclusive categories of aesthetic form, though this does not rule out the possibility that there may
be subcategories within a category, a possible example of which will be discussed in chapter seven.

_Kant's Critique of Judgment_

Theories of beauty usually recognize the possibility of type B aesthetic form, sometimes the possibility of type A and B aesthetic form, but never type C aesthetic form. The source of the notion of aesthetic form represented by types A and B, is usually understood to be found in Kant's _Critique of Judgment_. Often Kant's idea of aesthetic form is taken to be simply type B: however there is disagreement among Kant scholars as to whether or not he also included the possibility of type A. That is, there is disagreement as to whether in his third critique, Kant meant that aesthetic form is only consciously accessed in cases in which the sensations are given a form, but no determinate concept of the object is found for it (to use Kant's terminology), such as abstract artworks, music without words and according to Kant, nature (only type B aesthetic form): or including as well cases in which a determinate concept is found in which case the aesthetic form is abstracted from this concept (type A aesthetic form).

The 'determinate concept' as used by Kant can be understood in the context of this thesis as equivalent to what we have understood as representational content. As it is claimed that the central idea of this thesis has important implications for how we think about the relation between form and content in a judgment of beauty, I will take some time here to set out the problem according to an analysis of Kant's critique. In doing so I will be presenting how the problem is presently construed in philosophical aesthetics, because the way the problem is understood in philosophical aesthetics today has not changed, in any significant sense, from the way Kant represented it.

Donald Crawford, a well known Kant scholar, argues that it is consistent with Kant's deeper analysis that we can abstract the aesthetic form from any object. He writes:
In approaching an object aesthetically with respect to its beauty either we have no concept available or else we abstract from that concept in aesthetic perception; ... Since Kant believes that "the purposiveness of a thing, so far as it is represented in perception, is no characteristic of the object itself (for such cannot be perceived)" [C of J, Intro., VII, 189, line 26], it follows that the judgment of taste "brings to our notice no characteristic of the object, but only the purposive form" [CofJ, chapter 15, '228']. (Crawford, 1974, pp.95-96).

Another Kant scholar, Paul Guyer, on the other hand, says that it is far from clear that Kant's position is as unambiguous as this suggests: (1979, pp.425-426, see note 110). According to Guyer:

it is not clear whether the freedom of the imagination is a negative condition, which obtains only if a given object presents or forces no concepts on the mind, or a positive condition, a power of the imagination by which it can actually free itself of the constraints of whatever concepts actually - and perhaps even obviously - apply to the given object. ... [from] Kant's remarks that aesthetic judgment involves abstraction from an object's unity as end [section 15, p.227] ... [a]bstraction appears to be a power of the mind by which it can free itself from the constraints of both sensation and concepts, and thus at least set the stage for a free play between imagination and understanding. (1979, p.251)

However, Guyer further points out that from what Kant has said about free and dependent beauties, and nature and art (the necessity of judgments of perfection in the case of art which are not disinterested judgments of form and hence not judgments of beauty), he seems to imply that:

the mind is not always free to abstract, at least from the concepts which apply to objects. Under some circumstances, it seems, the freedom of the imagination can obtain only if no knowledge of even undetermined or indeterminate purposes imposes itself upon our attention. The knowledge that an object is a human being or a church, or a work of art produced according to some intention, appears to be such that it simply cannot be abstracted from for the sake of a pure judgment of taste (1979, pp.425-426).

When Kant provides examples to show which properties of the object can be taken to manifest aesthetic form as he does in Chapter 14 of his Critique of Judgment, he assumes that in the object only the design is relevant to a judgment of beauty:
In painting, in sculpture, indeed in all the visual arts, including architecture and horticulture insofar as they are fine arts, design is what is essential; in design the basis for any involvement of taste is not what gratifies us in sensation, but merely what we like because of its form (CoFJ, chapter 14, '225).

So according to Kant, whether or not the aesthetic form can be abstracted from the representational content, one thing remains constant: the properties of the object relevant to the perception of beauty are the design properties. This would mean in effect that the nature of the representational content of any work, its meaning, is irrelevant and unnecessary for a judgment of beauty. Kant writes:

we abstract from what this unity is as a purpose (what the thing is {meant} to be), so that nothing remains but the subjective purposiveness of the presentations in the mind of the beholder. (CoFJ, Ch.15, '227)

And

An aesthetic judgment [as opposed to a logical one] ... refers the presentation, by which an object is given, solely to the subject; it brings to our notice no characteristic of the object, but only the purposive form in the {way} the presentational powers are determined in their engagement with the object (CoFJ, Ch.15,'228).

The 'subjective purposiveness of the presentations', using the terminology of this thesis, equates with 'the aesthetic form of the percept'. Hence, it does seem that here at least, Kant is claiming that we can abstract the aesthetic form from the representational content of the object: that is, from what the object is meant to be or from what the object is. And we can do this because, according to his theory of perception set out in his Critique of Pure Reason, the form is provided by the mind and hence can be considered apart from all sensations.

while the matter of all appearance is given to us a posteriori only, its form must lie ready for the sensations a priori in the mind, and so must allow of being considered apart from all sensation' (CoF PR. In the Introduction to the Transcendental Aesthetic)

The broader interpretation of Kant, then, suggests that aesthetic form can be abstracted from content, but only in the way suggested by type A aesthetic form. That
is, given Kant's insistence that beauty resides in an object's design, the relation he envisages between the form of an object and its representational content, is one in which the meaning of the representational content is completely suspended while the focus is moved to the perceptual content conveyed by the object. It is only then that the aesthetic form can be perceived because, according to Kant, aesthetic form is only dependent on what I call the perceptual content. Kant also accepts, and in fact at times uses as his central example of beauty, type B aesthetic form. These are the cases of aesthetic form in nature and in those artworks which do not convey representational content, and so processing is arrested at the first stage (the processing of perceptual content) from which arises the aesthetic form.

Now, the result of interpreting aesthetic form in relation to the representational content of the artwork in this way, is that beauty is taken to be in the form of the object, while engagement in the meaning of the representational content is taken to be irrelevant to the perception of beauty in all cases. Furthermore, any object that does not exhibit design and structure in an obviously perceptual sense, cannot be regarded as beautiful. In other words, Kant's theory of beauty and those theories of beauty based on it, exclude the possibility of type C aesthetic form.

The full implication of an interactive theory for the notion of aesthetic form

While Kant's theory of beauty on a contemporary interpretation would be regarded as an interactive theory rather than an objectivist theory, in his conclusions he resorts to a view typical of aesthetic objectivists: that is, that beauty resides in the form of the object by which he meant the design of an object. However, I have attempted to show that if we adopt in full the implications of an Interactive Theory of Beauty, we can account for type A and B cases of aesthetic form, while also accounting for the possibility of type C aesthetic form. Type C aesthetic form, you will remember, represents those cases in which the relations holding between the combination of concepts conveyed by the representational content seem to mimic the relationships within the aesthetic form which arises from the perceptual content, and hence the
aesthetic form is experienced as arising from a total engagement with the object. If aesthetic form can arise from the relations holding within the combination of concepts of the representational content, as the Michelangelo example above suggests, then the nature of the representational content of an artwork, its meaning, would be relevant to a judgment of beauty.¹

According to an Interactive Theory of Beauty, the aesthetic form of an object is not a property of the object existing independently of the perceiver. Rather, it is an aspect of the perceptual processing of an object of which we can become aware in some cases. If we think of the representational content as not existing independently from the aesthetic form or perceptual content of the percept of the object, but as, in fact, just the perceptual content processed at a higher level, then the relation between aesthetic form and representational content is inextricably interwoven.

The key to an Interactive Theory of Beauty, then, is the idea that a percept acquires its form (which equates with the aesthetic form of the object) from certain perceptual processes which we can reasonably assume are innate. These processes are not stimulated into action until they have sensations to process. These sensations are processed into what I have called perceptual content by the operations of these innate perceptual processes. In this sense, the aesthetic form of the perceptual content is a result of innate processes and as such is universal. But the perceptual content also depends on the nature of the sensations which depend on what's out there. Hence, aesthetic form can be thought of as dependent on perceptual processes, though certainly not reducible to perceptual processes.

Now the relation between the aesthetic form and the representational content is slightly more complex. Perceptual content is processed into representational content, presumably by another set of processes: the kind of processes that would underpin the categories which give rise to concepts. However, I do not contend that these are the

¹ If this were so, there would be no reason why we couldn't extend this idea to cover the judgments of beauty of an intellectual construct. That is, the form of an intellectual construct could be abstracted from the relationships which hold between the concepts which make up the construct. This possibility is considered further in Chapter 7. Kant certainly did not recognize that aesthetic judgments might be involved in intellectual pursuits. See CoFJ, Ch.47.
processes involved in our awareness of what we call the aesthetic form of an object. I locate aesthetic form with the processes underlying the perceptual content. So as I have suggested, when our interpretations of representational content do figure in our experience of aesthetic form, it is as if the relations which hold between the concepts mimic those which figure in the operation of the relevant perceptual processes. Our experience of such cases of aesthetic form is that the resulting aesthetic form certainly depends in part on the interpretation given to the representational content of the object.

The relation then, between aesthetic form and both perceptual and representational content, can be understood as a dependency relation. Aesthetic form depends on perceptual content, and in some cases on both perceptual and representational content. However, while all objects that have the same perceptual and representational content either all do or all do not give rise to the perception of aesthetic form, aesthetic form does not necessarily entail a particular set of elements in the content. In other words, while aesthetic form does follow from content, aesthetic form cannot be reduced to or defined by perceptual or representational content. This relation between aesthetic form and content, then, when aesthetic form and content are thought of in terms of an Interactive Theory of Beauty, is a supervenience relationship.

Consider that A supervenes on B, B being a set of natural or other properties (including relations), if:

(i) B determines the higher order property A;
(ii) all objects with B also have A; and
(iii) the presence of A requires a certain combination of base properties but, there may be more than one combination of properties in the base family that can "ground" the supervenient property and thus there may be alternative supervenience bases that are each sufficient for the supervening property. ¹

Hence, aesthetic form supervenes on content: either perceptual content or both perceptual and representational content.

¹ This notion of supervenience is abstracted from Kim (1993): particularly chapter four.
The solution to the form/content dichotomy, then, is that when aesthetic form is thought of as an aspect of the percept of the object, aesthetic form supervenes on either perceptual content, or both perceptual and representational content. Because of the relation between perceptual and representational processing, even when aesthetic form supervenes on the perceptual content of the object alone, access to this aesthetic form is dependent on the nature of the representational content: that is, there are cases in which the nature of the representational content may militate against a refocus onto perceptual content and aesthetic form. Thus the way form and content are related within an aesthetic objectivist view as properties existing side by side in the object, is reconstrued within an interactive theory, such that form and content can be thought of as different stages within the one process. By understanding the form and content of the object in terms of different stages of processing of the same basic stimulus, we stop thinking that the nature of beauty resides in either form or content, and instead, focus on the kind of processes of perception that might underlie the percept involved in the perception of beauty. Beauty, then, is not simply located either in the form, or in the content of the object: rather, beauty is the aesthetic form of the object which supervenes on the nature of the content of the object.

1.5 The lawful/ineffable dichotomy

1.5.1 The problem

Before proceeding with this third dichotomy, a brief explanation is required regarding what I mean by sufficient conditions. This is necessary because this dissertation encompasses three different levels of explanation and the meaning of 'condition' has different connotations at each level. When I refer to sufficient conditions in relation to the lawfulness or ineffability of properties, I am referring to the kind of non-trivial conditions which can be perceived and/or experienced, and defined. I am not referring to the kind of conditions that a neurologist or a cognitive scientist might be able to pinpoint. For example, the neurological conditions for perceiving a straight line might have something to do with certain neurons firing in
certain parts of the brain. The computational conditions, on the other hand, might involve certain inbuilt assumptions underlying certain perceptual operations. However, the conditions to which I refer here in this section are those logical conditions or properties that are entailed by a particular concept: the properties subsumed by a particular concept, if you like. For example, the logical conditions for a straight line would be that 'it is a line that covers the least distance between two points'. Now, while we might find conditions for beauty at the neurological and computational levels, it does not necessarily follow that we can find sufficient conditions for the concept of beauty.

The larger part of this dissertation is concerned with a computational explanatory hypothesis for beauty, as you will see in subsequent chapters. In chapters two and three, I discuss the conditions that a theory of perception must satisfy for such an explanation. The conditions that a theory of perception must satisfy in order to explain beauty are conditions that are constructed at the computational level. The point to identifying such conditions is not to get closer to a logically sufficient set of conditions for the concept of beauty: in fact it is my contention that no such set of conditions exist. Rather, the point to identifying conditions for beauty at a computational level is so that we can construe beauty in a way which is more compatible with the phenomenology of beauty and in a way which transcends the problems traditionally identified in philosophical aesthetics as surrounding the notion of beauty. However, before transcending such problems I must point out what they are. I have already begun this task in 1.3 and 1.4. To continue onto the third dichotomy, I must discuss beauty in terms of the logical conditions underlying the concept of beauty. I proceed by drawing attention to the logical conditions underpinning concepts and demonstrate that the concept of beauty, like other aesthetic concepts, does not comply with the behaviour of concepts (apart from other supervenient ones perhaps), regarding lawfulness and ineffability. I explain why this might be in my solution to this section in terms of a computational level of explanation. Now I turn to the task of identifying what constitutes the lawful/ineffable dichotomy.
Implicit in many discussions on beauty is the assumption that attempts to analyze beauty are attempts to reduce beauty to a set of sufficient conditions. Conversely, it is further assumed that if beauty is ineffable, there is no point in attempting to analyze beauty.

For example, in W.E. Kennick's influential paper entitled 'Does Traditional Aesthetics Rest On a Mistake?', he identifies two mistakes on which traditional aesthetics rests. These mistakes he expresses as the assumptions that (i) all works of art possess some common nature which serves to separate art from everything else (1968, p.413), and (ii) that unless we know what art or beauty is, we cannot say what good art or beautiful art is (p.419). The first mistake which Kennick believes that he has uncovered does not concern us here. Regarding the second so-called mistake, I think Kennick rightfully recognizes that such assumptions lead to unsatisfying definitions. However he puts this down to the fact that while there are similarities between cases of beauty, there are no common denominators. I think his reasoning rests on two mistakes. His first mistake is to assume that beauty can only be thought of as a property of the object (which his reasoning suggests). His second mistake follows on from his first mistake, and that is to assume that common denominators are equivalent to sufficient conditions. On the contrary, I will argue that we can know what the common denominator of beauty is, without being able to reduce beauty to sufficient conditions. Consequently, knowing what beauty (and art) are, does not equate with being able to say what beauty (or beautiful art) is. This may at first seem like splitting hairs, but the assumption that knowing what beauty is or that identifying a common denominator underlying all cases of beauty is equivalent to reducing beauty to sufficient conditions, leads many who are confident in their phenomenology of beauty and hence who are aware beauty cannot be reduced to sufficient conditions, to drop all attempts to discuss or defend or enquire into, the nature of beauty. Hence such an assumption can undermine attempts to carry out discussions or disagreements on aesthetic matters within a rational framework.
The lawful/ineffable dichotomy is evidenced particularly in those theories which imply that as beauty cannot be reduced to sufficient conditions, either it cannot depend on the presence of any other properties, but must be itself a fundamental property, - one of the most basic properties, - or it must only represent a personal preference whose sufficient conditions would vary from person to person. Let's just take it as an assumption of this thesis that beauty does not mean simply a personal preference. Then we are left with the assumption that either beauty is inferred from the presence of other properties (which I define as lawfulness), or beauty is ineffable. This would mean that if judgments of beauty can be defended by alluding to the properties from which it arises, then in principle we should be able to define beauty by stateable, experiential, sufficient conditions. On the other hand, if beauty is ineffable, there is no point in defending judgments of beauty. Irving Kaufman in an article which targets art teachers, expresses a popular view among artists and art educators, when he highlights the ineffability of all matters aesthetic. His implicit advice could be interpreted to be that enquiry into the nature of art, beauty and creativity is counterproductive because it applies the tools of one realm of experience (reasoning, say) to another for which they are incompatible. He employs a quote from Louis Armstrong to express this attitude towards research into aesthetic matters: "If you have to ask the question, you ain't never going to know the answer" (1970, p.429). The thinking underlying Kaufman's paper could be expressed as the assumption that if a property is ineffable, it must be an irreducible element of experience, and as such it cannot be inferred from other more basic properties, because it is itself an example of the most basic kind of property. As such one could not defend judgments relating to aesthetic matters or educate oneself or others through reflection or enquiry: instead it would be a matter of doing, experiencing and feeling. This view can lead to a trivializing of aesthetic education and aesthetic matters generally.

Now I have identified the assumptions underlying this counterproductive approach as those related to what I have identified as the lawful/ineffable dichotomy.
Let's first look at what constitutes a lawful property and an ineffable property, and then locate the underlying assumption which gives rise to the dichotomy.

I call a property 'lawful' whose presence in an object is inferred from the presence of more fundamental properties. Now when a property is inferred from the presence of more fundamental properties we normally think of these more fundamental properties as equating with sufficient conditions. The way we defend judgments of beauty, suggests that we do infer the property beauty from more fundamental properties in the object. We defend our judgments of beauty by: (a) pointing out non-aesthetic features; (b) mentioning aesthetic properties; (c) attempting to link remarks about aesthetic and nonaesthetic properties by employing metaphor, analogy and examples. When we employ metaphor, analogy and examples to link the aesthetic and nonaesthetic, this necessarily involves an attempt to relate the parts to the aesthetic form. Consider the following example taken from a review by Robert Nelson of a painting by Rick Amor (see Plate 3):

In [the painting called] 

Sister Patricia, Amor has a pious woman meditating on her feet about 30 metres from the viewer. The figure keeps away from the path leading to the viewer and is hard by [sic] a huge fence and overshadowed by a venerable cypress pine. The light is oblique and the color vespertine. The eye mounts up a hill with long horizontal shadows, reinforcing the rhythms of monumental piers in the monastery's gate.¹

Nelson employs adjectives like 'venerable', 'oblique', 'vespertine' and 'monumental' in an attempt to draw our attention to certain aspects of the aesthetic form of the painting. Sometimes directly, and sometimes metaphorically, these adjectives draw our attention to the stark, dramatic contrasts which make up the aesthetic form: contrasts of light, size, scale, and orientation. The aesthetic form of this work emerges from the configuration of these contrasts. In the final sentence, the reviewer unites the 'hill with long horizontal shadows' on the one side, with the 'monumental piers in the monastery's gate' on the other, by suggesting that both present the pattern of intervals which, through an analogy with music, can be experienced as a rhythm.

¹ Nelson, in The Age (a Melbourne daily newspaper), 13/9/95, p.14
Hence, Nelson attempts to point to the configuration of contrasts which the painting presents, encouraging us further to link the nonaesthetic with the aesthetic by pointing out the overall rhythmic modulations of the aesthetic form of the work.

Plate 3 Rick Amor *Sister Patricia* (oil on canvas), 1995

This procedure which we employ when attempting to defend judgments of beauty suggests that beauty is inferred from more fundamental properties. However, the fact that we need to employ metaphor, analogy and so forth to link aesthetic and non-aesthetic properties in order to perceive the aesthetic form, suggests that beauty cannot be reduced to sufficient conditions. That is, when it comes to beauty, there are no conditions which are sufficient to predict that an object will be perceived as beautiful. In the case of beauty and other aesthetic concepts, then, the more fundamental properties from which they are inferred cannot be expressed as sufficient conditions.

A property which cannot be reduced to sufficient conditions is an ineffable property. Normally ineffable properties are fundamental properties (according to those who deem ineffability of concepts a possibility.\(^1\): that is, they are ineffable because

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\(^1\) See Jackson (1990) for the pro argument and Dennett (1990) for the opposing view.
they are the irreducible qualities of experience. Irreducible qualities of experience are not defended by referring to more basic properties because they are themselves the most basic properties. So it seems then, that beauty cannot be both lawful and ineffable, even though we experience beauty as both lawful and ineffable.¹

1.5.2 Solution to the third dichotomy

There is a way of thinking about beauty as ineffable without committing at the same time to its being a fundamental property. Similarly, we can think of judgments of beauty as lawful without committing to the idea that they can be reduced to sufficient conditions. However we need to draw upon a different level of explanation to grasp this possibility.

If we think of the experience of beauty as constituted by an experience of certain of the processes involved in the construction of the form of the percept, then all cases of beauty would have a common denominator. This way of thinking about beauty would explain why, while we may be able to describe how we experience beauty in a way that reflects something of the work of these processes, such as unity, harmony and so on, we cannot describe what we take to be the characteristics of beauty more precisely. This would be because as processes which underlie the operations which give us the percept in the first place, they could only be known by the feelings they evoked in us at the time of perception because, as processes responsible for perception itself, it would be reasonable to assume that they would not be able to be encoded in a form compatible with language. Think of it this way. If you divide perception into operations and incoming data, it is only the latter that can be matched with language schema because the operations constitute the mechanics, not the content. When the perception of an object stimulated an experience of the processes underlying these operations, given that we would not know what in fact the source of the experience was, we might defend judgments about the object based on this experience by drawing another's attention to a particular configuration in the object

¹ This same apparent contradiction may characterize all supervenient properties.
which in fact reflected the work of these processes. Hence beauty can have a common denominator, and can be defended as if it were inferred from more fundamental properties, without being reducible to sufficient conditions. This brings me to the notion of ineffability.

If the experience of beauty is constituted by an experience of certain processes underlying perceptual operations that are responsible for the construction of the form of the percept, then this would account for its ineffability without putting it into the category of the irreducible elements of experience in the sense described above, for which Kaufman's argument might hold. Instead, beauty could be ineffable, but could still be the kind of property, understanding of which could be enhanced by reflection, research and so on. Furthermore, beauty's ineffability need not contravene the fact that judgments of beauty can be defended by pointing to more basic properties in the object.

To date, when experiencing beauty we have tended to interpret this experience as a perception of certain objective properties in the object. However, when drawing another's attention to certain configurations within the object, my contention is that we are in fact trying to alert the person to the processes underlying the construction of perceptual form as they are manifested in our perception of the object. We cannot say exactly what these processes are and, phenomenologically, we are not aware that we are in fact experiencing these particular processes. We behave, then, as if the property 'beauty' depends on the presence of other more fundamental properties in the object. The peculiar nature of beauty, however, explains why, what seem like the more fundamental properties of beauty, cannot be expressed as sufficient conditions. Kaufman's argument and others like it, assume that because beauty is experienced as an ineffable property, it must be a foundational property. An Interactive Theory of Beauty leads us out of this wrongheadedness.

Hence, by adopting an Interactive Theory of Beauty, our experience of beauty as both a lawful and ineffable property, can be accounted for.
1.6 The Experience of Beauty As Distinct From Its Accompaniments

A key point to understanding the idea of beauty presented here, is to understand what is constitutive of beauty as opposed to aspects of experience which usually accompany an experience of beauty. The crux of an Interactive Theory of Beauty is that the perception of beauty is characterized by an ideal subjective response, and this subjective response is universal to our species. Some of the confusion and disagreement which arises on this point is due to the fact that when beauty is discussed, we are not always clear which aspects in our experience of beauty are being referred to. It is important to differentiate between those aspects of our experience of beauty which reflect what is constitutive of beauty, and those aspects which reflect what is a concomitant of beauty. The position I wish to defend is this: what constitutes the experience of beauty of a particular object does not vary from person to person. However, there might be aspects of experience which usually accompany the experience of beauty but which are not constitutive of beauty and are not universal.

Remember it was claimed that if we think of aesthetic form and content as elements within the percept, it can be seen how aesthetic form supervenes on content. Of course the content can be focused on for its own sake, without abstracting aesthetic form from it, and this would not be a perception of beauty. However, there is a way content can burst forth into the experience of beauty, such that our minds are filled with memories and nuance triggered by certain aspects in the content. The quality and content of these musings are not universal: furthermore the usual feeling is that only the broad outline of these musings could be communicated, so deep in memory their source is felt to be. This is not an experience of what is constitutive of beauty.

The aspect of the experience of beauty which is here taken to be an experience of that which is constitutive of beauty is the experience of aesthetic form. This is the feeling of clarity that comes from a profound sense of underlying order, unity in complexity and so on. My claim and the crux of the Interactive Theory of Beauty I here defend, is that this feeling of clarity can be explained as evoked by an experience of the processes underlying the construction of the percept of the object. This
experience is only known by the feelings evoked by it. The experience of beauty, then, is constituted by an experience of these underlying processes of perception which evokes in us a feeling of clarity.

There are many theories of beauty within philosophical aesthetics in which the responses to beauty discussed include responses to that which is not constitutive of beauty, according to my theory. For example, when Monroe Beardsley discusses beauty, he seems to conflate the response to the aesthetic form with the response to the personal memories associated with the content of the percept. Let's see how he does this. He defines beauty as a unity, complexity and intensity. In his favour, he emphasizes that these characteristics are aspects of the perceiver's experience of beauty in the object, rather than particular objective properties in the object. He distinguishes an aesthetic experience ' in terms of its own internal properties ' (1969-70, p.5), rather than in terms of the properties of the object that are instrumental in giving rise to aesthetic experience. According to Beardsley a person is having an aesthetic experience during a particular stretch of time if and only if the greater part of his mental activity during that time is united and made pleasurable by being tied to the form and qualities of a sensuously presented or imaginatively intended object on which his primary attention is centered (1969-70, p.5).

Beardsley lists five symptoms of an aesthetic experience. However, according to what has been said above about what constitutes as opposed to what accompanies beauty, these symptoms consist of responses to aesthetic form and responses to the musings evoked by an engagement in the content of the percept. He lists the first of the symptoms as necessary and at least three of the remaining four as necessary for any particular aesthetic experience: (i) object directedness, (ii) a felt sense of freedom, (iii) a sense of detached affect, (iv) a sense of active discovery, and (v) a sense of personal integration, of wholeness (1982, pp.285-297). I think (i) and (iv) refer to that experience which often accompanies the experience of beauty, the experience of associated memories and so on, covered by the 'intensity' of Beardsley's three criteria for beauty. The others are captured, I think, by the notion of clarity mentioned above.
as the feeling evoked by what constitutes beauty, the processes of perception, which subsumes Beardsley’s unity and complexity, and refer to the response to beauty proper. Hence, when Beardsley attempts to identify the characteristic response to beauty, according to the theory of beauty defended in this thesis, he in fact identifies not only the response to that which constitutes beauty, but also the response to certain experiences which often accompany the experience of beauty.

According to certain influential theories of beauty dating from prior to the end of the eighteenth century, that which was constitutive of beauty as compared to associated experiences, were clearly differentiated. When these theories are given a contemporary interpretation, they can be understood as precursors to an Interactive Theory of Beauty: theories in which beauty neither resides in the object nor in the perceiver, but is the property of being such that human perceptual processing of it will employ certain specific operations of whose operations the object makes us dimly aware. For example, Thomas Aquinas believed that a reference to the knowing subject was constitutive of beauty. He wrote: 'beauty is that which pleases when it is seen', and ' "beautiful" refers to something the mere apprehension of which gives pleasure' (Summa Theologica, Ia, Ilae, 27.1). However, the criteria Aquinas gave for beauty which were proportion, integrity and clarity, demonstrate that Aquinas was not an aesthetic subjectivist. Aquinas obviously had an Interactive Theory of Beauty in mind (even if to Aquinas this interaction would have involved a spiritual dimension).

Aquinas identified the subjective response to beauty as a pure and disinterested pleasure, tied up with a feeling of clarity. Eco interprets the meaning of the term 'clarity' as used by Aquinas:

> Clarity is the fundamental communicability of form, which is made actual in relation to someone’s looking at or seeing of the object. The rationality that belongs to every form is the "light" which manifests itself to aesthetic seeing (1988, p.119).

Now drawing upon our distinction between what constitutes beauty and what normally accompanies the experience of beauty, it is clear that Aquinas uses the term 'clarity' to refer to the response evoked by the aesthetic form. His proportion and integrity also
refer to the order of aesthetic form. Hence when Aquinas discusses beauty, he is
discussing what is identified in this thesis as constitutive of beauty. This interpretation
is consistent with Eco's further claim that Aquinas attributed to *claritas* an expressive
or communicative quality in itself, where it signifies a "manifestation" - that is,

In the tradition of Aquinas, Kant identified the subjective response to beauty as
a disinterested pleasure. He reasoned that it was a pleasure that differed from the
pleasure in the agreeable or the pleasure in the good because it was a pleasure that was
not based on sensual gratification or on thoughts of personal gain, nor was it based on
a liking of the good (judged against a concept of what was good). Aesthetic pleasure
was disinterested in that it was a pleasure devoid of personal interest. From this
conclusion Kant reasoned that aesthetic pleasure must be based on some universal
cognitive process, because this would be the only way to explain how a pleasure could
be disinterested. Thus he concluded that it was a pleasure in the form of the percept
(identified by him as the imagination's presentation of the object) because this form
was provided by the mind and was universal to humankind. Hence Kant's idea of
beauty was equivalent (though his idea of how this was manifested in examples was
more limited, as discussed in 1.4.2) to what is identified in this thesis as constitutive
of beauty.

A twentieth century aesthetician whose theory of beauty can be interpreted as
an Interactive Theory of Beauty is Susanne Langer. Langer characterizes beauty in a
way which equates with what this thesis treats as constitutive of beauty, along the
same lines as Aquinas and Kant. According to Langer, beauty is the expression of
aesthetic form. She thinks of this aesthetic form (which she calls expressive form) as
an aspect of a level of perceptual processing. According to Langer, the aesthetic form
is identified as the form of the percept (the form of the intuition in her terminology)
which, is ‘an apparition’. It is an apparition of organic unity whose origin is the
perceptual unity, the configuration or Gestalt of an experience (1957, p.165). Langer
implies that the intuition is the most primitive intellectual unit that can be considered.
When we contemplate the form of the intuition, then, or the aesthetic form, Langer can be interpreted to be implying that we are in fact experiencing certain fundamental aspects of perception.

Now Langer identifies aesthetic form with embodied feeling. Her formulation suggests that relationships are the salient aspects of our experience of aesthetic form through the feelings that they evoke in us. These relationships are those which make up the basic intellectual unit, the intuition according to Langer, and as such are universal. Being the relationships which make up the most basic intellectual unit they are intrinsic to this unit: that is, they can only be grasped in relation to the unit as a whole. They are the kind of relationships that Langer identifies, when illustrating the character of an organic as opposed to a systematic unity, as relationships which we intuitively grasp or not at all. The feelings that we experience in response to beauty, then, are feelings evoked by the relationships which constitute perceptual unity. Up to this point, I think Langer is on the right track. However, when she provides examples of the feelings evoked by the relationships inherent in the aesthetic form (perceptual unity), she slides into equating these aesthetic feelings with everyday emotional states. For example, she analyses music in the following passage:

The tonal structures we call "music" bear a close logical similarity to the forms of human feeling - forms of growth and of attenuation, flowing and stowing, conflict and resolution, speed, arrest, terrific excitement, calm or subtle activation and dreamy lapses - not joy and sorrow perhaps, but the poignancy of either and both - the greatness and brevity and eternal passing of everything vitally felt. Such is the pattern, or logical form, of sentience; and the pattern of music is that same form worked out in pure, measured sound and silence. Music is a tonal analogue of emotive life (1953, p.27).

This may be a valid component of our experience of music, but it is not the experience of the aesthetic form which is constitutive of beauty. While Langer identified aesthetic form as constitutive of beauty, she confused the aspects of the experience of this aesthetic form with aspects of the experience usually accompanying this experience.

The experience of a feeling of clarity (which can result in a felt sense of freedom, a sense of detached affect, a sense of personal integration, of wholeness, to
use Beardsley's terminology) is the characteristic subjective response to that which is constitutive of beauty, the aesthetic form. The feeling of intensity (object directedness and a sense of active discovery), on the other hand, is the characteristic response to the accompanying aspect of the experience of beauty. The feeling of clarity evoked by aesthetic form is the only universal aspect of a judgment of beauty.

1.7 Summary

The unified form which the perceptual process gives to the array of sensations it picks up, then, is the source of our experience of beauty. That is, when we experience beauty we are actually becoming aware of the processes which are responsible for this unified form. The way the perceptual processes are employed would depend in part on the nature of the object. Hence on such an account, beauty is neither purely subjective nor purely objective: it is an experience which emerges from an interactive process.

According to an Interactive Theory of Beauty, the key features of beauty can be summarized as that beauty is (i) characterized by a subjective universal response, (ii) constituted by aesthetic form which supervenes on perceptual content, or perceptual and representational content, in the object, and (iii) experienced as a property which is lawful and ineffable. These features can be explained by the fact that beauty is an experience of an aspect of an interaction between object and perceiver: an aspect of the perceptual process.

My contention is that the perception of beauty is constituted by an experience of certain underlying perceptual processes in the course of perceiving certain objects. The remainder of this dissertation will explore this idea by presenting an explanatory hypothesis for it. In the following two chapters, I will examine a theory of perception to see whether I can identify a level of perceptual processing whose underlying processes of construction look like the sort of processes which might explain the above features of beauty. Conversely, this explanatory hypothesis will serve as a further argument for an Interactive Theory of Beauty. Furthermore, some examples of
the implications of this theory of beauty for issues within philosophical aesthetics are explored. In particular, it is claimed that the central idea of this thesis, that the experience of beauty is constituted by an experience of certain underlying perceptual processes in the course of perceiving certain objects, has important implications for how we think about the relation between form and content in a judgment of beauty.

An interactive theory of beauty is one that is based on the idea that beauty is constituted by an experience of processes which underlie a particular perceptual operation. The idea is that we would experience these processes during the course of perceiving certain objects. It will be argued in chapter one, that according to an Interactive Theory of Beauty, the key features of beauty can be summarized in that beauty has (i) characteristics by a subjective universal response, (ii) constituted by an aesthetic form which experiences an perceptual moment, or perceptual and representational content, in the object, and (iii) experienced as a property which is lawful and unifiable.

If beauty is the property of being such that human perceptual processes of it will employ certain specific processes of whose operations it would be possible to discern; then these processes, given the features of beauty stated above, would have to have something to do with the construction of form, and be accessible to consciousness and universal. I will refer to the three conditions of these processes as the three conditions of an interactive theory of beauty; that is, they are the conditions that a perceptual theory would need to accommodate in order to be the basis for an explanation of an Interactive Theory of Beauty.

In this chapter, I begin to develop an explanation for an Interactive Theory of Beauty. Using Marx’s theory of value, I identify an internal level of operations which constructs perceptual form, and the which we can identify certain underlying processes. As stated in the introduction, if the experience of beauty is the experience of processes which underlie a certain aspect of perceptual operations, and if beauty is the perception of aesthetic form, then the first condition of a theory of beauty is that perception can be understood to include a level of operations which can be identified as the level at which, what we know of an aesthetic form would be constituted.
Chapter 2  The First Condition of an Interactive Theory of Beauty

2.1 The First Condition: Processes Underlying a Representation of Form

An interactive theory of beauty, as explained in chapter one, is based on the idea that beauty is constituted by an experience of processes which underly a particular perceptual operation. The idea is that we would experience these processes during the course of perceiving certain objects. It was argued in chapter one, that according to an Interactive Theory of Beauty, the key features of beauty can be summarized as that beauty is (i) characterized by a subjective universal response, (ii) constituted by aesthetic form which supervenes on perceptual content, or perceptual and representational content, in the object, and (iii) experienced as a property which is lawful and ineffable.

If beauty is the property of being such that human perceptual processing of it will employ certain specific processes of whose operations the object makes us dimly aware, then these processes, given the features of beauty listed above, would have to have something to do with the construction of form, and be accessible to consciousness and universal. I will refer to the three requirements of these processes as 'the three conditions of an interactive theory of beauty': that is, they are the conditions that a perceptual theory would need to accommodate in order to be the basis for an explanation of an Interactive Theory of Beauty.

In this chapter, I begin to develop an explanation for an Interactive Theory of Beauty. Using Marr’s theory of vision, I identify an internal level of operations which constructs perceptual form, and for which we can identify certain underlying processes. As stated in the Introduction, if the experience of beauty is the experience of processes which underlie a certain aspect of perceptual operations, and if beauty is the perception of aesthetic form, then the first condition of a theory of beauty is that perception can be understood to include a level of operations which can be identified as the level at which, what we know of as aesthetic form, would be constructed.
Furthermore, we would need to be able to think of this level of operations in terms of the processes underlying it. My objective in this chapter, is to identify processes that we can understand to be those responsible for the experience of beauty.

David Marr’s theory of vision is congenial to this task because Marr’s theory is designed as a series of ascending levels and a characteristic of his model is that the operations involved in the transformation of one level to the next are underpinned by inbuilt processes (which he discusses as inbuilt assumptions). This design is conducive to my task, seeing that it allows me to consider each level according to the kind of processes which are responsible for its construction. Given that Marr’s theory is a theory of vision, my explanatory hypothesis will in the first instance be an explanation of visual beauty. However, there are ways in which this explanation can be extended to cover other instances of beauty. I will return to this idea in 4.3.

The main task of this chapter, then, is to present the levels involved in Marr’s model and the processes which are involved in their construction. I present these levels in some detail so that it can be appreciated why one particular level of operations offers explanatory power over the other levels in relation to the phenomenology of beauty.

As Marr’s theory of vision is a computational theory, an explanation construed in terms of his theory will be a computational theory of beauty. However, my theory does not necessarily depend on such a theory being the only correct theory. So before proceeding to the main task of this chapter, I will briefly explain what characterizes a computational theory of mind and then present an alternative theory of mind and suggest how an Interactive Theory of Beauty might be accommodated by it.

2.2 A Computational Theory of Mind (CTM)

A Computational Theory of Mind\(^1\) is a theory which explains perception and cognition at the level of mental processes and functions. What characterizes a computational theory of mind, is that the mental processes are thought of as involving

\(^1\) See Marr, 1982, pp.19-29; Lycan, 1990, pp.8-10; and Loewer and Rey, 1991, pp.xv-xvii
the manipulation of symbols. For example, the process of input being transformed into information about the environment, is a process of symbols being acted upon by inbuilt rules, in ascending levels of transformation. To ascertain what these processes involve, one considers the goals of these processes and thinks about the mind as if it were a computer. For example, one must consider: what is appropriate input in relation to the task, what must the mind already know, and what must it do with the input in order to be able to carry out the task. In other words one considers, in relation to the appropriate input for the task and the desired output, what is computed, why it is computed and what sort of constraints the mind would need to impose to get the desired result.

There are several levels of explanation which could be adopted to explain what happens in the head when we carry out certain tasks. David Marr divides these levels of explanation into the level of computational theory which is the one we are concerned with here and is the most abstract; the level of implementation such as the sort of algorithms needed to implement any particular operation; and the physical level such as which neurons fire and when (neuroanatomy and neurophysiology). Although there are an indefinite number of ways in which any particular computational theory could be realized physically, certain physical structures may support or refute certain functional (computational) accounts.

While this computational level of explanation of mental processing explanatorily supervenes on (without being strictly reducible to) the physical, it is a level of understanding in which the character of the information-processing tasks carried out are independent of the physical. According to Marr, this computational level of understanding is:

analysed and understood in a way that is independent of the particular mechanisms and structures that implement them in our heads. ... Such analysis does not usurp an understanding at the other levels - of neurons or of computer programs [algorithmic level] - but it is a necessary complement to them, since without it there can be no real understanding of the function of all those neurons (1982, p.19).
Even though computational theory is analyzed and understood independently of the lower levels of explanation, none-the-less, certain physiological accounts of the mind are used as guides for functional accounts of mind and this is particularly true in the case of Marr's theory of vision as we will see in 3.3.2. While neurological-structural analysis has not advanced so far that functional theories can be totally endorsed, the evidence so far can offer some guide as to what is a plausible functional model. Functional accounts, like Marr's theory of vision, can be guided by what sort of functional structures would be likely to map onto neurological structures. For example, if early visual processes were located in specific identifiable areas, one task to one region and these regions were in close proximity to each other, rather than involving neurons which were spread out throughout the whole brain, this might lend some support to the idea that early visual processes were functionally encapsulated (using one source of input, rather than being penetrable to various high and low processes). In fact, according to Michael Posner and Marcus Raichle, data from imaging techniques such as PET scans (discussed more fully in 6.4.2) and exploratory work at the cellular level carried out on monkeys (taken as relevant to humans given the general similarity of the visual system of monkeys to that in humans), strongly suggest that there are specialized areas in close proximity to each other for processing depth perception, form, color, and direction (1994, p.15). As is shown in this example, Marr's theory in general is supported by the available evidence so far. But this is not to confuse the computational level with the physical or implementational levels.

Marr argues that different phenomena need to be explained at different levels. He points out that if we keep this in mind, it can help us to assess the validity of certain objections raised against a CTM. As an example he cites a favourite objection which is that the brain is not like a computer because one is parallel (distributed), the other serial. For example, the radical connectionists do not think that the human mind can be feasibly explained in terms of computational theory. Let's diverge here for a moment to see why.
Chapter Two

Connectionism and radical connectionism are inspired by our understanding of the neurophysiology of the brain. The main difference between connectionism and radical connectionism is that, while connectionism can be understood as an implementation of computational theory, the radical connectionists see themselves as an alternative model to CTM. Both connectionist models involve an interconnection of neuron-like elements which process information simultaneously. Pat Churchland refers to this as the parallel modeling strategy (1986, p.460). According to Churchland, ‘whereas in a conventional model a representation is a symbol, in the parallel models it is a pattern of activity distributed across a network’ (1986, p.460).

The basic components of the connectionist architecture are simple units which, like neurons, are, at any given time, either inactive or activated to some degree. Typically, this activation consists in possessing an electrical charge. These units, again like neurons, are connected (these connections can be of varying strengths) to other units so that, depending on their own activations, they can act to increase (excite) or decrease (inhibit) the activations of these other units.

The activity of such an ensemble begins when an initial pattern of activation is supplied to some or all of the units; for example, a pattern of light in the case of vision. This pattern can be viewed as a problem given to the ensemble. Processing ends when the system has settled into a stable state (for example, one where the passing of activations through connections does not lead units to change their activation strengths). The overall stable pattern, or the values on certain of the units when a stable pattern has been achieved, represents the system's answer to the problem.

In general, connectionists have employed two different types of interpretive schemes. In a localized interpretive scheme each unit represents some object or property. The alternative interpretive scheme is a distributed one in which an interpretation is assigned to a pattern of activation over an ensemble of units. In a distributed scheme, the activities of individual units may themselves have some
symbolic role (for example, representing features of an object to be recognized) but it is the overall pattern that is of primary interest, not the particular features.¹

Now, as mentioned above, computational systems can be implemented by connectionist networks and this is not controversial (Fodor and Pylyshyn, 1988). However, the radical connectionists claim that, computational theories of mind do not capture mental processing accurately because there is no level of interpretation at which we are computational systems, and, that connectionist systems do not implement a computational process in us (Van Gelder, 1994). Marr’s response is that the distinction between parallel and serial processing generally (and I assume this captures the distinction between connectionism and computational theories respectively) is a distinction at the level of algorithm: ‘anything programmed in parallel can be rewritten serially (though not necessarily vice versa)’ (1982, p.27). Furthermore, Marr argues that in order to understand an algorithm, one needs to understand the problem being solved which one does through computational theory, not by examining the mechanism in which it is embodied (1982, p.27).

Now the explanation I develop throughout the following chapters is developed at the level of computational theory and to do this I assume that such a level of explanation is valid. Whether or not a theory such as Marr’s has any application if the radical connectionists are correct is difficult to say and outside the scope of this thesis. Whether or not an Interactive Theory of Beauty could stand if the radical connectionists were correct and Marr’s theory was superseded is another question. I would proceed by determining whether we could rightfully think of the pattern of activations which occurred across the system in the course of perceiving an object, as underpinned by certain constraints related to which aspects of the form of the object were relevant to the activations. In other words, there are many ways in which a story could be told about how radical connectionism could accommodate an Interactive Theory of Beauty. This thesis sets the theory within Marr’s model because, not only is Marr’s model taken at present to be the mainstream theory within cognitive

¹ The explanations provided here for symbol systems and connectionists models are indebted to Bechtel’s analysis, in Lycan (ed), 1990.
psychology, but Marr's model presents a very congenial setting within which to plant the seeds of a new way of thinking about beauty.

In sum, a Computational Theory of Mind is an explanation, at a highly abstract level, of the functions carried out by the mind. It is an explanation of these functions given in terms of operations which involve the manipulation of symbols by inbuilt rules. It is a level of explanation which, when applied to perception, allows us to understand the problems being solved when the mind derives information from the retinal stimulus. Furthermore, it is a level of explanation at which the contribution and content of inbuilt rules or processes which are involved in these operations, can be ascertained. I draw heavily upon this latter point in developing my explanatory hypothesis.

2.3 Marr's Approach to The Problem of Vision

As an introduction to Marr's model of vision, let us begin by considering how Marr's approach to the problem of vision differs from how others have construed and attempted to solve the problem of vision. Pat Churchland sees the problem, not unlike Marr, in the following way:

In order for an organism to see, its nervous system must be affected by the world external to it. The fundamental fact constraining any hypothesis about how a brain can have visual perception is that the input to the visual system is the two-dimensional array of light falling on the retina. Out of that stimulus array, the brain must concoct an interpretation of what in the external world corresponds to the received pattern of light. And of course, there is no one inside to see the array and identify it as the sort of pattern made by, say, a bird or a pineapple. There are just networks of neurons that interact with each other and that, as a result of the interconnections, yield the global effect that is an interpretation of the 2D-array. Since it cannot be magic, there must be mechanisms. Hence, the problem is to figure out by what principles the brain visually recognizes objects (1986, pp.461-462).

The psychologist Irvin Rock construes the problem in a compatible fashion but at a more specific level than Churchland cited above:

The fact is that the light rays from two separate points within an object have no more connection with one another than the rays from one such point with those from a point outside the object. Therefore, it is a problem why we usually group together into one phenomenal thing all the proximal stimuli related to one object rather than group some stimuli from the object with others from the surfaces between objects, or for that matter, it is a problem why such organization occurs at all (1983, pp.71-72).

The traditional theories of perception were conceived, as they largely still are, according to Pinker (1985), as theories of shape recognition. That is, they were theories designed to answer the question, ‘how does the perceptual system recognize the retinal array as distinct objects in a particular space?’ Marr points out that this question was erroneously translated, by traditional theories of perception, into problems about detecting figure from ground and various regions (1982, pp.269, 272, 279). Marr thought that this was on the wrong track because such approaches to the problem of vision treated figure and ground as primitives. Marr, on the other hand, based his model on attempting to answer the question: how do we extract information about the three dimensional shape from information about surfaces? In construing the problem thus, he was influenced by the psychologist of perception J.J. Gibson, whose idea it was that a lot of visual information can be extracted from surfaces (1966). Thus Marr’s model begins by explaining how we derive information about surfaces from the retinal array and then how we derive information about the three dimensional shape from information about surfaces.

Marr reasoned that as early vision is closely tied to the image as it appears on the retina, this meant that early vision is tied to the vantage point of the subject. Consequently somewhere within the visual processes, probably the final step in vision, this viewer-centred image must be transformed into an objective image of the three-dimensional shape including spatial arrangement, so as to provide stable objects for recognition and a reliable map of the space through which we move.

Based on such considerations, Marr divided the derivation of shape information from the retinal image, into three ascending levels or stages. The first, which he called the 'primal sketch', derives information from the retinal array into
information about edges. This is then translated into information about surfaces in the second stage of processing which Marr calls the 2&1/2 D-sketch. This information is then transformed into information about the three dimensional shape at the third stage of processing which Marr calls the 3D-model description. In the following, I will examine these levels more closely, to ascertain whether one of these levels might be underpinned by the kind of processes, an experience of which, could explain the features of beauty identified above. In particular, in this chapter, we will see whether there are perceptual processes within Marr’s model, the nature of whose operations would account for the phenomenology of beauty; that is, an awareness of whose operations would explain that beauty is the experience of aesthetic form.

2.4 The Primal Sketch

According to Marr, the first level of perceptual processing, the level at which the most basic perceptual primitives are constructed, is called the primal sketch. The primal sketch involves two different scales of operation: namely the raw primal sketch and the full primal sketch. The raw primal sketch filters the image at several spatial scales to find the intensity changes: these intensity changes are constructed into the bars and blobs (general patterns of lights and darks), and the zero-crossings (crossovers from light to dark or vice versa). Marr writes that the raw primal sketch is a very rich description of an image, ... Its importance is that it is the first ... [level] derived from an image whose primitives have a high probability of reflecting physical reality directly (1982, pp.71-73).

The significance of the raw primal sketch in the overall theory of vision which Marr develops is that the full field of primitive elements derived from the retinal image is already present in the raw primal sketch.

The full primal sketch (the second scale of operation within the primal sketch), derives information about edges from the tokens furnished by the raw primal sketch. This involves grouping operations which select roughly similar elements from the raw material, grouping them recursively into larger scaled elements. That is, the bars, blobs and zero crossings of the raw primal sketch are formed into the lines, curves,
larger blobs, groups, and small patches of the full primal sketch to the extent allowed by the inherent structure of the image (see the frontispiece for an illustration of this). The full primal sketch, then, is an image of edges and boundaries.

The internal subprocesses involved in the primal sketch, then, involve the construction of descriptive primitives (the most primitive tokens of information for that module'). According to Marr, these descriptive primitives are decoded and translated at successively higher levels of perceptual processing into increasingly abstract properties of the image (1982, p.91).

Now, the assumptions that Marr envisages as operating at this level are assumptions which underpin the grouping operations. For example, for the perceptual system to group zero-crossings and read them as an edge, involves an implicit assumption that such groupings are adequate evidence of a physical edge. In other words, they are assumptions that underpin the basic elements of what we would think of as form, such as edges and boundaries. While such assumptions may be indirectly relevant to the processes responsible for beauty, they seem too primitive for my purpose of sketching out how the underlying assumptions of these levels can be thought of as the processes responsible for the experience of beauty. As such, while it is worth keeping these assumptions in the back of one's mind, so as to grasp how the elements which make up the 2&1/2D-sketch and the 3D-model description were originally constructed, we need not consider this level, in particular, as the level at which the processes which are responsible for the experience of beauty operate.

2.5 The 2&1/2D-sketch

The next level of processing in Marr's model is the 2&1/2D-sketch. The 2&1/2D-sketch is not simply the result of further grouping operations performed on the full primal sketch. Instead, it results from the combination of a number of independent decoding processes whose task it is to recover information about the geometry of surfaces from the descriptive primitives furnished by the primal sketch.

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1 For a definition of how the term 'module' is employed here, see 3.3. 1.
The input to these decoding processes can be information furnished from one or more of the subprocesses operating within the primal sketch.

To retrace our steps for a moment, imagine the overall process of the first stage of vision to involve something like this. The detection of a pattern of gray level intensities gives rise to zero-crossings and terminations, bars, blobs, etc. (the raw primal sketch). A grouping process is performed on these tokens resulting in larger groups of similar tokens which are read at a higher level as textures, contours (edges) and shading (the full primal sketch). Now, the decoding processes which when combined provide the 2&1/2D-sket, can have as their input information furnished by the raw primal sketch before it is grouped into the full primal sketch, as well as information furnished by the full primal sketch. An example of this is the input to, ‘stereopsis’ (a process explained below). The input to ‘stereopsis’ includes the zero crossings and the full primal sketch (1982, p.265).

The decoding processes that were discussed by Marr were: stereopsis, directional selectivity, structure from apparent motion, depth from optical flow, surface orientation from surface contours, surface orientation from surface texture, shape from shading, photometric stereo (the determination of surface orientation and reflectance from scene radiances - the intensity of reflected light - observed by a fixed sensor under varying lighting conditions), and lightness and color as an approximation to reflectance (1982, p.103). These processes translate information furnished by disparity, motion, shading, texture and contour information into information about surfaces.

The information furnished independently from these decoding processes, then, are combined into Marr’s 2&1/2-D sketch which explicitly represents three types of information about each point or small patch in the image. This information consists of: the approximate distance of the point from the observer, the local orientation of the surface containing the point and the contours created by discontinuities in surface orientation or depth (Marr, 1982, p.328). The 2&1/2-D sketch, then, does not contain explicit representations of the shapes of objects, nor does it contain descriptions of
objects or identifications of objects. The 2&1/2-D sketch can be grasped as representing the effect that judging the distance of each point from the viewer has on the full primal sketch. That is, in the 2&1/2D-sketch, the patches of texture and varying tones in the full primal sketch are translated into variously oriented surfaces from the vantage point of the viewer. The 2&1/2D-sketch, then, normally includes all and only the information furnished by the decoding processes (the reason for the qualifying ‘normally’ is discussed in 3.3.1).

To give the reader a more detailed understanding of the kinds of processes involved at the level of the 2&1/2D-sketch, in order that the transformation involved between the 2&1/2D-sketch and the 3D-model is fully appreciated, I will describe the processes involved in two decoding processes, ‘stereopsis’ and ‘surface orientation from surface contours’. These two decoding processes in particular, it seems to me, figure quite prominently in what we imagine is going on, when we detect an image of surfaces in the array of primitives furnished by the primal sketch. They also offer, particularly in the case of ‘stereopsis’, convincing support for the idea that at this level, the processing can be driven entirely by information extracted from the environment, without knowledge about the shape as a particular object, playing any role. This latter point will become important in the next chapter, when I discuss the third condition of an explanatory hypothesis of beauty.

2.5. 1 Stereopsis

Stereopsis is the disparity in the view of the object as seen from two eyes. If the object is closer, the views are less alike. As Ray Jackendoff puts it:

The information-processing problem that must be solved by stereopsis is that of taking two slightly different images (one from each eye), neither differentiated for depth, and combining them into a single perceived image that contains depth information (1987, p.165).

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1 See Stillings in Garfield, 1987, p.329, for a discussion of this point.
Marr analyzes the stereoptic process into two steps: the first involving a measurement, the second involving the recovery of information about three-dimensional shape. In stereopsis, the measurement depends on one crucial factor: the difference between two images cannot be measured unless the parts of the two images which count as the same are known. Marr, then, construes the problem of stereopsis as four consecutive steps: (i) a particular location on a surface in the scene must be selected from one image; (ii) the same location must be identified in the other image; (iii) the disparity between the two corresponding image points must be measured, and (iv) the two corresponding image points must be fused (1982, pp. 111-112).

The problem with the second step, matching the same points in the two images, is to first determine which features of an image are actually matched. While a knowledge of the image as a particular object would make this matching process quite easy, the way stereopsis works suggests that it is a process which, in fact, precedes the knowledge of the image as a particular object. That is, rather than depending on the discrimination of objects in order to operate, ‘stereopsis’ is a process which contributes to the discrimination of objects. This fact is demonstrated by Bela Julesz’s ‘random-dot stereograms’. ‘Random-dot stereograms’, are image pairs constructed of dot patterns that appear random when viewed monocularly, but which fuse when viewed one through each eye to give a percept of shapes and surfaces with a clear three-dimensional structure’ (Marr and Nishihara, 1978, p. 31).

The dots don’t represent any object: therefore, no knowledge of what the object is can help in this case.

This is how Bela Julesz’s stereograms work. Consider two square arrays, each made up of 100 x 100 black and white squares or pixels, distributed randomly. The two arrays are identical, except that a square region in the middle of the left-hand array has been shifted one square or pixel to the left in creating the right-hand array, and the column left blank as a result has been filled in with new random pixels. On ordinary viewing, however, no higher-order organization at all is apparent in these arrays. They appear simply as random dot arrays. However, when they are viewed
stereoscopically, one array presented to each eye, a vivid perception of a square region in the middle of the array floating above the rest of the page, emerges.

![Figure 2.1 A random-dot stereogram.](image)

Now the difference between the two random dot arrays reflects the same type of disparity in angle between the two views of an object which reach our two eyes respectively. Thus, these arrays present the appropriate sort of cue for stereoptic depth perception: a left-right disparity in the relative positions of parts of the retinal arrays. The system, then, imputes depth to the array, and this depth is part of what the viewer sees. The fact that the central square is seen as a unit due to the result of stereopsis rather strongly suggests that the discrimination of objects must be dependent on stereopsis.¹

Thus the problem of matching is not a matter of locating corresponding parts of objects in the field: rather, as Jackendoff points out, ‘stereopsis must be based (at least partly) on detection of purely local pattern correspondences’ (1987, p.165-167). This is in fact what Poggio and Marr suggest. According to Poggio and Marr, the input for the stereo matching process:

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¹ This description of Bela Julesz 'random-dot stereograms' is indebted to Ray Jackendoff's description, 1987, pp.165-167.
Chapter Two consists of the raw zero-crossings, labeled by the sign of their contrast change and their rough orientation in the image, and of terminations - local discontinuities - also labeled by contrast and perhaps very rough orientation (in Marr, 1982, p.130).

Marr suggests that the procedure is to match coarse, widely separated features first, then with the information so obtained, repeat the matching process at successively finer scales of resolution. In order to do this the matching process needs to be underpinned by certain assumptions. Marr translates these assumptions succinctly into three rules: (i)Compatibility: black dots can match only black dots. (ii)Uniqueness: almost always, a black dot from one image can match no more than one black dot from the other image. (iii)Continuity: the disparity of the matches varies smoothly almost everywhere over the image (1982, p.115). Added to this is what Marr refers to as the fundamental assumption of stereopsis:

If a correspondence is established between physically meaningful primitives extracted from the left and right images of a scene that contains a sufficient amount of detail, and if the correspondence satisfies the three matching constraints, then that correspondence is physically correct. It follows immediately from this assumption that the correspondence must be unique (1982, pp.114-115).

Once the matching process is completed, the disparity is measured and then the matching points must be fused. The object presents a slightly different angle to each eye, and this difference increases the closer the object is to the perceiver. Hence, by measuring this difference, the perceptual system can calculate the distance of the object. In addition, because it reveals the object from slightly different angles, this process yields information about three-dimensional shape.

Now as stated earlier, the matching process entails a series of matchings from coarse to finer scales of resolution. This means that the result of each matching would need to be stored somewhere before eventually being combined. Marr suggests that as each corresponding points are matched the information is stored in a memory buffer, eventually being combined into a depth map in the 2&1/2D-sketch. As Marr puts it:
the computational simplicity of the matching process, requires a buffer in which to preserve its results as disjunctive eye movements change the plane of fixation and as objects move in the visual field. In this way, the 2&1/2D-sketch becomes the place where global stereopsis is actually achieved, combining the matches provided independently by the different channels, making the resulting disparity map available to other visual processes (1982, pp.149-150).

Marr points out that stereopsis (and structure from motion, which involves discerning the structure of something through the change in angles caused by motion), are both best suited to delivering information about how things are changing locally rather than about absolute depth. Therefore, there is,

a strong sense in which both processes are very well suited to delivering surface orientation information, and it is probably more accurate to think of them in this way than as if they were primarily concerned with distance from the viewer (1982, p.282).

Stereopsis must be a relatively early visual process, then, which relies only on information furnished by the image. That is, to see a surface's orientation does not rely on higher level knowledge about what object is represented by the surface. Thus, early and intermediate processes specify 'the depth or surface orientation at arbitrary points in an image, rather than the depth or orientation associated with particular objects.' (1982, p.275). This they do solely by extracting information from the image, without incorporating high level interpretations. In the language of cognitive science, this means that early and intermediate visual processing are bottom-up, with little or no top-down processing involved.

2.5. 2 Surface orientation from surface contours

According to Marr, the fact that we judge surface orientation very accurately while having poor depth-judging abilities suggests that judging surface orientation does not rely solely on the judgment of depth (1982, p.283). Marr concludes that judging surface orientation probably includes various sources of information.

The processes identified by Marr as providing information about surface contours were: (i)discontinuities in distance from viewer, (ii)changes in surface
reflectance, and (iii) illumination effects like shadows, light sources and highlights (1982, p.215). Marr lists the detection of surface orientation from surface contours (interpreting a convexity or a concavity as either a protuberance or a recess) as a separate decoding process from 'stereopsis' and the detection of 'surface orientation from surface texture'. However, 'stereopsis' and changes in surface texture provide information about surface contour, so there would seem to be some overlap and interaction between Marr's decoding processes. Information furnished by stereopsis, then, can perhaps feed directly into the 2&1/2D-sketch or via information about contours. On my interpretation of how these decoding processes work within Marr's model, perhaps the decoding processes are best envisaged as an intermeshing system of interdependent operations.

Now to return to the derivation of information about surface orientation from surface contours: once these contours are detected, the question is how and why such contours can provide information about the orientation of surfaces. With regard to recovering information about the orientation of a surface from surface discontinuities or gradual changes in surface, it seems we are predisposed, according to Marr, to compute such discontinuities or gradations as corresponding to a convexity or a concavity on the surface. However, even examples which are loaded one way can be made to alternate. Certain psychologists including Irvin Rock have suggested that we have innate preferences for one way of perceiving these discontinuities over another (1983). That is, when a discontinuity can be interpreted as either convex or concave, we tend to perceive it in which ever way would be consistent with a light shining from above. For example, according to Rock, 'a region with attached shadow will tend to appear elevated, convex or in bas-relief if that shadow falls at the bottom: and it will appear recessed, concave, or in intaglio if the shadow falls at the top' (1983, p.334).\(^1\)

Some theorists claim that this tendency is innate, while others claim it is learned. Whatever the case, what is significant for our purposes is that the positioning of

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\(^1\) While this might suggest that this cue is learnt, Rock refers to evidence that chicks utilize shadow location as an indicator of convexity or concavity much as we do and do so even if raised with all light coming from below. See Rock, 1983, p.334
shadows, and discontinuities of other features such as texture, along with other decoding processes such as stereopsis, can furnish us with information about surface orientation. And this they can do solely by processing information extracted from the original stimulus.

A major assumption which Marr reasoned must be involved in combining the information from the various decoding processes into the 2&1/2D-sketch was the assumption that ‘the visible world can be regarded as being composed of smooth surfaces’ (1982, p.44). There are some rather interesting operations occurring at this level that remind us of some aspects of the phenomenology of the perception of visual beauty in three dimensional objects: such as the contemplation of modulating surfaces and the nuance of variations in surface orientation. However, as will be seen in the next section, the kind of assumptions which we could speculate might be involved in transforming this image of surfaces into the next level which is the 3D-model description, offer the most promising explanation for the phenomenology of beauty.

2.6 The 3D-model Description

The 3D-model description is the level at which the image of surfaces of the 2&1/2D-sketch (the viewer-centred image) is transformed into an object-centred image of the spatial arrangement of the three-dimensional shape. As such, the 3D-model description represents a discrete form: that is, a three-dimensional shape distinct from other shapes and from its background. To achieve this, the visual system, in effect, discerns which surfaces go together, and which surfaces represent background. If we think of this process as a matter of applying certain relationships, or selecting elements of the 2&1/2D-sketch which in combination create certain relationships, then the assumptions operating at this level seem promising candidates for the processes responsible for the experience of beauty. Most relevant to our purposes here, is that the assumptions or processes underlying the 3D-model description are involved in the construction of form.
In order to get a clearer idea of what sort of assumptions we might envisage as involved at this level, let us look more closely at what Marr says is involved in the 3D-model description. The purpose of the 3D-model description is to transform the viewer-centred image into a shape which is able to be recognized. Marr thought of the process of object-recognition as a matter of ‘indexing into a catalogue of stored 3D-model descriptions’ (1982, p.313). The 3D-model description, then, would need to be accessible to matching. On this basis, Marr reasoned that the 3D-model description, while it would need to offer a unique description if it were to be recognized as one object rather than another, would, none the less, need to be versatile enough so that on the basis of the one 3D-model description, various views of the object could be recognized. Marr needed to design the 3D-model description so that it presented a stable image, but one sensitive to slight deviations in angle, perspective and other variations in viewing conditions, given the multiplicity of views that any one object can present to perception.

In order to solve this problem, Marr looked for examples of what we do best, so to speak, regarding object recognition. He found such an example in the way we are very good at extracting information about three-dimensional shape from silhouettes, which in fact provide a minimum of information. Marr referred to silhouettes as occluding contours, as the only source of information a silhouette provides is via its contour. This was significant, given that this information is prominent in the 2&1/2D-sketch. Marr provided as an example, the silhouettes in Picasso’s *Rites of Spring* (see figure 2.2) which, he noted, we immediately interpret in terms of three-dimensional shapes, namely human figures playing musical instruments, despite the paucity of information in the image itself (Marr and Nishihara, 1978, pp.47-49).
Note that in Picasso's *Rites of Spring* the information we extract is not derived from context: it is not as if when we turned to this page we expected to see figures playing musical instruments. An occluding contour then, can provide enough information for us to recover the geometry of the whole shape and thus the orientation of all of the surfaces in generalized form. In order for this to be possible, without top-down knowledge, Marr reasoned that we must unconsciously invoke certain a priori assumptions and constraints about the nature of the shapes. Marr thinks that for occluding contours to elicit information about surface orientation, three assumptions must be built into the process. These are: (i) each point on the contour generator projects to a different point on the contour, (ii) nearby points on the contour arise from nearby points on the contour generator (this is why we see those various hand sculptures when viewed as silhouettes as various animals rather than as overlapping or joined hand shapes), and (iii) the contour generator lies wholly in a single plane (this also explains the hand-silhouettes-viewed-as-animals phenomenon).

While Marr came to the above points by considering what we assume when we view a silhouette as a three dimensional figure, he realized that the assumptions
amassed to viewing the occluding contours as the contours of generalized cones. That is, if you consider what sort of form could be described by the above points, you realize that these points describe the silhouette of a generalized cone. If something like generalized cones are built into the perceptual process, this would mean that you recognize the silhouette as a form because you assume that the outside contours reflect the contours of an object parallel to the silhouette, so that each point on the contour projects to a corresponding point on the object, points which in combination create a continuous outline. If we did not make these sorts of assumptions, then a silhouette would not reveal any object to us because we might, for example, perceive the silhouette as a flat shape, or as an outline of various shapes and volumes jumbled together. But we don't do that. We perceive a silhouette as the outline of generalized cylinders.

Marr reasoned, then, that somewhere in the visual process there is a link between the imaging process and generalized cones. Marr wrote: 'in general, shape cannot be derived from occluding contours alone unless that shape is made from generalized cones and is viewed from a position from where its axis is not foreshortened' (1982, p.224). Marr reasons, then, that the principal axes of a shape, those axes which indicate symmetry and elongation, must also figure in the process.
In his search for what we do well and with ease concerning perception, Marr notes that stick figures, of animals or humans for example, are usually recognized easily despite the limited amount of shape information they provide. Marr writes that while 'this does not demonstrate that the human visual process is based on stick figures, it does suggest that the type of information carried by stick figures plays an important role in it' (1982, p.327). Furthermore, we can easily detect principal axes in cylinders when the cylinders represent the object from a nonforeshortened angle, or the axes are constructed to show elongation and symmetry, which amounts to the same thing. From this Marr reasoned that once the cylinders are constructed, the principal axes which provide information about elongation and symmetry, can be detected. Once the main axes are detected, including their relative positions and proportions, then volumetric primitives can be constructed around these axes.
Hence, the principal axes can be derived from occluding contours and these principal axes offer the perfect unit, alone with volumetric primitives, for the construction of a 3D-model description which will be sensitive to the various angles which an object presents to perception.

If recognition is a matter of matching a 3D-model description with a stored catalogue of shape descriptions, then a description whose units are axes and volumetric primitives could provide the basis for the object-centred 3D-model description. A description of principal axes and volumetric primitives would not contain information about the object seen from only one angle (like the viewer-centered image) but would represent the three-dimensional hierarchical decomposition of the object into parts and parts of parts and so on (see figure 2.5).
Figure 2.5 An illustration of the units involved in a 3D-model description. This illustration, like all drawings, is a viewer-centred projection and so does not properly show the relative arrangement of each model's component axes.

Jackendoff describes the 3D-model description of a human figure in the following way:

At the coarsest layer of description the figure is represented simply by a cylinder, itself defined by a vertical axis down the middle and a cross section. At the next layer of description the cylinder is elaborated into a torso, a head, and four limbs, each of which is a cylinder defined by its own axis. The points of attachment of the head and limbs to the torso, and the angles that they form, are specified in terms of the coordinate system defined by the axis of the torso. In turn, each of the parts is subject to elaboration at finer levels of detail. For instance, the arm cylinder can be elaborated as two connected cylinders corresponding to the upper and lower arm; the lower arm can be elaborated into lower arm and hand; the hand can be elaborated into palm and fingers; the fingers can be elaborated into joints. Thus, the 3D model is a sort of tree structure (1987, pp.174-175).

According to Marr, this 3D-model description is made up of shape primitives (orientational and volumetric) which would make explicit the organization of the space occupied by an object and not just its visible surfaces (1982, p.330). In this way the object would be grasped as a three-dimensional form and could thus be recognized from various angles because the three-dimensional model would provide information...
which would not be relative to any one viewpoint but rather would be relative to objective coordinates in the distal array.

As will become increasingly evident in the next chapter, Marr's approach to the problem of vision was to draw upon various sources of information about vision. One such source was the psychologists' laboratory. Among empirical observations drawn from this source which interested Marr was the following exercise. Imagine a line of equilateral parallelogram shapes arranged vertically, one under the other. If we turn this vertical arrangement 45 degrees, which means that taken individually each shape objectively resembles a diamond, our most dominant impulse is still to perceive these shapes as squares pointed obliquely, rather than as diamonds arranged diagonally. This is because perception takes note of the global axis to define a shape. The global axis, in this case, runs through the centre of squares, not diamonds. However, if we take each unit of this obliquely pointed column of squares, and arrange them horizontally, we perceive them as diamonds because the global axis defines them as such (see figure 2.6).

![Figure 2.6](image)

**Figure 2.6** According to Marr, these diagrams show the effect that different choices of an object-centred coordinate system have on the perception of shape. From Marr, 1982, p.327

According to Marr, such examples provide evidence that 'local shape information is described relative to axes that are defined more globally.' In this case the global pattern 'influences and therefore probably precedes the description of the shapes of the
local elements’ (1982, pp.327-328). Marr used such evidence to construct the 3D-model description from the most dominant axes, the axes that represented the most global orientation of the shape, down to the smaller axes.

Another source of information about vision which Marr drew upon, was clinical neurology. Apparently, patients with a parietal lesion, which is a part of the brain associated with language, learning and memory, had difficulties recognizing objects, but the nature of these difficulties differed according to whether the lesion was in the left parietal lobe or the right parietal lobe. The difference in the nature of the difficulties between those affected on the left side with those affected on the right side, was what interested Marr. Patients with left parietal brain lesions according to Marr’s interpretation, could not recover the semantics of an object but could reliably construct the geometry of surfaces of objects even when only presented with foreshortened angles of objects. Patients with right parietal brain lesions could not provide the geometry of an object but could provide the semantics of an object and then only when the object was presented from a characteristic angle. For example, patients with right parietal lesions would be unable to recognize water pails (buckets) seen end-on and in fact would vehemently deny that such a view could belong to a water pail. However, the object shown side-view was recognized and when patients with right parietal lesions did recognize an object, they were able to name it, describe its function, its size and so on.

Patients with left parietal lesions, on the other hand, often had no language so could not state an object’s name or function but they could convey that they correctly perceived its geometry (shape) even from the unconventional view. From this it was assumed that patients with left parietal lesions could not recognize objects. Marr does not say whether or not these patients could convey the functional information about the object by means other than language. We must assume that other tests confirmed that they could not recognize the object, its function and so on. According to Marr, the evidence from these patients with left and right parietal lesions suggested that the construction of the internal description of the shape of an object involved different and
independent processes from those involved in constructing a representation of the object's use and purpose. Marr concluded that vision alone can deliver an internal description of the shape of a viewed object, even when the object was not recognized in the conventional sense of understanding its use and purpose (1982, p.35).

In other words, according to Marr, the data strongly supports the notion that the construction of a 3D-model description is involved in the visual system and can operate independently of recognition (1982, p.35).

However, recognition, according to Marr, involved matching the 3D-model description with a stored catalogue of shape descriptions. Furthermore, he envisaged that this process of recognition would begin during the construction of the 3D-model description. He wrote:

the two processes of construction [of the 3D-model description] and matching cannot be rigorously separated because a natural aspect of constructing a three-dimensional representation may include the continual consultation of an increasingly specific catalogue of stored shapes (1982, p.326).

One would assume that during the course of object recognition the initial 3D-model description would have to be constructed independently of object recognition in order that the processes involved in object recognition have something to operate on.

As indicated earlier, the 3D-model description is necessary for object recognition. There would seem to be some exceptions though, as indicated by those patients who were right parietally damaged. In such cases, the perceptual system might be able to skip the 3D-model description and replace this with a higher level schematization drawn from memory. Perhaps the perceptual system can only do this in cases where brain damage prevents the normal course of events.

One could say, then, that even though Marr states that the 2&1/2D-sketch is 'probably the end of pure perception' (1982, p.268), the initial 3D-model description is most likely, in most cases, to be a product of bottom-up processing. This is suggested by the evidence from the patients with left parietal lesions, and the need for
a starting point for matching with a stored catalogue of shapes. Hence, we can think of the 3D-model description as providing enough information for object recognition.

As the 3D-model description is the level at which the three dimensional shape is constructed, this might be a level which we could consider as equivalent to the level of the construction of aesthetic form, discussed in chapter one. As such, this may be the level of operations, aspects of whose underlying processes we become dimly aware of, in the perception of beautiful objects. The assumptions involved in constructing the 3D-model description are those we need in order to perceive in the image of surfaces (the 2&1/2D-sketch), the cylinders within which we can detect the principal axes and around which we can construct volumetric primitives. They are assumptions about the information we derive from contours: assumptions which give rise to the detection of perceptual forms as distinct from background. The elements involved in these assumptions include the principal axes which indicate elongation and symmetry, the global axis in relation to minor axes which are all related within a space defined by the global axis: in short, a hierarchy of elements within elements, which makes up a description which is flexible in that it covers various views of the object, but is rigid in that it captures the essence of the shape of the object so that the shape cannot be confused with that of other objects.

My contention is that the experience of beauty is an experience of the processes which underlie the operations involved in the construction of the 3D-model description during the human perceptual processing of beautiful objects.

2.7 Underlying Processes

Now, obviously, in each case of perception, the way these assumptions would be employed, would vary. For example, the perception of certain objects might stretch or challenge these assumptions while the perception of other objects might epitomize them, so to speak. Perhaps in certain cases, the way the perception of the object employs these assumptions is such that our focus is shifted from what the
object represents, to the work of these assumptions which we experience as relationships of form. This idea will be explored through examples in chapter four.

As the explanatory theory I am developing rests heavily on this notion of underlying assumptions, in this section I will look more closely at how Marr envisaged the nature of these assumptions. As discussed above in 2.2, a computational theory considers from the desired output, what would amount to appropriate input and then the processes in between which would account for this transition from input to output. As the output is underdetermined by the input (which means that there seems to be more information needed to get the desired output, than what is picked up by perceptual transducers), Marr proposes that there are certain constraints built into the perceptual system which he refers to as assumptions.

Marr arrived at what these assumptions would be, by considering the interaction between the imaging process (which is the forming of each level within the perceptual system) and the underlying properties of the physical world that give rise to structure in images (1982, p.103). Marr writes:

This interaction between the imaging process and the underlying properties of the physical world commonly occurs in the study of visual processes, ... Frequently an apparently insoluble problem arises, such as [for example in the case of stereopsis] which dots in the left-hand pattern ... should match which dots in the right-hand pattern. From the image alone one just cannot tell. The critical step in formulating the computational theory of stereopsis is the discovery of additional constraints on the process that are imposed naturally and that limit the result sufficiently to allow a unique solution. Finding such constraints is a true discovery - the knowledge is of permanent value, it can be accumulated and built upon, and it is in a deep sense what makes this field of investigation into a science. ... the secret of formulating the processes accurately lies in discovering precisely what additional information can safely be assumed about the world that provides powerful enough constraints for the process to run - for example, uniqueness and continuity in stereopsis, rigidity in motion, and so forth (1982, pp.265-266).

Marr's particular contribution here is to emphasize that the assumptions are tied to the underlying properties of the physical world. That is, they are assumptions about how the world is, like 'all objects are rigid' or 'there are relatively few connected surfaces'. They are assumptions which would prompt a certain transformation over another. In
the case of these two assumptions, one can see how they would influence the way the 2&1/2D-sketch would be transformed into the 3D-model description. Furthermore, Marr argued, these assumptions needed to be general so that they applied to all cases of vision.

As for the question of what additional knowledge should be brought to bear, general knowledge must be enough - general knowledge embedded in the early visual processes as general constraints, together with the geometrical consequences of the fact that the surfaces coexist in three-dimensional space (1982, pp.272-274).

Marr explains that once the needed constraints have been worked out - in what ways, if you like, the percept is constrained by assumptions about the world - we can incorporate them into the design of a process. For example, for the perceptual system to group zero-crossings and read them as an edge involves an implicit assumption that such groupings are adequate evidence of a physical edge. Thus according to Marr, the processes involved in vision are underpinned by assumptions which operate regardless of the object or scene under scrutiny.1 These assumptions operate automatically, are mandatory and are impenetrable to high level processes like expectation.

Here we are interested, in particular, in the kinds of assumptions which would constrain the transformation of the image of surfaces (the 2&1/2D-sketch) into a three-dimensional form (the 3D-model description). While we have seen which units Marr suggested were used to build up the 3D-model description, it will help at this point to turn to another theorist, Irvin Rock, who offers certain processes which, he says, underpin visual processing at this level. The processes he offers are very general, and perhaps too general to be of interest here. However, the way he construes these processes as innate preferences rather than assumptions, and innate preferences for an underlying solution, rather than a preference for a particular configuration, is of interest here.

1 Face recognition seems to involve domain specific processes and assumptions, but these would depend upon or incorporate the assumptions of early vision.
In Rock's theory of perception, the underlying constraints are construed as innate preferences. The innate preferences responsible for the formation of the preferred percept (which is Rock's term for a level equivalent to Marr's 3D-model description) determine how the information is formally structured, such as the relationship of the parts to the whole, what constitutes figure and what ground, and so on. One such preference, according to Rock, is the 'Common-Cause Principle' (1983, pp.134-138). According to the 'Common-Cause Principle', when the proximal stimulus is compatible either with a perception entailing no change or with one entailing a change, the former will be preferred. One example of this provided by Rock, involves a single tilted rod rotating in depth about a vertical axis. The viewer-centred image is a sequence of lines, gradually changing in length and orientation. After a while this sequence will produce the effect of a rigid rod of unchanging length rotating in depth (the object-centred view), rather than the alternative of a line spinning around its centre point on a flat plane, continuously shrinking then stretching then shrinking as it spins (the viewer-centred view). The effect settled on by the perceptual system is the one which involves no change in the 3D-model description of the rod.

![Figure 2.7](image.png)

*Figure 2.7* A single tilted rod rotating in depth around a vertical axis

One of the assumptions posited by Marr was that 'objects are rigid'. This assumption was needed to account for the way in which we can derive shape from motion and would seem to underpin the transformation of the 2&1/2D-sketch into the 3D-model description. However, Rock points out that the Common Cause Principle is more general than any of Marr's assumptions. For example, this principle can
operate on stationary configurations under the Coincidence Explanation (1983, pp.138-164). The Coincidence Explanation, according to Rock, applies the Common Cause Principle to stationary configurations rather than to events. This principle refers to the tendency to prefer and search for a common cause or single explanation of covarying stimulus transformations, correlated events, or apparent regularities in the organized pattern. That is, if there is a choice between two or more configurations, the principle is that the configuration which is based on the explanation which avoids accepting coincidence will be preferred. This does not mean that the simplest configuration will be preferred. That idea is the idea of the good gestalt (Arnheim, 1974). On the contrary, while the explanation which avoids coincidence is preferred, the configuration resulting may be quite complex while the configuration resulting from an explanation based on accepting coincidence might be the simpler one. An example is when two regions are side by side, apparently connected along one irregular boundary. Our perception of these two regions settles into the perception of one region overlapping the other or one as figure, the other ground. To perceive these two regions as if they are on the same plane would mean that they shared exactly the same irregular boundary, which in turn would mean accepting coincidence. On the other hand, perceiving one shape as partly obstructed by the other, avoids coincidence, particularly in cases in which the boundary in question is irregular. Yet arguably, the resulting configuration is somewhat less simple than the one which is based on coincidence.

![Figure 2.8](image)

*Figure 2.8* One shape is perceived as being in front of the other to avoid an underlying explanation based on accepting the coincidence of one irregular boundary being shared by two different shapes.
Hence, according to Rock, it is not the anticipated solution about which the system possesses preferences, but rather the type of explanation behind the solution which stimulates a particular preference. Another point made by Rock worth noting is that, ‘the preference for the common explanation solution becomes greater as a function of the number of coincidental features’ (and I would suppose also greater as a function of the number of complex or apparently contradictory features).

The ‘Common Cause Principle’ is an example of an underlying principle of perception. Rock construed such processes as a (normally nonconscious) psychological act of preference. In a sense, then, the perceptual system, due solely to its very nature without any influence of top-down knowledge or bias, is capable, in effect, of preferring certain configurations over others due to the way in which the underlying processes are employed in constructing the configuration. The preference, as noted above, is actually for the way in which the underlying processes are employed in the perception of the configuration, rather than for the configuration itself, although phenomenologically, it amounts to the same thing. Taking my cue from Rock, I will suppose that the transformation of the 2&1/2D-sketch into the 3D-model description involves detecting or selecting (preferring) certain relationships within the image of surfaces. The Common Cause Principle represents one such preference.

Marr's 3D-model description is not meant to be thought of as a little three-dimensional model stored in the head: rather it is a description. The assumptions or processes which underpin the construction of this description can be thought of as relationships. Hence it would be the nature of these relationships about which, in Rock's terms, the system would have preferences. In this way, this explanation of beauty can be applied to other perceptual modules, as we will see in 4.3.

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1This echoes certain notions of, what is called, scientific beauty. For example, Steven Weinberg points out that Newton's theory of gravitation includes three equations about gravitational forces while Einstein's includes fourteen. So on the face of it, Newton's was a simpler theory. However, Einstein's theory was by far the more beautiful because of his central idea about the equivalence of gravitation and inertia (1993, p.107). This was not an equivalence based on accepting coincidence, but an equivalence based on the Common-Cause Principle: a single explanation for covarying stimulus transformations.
As to what makes some objects appear beautiful and others not so, perhaps in certain cases, the preferences or processes underlying the construction of the 3D-model description are challenged, epitomized, or perhaps violated, such that there is something out of the ordinary about the way these processes are employed in the perception of the object. Perhaps when this happens we become dimly aware of the processes as they are involved in the perception of the particular object.

2.8 Summary

Marr's model of vision involves three levels of processing which look something like this: (i) the primal sketch represents information about the two-dimensional image: it represents the geometrical distribution and organization of intensity changes such as zero-crossings (changes from dark to light and vice versa), blobs, terminations and discontinuities, which, as the result of grouping operations, are transformed into edge segments, virtual lines, groups, curvilinear organization and boundaries: (ii) the 2&1/2-D sketch involves the decoding of the information about boundaries and edges provided by the primal sketch, the result being an image of surfaces which conveys information about local surface orientation, distance from viewer, discontinuities in depth and discontinuities in surface orientation in a viewer-centred co-ordinate frame: and (iii) the 3-D model description derives information about three-dimensional shapes from the 2&1/2D-sketch, each shape based on a spatial configuration of a few sticks or axes: it conveys information about the relative proportions and arrangement of the main axes, as conveyed in a stick figure, and about the volume of each segment as conveyed by general cylindrical shapes. This last level, the 3D-model description, describes shapes and their volume and spatial organization in an object-centred coordinate frame.

At the beginning of this chapter it was noted that the first condition a theory of perception must satisfy, if it is to explain beauty, is that it must include a level of processing which can be identified as the level at which aesthetic form would be processed. Furthermore, in order to think of this level in terms of the processes
underlying it, a theory of perception would need to identify something equivalent to underlying processes in relation to this level of operations. The characteristics of Marr's model which satisfy this condition are that early levels of visual processing are concerned with the construction of perceptual form and these processes are underpinned by assumptions that can be construed as underlying processes which are embedded in the system. That is, these processes operate independently of top-down influences like expectation, belief and so forth. The assumptions involved in transforming the 2&1/2D-sketch into the 3D-model description, according to Marr's theory, are assumptions concerning the detection of cylinders in occluding contours, and the detection of principal axes within cylinders and the construction of volumetric primitives around these axes. In addition, we found that by borrowing certain notions of Rock's regarding innate preferences for underlying solutions, we could construe Marr's idea of assumptions in a way which does not alter Marr's general ideas but which is more conducive to developing an explanatory hypothesis for beauty. That is, the assumptions or processes which underpin the construction of the 3D-model description can be thought of as relationships and it would be the nature of these relationships about which, in Rock's terms, the system would have preferences. In this way, this explanation of beauty has explanatory power for the features of beauty discussed in chapter one (as will be discussed further in chapter five) and is also recommended by its potential relevance to other perceptual modules (see 4.3).

Marr's theory of perception satisfies the first condition of an explanation of beauty, that there be a level of perceptual processing which is driven by underlying processes concerned with the construction of perceptual form. In Marr's theory of vision, this is the 3D-model description. We will have to wait until chapter four to look at examples of how the processes underlying the 3D-model description might be employed in the perception of an object in a way which challenges, epitomizes or violates their normal operations. However, before embarking on this closer consideration of the phenomenology of beauty to see whether it is explained by my explanatory hypothesis of beauty, I need to first ascertain whether Marr's theory
satisfies the second and third conditions of an interactive theory of beauty, which I will do in the following chapter.
Chapter 3  The Second and Third Conditions of an Interactive Theory of Beauty

3.1 Introduction

In the preceding chapter, I argued that if the experience of beauty is an experience of the processes underlying a certain perceptual operation of which the perception of beautiful objects makes us dimly aware, then these processes, given the second key feature of beauty, that beauty is constituted by aesthetic form, would have to have something to do with the construction of perceptual form. If a theory of perception was to accommodate this condition, which I refer to as the first condition of an Interactive Theory of Beauty, then the theory of perception would need to include an internal level of processing which involves the construction of perceptual form, for which certain underlying processes could be identified. It was found that Marr's theory of vision satisfied this condition, with a level of processing he called the 3D-model description.

Now, if the experience of visual beauty is constituted by an experience of the processes which underlie the 3D-model description, then, in addition, given the first and third features of beauty (that beauty is characterized by a subjective universal response and is experienced as a property which is lawful and ineffable), a theory of perception would need to satisfy two more conditions if it were to account for the experience of beauty. These two conditions, which I will call the second and third conditions, are that the processes underlying the construction of perceptual form are accessible and universal, respectively. Applied to visual beauty, the second condition is that the processes underlying the 3D-model description are processes which are accessible to consciousness, even if we cannot describe them and are not aware during the experience of beauty of their source. The third condition is that these processes are not influenced by cultural conditioning, or background belief of a kind that varies from
person to person: in short, not influenced by the kind of knowledge I have referred to in relation to perception as involving top-down processing.

In this chapter, I will ascertain whether Marr's theory of vision satisfies the second and third conditions, respectively. This will include a consideration of the philosophical issues involved in positing these conditions. That is, the second condition broaches the subject of the possibility of a percept (of which we are conscious) being ineffable. The third condition involves the question whether perception is neutral or theory-laden and touches upon Jerry Fodor's idea of the modularity of input systems.

I complete the discussion of Marr's theory of vision in relation to these two conditions by arguing that we should accept Marr's model and the possibility of the second and third conditions in relation to Marr's model by presenting some evidence in favour of doing so. This evidence includes the explanatory power for autism, and for certain drawing techniques, of accepting a possible prerequisite (which is that the percept of the 3D-model description itself is accessible) to the second condition. In the case of the third condition, I present the empirical evidence drawn upon by Marr.

In this chapter then, I complete the analysis of Marr's theory of vision to see whether it can accommodate an explanation of beauty.

3.2 The Second Condition: Accessibility of Processes Underlying Perceptual Form

In this section I consider whether it is reasonable to assume that we can have conscious access to the processes of perception underlying the construction of the 3D-model description during the course of perceiving certain objects. By conscious access, I do not mean that we would be aware that we are experiencing certain underlying processes of perception. Rather I mean that the apparent experience is of certain relationships which make up an aesthetic form, which in fact is an experience of the underlying processes of a particular level of perceptual operations of which we become aware during the course of perceiving beautiful objects. Now the debate regarding accessibility to early levels of processing does not include a direct reference
to whether the processes involved in these operations are accessible, but rather whether the internal image processed at this level is accessible. Of course, if the interlevels of perceptual processing are accessible as percepts, it does not necessarily follow that the processes underlying the percept's construction are accessible. Conversely, that these processes are accessible, does not necessarily mean that the interlevel of operations which they underpin is accessible. However, the only course that seems open to me in order to ascertain whether these processes would be accessible, is to consider whether the interlevel of perceptual processing that they underpin is accessible to consciousness. The bottom line is that I hope to convince the reader of the possibility that the underlying processes of the 3D-model description are accessible by demonstrating the explanatory power of doing so for an explanation of the features of beauty.

After discussing what is at stake in assuming that the interlevels of perceptual processing are accessible, I present evidence in support of the idea. This involves illustrating the explanatory power of such a possibility in relation to autism and the drawing techniques used by artists. For example, I suggest an explanation for autism which has aspects to recommend it as an alternative or supplementary explanation to that offered by mainstream cognitive science. My explanation depends on the possibility that we have access to interlevels of perception and these interlevels are as Marr envisaged them. By ‘interlevels’, I mean the primal sketch, the 2&1/2D-sketch and the 3D-model description.

3.2.1 Marr's Theory of Vision in Relation to the Second Condition

Certain theorists claim that only those levels that are schematized into literal or representational concepts are accessible to consciousness (Dennett, 1990). By 'representational' concepts, I mean those for which we have words in our natural language (e.g., English). Others have implied that only those representations that have involved top-down processing in their formation are accessible to consciousness (Baergen, 1993). Now in addition to the general demonstration provided throughout
chapter two of what top-down processing means in relation to vision, I explain in more detail in 3.3.1 below, what is meant by top-down processing. Suffice to say here, top-down processing involves the conscious interpretation of an image by drawing upon knowledge gained by the kind of experience which is susceptible to personal difference: such as cultural conditioning, subjective experience and so on. Now the views represented by Dennett and Baergen on what kind of internally processed information is accessible to consciousness, in effect, contravene the possibility of accessing the level of processing that, according to Marr's model, is the 3D-model description: the level at which the object-centred view of the three dimensional form is first constructed.

The 3D-model description is a level of processing that is strictly speaking, prior to object recognition and thus prior to the construction of 'representational' concepts. Furthermore, the 3D-model description is a level that can be transformed from the prior level (the 2&1/2D-sketch) without top-down flow of information such as a knowledge of what the object represents. Both of these aspects of the 3D-model description suggest that if it is accessible, it would be ineffable, because it is a level prior to object recognition and the application of 'representational' concepts. This is the crux, I think, of the origins of the arguments against the possibility of accessing these interlevels of perceptual processing: the argument being that no consciously accessible image could be ineffable.

Of course, there are those who defend this possibility. Diana Raffman bases her explanation of nuance ineffability in musical appreciation on the possibility that there are shallow representations in perceptual processing that are too rudimentary to have corresponding language schema. She employs Jerry Fodor's model of perception to argue that some sensory-perceptual states have semantic contents that are 'consciously accessible but not reportable' (Raffman, 1993, p.5). Conversely, the explanatory power of Raffman's theory could be taken as an argument for such a possibility. If Raffman is right, it would explain the phenomenology of music appreciation: that sense that while we experience in some music much that cannot be
expressed other than through music, we none-the-less feel not that we have entered a personal realm of nuance but that what we are experiencing is universally available. This is a powerful experience and one that I think is behind the efforts of those who attempt to defend the possibility that the ineffable can be knowable: or shallow levels of representations for which there are no language schema can none-the-less be consciously accessible.

Along these lines, Fodor recognizes that, 'the further you get from transducer outputs, the more accessible the representations recovered are to central cognitive systems that presumably mediate conscious report' (1983, p.56). However, he reasons that it would be inconceivable that the information furnished by each successive level were not registered somewhere 'within the comprehension process'. As such, it might be possible to access this information 'by the manipulation of instructional variables' (1983, p.57). However, he further points out that as the central cognitive systems have a finite number of neurons that limit the amount of information we can attend to at any one moment, it seems plausible that

intermediate input representations, when not discarded, are retained only at a special cost in memory or attention, the existence of such charges-for-internal-access being itself a prototypical feature of modular systems (1983, pp.57-58).

The special cost in memory or attention referred to by Fodor above could be the suspension of higher processes such as object recognition. That is, while the result of all perception is object recognition, in some cases a certain attention can refocus from object recognition to an earlier level of processing: in effect suspending object recognition after it has been processed.

It must be kept in mind though, to avoid confusion regarding the definitions of the three types of aesthetic form given in 1.4, that when object recognition is suspended and the focus shifted onto an earlier level of processing such as the 3D-model description, this does not involve top-down processing in the sense referred to above. That is, top-down access is not the same thing as top-down processing. The latter involves explicit theory (information generated by higher cognitive processes)) being brought to bear on the
processing of earlier levels of operations. Top-down access, on the other hand, merely means that a level of processing has been raised to consciousness after a higher level of processing has been completed and then suspended in favour of the earlier level.

If we want to explain the phenomenology of artistic appreciation, the very powerful sense of ineffability coupled with that sense of universality, (which are characteristics of the perception of beauty), then Fodor's and Raffman's argument is rather convincing. Certainly composers of music, and those who have experienced what is involved in attempting to express, what might best be referred to as feelings, in artistic form, know that there is a realm of mental life that cannot be expressed as representational content (in the sense described in 1.4). If there were percepts prior to object recognition and prior to the application of 'representational' concepts that were accessible to consciousness, then the powerful phenomenology referred to above could be explained.

According to Marr, the earliest level of processing, the raw primal sketch, is accessible. He writes:

Subjectively, you are aware of the raw primal sketch ... but you are not aware of the zero-crossings from which it is made (1982, pp.71-73).

In normal perception you would not be aware of the raw primal sketch so perhaps Marr means that such a sketch is available to consciousness given the right focus. Presumably then, the other levels (the 2&1/2D-sketch and the 3D-model description) given that they are 'further from the transducer outputs' (according to Fodor as quoted above) are also understood by Marr to be accessible. Marr did not make much of this issue but he did demonstrate his position when he indicated which interlevels of visual processing were being accessed by certain artists. According to Marr the pointillists (for example, Seurat) were tampering primarily with the image (the primal sketch); Picasso disrupted most at the 3-D model description level and Cezanne perhaps operated primarily at the 2&1/2D-sketch level (1982, p.356). Now lets consider for a moment what Marr would have meant by this.

Taking Seurat first, in his drawings Seurat depicts objects and people using dots (see figure 3.1). The closer together and the darker the dots, the darker the area
Figure 3.1  Georges Seurat  *The Artist’s Mother*
appears. Furthermore, when a dark area changes abruptly into a light area, one perceives a boundary. Whereas, when the dots change gradually from dark to light, one perceives a change in surface orientation. Seurat's depiction of people and objects is photographic-like. On close inspection one realizes that he achieves this without actually drawing any lines. We perceive the boundaries and edges through the changes in tone; or to put it in the language of the primal sketch, through performing grouping operations on the zero-crossings. Hence, Seurat employs the primitives constructed in the primal sketch and relies on the perceiver to group these primitives into a three-dimensional object.

Now let's turn to Picasso. Picasso's early cubist works analyze the object into parts, the parts defined according to a change in axis or surface orientation or volume. In some of his early cubist works, it is as if he wanted to define the surface and volume of the figure according to the smallest perceivable units. He defined these units by either the slightest change in surface orientation or axis (see Plate 4). Eventually he began to distort these units in relation to the main axis of the object or figure, so that a unit might be turned 45 or so degrees, or enlarged. Largely because the principal axis was left in tact, we are still able to recognize the figure or object. In some of his post-cubist works he actually moves the parts around as well as changing their axes, surface orientations and volumes. The distortions that Picasso imposes on the objects and figures in his paintings and drawings during this phase of his career are largely distortions of the units of the 3D-model description. They involve perceiving the image in terms of its shape primitives (axes and volumetric parts), and then distorting the way these elements are combined (see Plate 5).

Now let's take Cezanne. Marr suggested that Cezanne was perhaps operating primarily at the 2&1/2D-sketch level. It seems to me that Cezanne was attempting to convey the relative volume of objects by means of colour. A green surface will recede into a reddened green creating the effect of volume. An orange-brown area changes abruptly into an intense blue: or yellow will be juxtaposed with violet. The effect is to
Plate 4  Pablo Picasso  *Portrait of Ambroise Vollard*  1910
create an image of receding surfaces, variously angled surfaces and, hence, volume. The colour combinations that Cezanne employs are complementary pairs: defined as such, at least in terms of the properties of pigments, in that mixed together, complementary colours produce black. In terms of coloured light, in combination they produce white. As such, a colour when mixed with smaller amounts of its complementary colour, produces the effect of that colour in shadow (if instead you attempt to create shadow by mixing the colour with black, in most cases you end up with a dirty looking colour and a very dead looking area on the canvas to boot). There is a sense in which Cezanne, by concentrating on the variations in surface tone and depicting them by means of certain colour combinations, was concentrating on the two-dimensional image of surfaces. However, his work sometimes gives the impression of wavering between what we have identified as the image of surfaces and the three-dimensional shape, and sometimes, the representation of the recognized object with the specificity of detail that this implies. Perhaps this is why the effect of some of Cezanne's paintings is unsettling: as though one cannot settle into one particular focus. Perhaps Cezanne's work did operate primarily, as Marr suggested, at the level of the 2&1/2D-sketch, but he seems to have also incorporated information gleaned from the 3D-model description and sometimes, the representation of the recognized object (see Plate 6).

In any case, it is clear that by identifying artworks by the level of perceptual processing involved, Marr is illustrating how the levels within perceptual processing can be accessed and that when they are accessed one is forced to suspend other levels of processing such as object recognition. The latter explains why such artworks created such a strong resistance initially in the public, given that presumably perceptual mechanisms have evolved, in the main, to recognize objects, rather than to focus on lower-level percepts.
Plate 5  Pablo Picasso  *Woman Dressing Her Hair*  1940
Marr's theory of vision, then, is conducive to the assumption that the processes underlying the 3D-model description are accessible to consciousness, which is the second condition of an explanatory hypothesis for beauty.

3.2.2 Realistic Drawing Ability and the Second Condition

In this subsection I consider what kind of perceptual processes are involved in capturing a realistic image in drawing. This ability in drawing requires a different focus from that required in day to day perception, such that most adults who are without art training find it a difficult task. To examine what might be involved in such a focus, then, might teach us something about perceptual processing. In particular, it might suggest something about the accessibility of interlevels of perceptual processing.

The approach I take is to (a) discuss a drawing exercise used by art teachers to encourage a certain focus in students which improves their ability to draw realistically. I suggest that what is going on in this drawing exercise is that students are learning to suspend object recognition, in order to focus on interlevels of perception: namely the 2&1/2D-sketch and the 3D-model. This explanation assumes that these interlevels of perception are accessible. It is hoped that the plausible nature of this explanation will recommend its preconditions: namely that certain interlevels of perceptual processing are accessible to consciousness. I follow this discussion with (b) an examination of exceptional drawing ability in some autistics for which I present an explanation which draws upon the explanation of the above drawing exercise and hence further exemplifies the explanatory power of assuming that interlevels of perceptual processing are accessible.

(a) A Drawing Exercise Explained

Drawings that are produced by young children from their first scribbles at about eighteen months old to their schematic drawings produced when they are about three to nine years old, are best understood as personal explorations of their
Plate 6 Paul Cezanne *Mont Sainte-Victoire*  1904-06
developing conceptual understanding of the world around them. The images drawn are like symbols which depict the characteristics that are important or significant to the child. They are often called schematic because the symbols reflect the way reality is being assimilated into the private schemas of the child (J. Piaget, 1924/1969).

However, at the age of about nine to twelve years, children begin to show an interest in making realistic art. This corresponds with the age at which children become aware of themselves as a part of a group and such pressures as conformity to the group exert an influence (Lowenfeld, 1947/1970, p.207; Piaget and B. Inhelder, 1956).

According to Jean Piaget, at this age the child is moving away from the subjectification of experience to a striving towards socialized thought (1924/1969, p.204). Their interest in realistic art is perhaps a reflection of this. However, many children find this transition from the schematic stage of drawing to a more realistic approach very difficult and frustrating. In some cases, such children turn away from art making forever.

Being able to draw realistically is not the measure of the artist. However, to the young child who reaches this stage, it can be a major obstacle to developing confidence in their art making. Hence many art teachers have experimented with various ways to promote the kind of focus required of realistic drawing. Normal perception when it is applied to drawing leads to what many art teachers refer to as ‘drawing what you know’ rather than ‘drawing what you see’. The focus required of the latter is the focus which is encouraged in the following exercise.

This exercise involves giving the student a line drawing of an object, turned 180 degrees, so that to the student the line drawing is upside down. It is crucial to the success of this exercise, that the student not rotate the image the right way up in the mind’s eye/imagination, or otherwise try to recognize the object depicted in the drawing. The student will probably not be able to help recognizing the object. However, what is being attempted here is for the student to begin to develop the ability
to focus on an object as simply an array of lines in a particular relation to each other rather than on what the sum of the lines represent. The way the exercise proceeds is that the student copies the lines, noting the relative positions, angles and thicknesses of lines, and in more complex drawings, possibly the relative lights and darks and so on. The idea is that when the student has completed copying the image, she then turn her drawing up the right way to find that her drawing reflects an improvement in her ability to draw realistically. With continued practice, this is meant to develop the student’s ability to focus on objects as simply an array of lines, tones, textures or shapes: that is, it teaches the student how to suspend her awareness of the image as a representation of something. This ability is the key to drawing realistically.

I have tried this exercise on various groups of school aged children ranging from twelve to fifteen years of age and have found that students in most cases can improve their attempts at realistic drawing by practising the kind of focus encouraged by this exercise. For those students who are already able to draw in this way, these types of exercises have a marked effect in improving their sensitivity to visual nuance.

This exercise shows that to capture a photographic-like image of an object or scene, the artist needs to focus on the image as a series of lines and shapes arranged on a surface. If, instead, the artist is focussed on the array as a particular object, then the resulting drawing reflects the elements in the object which figure predominantly in the artists personalized schema of the object. My suggestion is that if we employ Marr's model to explain the effectiveness of this drawing technique, we could understand what’s going on as due to the difference between focusing on the 2&1/2D-sketch and the 3D-model, as opposed to focusing on the representation of the recognized object. I will return to this idea later.

(b) The Autistic Artist

I am interested in cases of autistic children who display the ability to draw realistically. In some cases, this ability is apparent in the autistic child from as young as three years old (Selfe, 1977). What is of particular interest to me is what marks
these cases apart from both normal children who show a precocity in such drawing, and the work of the mature artist/draughtsman. The exceptional aspects of the autistic artist phenomenon are that: (i) the autistic artist does not develop through the normal drawing stages which, according to numerous developmental psychologists and researchers (discussed below), are universal in normal children; even normal children who show a precocity in drawing ability at a relatively young age, still can be seen to develop through the various stages identified in all normal children, only they develop through these stages at a faster rate: and (ii) the mature artist/draughtsman captures a realistic scene by first drawing global forms and then proceeding to the details in a way which reflects a processing of visual data into a hierarchy of parts from global to local. The autistic artist shows no such ordering. Instead, the autistic artist draws the image from one end to the other: the only guiding factor as to the order in which the lines are drawn are their proximity to one another in the image (discussed below; see Laurent Mottron and Sylvie Belleville, 1993). The explanation of this exceptional drawing ability in some autistics which I present here explains the difference between their achievement and procedures compared to the two groups identified above. Before presenting this explanation, then, I will look more closely at the way the autistic artist compares to these two groups.

(b) - 1 Normal drawing ability in children

Much research has been completed on the developmental levels of children’s drawing. The general consensus is as follows: random scribbling by the eighteen month old child develops into naming scribbling from about 2.5 years, to shapes approximating geometric shapes occurring from about 3.5 years. The mandala shape occurs in the drawings of children around the ages of three to four years old. By mandala shape, I mean that the child draws something approximating a circle, and puts dots and/or lines within it. This eventually develops into a sun-like shape and then later develops into a head with arms and legs protruding from it: usually referred to as the tadpole shape; this occurs at around four to six years old. At this stage, the child will draw objects randomly placed around the page showing no awareness of spatial
relations. The next stage occurs roughly between the ages of about five to eight years old. At this stage, the child will begin to draw the figures on a base line, usually corresponding to the bottom edges of the page. This is the first indication that the child is developing a spatial awareness in their drawing. From here a few different devices for constructing spatial relations develops. What is known as the fold over drawing has objects drawn from various perspectives. For example, a pond might be shown from above; a figure from the side, a tree from the side etc. Another device often seen at this stage, is that the foreground figures are drawn along the bottom edge of the paper and then another base line is drawn above this with another scene drawn above it to show the middle or background. It is also around this stage that you often see the X-ray drawing: for example, a drawing of a house with all the inside details exposed. Now these levels of development in children’s drawing are universal (see N.Freeman 1980, R.Kellogg 1970, K.Lansing 1968, V.Lowenfeld 1947/1970, L.Selfe 1983).

When a child reaches about eight or nine years old, or sometimes as old as twelve, she begins to show an interest in realistic drawing as discussed in the previous section. The awkwardness in these first explorations into this realism is the stage at which the drawings of most adults, those without art education, remain. The universality of the scribbling and naming scribbling stages are usually attributed to the fact that initially the child is limited by both physical coordination and conceptual understanding. The universality of the first symbols or schemas which occur by about three years old when the child can control the pencil is usually attributed to the fact that the symbolization process involved in language development which is universal is being reflected in the child’s drawing. That is, the child’s drawing symbolization reflects her cognitive development; namely her understanding of concepts. Perhaps the actual drawing is motivated in part by the desire to share one’s experience with another. Another explanation is that such drawing provides the child with a means of ordering her experience. For example, according to Lowenfeld, up until the stage he calls the ‘dawning realism’ stage (which occurs at about 9-12 years of age), children’s
drawing is not about capturing an image of an object as seen from only one particular point of view like the viewer centred image drawn by normal adult artists/draughtsmen. Remember I suggested that realistic drawing involves, to some degree, a focus on the 2&1/2D-sketch and the 3D-model. To interpret young children’s drawing according to the same model we can say that their drawing prior to the dawning realism stage is about expressing and/or exploring and/or making sense of the object as it is understood and interpreted by central systems. Lorna Selfe explains what is going on in normal children’s drawing in the following way:

It has frequently been stated that in drawing, normal young children are dominated by the need to set down their conceptual understanding of an object (Goodenough, 1923; ...). This has been referred to as a symbolic activity ... or canonical representation (Freeman, 1980). The child represents the characteristic rather then the idiosyncratic features of an object. It was earlier argued that this “conceptual domination” evident in young children’s drawings is partly a response to normal socialization but arises mainly from the central activity of generalization and categorization in thinking processes (Bruner, 1964). This theoretical model finds echoes in the work of Piaget and Vygotsky, but is specifically related to Bruner’s (1964) description of early childhood development. Language is seen as pre-eminently a categorizing and symbolizing activity whereby the welter of perceptual and sensory experience is ordered and reduced. (1983,p.189)

Perhaps the ‘central activity of generalization and categorization’ referred to above by Selfe can in this context be understood as underpinned by what Uta Frith, a psychologist working on autism, explains is possibly malfunctioning in autism and this is the drive for central coherence (1989, p.179). If so, it might be this drive which causes the normal young child’s drawing to be a symbol of the concept of the object rather than a more realistic view, before they reach the dawning realism stage. This is because to capture a more realistic view involves, as I have suggested in the previous section, a suspension of higher processing to focus on an interlevel of perception. Children’s intense and rapid conceptual development at this time would militate against such a refocusing. There are cases of drawing precocity in normal children, in which a child reaches the dawning realism stage well before the normal
age, but as mentioned before, this involves the same developmental stages seen in other normal children's drawings, only at a faster pace.

![Figure 3.2](image) Normal child's drawing at about five years of age.

(b) - 2 *The procedure used by normal adult artists and draughtsmen*

Usually the mature artist/draughtsman begins the process of capturing a realistic image on paper or canvas by first grasping the overall shapes and their relative positions within the scene. Notably, she does this by closely observing the scene in front of her. If she wants a very faithful rendition she will not draw from memory. Drawing from memory results in a more subjective interpretation: one which reflects the artist/draughtsman’s interpretation of the scene because she will tend to remember those aspects of the scene of interest to her and hence will accentuate certain features over others. The realistic rendition will be executed in front of the model or scene. In order to establish the main shapes and their relative positions, the main axes of the shapes and their overall volumes in relation to other objects in the field will be gradually built up. In other words, the global layout is set down first. This involves drawing the dominant axes in their relative positions to each other. Then the artist/draughtsman can focus on the parts of these axes, capturing the deviations from the major orientations. Around these axes, cylinder-like forms can then be constructed. Shifting into a different focus again, one which is mindful of the
specificity of the object, the cylinder-like forms can be modified to capture the idiosyncrasies of the object.

(b) - 3. The comparison with autistic artists

As mentioned earlier, there are cases of drawing precocity in normal children, in which a child reaches the dawning realism stage well before the normal age, but this involves the same developmental stages seen in other normal children's drawings, only at a faster pace. The autistic child artist, on the other hand, does not display this developmental trajectory. Instead, he or she begins to draw realistic images, seemingly from the moment he or she can control the pen or pencil. For example, a young autistic girl known in the literature as Nadia, began drawing her realistic images from about the age of 3.5 years, apparently with no former scribbling or schematic drawing (Selfe, 1977, p.3 and p.102). Another example is an autistic man referred to as E.C by Mottron and Belleville, who began drawing at 7-8 years old with no former scribbling or schematic drawings (p.284). These two cases of autistic artists are typical of the lack of developmental stages prior to the precocious drawing abilities seen in autistics (Selfe, 1983).

Continuing on to the second point of comparison, unlike the procedure used by mature artists/draughtsmen, the drawings of these two autistic artists were not built up gradually, say, from basic shapes, slowly developing the image from global to more detailed aspects, which is how a nonautistic adult artist/draughtsman usually captures a photographic image of a scene. Instead, the autistic artist, usually favouring a biro or pencil (incidentally, colour seems to hold little interest, see Selfe, 1977, p.9, Mottron and Belleville, p.287, 290 & 306), draws an image from end to end, sometimes drawing off the page or ending abruptly at the page's border. The autistic artist favours line drawings. Furthermore, they usually draw from a memory of the object seen in a photograph or book, rather than directly from the object. Mottron and Belleville video-taped E.C drawing objects from memory. Before one taping they showed the final component of a flute, seen backwards, to E.C. for 15 seconds, then took it away and asked E.C to draw it. They found that
instead of drawing complete parts one after the other, that he generated contiguous lines irrespective of their positions in parts. ... E.C. drew the flute outline only when he came upon a component contiguous with the body of the flute (p.297).

They compared this to the procedure used by the professional artist/draughtsman and found that the latter started by constructing the outline of the flute and proceeded to the juxtaposition of various parts. They noted that in both cases the final production was excellent in terms of photographic likeness.

Figures 3.3 and 3.4 Drawings by Nadia at about five and a half years of age

According to Mottron and Belleville, E.C.’s drawing characteristics are comparable to those of other autistic artists with exceptional drawing ability, presented in the literature (p.306). In reference to this claim, they cite, Hermelin and O’Connor, 1990; O’Connor and Hermelin, 1987; O’Connor and Hermelin, 1990; and Selfe, 1977, 1983: the latter’s work included in this discussion. According to Selfe (1977) Nadia drew from the memory of images she had seen in story books. She was
oblivious to the boundaries of the page, often drawing off the page onto the table or backing. She would begin at one end of the image and simply seemed to relay what she had memorized onto the page. Just as with Mottron’s and Belleville’s findings concerning E.C.’s drawing technique, Selfe reports that Nadia drew the lines of the image from one end to the other, with the only order in which she drew the lines being their proximity to each other (1977, pp.9-10).

Mottron and Belleville varied the above experiment by asking E.C to copy and recall two different and familiar objects a number of times, so that they could see whether the order of segments drawn would be repeated or not. They found that:

E.C. showed a randomized order of feature production on both copy and recall conditions. Only 20% of the transitions made were repeated. In contrast, normal controls, as was hypothesized, exhibited very rigid recall sequences. The same sequences were indeed repeated on 90% of the transitions. (p.298)

(b) - 4 The Explanation

Mottron and Belleville had already conducted previous experiments in which E.C.’s performance was compared with normal controls on tasks related to the levels of processing within visual perception, using as their guide to these levels, Marr’s model of vision. From these experiments they concluded that E.C. had normal processing of both the global and the local features of objects. However, the findings that E.C.’s drawings were constructed by local progression without global information (like outlines) occupying a primary position in the order of feature drawing, suggested to them that E.C.’s graphic strategies were compatible with a lack of hierarchical organization (p.298). To resolve this conflicting evidence they conducted further experiments to test the relation between local and global processing in normals compared to E.C. They found that when there was a conflict between the two, while normals gave priority to the global, there was no such priority in E.C. They write:
The global interference effect usually observed in normals when the two levels contradict is caused by the global level having a privileged status in perception. In the case of E.C., the speed advantage of the global level disappears when the two levels contradict to allow a local interference effect to show. We suggest that this local interference effect is observed with incongruent stimuli not because the local level has a special status, but because the global level has no particular status in E.C. Since the elements composing the local level are much more numerous than those composing the global level, the former just outweigh the latter in the response selection. (p.302)

Uta Frith explains this as due to a disengagement between central and peripheral devices (such as perception) in autistics (1989, p.117). This would explain why the drawings of autistics might display the details of intricate parts of the object which are processed by the input processes but disregarded in the conceptual grasp of the object; the latter being what is reflected in normal children’s drawings prior to the dawning realism stage.

In any case, if Mottron and Belleville’s and Uta Frith’s explanatory theories are correct, then the processes involved in local and global coherence play a part in perceptual processing as distinct and independent processes: independent from the operations they underpin and potentially independent from each other. My understanding is that the processes involved at the global and local levels do not necessarily correspond to any particular levels within Marr’s model, but in fact may both play a part in each level to varying degrees depending on the operations involved. One would expect, though, that the level involved in the construction of form, such as the 3D-model description, would be dominated by processes at the global level. In the case of the normal adult artist/draughtsman, when they suspend the focus on object recognition, to focus on the 2&1/2D-sketch and the 3D-model description, they still have to alternate between the global and local in order to capture the lines, shapes, forms and textures in relative positions and proportions. The autistic, on the other hand, focusses on these same levels, the 2&1/2D-sketch and the 3D-model, but perceives seemingly, the local over the global. You can see then, that positing that the 2&1/2D-sketch and the 3D-model description are accessible to consciousness, in
conjunction with Mottron and Belleville’s theory, has explanatory power for explaining the drawing techniques used by normal artists/draughtsmen and for explaining those aspects of the drawing ability in autistic artists which make their ability exceptional.

Just as in the case of the ineffability and universality of aspects of artistic appreciation mentioned above in 3.2.1, the explanation for exceptional drawing ability in some autistics and the explanation for certain drawing techniques offered here, are examples of the explanatory power of positing that interlevels from within perceptual processing are consciously accessible. If certain interlevels of perceptual processing are accessible to consciousness, this opens the way for the possibility that the processes underlying the construction of a particular interlevel of perception are accessible to consciousness. The only argument I have generated myself for the latter claim is its explanatory power in relation to the experience of beauty which I will discuss in more detail in chapter five.

3.3 The Third Condition: Universality of Processes Underlying Perceptual Form

In this section I ascertain whether the processes underlying the 3D-model description can be considered to be universal within Marr’s model of vision. First, I will examine some philosophical issues which arise in relation to this possibility. For example, the notion of modularity which I introduce through Jerry Fodor’s model of perception is one such issue. Next is the debate in philosophy regarding the theory-ladenness of perception versus the neutrality of perception. I conclude this section by arguing that Marr’s theory of vision and the third condition of an Interactive Theory of Beauty should be accepted. I argue this by presenting the empirical evidence that Marr drew upon in devising those aspects of his model relevant to this third condition.

I initially assume in this section that for the processes underlying the 3D-model description to be universal, the 3D-model description for any one object would need to be universal. Furthermore, I initially assume that if top-down knowledge is incorporated into
the 3D-model description during the course of object recognition, then the 3D-model description and the processes underlying its construction, cannot be assumed to be universal. This is important because if the processes underlying the construction of the 3D-model description are not universal among people during the perception of a particular object, then judgments of beauty made about that object, would not be universal.

3.3.1 Marr's theory of vision in relation to the third condition

In order to ascertain whether the processes which underlie the construction of the 3D-model description are universal, I will consider whether the resulting 3D-model description in the course of perceiving any one object can be considered universal. This involves positing that perception up to this level is driven by bottom-up processing. Jerry Fodor's theory of perception is notorious for the extremes to which he takes this idea (1983). I do not need to adopt Fodor's stance in full, but it is worth considering how Marr's theory of vision relates to Fodor's theory of perception on this point.

According to Jerry Fodor, the perceptual apparatus in humans extracts information from the distal array (objects in the world) which is then transformed by innately constrained mechanisms into the kind of information from which higher processes can infer knowledge about the world. Fodor thinks that for this to happen the mind must consist of three types of system: transducers, input processing systems and central systems (1983). In visual perception, the transducer is the retina which transforms information from the environment into neural messages. Input processing systems translate these neural messages into a form which can be accessed by central systems. That is, input systems translate neural messages into units of information about the external world. Central systems employ these units to construct thoughts, beliefs, etc.

According to Fodor, perception is an input processing system. We can understand the data of perception as the two-dimensional array on the retina. The output of perception, according to Fodor, are the 'basic perceptual categories', like cat, dog, tree
and so forth (1983, p.94). Fodor identifies these categories based on what he calls phenomenological salience by which he means these categories are accessible without sustained inspection (p.96). Hence from the category hierarchy, 'poodle, dog, mammal, animal, physical object, thing', the basic perceptual category is dog, evidenced in its 'peculiar psychological salience' (p.94). This means that these basic perceptual categories can be processed by perceptual processes alone without information drawn from higher post-perceptual processes. This amounts to saying that the potential for having these basic perceptual categories is innate. According to Fodor, the processes involved in perception are informationally encapsulated, automatic and mandatory. We can understand informationally encapsulated as meaning that they are not influenced by top-down knowledge: by which I mean the kind of knowledge which is susceptible to cultural conditioning, personal differences in experience and so on (the kind of knowledge that constitutes explicit theory, as will be explained below in 3.3.2). When a process or a number of processes are encapsulated into one functional unit whose operations are automatic and mandatory, Fodor says the unit is strongly modular. According to Fodor, such modules 'do not share, and hence do not compete for, such horizontal\(^1\) resources as memory, attention, judgment, intelligence, etc.' (1983, p.21). Thus they can, as a consequence, be fast relative to problem solving, place minimal demands on attention, are automatically triggered by their stimulus conditions without conscious intent or control, and as they are informationally encapsulated, they cannot be influenced by beliefs or memories which are generated by other modules or higher systems.\(^2\) For example, if we were to identify the visual module as strongly modular, this would mean that high-level expectations or knowledge about the content of a scene or prior knowledge about the shape of an object could have no effect on the processing of visual information. We could

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\(^1\) A decomposition of the brain into horizontal faculties means that there is one faculty of memory, one of intelligence, one faculty of judgment, one of attention etc., which subserve all functions of the brain. Opposed to this is the view that the brain is composed of vertical faculties which means that each function has its own particular faculty of memory, intelligence etc., such that we can accurately speak of someone having a good memory for mathematics but no memory for historical facts etc. Generally I support the former view and believe that studies of how motivation functions and influences other brain functions will reveal or at least greatly assist the finding of the reasons behind competence in one field rather than another.

\(^2\) Generally strong modules involve peripheral processes such that their input would not be furnished by other nonmodular processes.
say then that visual processing was uninfluenced by top-down processes and was hence, universal.

An alternative to Fodor's idea of modularity is the idea that vision is weakly modular. This could mean that in most cases the visual module was encapsulated, unless for some reason such as a deficit caused by injury, or a shift in the available environmental information, a computational function was taken over by another parallel or higher process. Another case of weak modularity might be if vision is normally modular, but in cases in which an image is ambiguous, visual processing incorporates information generated by higher processes about what could be expected to be perceived in any particular instance. This is closer to Marr's idea of the visual system in relation to this issue.

Fodor's view about the modularity of perceptual systems represents one extremity of a whole range of feasible positions on the modularity or otherwise of perceptual systems. Marr, on the other hand, believed that visual processing was more plastic. While the primal sketch could not be influenced by any information apart from that which entered the perceptual system through the specialized channels bottom-up, which means the primal sketch only operated on neural messages triggered from the retinal image, the 2&1/2D-sketch and the 3D-model description, on the other hand, were not so rigidly encapsulated. Under optimum viewing conditions, the 2&1/2D-sketch could be processed entirely from the information processed bottom-up from the retinal image. And as discussed in 2.6, the initial 3D-model description could be processed without top-down knowledge. However, when the image is ambiguous (see figure 3.5), Marr believed that some top-down knowledge could be incorporated as far down as the construction of the 2&1/2D-sketch or in some such cases, just as far as the construction of the 3D-model description. This would mean that in such cases, knowledge of what the object is would figure in the construction of these early levels. The example of the Dalmatian below, is an example in which you struggle to construct a 2&1/2D-sketch and a 3D-model description: you keep trying alternative ways to construct an image of surfaces but you do so in part
but continually trying to anticipate what the object might be. Hence, there is an interaction between the stored catalogue of shape descriptions and the 2&1/2D-sketch.

Here is another example: it could be argued that a mechanic actually perceives more separate parts in a car engine than a person who is unfamiliar with car engines. This would be a case of top-down knowledge influencing the detection of surfaces and the 3D-model description constructed from them, within the car engine. This kind of top-down knowledge is called explicit theory. When perception is influenced by such explicit theory we say it is theory-laden. The extreme opposite to Fodor's view about the strong modularity of perceptual systems, is the idea that all perception is explicitly theory-laden. Marr's position on this issue is closer to Fodor's, except at the level of object recognition. While Marr's theory of vision was not highly developed at this end, that is, about object recognition, my interpretation of his views on this is that he believed that in most cases, if not all, object recognition was explicitly theory-laden. On my understanding, the stored
catalogue of shapes involved in object recognition would need to be attached to some explicit theory about the object, such as its use, to qualify as recognition. Knowledge of an object's use would not be extracted purely from bottom-up perceptual processing but would involve the application of higher categories such as cause and effect for example.

The reason I have called the kind of top-down knowledge that is susceptible to cultural conditioning and personal differences, explicit, is because there is another kind of theory which is implicit, and unlike the explicit kind, does not vary form person to person. For example, according to Marr, early vision, like high-level vision, is underpinned by assumptions, this being a form of theory. However these assumptions are assumed to be universal because they are largely innate. That is, when speaking about the assumptions that underlie visual processing, we are speaking about rules of operation. These may involve some kind of knowledge store and may be altered by learning of a perceptual kind, but such knowledge and learning would be of a highly specialized kind, involving purely visual information about the physical world and as such would not usually vary greatly between people or cultures. That is, these assumptions might be modified by certain perceptual experiences, but these experiences would fall within a very specialized and narrow band like the effects of gravity on objects, information conveyed by shadows etc.: the sort of information we glean from the environment unconsciously, and that would be unlikely to vary among cultures or individuals.

This distinction between implicit and explicit theory, then, corresponds to what I mean by the distinction between bottom-up and top-down processing respectively. Michael Posner and Marcus Raichle, researchers involved in empirical studies of cognition in humans, explain various ways in which bottom-up and top-down processing can be combined. By drawing their conclusions from a consideration of data provided by neurological and psychophysical sources and imaging techniques, they hypothesize that the dominance of top-down as opposed to bottom-up processing varies according to the task being carried out. Bottom-up processes, according to Posner and Raichle, are 'those processes that are driven automatically or reflexively by stimulation ... In contrast, top-down processes are generated internally by the person,
usually with his active attention' (1994, p.84). According to Posner and Raichle, simply having sensations only employs early perceptual processes which are entirely bottom-up. In addition they believe that under favourable conditions perception is totally bottom-up, but that under reduced or ambiguous conditions early perceptual processes are bottom-up, while higher perceptual processes are top-down. For example, when the image does not present enough information for you to make out what it is, you automatically draw upon what you would expect it to be, given the context, which involves drawing upon memory of past experiences (top-down processing). When dreaming or hallucinating, they suggest that early and high perceptual processes are employed, but in a totally top-down manner. This is because dreaming and hallucination draw upon memories of perceived objects rather than being a direct response to an object stimulus. For the same reason, imagining and remembering, according to Posner and Raichle, involve only high perceptual processes employed in a totally top-down manner. When thinking in nonverbal thoughts they suggest only a top portion of the highest perceptual processes are employed and these are employed top-down.

Posner and Raichle's work, then, supports Marr's model in positing that in normal conditions perception can be totally bottom-up, presumably excluding object-recognition which is not strictly speaking a perceptual process when perception is thought of as an input system (unless you are a Fodorian in which case even perception thought of as an input system does entail some degree of object recognition).

My interest in whether perception is bottom-up or top-down, or, in other words, to what degree it can be influenced by explicit theory, is because I want to ascertain whether we can rightly assume that the construction of the 3D-model description for any object is universal. If the 3D-model description was the result of bottom-up processing, then, we could assume that the underlying processes of the 3D-model description for any one object are universal. If the experience of beauty is an experience of these processes, then for judgments of beauty to be universal, these
Chapter Three

processes would need to be universal. Now I have assumed that if explicit theory can be incorporated into the 3D-model description, then this 3D-model description of a particular object would not be universal but would vary between people. Hence, the argument would be, then, that if in cases in which the 3D-model description was not universal the object was judged beautiful, it could not be assumed that this judgment of beauty was universal.

Now given the relation of the 3D-model description to the higher levels of processing from which explicit theory originates, I may be mistaken in assuming that explicit theory can threaten the universality of judgments of beauty. Let's clear this up. I stated earlier that if an image was ambiguous, top-down knowledge might be incorporated as early as the 2&1/2D-sketch and that this would contravene the possibility of the underlying processes of the 3D-model description being universal. However, it might be reasoned that as the level involved in the perception of beauty precedes object recognition, and an image is only ambiguous in relation to object recognition, then, this might seem to exclude the relevance of those cases in which top-down processes do influence say the 2&1/2D-sketch and the 3D-model description in the course of recognizing the object. On the other hand, it might be thought relevant that, as was explained in 1.4, and will be readdressed in 5.3, the recognition of the object though a higher process than the one involved in the perception of beauty, actually precedes the refocus on the level involved in the perception of beauty. That is, object recognition is processed and then suspended in order to focus on the construction of the 3D-model description. Hence, one might conclude that how the 2&1/2D-sketch and the 3D-model description have been constructed and to what degree top-down influences have been incorporated, would be relevant to the nature of the processes underlying the construction of the 3D-model description.

There is another way of looking at this issue. For the 3D-model description to incorporate explicit knowledge, the perceiver would need to focus consciously on the construction of representational content. However, when one's focus is on the 3D-model description, one has effectively suspended representational content. It would seem then that any explicit knowledge consciously brought to bear on the interpretation of the 3D-
model description, would also be suspended. In fact, in focusing on the 3D-model description, we would not be aware of the ambiguity as the ambiguity only exists, to my understanding, in relation to object recognition. This does seem to be the right way of looking at this issue when you consider that when we suspend object recognition (representational content) to focus on the underlying processes of the 3D-model description, we are in effect suspending all explicit knowledge to focus on implicit knowledge. This conclusion does not render unnecessary the above discussion on top-down, bottom-up, explicit theory and implicit theory, because we still need to understand Marr's model of vision as, in the main, a matter of bottom-up processing, involving implicit theory, for the claim of universality to make any sense. The universality of judgments of beauty are not threatened by explicit theory, as long as one accepts that perceptual processing is virtually bottom-up, up until and including the construction of perceptual form.

A reminder is justified here so as to avoid confusion. It is important to bear in mind a point made above in 3.2.1. Top-down processing is not equivalent to top-down access. Hence to go from object recognition to the 3D-model description, after suspending object recognition, is not an example of top-down processing. Top-down access does not equate with top-down processing. In top-down access one suspends the higher level rather than incorporating the information drawn from the higher level into the lower level.

Now the reader may be wondering whether the necessary suspension of the representational content in order to focus on the processes underlying the 3D-model description, which is the process involved in the perception of aesthetic form and hence the experience of beauty, precludes the possibility of type C aesthetic form. Type C aesthetic form, you will remember, are those cases of beauty in which aesthetic form supervenes on perceptual and representational content. I will explain how the suspension of representational content does not preclude the possibility of type C aesthetic form, in 5.3.3 and in more detail in chapter six, particularly in 6.3.
My contention, then, is that in employing Marr's theory of vision to explain visual beauty, we can think of the processes underlying the 3D-model description (the processes underlying the construction of perceptual form), as universal. Hence, Marr's theory of vision satisfies the third condition of an Interactive Theory of Beauty.

3.3.2 Evidence in support of the third condition

In order to convince the reader that Marr is right in his ideas regarding bottom-up and top-down processing in relation to vision, I will present the evidence that Marr drew upon to form his ideas on this question. This in turn will serve as an argument in support of the third condition, which is that the way the processes of perception are employed up until the level involved in the experience of beauty can be generally considered to be universal.

As we have seen, Marr envisaged early vision as consisting of a number of small, independent subprocesses which are combined at an intermediate level, the 2½D-sketch. He reasoned that this must be the case on evolutionary grounds:

if visual information processing is not organized in a modular way, [which means, in addition to it being encapsulated, automatic and mandatory, that, according to Marr, any large computation must be split into a collection of small, nearly independent, specialized subprocesses], incremental changes in its design, presumably an essential requirement for its evolutionary development, would be unable to improve one aspect of visual performance without simultaneously degrading the operations of many others (1982, pp.325-326).

In deciding what happens in early visual processing, Marr drew upon the evidence provided by various relevant sources such as neurobiology, random dot stereograms (see 2.5.1), clinical neurology (left and right parietal lesions discussed in 2.6), and introspective evidence provided by everyday experience. In particular this evidence led to the idea that there were three levels of processing within vision, as we have seen in the previous chapter.

An example of information from neurobiology that suggested to Marr that the first level of visual processing involved small modular subprocesses whose task was to construct edge and boundary primitives, was provided by David H. Hubel and Torsten N.
Wiesel. The advent of electrophysiology in the 1940s and '50s made single cell recording possible, and with Stephen W. Kuffler's study of retinal ganglion cells (the neurons of the optic nerve) a new approach to studying vision at the cellular level was born. Its most renowned practitioners, according to Marr, are Hubel and Wiesel, who, since 1959, have conducted an influential series of investigations on single cell responses at various points along the visual pathway in the cat and the monkey.

Hubel and Wiesel used the notion of a cell's "receptive field" to classify cells in the so-called primary and secondary visual areas of the cerebral cortex into simple, complex, and hypercomplex types. Simple cells are orientation-sensitive and roughly linear. That is to say, the simple cell monitors a particular district of visual space, a so-called receptive field, in this case divided into parallel elongated excitatory and inhibitory parts; events in the first of these promote the cell's electrical activity, events in the second tend to inhibit it; the two opposing phenomena act simultaneously on the cell - in a word, they summate; and finally, a simple cell's response to a stimulating pattern is roughly predictable from its receptive field's geometry. Complex cells, on the other hand, apparently respond to edges and bars over a wider range than a simple cell's field. Hypercomplex cells seem to respond best to points where an edge or bar terminates (Marr and Nishihara, 1978, p.31).

You will remember that the first stage of processing in Marr's model was the primal sketch. The primal sketch processed edges and boundaries. The raw primal sketch, an interlevel within the primal sketch, processed information about the relative light intensity of every point on the image (zero-crossings, bars and blobs), while the full primal sketch grouped similar tokens into edges and boundaries. The edges and boundaries of the full primal sketch represent a wider range or broader resolution to the zero-crossings, bars and blobs of the raw primal sketch. Hence, it is clear how Hubel and Wiesel's work influenced Marr on these points.

In addition, according to F.W. Campbell and J.G. Robson, imaging techniques (ascertaining which areas of the brain are active during any particular task) in conjunction with anatomical studies, have shown that the visual system partitions the information in the retinal image into a set of channels each specific to a certain range of spatial frequencies (equivalent to sending the retinal information through a set of bandpass filters and keeping the outputs of those filters separate) (1968, cited in Pinker, 1985, pp.10-11).
The above two sources of empirical data support the idea of the primal sketch in Marr's model which involves a family of arrays, each one containing information about intensity changes over a different scale, and, although they are combined in the full primal sketch, they are each one available separately and directly as input to processes beyond the primal sketch.

Another source of information drawn upon by Marr was, as we saw in 2.6, clinical neurology. From the studies of patients with parietal lesions, Marr concluded that the objective of many early visual computations was to describe the geometry of the visible surfaces. To decide what kind of processes would be involved in transforming the primal sketch into the next level which represents the visible surfaces, Marr drew from various other sources. For example, Bela Julesz's random dot stereograms (discussed in 2.5.1) proved two things according to Marr:

(i) [d]isparity [the degree of difference in the angles of the objects seen from both eyes] alone can cause the sensation of depth, and (ii) if there is any top-down component to the processing (and, in fact, we think that there probably is a little), it must be of a very limited kind, because neither image contains any recognizable large-scale monocular organization (1982, p.102).

Furthermore, by considering the introspective evidence like the ease with which we recognize silhouettes and stick figures (discussed in 2.6), Marr envisaged that the third successive level within visual processing would be the 3D-model description and that visual processing alone can deliver a 3D-model description virtually independently of top-down processing and object recognition.

A notable influence on Marr's model and the notion of the modularity of vision in particular, was an aspect drawn from the ecological approach to vision developed by the psychologist of perception, J.J. Gibson. Gibson thought of vision as adapted to the organism's survival needs. As was briefly mentioned in 2.3, he believed that the relevant information was encoded in the shape's local surface properties. Gibson pointed out that there is a great deal of information about the world that is contained in the light array. Marr's idea of vision is modeled on the same ideas. However, when it comes to explaining how the organism extracts information about the world from the light array,
Marr parts company with Gibson. According to Marr, Gibson asked the right question which was 'How does one obtain constant perceptions in everyday life on the basis of continually changing sensations?' (1982, p.29), however Gibson thought of the nervous system as in some way "resonating" to the flowing array of ambient energy from which the information about the environment was extracted. This approach underestimated, according to Marr, the complexity and sheer difficulty of detecting physical invariants in the environment. Gibson relied on higher processes like interest and attention to account for the information extracted from the environment. If this were true, then all perception would be explicitly theory-laden, and consequently the claim that the processes underlying the construction of a particular percept are universal would be meaningless. Instead, there would be a high degree of variation among the percepts constructed by different people for any one object. Marr and his associates were not concerned with or seemingly aware of how Gibson's construal of perception undermined an explanation of beauty but they objected to it on other grounds. While they recognized that higher processes like interest and attention were eventually involved in interpreting the output of visual processing, they were concerned to show what sort of processing would need to go on prior to there being anything for the higher systems to interpret. That is, they set out to design a model of visual processing in which as much of the relevant information as possible is extracted from the environment: the relevant information being that which is needed to be processed (according to innate operations in conjunction with implicit assumptions) so that there is something for higher processes to interpret. The result was a model of vision in which three ascending levels can be processed from information extracted from the environment: or in other words, processed without drawing on the kind of high-level knowledge that would contravene a claim of the universality of underlying perceptual processes at the level of the construction of the 3D-model description.

3.4 Summary

To bring the reader up to date I will briefly explain where we are up to in the development of the thesis.
In chapter one, I identified the key features of beauty and suggested a general explanation of beauty which would explain these features. In chapter two and three, I have analyzed Marr's theory of vision to see whether it could satisfy the three conditions which I reasoned a perceptual theory would need to satisfy if it were to explain beauty, when beauty was understood according to those features identified in chapter one. I found that Marr's theory satisfied the three conditions.

This chapter ascertained that Marr's theory of vision satisfies the second and third condition of an Interactive Theory of Beauty. The second condition is that the processes underlying the construction of perceptual form are accessible to consciousness, even if we cannot describe them and are not aware during the experience of them of their source and so we attribute them to objective properties in the object. The third condition is that the way the processes underlying the level of perceptual operations involved in the experience of beauty are employed, in the perception of any one object, is universal: that is, they are uninfluenced by cultural conditioning, background belief, a priori knowledge about a particular object and so on.

In the course of considering whether Marr's model satisfied these conditions, I presented evidence which also serves as support for the veracity of Marr's model and the second and third conditions.

In the remainder of this thesis, then, I will assume that Marr's model is correct. I will also assume that the conditions identified as those a perceptual theory must satisfy if it is to explain beauty when it is construed according to an Interactive Theory of Beauty, hold within Marr's model. In the next chapter, I will look at how the processes underlying the 3D-model description might be experienced and whether these processes can explain the phenomenology of visual beauty.
Chapter 4 The Principles of Beauty

4.1 Introduction

The 3D-model description was identified in chapter two and three, as the level of operations whose underlying processes offered explanatory power for the features of beauty discussed in chapter one. This explanatory potential is based on the fact that the processes underlying the 3D-model description are processes involved in the construction of three-dimensional shape, are processes likely to be accessible and are processes likely to be employed in the perception of any one object in a manner that is generally universal to all people. Furthermore, as these processes amount to rules of operation underlying the construction of the 3D-model description, it is likely that if we can become conscious of these processes, they would not be able to be translated into representational content and hence, literal language (discussed in 5.4). Hence, the finer details involved in what the processes underlying the 3D-model description actually do, are not important in relation to explaining the features of beauty, namely: universal subjective response, that it is an experience of the aesthetic form which supervenes on content and that it is experienced as a lawful and ineffable property. In fact, if we thought of the processes responsible for the experience of beauty as those underlying the construction of perceptual form, rather than as the processes underlying the construction of the 3D-model description, we would not sacrifice any of their explanatory power in relation to the key features of beauty. On the contrary, this more general explanation offers greater explanatory power by extending the applicability of the explanation to other perceptual modules.

However, there is still something to be gained by examining what is involved in this construction of form within one particular perceptual module. For example, in the case of the visual perceptual module, by examining the operations and processes involved in the construction of the 3D-model description, we will be able to assess whether the explanation of beauty based on these processes seems compatible with the
phenomenology of visual beauty. Furthermore, in 2.7, it was suggested that the perception of certain objects might make us conscious of the processes involved in the construction of perceptual form because the perception of these objects employ these processes in a way which epitomizes their operations, in an unprecedented way, or in a way which violates their operations. By examining cases of visual beauty, we can ascertain whether this explanation seems feasible. If what we find fits nicely with our experience of visual beauty, this can be taken as an instance of and hence an argument for, the central idea of this thesis: that the experience of the processes involved in the construction of perceptual form constitutes our experience of beauty. With such specific examples in mind, we are in a better position to judge the feasibility of the theory.

In this chapter then, I present in more detail what Marr envisaged was going on in the transformation of the 2&1/2D-sketch into the 3D-model description during visual processing. Through the use of examples, I then demonstrate how in some cases, the visual perception of certain objects might involve the processes which underlie the 3D-model description in such a way, that our focus is arrested and drawn to them such that we become dimly aware of them. We experience them not as perceptual processes but as certain relationships in the object. When this happens we are experiencing beauty. By discussing examples of how these processes might be experienced, I will be placing the reader in a better position to judge whether these processes can explain the phenomenology of visual beauty. In conclusion, I then suggest how such an explanation of beauty might be applied to other relevant perceptual modules.

4.2 Visual Beauty

In this section I will consider what kind of assumptions would need to operate in order that an image of surfaces (the 2&1/2D-sketch) be transformed into an image of a three-dimensional shape in order to relate this to the phenomenology of visual beauty. This will involve a discussion of the primitives involved in the construction of
the 3D-model description with an emphasis on what it is about these primitives which allow the 3D-model description to be described in such a way that it is an object-centred description rather than a viewer-centred description. Then I demonstrate through examples how the visual perception of certain objects might, due to the effect that certain objective properties in the object have on certain perceptual operations, employ the processes underlying the 3D-model description in such a way that we become conscious of them.

4.2.1 Occluding Contours and Generalized Cones

You will remember that the level of visual processing in which the image of surfaces (the 2.5D-sketch) is constructed, provides information about occluding contours (silhouettes), surface texture, surface contours and surface orientation. Marr considers the most salient aspect of the image of surfaces to be their occluding contours. He reasons this on the basis that we derive more information, more quickly, from silhouettes (occluding contours) than we do from the other sources of information provided by the image of surfaces. As an example, he refers us to Picasso's black and white silhouette print of the Rites of Spring (see figure 2.2), marveling at how much knowledge we automatically derive from this silhouette even though it consists of such rough and general outlines (Marr and Nishihara, 1978, p.48). In order to understand how the information about three-dimensional shapes is derived from occluding contours, Marr considers what kind of assumptions the perceptual system would need to make. As Marr puts it:

Somewhere buried in the perceptual machinery that can interpret silhouettes as three-dimensional shapes, there must lie some source of additional information that constrains us to see the silhouettes as we do (1982, p.219).

As we saw in 2.6, Marr found that the assumptions that in combination would account for this ability to discern three-dimensional shapes in silhouettes are that: ‘each line of sight from the viewer to the object should graze the object’s surface at exactly one point’, ‘nearby points on the contour in an image arise from nearby points on the
contour generator on the viewed object’ and ‘the contour generator is planar’ (1982, pp.219-220). While these assumptions pertain to the nature of the viewed shape, they are general rather than particular in that they do not require a priori knowledge of the viewed objects. This means that we can think of these assumptions as universal to our species.

There are many other more finely grained assumptions which may work in combination with the above assumptions. Consider, for example, that the information derived from surface texture, in combination with surface orientation, can result in our perceiving certain surfaces as slanted without us having recognized the object represented by the surface. This suggests that innately constrained assumptions are at work here. Furthermore, information about surface contours which may arise within the surface because of internal surface markings or various kinds of illumination effects might provide other kinds of information relevant to the perception of three dimensional shape. However, these sources of information are additional rather than the key to discerning three dimensional shape in the surface of images, and so I do not discuss them in detail. Now lets look more closely at the main three assumptions which underlie the detection of three dimensional shapes within occluding contours.

Take the first assumption that ‘each line of sight from the viewer to the object should graze the object’s surface at exactly one point’. This means that each point on the silhouette should correspond to one point on the viewed surface. If we did not assume this, silhouettes would not yield information about shapes because for all we knew, the silhouette’s outlines might correspond to a number of points on the object, resulting from an accidental alignment of the outlines of two or more parts of the object along the line of sight. Marr points out that, if this assumption is in fact correct, then a surface which violates this implicit assumption, will be seen incorrectly. ‘Our perceptions should deceive us in the sense that the shape we assign to the contours will differ from the shape that actually caused them’ (1982, p.219). This is in fact what happens. If you have ever attempted to present a slide show of artworks to adolescents, you may have noticed the silhouettes of ducks, rabbits and whatnot
mysteriously appearing on the projector screen whenever there is a lull inbetween slides. Through an appropriate arrangement of hands, the pupils produce the shadow of an objectively quite different three-dimensional shape. An analysis of why these silhouettes appear as animals rather than variously arranged hands, demonstrates that we automatically perceive the silhouettes as if each point on the silhouette corresponded to one point on the viewed surface.

The second assumption, that ‘nearby points on the contour in an image arise from nearby points on the contour generator on the viewed object’ means that if, for example, the outline of the silhouette we see is the outline of an uncharacteristic angle of the object, this fact is usually lost on us. If we were seeing the shadow of, say, a piece of wire which had regular curves in it, but because of the moderately foreshortened angle from which the shadow was projected from the wire, it appeared as the shadow of an irregularly curved piece of wire, we would be unable to ascertain its true nature by looking at the silhouette. We would perceive it as we do because we assume that points that appear to be close together in the image actually are close together on the object's surface.

The third assumption, that the contour generator is planar, is a little more sophisticated, according to Marr. It allows us to assume that if a contour bends one way and sometimes the other way, this corresponds to convex and concave segments in the object, rather than being the result of a foreshortened angle of the object being projected. For example, the shadow of a cube can be projected from various angles resulting in various interpretations. One projected from slightly above the cube results in a two-dimensional hexagon. Thus this third restriction, severely limits what kind of silhouettes can yield information which is relevant to the construction of the three-dimensional image. Silhouettes of foreshortened objects cannot provide the relevant information. This assumption may at first seem to contribute little to the other two assumptions, but according to Marr, it was necessary to introduce this restriction to account for the way we perceive undulations in contours as reflecting concavities and
convexities in the object, that is, information about the object, rather than just a reflection of some quirk of the imaging process which leads to optical illusions.

Marr then concluded that if these three assumptions in combination hold, then we are in fact assuming that the viewed surface bounded by these occluding contours is a reflection of the outlines of a generalized cone or made up of generalized cones (1982, p.223). Hence, the transformation of the 2&1/2D-sketch into the 3D-model description, is underpinned by the assumption that the contours of the surfaces are generated by the contours of generalized cones. In this way, the shape of the object can be, at least partially, constructed from the image of surfaces (the 2&1/2D-sketch).

### 4.2.2 Principal Axes and the 3D-model Description

The above assumptions, the three concerning the perception of generalized cones within occluding contours, and the more fine-grained assumptions about surface contours, texture and orientation, all provide information about the object within a viewer centred co-ordinate system. That is, the information derived from the image about the object's shape, depends upon the vantage point of the perceiver. Now this is problematic when you consider that the output of perceptual processing is the representation of a recognized object. As we saw in 2.6, recognition involves the matching of the description of the shape with a shape description drawn from the stored catalogue of shape descriptions. If the perception of each object can only provide information about that object relative to the particular angle projected to the perceiver, then for each object there would need to be as many stored shape descriptions as there were possible angles from which to view the object. Some theories of vision actually treat distinct views of an object as essentially distinct objects. As Marr points out, 'this approach requires a potentially large store of descriptions in memory in exchange for a reduction in the magnitude and complexity of the computations required to compensate for the effects of perspective' (1982, p.300). As we saw in chapter two, Marr does not take this approach. Instead he wondered whether there could be just one three-dimensional shape description for any
one object which would allow the perceiver to recognize the object from all perspectives.

Now the assumptions discussed above, relating to the perception of generalized cones within occluding contours, will only lead to a representation of a recognized object when the contours represent the outlines of the object's characteristic angle: say, the outlines of a human figure in profile. Conversely, if the occluding contours represent the outlines of a foreshortened angle of the object, this alone would be insufficient information for the construction of the 3D-model description of the object. For example, consider the silhouette of a foreshortened bucket (see figure 4.1). The assumptions underlying generalized cones would not be sufficient to allow us to perceive it as a bucket. We would need more information. Such information which is needed might be provided by surface texture, surface contours and surface orientation. Marr wondered then, what kind of assumptions would be needed for us to derive from information about generalized cones, surface texture, contours and orientation, information about the three dimensional shape which was independent of the particular viewpoint of the perceiver: that is, viewed within an object-centred coordinate system rather than a viewer-centred coordinate system.
As discussed in 2.6, Marr had previously noted that the efficiency and ease with which we recognize silhouettes when they represent a characteristic angle, applied also to the way we derived information about three-dimensional shape from stick figures (Marr and Nishihara, 1978, p.43). The difference with stick figures, is that they can provide information about the object that is more easily applicable to various viewpoints (see figure 2.4). Now, if assumptions relating to stick figures were a part of the perceptual process, this might be the key to the transformation of the viewer-centred to the object-centred coordinate system. To demonstrate this, consider the silhouette of the foreshortened bucket again. We would not know that it was a bucket simply from its silhouette. However, if the principal axes indicating symmetry and elongation were known, even from this foreshortened viewpoint, we would have a much greater chance of recognizing it as a bucket-like shape. Only in this case the axes would need to be detected with the help of the additional information provided by surface texture, surface contours and surface orientation, rather than directly detected in the generalized cones constructed from the occluding contours which in this case...
would be misleading. After the axes have been found, we could fill in the volumetric information. Marr reasoned, then, that the assumption which would explain how we derive a three-dimensional shape description, which would be applicable regardless of the viewpoint of the perceiver, from occluding contours, is the assumption that within the generalized cones derived from occluding contours are principal axes indicating symmetry and elongation. Now the way the axes once detected are converted into an object-centred coordinate system is a little more complicated and need not concern us here. As Marr set out the problem:

Techniques for finding axes in a two-dimensional image describe the location of the axes in a viewer-centred coordinate system, and so a transformation is required to convert the specifications of the axes to an object-centred coordinate system (1982, p.317).

Marr called the mechanism involved in this transformation the ‘image-space processor’. For our purposes it is enough to know that the detection of the principal axes is the crucial point in transforming the viewer-centred image (the 2&1/2D-sketch) into the object-centred coordinate system: that is, in allowing, in principle, that one description of three-dimensional shape suffices for almost every possible view of the object. This indicates the importance of thinking of the 3D-model as a description, rather than as a little ‘sculpture-in-the-head’.

Marr, then, devises a description of the 3D-model which is made up of primitives, which is independent of the vantage point of the viewer. Along with the principal axes, the other main shape primitive is volume. Axis-based primitives provide information about size and orientation. The volumetric primitives correspond roughly to spherical regions. Now, shapes that have natural well-defined axes based on a shape’s elongation and symmetry, are generalized cones. If the occluding contours of the image of surfaces are assumed to be the contours of generalized cones, then the principal axes can be found, and according to Marr, this is the basis of the construction of the 3D-model description.

An additional point to consider in relation to the description of the object according to its principal axes, is that while the one description of the object based on
these axes could apply to the perception of the object from various perspectives, in the case of living creatures and some inanimate objects, one needs to also be able to recognize various configurations of the object. For example, presumably we would need one description of a human figure which would apply to a seated figure, a standing figure, one with arms outstretched, one with arms bent and so on. Marr satisfied this requirement by envisaging that the description of the 3D-model would be made up of a hierarchy of descriptions of each component part. Hence the 3D-model description would capture the overall shape, then the major component parts, then the component parts of these parts and so forth potentially down to the smallest possible part. Each part is conceived as both a part of the overall figure and as a separate part. It is in this sense, that Marr refers to this 3D-model description as canonical. This would also mean that if we were confronted with say, a picture of an arm, in recognizing it we would be drawing upon the same 3D-model description used to recognize a whole figure.

So far, I have provided a general idea of the operations involved in the 3D-model description. However, there are more fine-grained processes involved. For example, Marr says that the 3D-model description can be extended to include surface primitives, roughly of two kinds (1982, p.310). These might include rough, two-dimensional rectangular surfaces of various sizes, including elliptical shapes and circular ones. He writes: ‘Not very many primitives would be needed by the average man, although presumably a sculptor like Henry Moore has a repertoire of hundreds’ (p.310). The second kind of primitive is the notion of something that is not solid but hollow, like a tube or cup, for example. This kind of primitive would certainly enhance our ability to recognize the bucket in our previous example. Furthermore, according to Marr, if we also admit curved axes into the description, much can be done to represent the more common objects we encounter in everyday life.

Marr admits that the restriction on this idea of the 3D-model description is that some objects lend themselves to this kind of description better than others. For example, shapes whose axes are based on a shape's elongation or symmetry can be
constructed into a 3D-model description more easily. Alternatively, there might be cases, say, in which the most pronounced axis in the image is not the right one and we fail, consequently, to produce a recognizable description. If the object's most salient axis fails to give a recognizable description, it might be through trial and error, that we seek an alternative axis on which to build a description, such as we saw in the case of the foreshortened bucket. This is where the interaction between the 3D-model description and the stored catalogue of shape descriptions, discussed in 2.6, becomes a necessity.

4.2.3 The Processes Underlying the 3D-model and the Principles of Visual Beauty

The points which emerge from the previous two subsections which might help us to understand the experience of visual beauty are that: the occluding contours of the image of surfaces are assumed to be the contours of generalized cones; the generalized cones indicate the principal axes of the object based on symmetry and elongation; the principal axes are the basis of the construction of three-dimensional shape description; and the other primitives employed in this construction are spherical shapes indicating volumes, flat two-dimensional rectangular, round and oval shapes of various sizes, hollow forms and curved axes. When I refer to the processes underlying the 3D-model description, then, I mean the innate rules of operation embedded in the perceptual system which determine that the information provided by the image of surfaces which is the 2&1/2D-sketch is transformed into the 3D-model description: this means the rules of operation which underpin the processes involving generalized cones, principal axes, volumes and the other primitives.

My hypothesis, remember, is that the human perception of certain objects employs the processes underlying the 3D-model description in such a way that we become conscious of these processes and this experience constitutes the experience of visual beauty. This means then, that the experience of visual beauty would be an experience, in some sense, of the rules of operation underpinning generalized cones, principal axes, volumes and the other primitives, in the construction of the 3D-model
description during the course of perceiving certain objects. Let's now look at an example, to see if this hypothesis is supported by the phenomenology.

Consider the work of the English sculptor, Henry Moore. Many of Moore's sculptures could in fact be understood as illustrations of the sort of primitives which according to Marr, make up the 3D-model description. Even though Moore often provides in his sculptures only information about axes, volumes, and the other 3D-model primitives, we find it very easy to recognize his shapes. This could actually be understood as a demonstration of, and hence support for, Marr's idea of what is happening in the processing of visual perception. Now much of Moore's work gives rise to the perception of aesthetic form. For example, the sculpture *Recumbent Figure* 1938 (see Plates 7 & 8), presents an image of undulating surfaces and occluding contours which from all perspectives seduce us into visually following their curves which we do effortlessly. The surface is never still, defining contours at every moment. This effortlessness is punctuated with the abrupt pauses of the unexpected hollows in the abdomen and under the knees. All of these features are integrated such that the sculpture is experienced as harmonious and balanced: in other words, our perception of the object gives rise to the perception of aesthetic form.

Now if my explanation of aesthetic form and beauty is correct, the reason we experience this sculpture in this way, is because of the way the perception of it employs the processes involved in the construction of the 3D-model description. The sculpture presents us with an image of surfaces which from some angles epitomizes the assumption that occluding contours represent the outlines of generalized cones. Perhaps this is why our gaze glides so effortlessly and pleasurably over and around the surfaces. From other angles, the sculpture presents a contour generator which is not planar. When this happens, Moore's sculpture relies heavily on surface reflectance to provide information about generalized cones so that the principal axes can be found. The hollows are experienced as abrupt pauses because in part they violate the processes of the 3D-model description by disrupting the finding of principal axes. For example, the carved away abdomen frustrates the attempt to find a dominant axis,
shifting the emphasis instead to two parallel axes running through the shapes which represent arms. This might prompt us to construct a 3D-model description in an unprecedented way. The effect which the sculpture has on us is to engage our perception in a contemplation of its forms which is ultimately satisfying. This suggests that we can construct an integrated 3D-model description. Perhaps, then, the occluding contours which present from every angle, in combination with information about surface contours provided by variations in reflectance (shadows), present the appropriate information for us to find the principal axes, even though the complexity and ambiguity of the configuration from certain perspectives, might employ the processes underlying the 3D-model description in an unprecedented way.

Moore's sculpture from some angles seems to flatter us with the ease with which it lends itself to our gaze, while from other angles it seems to challenge us to find a suitable way in which to grasp its combination of forms. The ease with which we view the work is perhaps due to the fact that the principal axes epitomize axes based on elongation and symmetry. The challenge it offers is perhaps explained by the novel way in which the surface primitives are combined: solids, hollows, gentle dints, and pronounced bulbous spheres which arouse and put an unusual demand on perceptual mechanisms unaccustomed to such intrigue.

Moore's work never disintegrates into unresolved bits such is its strong intuitive grasp of the basic requirements of a 3D-model description. Our perceptions glide with ease here, are halted and challenged there, but are reassured with the continual promise of an underlying pattern. The perception of Moore's work employs the processes underlying the construction of the 3D-model description in a variety of ways. His work could be said to epitomize certain processes of perceptual form, to violate others and to employ yet others in an unprecedented way. Hence the integrated perceptual form which results, surprises and pleases, and alerts us to the processes involved in its construction.

If my analysis of Moore's work is generally on the right track regarding how we perceive its aesthetic form and experience its beauty, we can see that certain objects
Plate 7  Henry Moore  *Recumbent Figure*  1938
might evoke an experience of beauty because the perception of them employs the processes underlying the construction of the 3D-model description in a way which epitomizes their operations, and /or in a way in which the processes are employed in an unprecedented way, and/or in a way which violates these operations. If the latter mode is not carefully counteracted, perhaps we would end up experiencing the object as ugly, an idea explored further, later (see 5.6.2). Moore's work exercised all these possibilities, the result being a work which is forever engaging. Certain works are less complicated but still rewarding, if in a more limited sense. Imagine a form like Constantin Brancusi's *Birds in Space* (see Plate 9) which seems to epitomize the three assumptions that hold when occluding contours represent the outer boundaries of generalized cones: that each line of sight from the viewer to the object should graze the object's surface at exactly one point; that nearby points on the contour in an image arise from nearby points on the contour generator on the viewed object; and that the contour generator is planar. Consequently within the generalized cones, the principal axes are found with ease and the volumes constructed with little effort. Hence the perception of Brancusi's *Birds in Space* is so effortless, because the construction of its 3D-model description during the process of perceiving it, employs the processes involved, in a way which epitomizes their operations.

You will remember that the psychologist Irvin Rock construes the processes involved when the perceptual system is constructing the 3D-model description as a matter of applying preferences. According to Rock, it is not the anticipated solution, by which he means the anticipated shape, about which the system possesses preferences, but rather the type of explanation behind the shape which stimulates a particular preference. In other words, it is the type of description about which the system has preferences. This coincides with my explanation of beauty, then, in that it is not the configuration itself which stimulates the perception of beauty, but the way the perceptual processes have been employed in the process of perceiving the object which stimulates the response to beautiful objects.
Remember as in § 2, I identified three types of aesthetic form. Here the way I analyzed Moore’s sculpture above, suggest that it might represent either a case of type A or type B aesthetic form. Nevertheless, this sculpture was completed according to the above analysis, did not include the recognition that the sculpture was a female figure. Hence, such the form did not appear on representation until in this color. However, once the sculpture is completed according to the 3D model which has been described above, this figure will appear as a female image as we described above. Therefore, the perception of such a structure embedded in the perceptual system. In particular, the mechanism of memory of the image of a sculpture is visualized as the shape of an object, the principal form of the object based on memory. The mechanism of transformation of this form, the perception of spherical and cubic shapes of various objects, the forms of curves and curved axes. My claim is that the perception of certain objects employs the processes underlying the 3D-model description in such a way that we become aware of them. The processes might be visualized in a way which emphasizes their visual properties, or in other cases, the

Plate 8 Henry Moore *Recumbent Figure* 1938
Remember in 1.4.2, I identified three types of aesthetic form. Now the way I analyzed Moore's sculpture above, suggests that it could represent either a case of type A or type B aesthetic form. The way the sculpture was perceived, according to the above analysis, did not include the recognition that the sculpture was a female figure. Hence, aesthetic form did not supervene on representational content in this case. However, Moore's sculpture could be perceived as a case of type C aesthetic form, in which case the recognition that the sculpture was a female form could figure in the perception of the aesthetic form of the work. I take up this possibility in 5.3.3, where I explain generally how recognition of the object can figure in the perception of aesthetic form. Then in chapter six, I return to this possibility in more detail, providing a detailed analysis and explanation of how representational content can figure in the perception of aesthetic form, in reference to Jan Vermeer's painting, The Milkmaid. So the specifics of type C aesthetic form must wait until then.

The most important point which has been demonstrated above in relation to visual beauty is that it is not the configuration itself which stimulates the perception of beauty, but the way the perceptual processes underlying the 3D-model description have been employed in the process of perceiving the object which stimulates the response to beauty. When I refer to the processes underlying the 3D-model description, I mean the innate rules of operation embedded in the perceptual system; for example: the occluding contours of the image of surfaces are assumed to be the contours of generalized cones; the generalized cones indicate the principal axes of the object based on symmetry and elongation; the principal axes are the basis of the construction of three-dimensional shape; the other primitives employed in this construction are spherical shapes indicating volumes, flat two-dimensional rectangular, round and oval shapes of various sizes, hollow forms and curved axes. My claim is that the perception of certain objects employs the processes underlying the 3D-model description in such a way that we become dimly aware of them. The processes might be employed in a way which epitomizes their normal operations, or in other cases the
Plate 9 Constantin Brancusi  *Birds in Space*  1931-36
perception of the object might employ these processes in an unprecedented way, or in a way which violates their normal operations. When they are employed in any of these ways during the course of perceiving an object, we become dimly aware of them.

4.3 The Principles of Beauty and Other Perceptual Modules

In identifying the principles of beauty as an experience of the processes which underlie the construction of perceptual form, which in the visual module are the processes underlying the 3D-model description, I am not attempting to find processes which can be translated into the kind of sufficient conditions for beauty which will allow us to predict judgments of beauty or which will act as a formula for the creation of a beautiful artwork. I do not think that this is possible due to the nature of the processes responsible for the experience of beauty, which will be discussed later in 5.4. However, by discovering the general nature of the processes responsible for the experience of beauty, we will be able to understand what constitutes beauty.

When we do not know the source of the experience of beauty, we tend to attribute the experience to certain objective properties in the object. However, certain characteristics of our concept of objective properties are incompatible with certain elements of our experience of beauty. This incompatibility leads to contradictions when we try to talk about beauty as if it were a property of the object. Recognizing the true source of the experience of beauty avoids such problems.

In order to resolve some of the philosophical dilemmas surrounding beauty, only the general nature of the processes involved in the perception of beauty needs to be considered. This means that the explanatory power of this notion of beauty rests on an explanation of beauty that might be applicable to other perceptual modules. That is, as will become evident in the next chapter, it is enough to think of these principles of beauty as an experience of the perceptual processes responsible for the construction of the perceptual form of the object, regardless of the kind of primitives involved in this
processing within any particular module. In this general idea alone is to be found most of the explanatory force of this theory for aesthetics.

The enquiry into the kind of primitives involved in the construction of form within a particular module is necessary as a further argument for the central idea. This is a way of demonstrating how the central idea of this thesis can explain the phenomenology of particular cases of beauty. The fact that the construction of visual form involves only primitives relevant to visual beauty, does not reduce the explanatory power of the central idea. As long as it is reasonable to assume that other relevant perceptual modules, that is, those through which beauty can be experienced, at some stage process the perceptual form of the object relevant to that module, then the central idea of this thesis can reasonably be applied to other relevant perceptual modules.

In order to extend the explanatory power of this theory of beauty, one needs to bear in mind that the percept of form processed in the visual system is a kind of description. That is, as stated earlier, the 3D-model should not be thought of as a little ‘sculpture-in-the-head’. Rather, it can be thought of as a description of the form of the object which applies to the relations between the overall form and its component parts and is not limited to one viewpoint.

Now as to other perceptual modules. I understand that there are five perceptual modules, not all of which are relevant to this thesis: hearing, sight, smell, taste and touch. I do not consider that the olfactory or gustatory perceptual modules can, at least on their own, provide an experience of beauty. I will not argue for this here but assume that it is self-evident. The other perceptual modules, hearing and touch, on the other hand, are a different story. Perception through touch might evoke a perception of beauty, particularly in nonsighted persons. However, at least in the case of sighted persons, it seems likely that this module only gives rise to the experience of beauty in combination with the visual module. It seems quite reasonable to assume that there would be a level of processing involved in the processing of information derived from touch which would be involved in the construction of form. If this is so, then this
suggests a possible extension of my central idea to cover the experience of beauty through touch or through a combination of vision and touch.

The auditory perceptual module remains. This module and that of vision, are the most dominant through which we experience beauty. There are some apparent differences, though, between the way beauty is experienced through these two modules. The explanation of beauty in visual objects involved the processes which underlie an operation involved in the normal vision of objects. The experience of beauty is the experience of these processes at work: an experience caused by the way these processes are employed in certain cases. Hence, it is conceivable that ordinary objects might in some cases be able to be perceived as beautiful. As the recognition of objects is recognized as the main role of vision, the experience of beauty can be understood as some kind of offshoot or even a corollary of this role of vision. Now in the case of the experience of beauty in sounds, the relation of the experience of beauty to the main role of hearing is not so clear. We do not normally, if at all, experience beauty in the sound of words (it has been argued that it is impossible to listen to words from one’s own language as mere sound: see Pinker, 1994) or in the everyday sounds which surround us and certainly not in those sounds which arouse us to action to avoid danger, like the horn of an oncoming car or the crack of a tree trunk about to fall on us. Even sounds created in less dramatic circumstances normally evoke a response in us which militates against an experience of the processes underlying the construction of the perceptual form of these sounds. Even if we were able to focus on them in a certain way, it is hard to imagine them evoking the experience of beauty. In the same vein, consider the sounds of the bush: the crackling of dried leaves under your feet, the creaking of branches and the rustle of leaves in the wind and the sound of bird song. While these sounds can evoke an intensity and richness of felt experience, they are unlikely to arouse in you an experience of their underlying form. This might happen in listening to birdsong, but even this is unlikely. It seems that in the case of hearing, we need to turn to music to experience beauty. Certain pieces of music seem as though they are designed to arouse in us the experience of beauty and
the nature of this experience suggests to me that the explanation underlying the beauty in visual objects has an equivalent version in the case of music.

Music can evoke an experience of emotions associated with various actions, experiences and occasions, and in fact this does seem to be a characteristic response to music. However, this is not what I refer to as the experience of beauty in music (see 1.6 and 5.5 for an explanation of what this kind of experience is). Beauty in music is, like visual beauty, experienced in the aesthetic form of the work. It is experienced as balance, harmony, unity-in-variety: sometimes it seems to emerge from the unexpected nature of the way the piece comes together, but always there is a strong sense of the inevitability of the order and form which underlies the work and integrates the various components of the piece into the one perceptual form. The features of beauty discussed in chapter one, namely: universal subjective response, that beauty is the perception of aesthetic form and that we discuss and defend judgments of beauty as if beauty were an ineffable but lawful property in the object, characterize the beauty in music no less and no less comprehensively, than they characterize visual beauty. This suggests that the central idea of this thesis may well have explanatory power for musical beauty. The processing of sound may involve a level of processing responsible for the construction of form. The explanation for musical beauty, then, might be that the perception of form in certain pieces of music employs the processes underlying the construction of perceptual form within auditory perceptual processing, in such a way that they epitomize the normal operation of these processes, or in an unprecedented way, such that we experience these processes.

I am not going to offer any more detailed explanation for musical beauty here. This would involve a description of a theory of auditory perception in which processing takes place through ascending levels of representations in a way roughly equivalent to the levels involved in Marr’s theory of vision presented here in chapters two and three. Diana Raffman provides the outline of such a theory in relation to music perception based on a Fodorian model of perception in Language, Music and Mind (1993). Some evidence for this possibility might also be drawn from the case
of the autistic boy who could reproduce the sounds of an opera perfectly, with
apparently no understanding or interpretation (discussed in 3.2.2). Given that his skill
in copying music seems to directly parallel the ability of autistic child artists who draw
photographically, then a similar explanation is likely to apply to both cases. If my
explanation for the exceptional drawing ability in some autistics, which argues that
their exceptional drawing ability involves access to high interlevels of perceptual
operations, is correct, then this would suggest some equivalent hierarchy of levels of
processing in the auditory module.

For my purposes here, it is enough to say that to envisage music perception in
a way which is equivalent to Marr's theory of vision is feasible within a contemporary
cognitive science framework. This, in combination with a consideration of the
phenomenology of musical beauty, is enough to suggest that, the idea that the
experience of beauty is an experience of the processes underlying the construction of
form within perceptual processing during the course of perceiving beautiful objects,
has explanatory power for musical beauty.

In this section I have discussed the nature of the principles of beauty with a
view to showing that my explanation of visual beauty applies to the experience of
beauty generally, at least in relation to other relevant perceptual modules. While I have
not explored this possibility in detail, my theory does provide the guidelines within
which others might consider this theory's applicability to other perceptual modules,
such as: the experience of beauty in touch in nonsighted persons; the experience of
beauty in a combination of touch and sight; and musical beauty.

4.4 Summary

In this chapter I have demonstrated, using visual beauty as my example, that
beauty is a relational property of beautiful objects: the property of being such that
human perceptual processing of it will employ certain specific principles of whose
operations the object makes us dimly aware. I have further demonstrated that we
become dimly aware of these processes when the construction of perceptual form
involved in perceiving the object epitomizes these processes or employs these processes in some unprecedented way, or violates these processes during the perceptual process. I argued that this explanation of beauty can be extended to cover other nonvisual cases of beauty, if we can assume that the processing involved in other relevant perceptual modules is arranged in ascending levels of processing, one of which is responsible for the construction of perceptual form. This is a feasible assumption and so from here on, when I refer to visual examples, I assume that there would be an equivalent example that could be drawn from phenomena relevant to the other relevant perceptual modules. Hence, when I refer to the object, I mean to include, besides objects like paintings, sculptures, everyday objects and those found in nature, also more temporally extended and structured objects, like performance of a dramatic work and music.

While I have demonstrated the processes responsible for beauty, I have not translated this into sufficient conditions for the concept of beauty. The fact that I have been unable to express these principles in terms of a finite set of rules, is not a limitation of my thesis. On the contrary, I interpret my inability to express these principles in terms of sufficient conditions for the concept of beauty as an indication that I am on the right track, given the phenomenology of beauty.

The explanatory power of the principles of beauty are that they provide us with a way of thinking about beauty in which the features considered to characterize the concept of beauty are not contradicted by those features recognized as characterizing the phenomenology of beauty. In the following chapter we will see that this explanatory power is derived, not from the module-specific content of the processes, but from the fact that they are processes which underlie the construction of perceptual form.
Chapter 5  The Explanatory Power of an Interactive Theory of Beauty

5.1 Introduction

In this chapter, I will demonstrate the explanatory power of my hypothesis. First, let's pause for a moment to take stock of the explanatory hypothesis presented for an Interactive Theory of Beauty in the previous chapters. In chapter one, I presented an Interactive Theory of Beauty. According to this theory, beauty, in experiential terms, is a subjective universal response (which can best be described as a feeling of clarity) to the aesthetic form of an object. The aesthetic form supervenes on the perceptual or perceptual and representational content of the object. Furthermore, beauty is experienced as a lawful (inferred from more fundamental properties) but ineffable (cannot be reduced to sufficient experiential conditions) property of the object. In the way that beauty is thought of according to the traditional concept of beauty, there are contradictions inherent within this combination of features. However, it was suggested that if beauty was thought of as a response to certain features in the perceptual processing of the object, a feature of the interaction between perceiver and object, then these features of beauty could be explained in a way that avoided these logical contradictions. In particular, it was suggested that if the experience of beauty is an experience of certain specific perceptual processes employed in the human perceptual processing, of which beautiful objects make us dimly aware, then the discrepancies which arise between a conceptual analysis of beauty and a description of the phenomenology of beauty would be resolved.

Chapters two, three and four, presented the explanatory hypothesis for this Interactive Theory of Beauty. In chapter two, it was reasoned that if the experience of beauty is the experience of perceptual processes underlying a certain perceptual operation and if beauty is the perception of aesthetic form, then the first condition for such a theory of beauty is that there be a level of perceptual processing responsible for the construction of perceptual form, for which certain underlying inbuilt assumptions
must operate. In chapter three, it was further reasoned that if an experience of the processes underlying the construction of perceptual form in the course of perceiving beautiful objects constitutes the experience of beauty, and if the experience of beauty is universal, then these processes must be accessible and universal. These constitute the second and third conditions for the Interactive Theory of Beauty. I found that it is feasible to assume that these three conditions are met within perceptual processing. In chapter four, I examined the processes underlying the construction of perceptual form in relation to the phenomenology of visual beauty to demonstrate that they adequately explained the phenomenology of visual beauty. I further argued that this theory of beauty could also account for beauty experienced through other relevant perceptual modules, such as musical beauty, if such perceptual modules could be assumed to involve a level at which perceptual form was processed.

In this chapter, I argue for an Interactive Theory of Beauty, by showing how the explanatory hypothesis for this theory can further explain the features of beauty identified in chapter one. An additional point was made in 1.6, about the difference between what constitutes the experience of beauty and what sometimes accompanies an experience of beauty. So as not to leave any loose ends, I suggest a possible explanation for this accompaniment to beauty which requires some embroidery of Marr's model. Then, as a further example of the explanatory power of this theory of beauty, I suggest how certain other perceptions often referred to as aesthetic, and the perception of ugliness, can be explained, employing the central idea of this theory.

5.2 Universal Subjective Response

The phenomenology of the experience of beauty is important because the only way we know something is beautiful is by the experience it evokes in us. This is because as demonstrated in 1.5.1, it is not on the basis of any logically sufficient set of conditions that we judge a theory to be beautiful. We do not measure the object against a set standard, or determine whether certain required nonaesthetic qualities are present before reasoning that the object is a beautiful one. Instead, we experience the object's beauty first and then attempt to ascertain what it is about the object that
inspired this response. This is what I take Kant to mean when he says that the judgment of beauty is immediate (C of J). This does not mean that there is no time lapse between first setting eyes on something and realizing its beauty. To realize an object’s beauty can require first a certain familiarization with the object; the nature of this familiarization will vary between objects according to their nature (for the difference between artistic and intellectual beauty see chapter four and chapter seven). In fact it is conceivable that quite a considerable time might elapse between first seeing or becoming acquainted with the object and experiencing its beauty.

Beauty is different from mere formal attractiveness. Formal attractiveness can be reasoned from criteria approaching a set of stateable, necessary and sufficient conditions and does not necessarily involve the approval and personal involvement that are essential ingredients of a response to beauty (see 1.3.1). The personal involvement necessarily implied by the concept beauty is a feeling of pleasure. This pleasure has a quality about it which differentiates it from other kinds of pleasure. Hence when we experience this pleasure we know it is caused by the perception of beauty. Aquinas and Kant characterized aesthetic pleasure as disinterested. I think this is right and is the key to differentiating between aesthetic pleasure and other kinds of pleasure. Consider the difference between aesthetic pleasure and the pleasure associated with love. Mothersill (1984, p.262) thinks that any aesthetic theory must take into account what Plato thought were fundamental truths about beauty. The one that concerns us here is that according to Plato, beauty is linked to pleasure and inspires love. I think it is important to point out that the feelings inspired by beauty are quite different from those inspired by love. Feelings of love necessarily involve the desire to possess in one way or another, while feelings evoked by beauty do not. The experience of beauty may be allowed to descend into a desire to possess (love) but this is not necessarily the case. When there is a link between beauty and love, it has always seemed to me that the more typical order of appearance is that the experience of love inspires an experience of beauty in the desired object. That is, once the feeling of love for a person (I assume we can only love people and any other use of the term is
metaphorical) has overtaken one, only then can we realize the beauty of the loved person. It is only in this case that we can in fact perceive a person as beautiful. If on the contrary we believe a person to be simply beautiful without having felt any prior love, I would strongly suspect that the so called beauty is perhaps something else: formal attractiveness, or suitability to desired ends etc. I cannot say what inspires love (so I leave it to the poets) and I may not want to know what inspires it (so I avoid psychologists and evolutionary biologists on the topic) but it is only after this feeling has overtaken me that I can experience the beauty in a person. While love and the experience of beauty can be inspired by the one person, and while the associated feelings can overlap (an exhilarating, powerful kind of desire tinged with the mystical), the feelings of love and beauty are still quite distinct. Aesthetic pleasure itself, produces no desire. The anticipation of aesthetic pleasure can be a motivating force, as in the search for a beautiful solution to a problem (see chapter seven), but the pleasure itself is not based on personal gain or the satisfaction of what we call basic appetites or some satisfaction in the good. Enough of what aesthetic pleasure isn’t.

Monroe Beardsley, as we saw in 1.6, identifies five symptoms of an aesthetic experience. The first he says is necessary, and three of the remaining four are necessary. These are (i) object directedness, (ii) a felt sense of freedom. (iii) a sense of detached affect, (iv) a sense of active discovery, and (v) a sense of personal integration, of wholeness (1982, pp.285-297). It seems to me that the object directedness is not a symptom of aesthetic response but more a prerequisite of it. A sense of active discovery, Beardsley’s fourth symptom, might be a consequence of aesthetic experience but I do not see how it could be a symptom of it. However, I find his other three symptoms very helpful in pinning down the character of aesthetic experience. I cannot argue for this or even demonstrate this: I simply claim that by aesthetic experience I mean an experience which combines a felt sense of freedom, a sense of detached affect and a sense of personal integration, of wholeness. The latter can also be captured I think or related to a feeling of clarity: as though for a split second everything, all experience, is integrated into the one whole. This response to
beauty is the cause of the pleasure. It is disinterested which makes the claim of its universality possible because it is caused by a relational property of the object: the property of being such that human perceptual processing of it employs certain specific perceptual processes of whose operations the object makes us dimly aware and which are universal.

The reason this experience is pleasurable is open to speculation. It seems to me to be plausible that if the experience of beauty is the experience of certain specific perceptual processes of whose operations the perception of the beautiful object makes us dimly aware, then the experience of these processes may reflect something of the nature of their operations. If their role is to construct a global form (a 3D-model description in Marr’s terminology) from various elements provided by lower level operations (the 2&½D-sketch and the primal sketch in Marr’s model), then we might experience them as a feeling of integration, wholeness, maybe clarity. Because this experience is free from the constraints of higher level processing - personal bias, personal knowledge etc. - and is based on automatic innate processes (even though our conscious access to them may not be automatic), the experience of them or our focus on them frees the mind from the constraints of conceptual categories, opening the mind to the experience of a realm of feeling which is usually crowded out by reasoned thought. This might explain the sense of freedom and the sense of detached affect characteristic of aesthetic response. It is not implausible that feelings like clarity, wholeness and freedom might be experienced as pleasurable: they can act like a sudden release of tension. In fact, I don’t think we need be shy of asserting that such feelings are quite likely to be experienced universally as pleasurable.

In sum then, we only know that something is beautiful by the affect that it has on us, not because of conditions we reason are met by the object. This affect is a disinterested pleasure because it is caused by us becoming dimly aware of certain specific processes employed in the human perceptual processing of beautiful objects. And these certain specific processes are not influenced by personal bias or knowledge but are inbuilt and universal. The nature of aesthetic experience reflects the operations
of these perceptual processes. The experience of beauty can be understood, then, to be universal and subjective, without apparent contradiction.

5.3 Aesthetic Form and Content

In chapter one, it was claimed that there were three ways in which aesthetic form could be related to the representational content of the object. This was taken as indicative that there are three separate ways of perceptually constructing aesthetic form. In order to understand the difference between these three ways, it was suggested in chapter one that one needed to think of the perception of the content of the object as involving two stages in processing. The first stage would be the construction of the perceptual information; the second stage, the construction of the representational content. I suggested that in some cases, we could experience the output of the first stage at the expense of the second stage. Hence I suggested that some objects might be perceived in terms of perceptual content alone, rather than representational content.

When I refer to the ‘object’ in explaining the three types of cases of aesthetic form, I mean to include ordinary objects and artworks. However, the artwork involves two separate perceptions. The first perception is that it is an artwork. The second perception is that it represents or conveys ‘such and such’. When I refer to the perceptual process involved in perceiving the artwork, I am referring to the second perception: what the artwork conveys. This second perception involves a rerun of the perceptual process, after we have recognized that it is an artwork.¹

Let me summarize what was written on this topic in chapter one. In relation to ordinary objects, the perceptual processing involved in the perception of aesthetic form is the same process involved in perceiving what the object is, only it involves a suspension of the latter. In the perception of ordinary objects, we do not normally separate the recognition of ‘what the object is’ from the recognition of what it conveys, because what an ordinary object is, is the same as what it conveys. For example, a lamp is what the object is (we do not recognize it as ‘an ordinary object’ first but

¹ This idea about the need to reperceive the artwork was introduced in 1.4. 2, when discussing the nature of content and type B aesthetic form.
simply as ‘a lamp’): that it is a lamp is what the object conveys. However, the
sculpture by Michelangelo known as the Pieta is an artwork: on the other hand, ‘Mary
with her dead son’, to put it bluntly, is what it conveys. So when I refer to the
representational content of the object, in the case of artworks I am referring to what the
artwork conveys, and in the case of ordinary objects, I am referring simply to what the
object is. In the case of what an artwork conveys, I assume that when an artwork
conveys representational content, then perceptual processing as in the case of the
perception of ordinary objects, automatically proceeds onto the second stage of
processing, the recognition of representational content. However, when an artwork
does not convey representational content, it may be that perceptual processing is
arrested at the first stage of processing.

Given the theoretical framework provided by the preceding three chapters, we
can think of the first stage in relation to the explanation of aesthetic form as the
construction of perceptual form, and the second stage as the construction of
representational content involving object recognition and higher interpretative
processes. Now with the above clarifications in mind, I can present an explanation of
the three types of cases of aesthetic form which were identified in chapter one.

5.3.1 Type A cases of aesthetic form

Remember type A cases of aesthetic form were those in which aesthetic form
seemed to be focused on at the expense of representational content. Now the
possibility of accessing interlevels of perceptual processing was explored and
vindicated in the discussion of the second condition of an Interactive Theory of Beauty
in 3.2. Here I suggest that the perception of aesthetic form when it involves a
suspension of one's focus on representational content, can be explained as due to a
focus on the perceptual content of the object. In this case, the perception of aesthetic
form would involve perceptually processing the object up to the second stage, then the
suspension of this stage in order to focus on the first stage which provides the
perceptual information about the object. One would expect that type A cases of
aesthetic form would normally only involve artworks (including certain examples of architecture), because it is normally only objects designed with the aim of drawing our attention to aesthetic form which evoke this type of focus. However, in principle the perceptual content of all objects could be focused upon by suspending the focus on their representational content, or suspending consciousness of what the object is, even though there is no guarantee that the perceptual content of an object would necessarily give rise to the perception of aesthetic form.

5.3.2 Type B cases of aesthetic form

In chapter one, the perception of aesthetic form in artworks which conveyed no representational content was identified as an example of type B aesthetic form. In this case the information required for the construction of representational content is not conveyed by the artwork and so the perceptual processing is arrested at the first stage of processing, the construction of the perceptual information. Examples of these cases of aesthetic form are to be found in nonobjective or abstract artworks, music without words and so on. I refer specifically to artworks here because this type of aesthetic form is probably only perceived in those objects upon which we focus as artworks. If we introspect on the phenomenology of normal perception we find that all perception ends in some form of recognition. Even an object which cannot be labeled with a specific mental label, will be recognized as something: even if the something is 'an unrecognizable object' as suggested in 1.4.2. We always classify things according to their intended purpose. Perhaps, then, when the internal processing that goes on when we perceive an object is not provided initially with the right information to get beyond the first stage of processing: that is, if the output of the first stage of processing does not provide a match with the stored catalogue of shape descriptions (see 2.6), we continue to reconstrue the output of the first stage until some kind of recognition takes place: even if the result is something like 'an unrecognizable blob' or a 'useless heap of metal scraps'. Hence, the arresting of the perceptual processes at the first stage of processing, is probably only possible in those objects which we
choose to reperceive as aesthetic objects and which do not convey the appropriate information for the processing of quite specific representational content. Hence cases in which aesthetic form is perceived in the perceptual content of the object and when the perceptual content is accessed by arresting the perceptual processes at the first stage of processing, are limited to the perception of aesthetic form in artworks which convey no representational content.

There may be another important example of this type of aesthetic form to be found in nature. Nature does not present perception with an object intended specifically for anything because we do not detect another person's will behind it. In the preamble to these three explanations above, remember I implied that the recognition of representational content involved recognizing the intended purpose of the object. Nature, then, would present a unique category of object recognition, unless you were perceiving nature teleologically: that is, unless you were perceiving nature as if it were designed for a purpose by either a superior will or by evolutionary forces etc. When we perceive the aesthetic form in nature, it is not apparent that we suspend our engagement in what it is (its representational content) to focus on the perceptual content in order to experience nature's aesthetic form. On the contrary, nature seems to deliver her aesthetic form to us without us needing to consciously focus in a particular way. Yet the aesthetic form is experienced as independent from representational content. It does not seem to depend on suspending or engaging with representational content. Perhaps because nature does not convey intention, we can say that nature does not convey representational content: rather nature conveys only perceptual content. This differentiation is significant here because remember in the case of artworks, when we reperceive them to perceive what they convey and when they do not convey representational content, perceptual processing is arrested at the

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1 This is a controversial point. I do not argue for it here but assume it in order to present one possible way of differentiating between the perception of nature and the perception of other things. It is not a crucial point in the development or support of my central thesis or in its explanatory power for the different types of cases of aesthetic form, discussed here. If it turned out to be wrong, I am confident that there would be other ways to differentiate between the perception of nature and the perception of other things in a way which would provide a basis for the inclusion of the perception of aesthetic form in nature as a type B case of aesthetic form.
first stage because there is not the appropriate information to stimulate processing at the second stage. Perhaps in the case of nature, perceptual processing can be arrested at the construction of the perceptual content stage rather than automatically being compelled to proceed to the construction of representational content stage. This might be explained because, from the explanatory point of view, the perceptual content processed in the perception of nature is what nature conveys: and this is what we tend to perceive when we perceive nature. The processing of the perception of nature might only proceed onto the construction of representational content stage, when nature is perceived in terms of its intended purpose, which is the type of perception imposed by the scientific frame of mind. In most cases, though, the perception of nature might present a case, perhaps the case \textit{par excellence}, of type \textit{B} aesthetic form.

5.3.3 \textit{Type C cases of aesthetic form}

Type \textit{C} cases of aesthetic form, you will remember, were those cases in which the representational content of the object played a part in the aesthetic form perceived in the object. Now the explanation for this type of relation is more complex than the explanation for type \textit{A} and \textit{B} cases. The perception of aesthetic form in type \textit{A} and \textit{B} cases involves a focus on the output of the first stage in the construction of the object’s content: that is, a focus on the perceptual content of the object. In type \textit{C} cases, however, while the aesthetic form does emerge from the perceptual content of the object, it also seems to emerge from the representational content as well. It is as though the relations which hold within the aesthetic form emerging from the perceptual content of the object, are mimicked in the relations which hold among the elements of the representational content: and these relations are experienced as unified into the one aesthetic form emerging from the object.

My explanation for this is as follows. In cases of type \textit{C} aesthetic form, the object is first perceived in terms of what it is. Then, because of the way the processes have been employed in its perception, the focus on the representational content is suspended, and we experience those processes which underlie the construction of
perceptual form. Now if we sustain our perception of the aesthetic form of the object, we will find that our focus eventually shifts back to the representational content of the object. Then with this renewed focus, we again experience the employment of the processes underlying the construction of perceptual form in a way which brings them back into our focus and hence we lose our focus on the representational content in favour of the perceptual content and its underlying processes, once again. If we maintain our inspection of the object, this shift in focus backwards and forwards from the representational content to the aesthetic form will continue to happen involuntarily.

As an analogy, study a Necker cube (see figure, 5.1)

![Necker Cube](image)

Figure 5.1 The Necker cube, named after L.A. Necker, the Swiss naturalist who developed it in 1832. With sustained inspection, the perception of (a) flips from (b) to (c), then back again, indefinitely and involuntarily.

You will find that there are two interpretations of this cube and that your perception characteristically flips between the two interpretations involuntarily. The explanation I offer for this involves the idea that there are two possible ways in which the perceptual system can construct a 2&1/2D-sketch for this image, neither of which has any advantage over the other in terms of how it employs the perceptual system. That is, both constructions lead to the same 3D-model description. Because of the limited number of neurons available, the system cannot deliver both constructions at once, and so with sustained inspection, the perceptual system automatically shifts from one construction to the other.

Now the explanation for the way in which we alternate between an experience of the processes underlying the construction of perceptual form and an awareness of representational content is not exactly parallel to the explanation for the Necker cube.
It is not as if the experience of the processes underlying the construction of perceptual form depends on there being two possible ways to construct the 2&1/2D-sketch. I included a reference to the Necker cube because of the similarity between its phenomenology and what we have here: that is, the flipping from one aspect of internal processing to another, backwards and forwards, involuntarily. Rather, my explanation for the alternation between the awareness of representational content and the experience of the processes underlying the construction of perceptual form, is this.

The aim of delivering representational content drives perceptual processes and so other perceptual experiences can be thought of as deviations from this main aim. However, we cannot remain in a state suspended from the awareness of representational content for long, when we are sustaining an inspection of perceptual content. The experience of the processes underlying the construction of perceptual form is automatic because of the way these processes have been employed in the perception of the object, but we cannot maintain this experience for too long at a stretch, because of the pull of representational content. Hence, with the sustained inspection of certain objects, our perception flips from the representational content to the experience of the processes underlying the construction of perceptual form, and back again.

Now in cases of type A aesthetic form, this would happen also, but when we return to the focus on the aesthetic form we find we are back where we were before, having left the representational content behind completely, once again. However, in type C cases of aesthetic form, we find that we begin to grasp the representational content in terms of the kind of relationships experienced in the aesthetic form of the perceptual content. We do this involuntarily, in some cases, because the relationships holding within and between the concepts conveyed in the representational content, mimic the relationships holding within the aesthetic form. We can think of this as a kind of metaphoric interpretation of the ideas conveyed in the representational content, according to the relations holding within the aesthetic form (in other words, according to the processes underlying the construction of perceptual form): and the resulting experience is of a unified aesthetic form involving the whole object.
I mentioned in 3.3.1, that if I was right in assuming that the perception of aesthetic form involved a suspension of representational content, this did not preclude the possibility that in some cases aesthetic form supervened on both perceptual and representational content, which is a characterization of type C aesthetic form. I have demonstrated this claim in this explanation of type C aesthetic form.

Now type C cases of aesthetic form would occur most prominently in artworks. To achieve this unity between the aesthetic form of the work simultaneously with the relations holding within the representational content of the work is a finely tuned achievement and as such, is one which we would expect was intentionally orchestrated.

The explanation of beauty according to the three types of cases of aesthetic form presented above, can suggest an explanation for why certain artworks and other objects cannot be perceived as beautiful when their content contains morally offensive material or when one is functionally predisposed towards the object. In the case of morally offensive material, the content engages response mechanisms in us which militates against suspending the representational content of the work. In the case of being functionally predisposed towards an object, our mindset towards the object may be so geared towards how it functions in our lives that we are almost incapable of suspending its representational content. For example, try looking at a chair in terms of aesthetic form. No matter how a chair has been designed, I think it would take a finely tuned sensibility to perceive one as beautiful: not in terms of appearance alone mind, which elaborate designs and sensuous textures invite, but in terms of aesthetic form and beauty: the difference is discussed in 5.6.

5.4 Lawful and Ineffable

When attempting to identify the base properties of beauty, the fundamental properties in the object from which we have assumed beauty has been inferred, we identify the relevant properties as those that have to do with its composition. We might also use adjectives like balanced, harmonious, etc., to attempt to identify these
base properties in the object. We always talk about the form of beauty by employing words which describe relationships. We find that the closest we can get to pinpointing what beauty is, is to allude to certain configurations within the object: a certain arrangement of elements. However, when pressed to identify how the object exemplifies these relationships, we resort to metaphor and analogous examples hoping that the other person will perceive or feel what we mean. It is as though we feel the beauty rather than simply perceiving it. We know the balance and harmony of an object because we know the feeling associated with the perception of it.

Now imagine what the phenomenology of a perceptual experience would be like that was caused by an experience of the way perceptual processes were employed in the perception of an object. When we tried to account for this experience, we would most probably look to the object involved to try to pinpoint the origin of this experience. But we would experience some difficulty in trying to do so. For one thing, perceptual processes are a rule of operation, not the content of perceptual processing. They would not conform to the characteristics of our concept of objective properties. Objective properties can be divided into irreducible qualities of experience, like red (no stateable, non-trivial, experiential sufficient conditions) and those inferred from more fundamental properties which can be expressed as sufficient conditions. In terms of objective properties these two categories are exhaustive and exclusive. However, the processes underlying a perceptual process, if they can be experienced, would not be stateable as experiential sufficient conditions, but, as they were experienced as manifested in the object, might be discussed as though they were inferred from more basic properties in the object like a certain configuration or arrangement of elements. Hence the experience of perceptual processes would be such that attempts to verbally characterize the experience would result in features which in combination would amount to a property which was lawful and ineffable: a logically impossible combination in the one objective property.
This is in fact the dilemma which faces us when attempting to defend judgments of beauty when we assume that beauty is an objective property of the object.

The crux of the explanation for the lawfulness and ineffability in the case of beauty is that the experience of beauty is constituted by an experience of the processes underlying the construction of perceptual form. Perhaps we gain access to these processes by intuitively sensing their application in the perception of certain objects. It might be that given the nature of these processes they cannot be stored in memory because they are encoded in a form incompatible with language schemata. Hence we might only be able to remember the feelings which this experience evoked in us at the time of the experience. This does seem to be how we experience beauty. We characterize beauty as harmonious, balanced, unity-in-variety and so forth which, as pointed out above, all refer to relationships between elements of an object. These are also features closely linked with feeling responses. It seems quite plausible then that we remember the balance, harmony, unity-in-variety of beauty because these are the terms we find are closest to the feeling response which the processes underlying the construction of perceptual form evokes in us.

When we defend judgments of beauty we point to particular arrangements of elements within an object. We cannot define beauty in terms of experiential sufficient conditions because its source is not communicable in language, but we can defend judgments of beauty by pointing to certain properties of the object which in certain relationships give rise to certain configurations: in short, by inferring beauty from other more fundamental properties. Now while beauty is not strictly speaking inferred from the presence of more fundamental properties in the way lawful properties which can be reduced to sufficient conditions are, we still defend judgments of beauty as if it were a lawful property: that is, as if it were inferred from other more fundamental properties.

Hence, we treat beauty as though it were ineffable and lawful, two mutually exclusive characteristics in an objective property. However, if we think of beauty as
constituted by an experience of the processes underlying the construction of perceptual form, we can treat beauty as ineffable and lawful without contradiction.

The reason for the lawfulness and ineffability of beauty, then, actually has a different source to the either lawful or ineffable nature of an objective property. The reason beauty is lawful and ineffable is that the particular nature of the processes of perception which constitute the experience of beauty is lawful and ineffable.

Hence attempts to find the sufficient conditions for the prediction of beauty or for a formula for beauty are misguided attempts. They are misguided not because there is no common ground for all cases of beauty, because I have shown that there is a common ground. They are misguided because they have assumed that beauty is an objective property in the object. When beauty is understood according to the Interactive Theory of Beauty presented in this thesis, many of the problems which have occupied philosophers of beauty in the past, will dissolve.

5.5 Beauty's Accompaniment: Aesthetic Ideas

In chapter one I briefly pointed out that there was a difference between the experience of what constitutes beauty as opposed to the experience which can accompany the experience of beauty. Here I suggest a brief explanation for this accompaniment which I call 'aesthetic ideas'. This explanation is not a direct example of the explanatory power of my central idea, instead it is an example of the possible explanatory extensions which my general approach might permit.

My identification and explanation of aesthetic ideas is indebted to two sources: Kant's notion of aesthetic ideas (from whom I borrow the term) and selected cognitive theories of metaphor. The point at which these two sources overlap is particularly relevant. The explanation presented in this section needs to assume additional features about perceptual processing to Marr's model because Marr's model unembroidered, could not explain aesthetic ideas.
Aesthetic ideas are the thoughts which sometimes flood the mind during an experience of beauty. There is a peculiar quality to these thoughts which distinguish them from the sort of directed thinking typical in our day to day lives. The overall feeling which is evoked by aesthetic ideas is not to be confused with those feelings I have associated with the experience of what is constitutive of beauty. Remember the latter are evoked by an experience of the processes underlying the construction of perceptual form: or to put it in experiential terms, the relations holding within the aesthetic form, such as feelings associated with balance, harmony, unity etc., which characteristically culminate in an all pervasive sense of clarity. The definitive feeling associated with aesthetic ideas, on the other hand, is a feeling of directed intensity unlike the detached feeling of clarity felt in the experience of that which constitutes beauty. Aesthetic ideas evoke an experience of the richness of felt experience.

The distinct phenomenology of aesthetic ideas involves a sense that: (i) they occur all at once, overlapping, interweaving and interacting; (ii) they cannot be captured by verbal description; and (iii) they arouse an unusually intense sense of engagement with the object of contemplation. For example, consider the seventeenth century Dutch painting by the artist Jan Vermeer called *The Milk Maid* (see Plate 10). The thoughts that flood my mind when reflecting on this painting relate to servitude, resignation, honest physical toil, simple rewards, the solace of hard work, traditional female roles, the security and certainty of older cultures weighed against their rigidity and emphasis on conformity, and so on. At the same time this painting conjures up feelings associated with home baked food, cold crisp air, hand-woven cloth, the smell of damp stone, the clatter of wooden shoes on terra-cotta floors, etc. Here I have listed these thoughts and feelings one by one as complete separate thoughts and feelings but this is not how they are experienced as aesthetic ideas. As aesthetic ideas they are experienced partially, simultaneously flooding together, such that the ideas experienced are different than simply the sum of these stated thoughts and feelings. There is an intensity, a sense of experiencing something fundamental: a sense of the
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richness of felt experience, such that one has an overwhelming sense of engaging with the object of the painting. The intensity seems to come from the way the various thoughts and feelings interact, so that the thoughts and feelings which emerge are altered, fuller, more fertile somehow.

This multiplicity of partial presentations, fleetingly, flooding together, cannot be expressed in words because we cannot present them partially and all together. I attempted to above but this was an attempt to point to the experience. The thoughts I expressed above in relation to Vermeer's painting were complete and reasoned thoughts: but the way I expressed these thoughts did not do justice to the way in which I experienced these ideas. They were experienced as intimations of these ideas.

5.5.2 An explanation

Aesthetic ideas seem to be retrieved from memory through some kind of stimulus. Because they are experienced simultaneously with some cases of aesthetic form, then the experience of beauty would be a likely candidate for this stimulus. Perhaps then when Kant wrote that beauty can be regarded as 'the expression of aesthetic ideas' (CofI, Ch.51, '320), he was recognizing the fact that the experience of beauty could in some cases evoke the experience of aesthetic ideas.

If the experience of beauty involves access to the processes underlying the construction of perceptual form, it would be reasonable to assume that during this experience we have temporarily suspended the directedness of reasoned thought and those concepts whose nature is determined by the demands of reasoned discourse. A consequence of freeing our minds from the straight jacket imposed by the demands of reasoned discourse might be that a multiplicity of representations is released into our minds, partially presented, flooding together. This would explain the phenomenology of aesthetic ideas. According to Kant the source of these representations experienced as aesthetic ideas is 'a wealth of undeveloped material' which the understanding 'disregarded in its concept [of the object]' (CofI, Ch.49, '317).
Now according to Kant, aesthetic ideas are connected to the concept.

However, this richness of associations attached to the concept is not salient once the concept is engaged in reasoned discourse (which is what he means when he refers to the ‘determinate’ concept). He writes:

even though this presentation belongs to the exhibition of the concept, yet it prompts, even by itself, so much thought as can never be comprehended within a determinate concept and thereby the presentation aesthetically expands the concept itself in an unlimited way (CofJ, Ch.49, '315).

And later,

an aesthetic idea is a presentation of the imagination which is conjoined with a given concept and is connected, when we use imagination in its freedom, with such a multiplicity of partial presentations that no expression that stands for a determinate concept can be found for it. Hence it is a presentation that makes us add to a concept the thoughts of much that is ineffable, but the feeling of which quickens our cognitive powers (CofJ, Ch.49, '316).

This way of thinking about aesthetic ideas, as though they are a multitude of thoughts, nuance and intimations connected to a given concept and which are gathered over time in memory, allows us to differentiate between aesthetic ideas as opposed to the way ideas are associated in reasoned discourse. The following example might demonstrate this difference. When I employ the sentence ‘it is raining’ in reasoned discourse, your comprehension of my meaning requires that you have learnt what each term signifies, which in turn, involves you having experienced a finite set of certain conditions. On the other hand, if you were to contemplate the underlying material to the concept ‘rain’, that is, the aesthetic ideas associated with rain, you would experience less directed thoughts: for example, the feeling of a trickle of cold water running down the back of your neck and its cold chill; the smell of wet pavements or wet grass etc. The extent of your engagement in the underlying material of the concept would draw on your personal profile of experience and sensitivity in a way not called upon in understanding the representational sense of the word, ‘rain’. According to Kant the proper function of aesthetic ideas ‘is to quicken the mind by opening up for it a view into an immense realm of kindred presentations’ (CofJ, Ch.49, '315).
It is as if, with aesthetic ideas, the thoughts evoked are somehow attached to the representational content in memory but not usually accessed when this representational content is engaged. This concurs with certain conceptions of metaphor. For example, Philip Wheelwright argues that metaphor involves not only a resemblance between two concepts but also a new synthesis of the associated underlying material. This underlying material is, according to Wheelwright, connected to the representational concept and can be focused on at the expense of the representational concept (1972, p.61-72). Eva Kittay and Earl MacCormac provide a name for this undeveloped associated material. Kittay calls them ‘semantic fields’ (1987), while MacCormac calls them ‘fuzzy sets’ (1985), in recognition that they are malleable, unstable and fluid. On my understanding, theoretically, each person past a certain age, say eight to twelve months old, possesses a ‘semantic field’ or a ‘fuzzy set’ for each representational concept that they have, and this field or set in its detail is unique to the individual and liable to change. Wheelwright, Kittay and MacCormac believe that the way metaphor works is that it accesses these sets, intermingling them and creating new syntheses, for which, initially at least, there are no matching representational concepts.

My suggestion is that these semantic fields or fuzzy sets refer to the same phenomenon as aesthetic ideas. I think the experience of beauty in some cases can stimulate an experience of the aesthetic ideas which are attached to the representational content of the object perceived to be beautiful, just as metaphor arouses the aesthetic ideas connected to the representational concepts and combines them in a new synthesis.

Aesthetic ideas thought of in this way would be consistent with the apparent fact that it is characteristic of type C cases of aesthetic form and beauty that they are often accompanied by the experience of aesthetic ideas. Type C cases of beauty are the only cases in which the experience of beauty involves an engagement with the representational content of the object while still involving access to an interlevel of perceptual processing. Hence here is a case in which there are representational
concepts involved in the perception of aesthetic form and hence representational contents whose underlying material might be let loose. If the explanation for type C aesthetic form was that the relationships between the concepts are interpreted according to an abstract version of the perceptual processes involved in the construction of perceptual form, then this would involve suspending our engagement in these concepts at the level of reasoned discourse. According to the explanation given for aesthetic ideas here, this would explain why when aesthetic form supervenes on perceptual and representational content, which it does in cases of type C aesthetic form, we experience with beauty, aesthetic ideas.

Aesthetic ideas are retrieved from the perceiver's memory. The nature of aesthetic ideas are such that the extent and richness of their presentation to the perceiver's mind will depend on the perceiver's experience and 'discrimination profile'\(^1\). Hence aesthetic ideas are not universal. Often the disagreements among philosophers and others about the universality of judgments of beauty, arise because the experience of aesthetic ideas is conflated with the experience of beauty. For this reason, I have included an explanation for this accompaniment of beauty, in order to support the claim that this experience is not constitutive of beauty, and hence does not threaten the claim of the universality of judgments of beauty.

5.6 Aesthetic Perception and the Perception of Ugliness

In this section I will show how my central hypothesis can be extended to explain certain aspects of experience often associated with the aesthetic. I take as an example those aspects usually associated with the perception of aesthetic form in visual objects.

5.6.1 Appearance

The appearance of the object does not equate with aesthetic form. It probably does, however, equate with the perceptual content I referred to in 1.4.2 and 5.3. The

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\(^1\) This term borrowed from Raffman, 1993, p.145
perceptual content was the first stage of processing: the stage of processing which gave rise to aesthetic form. In other words, the perception of aesthetic form involves access, whether conscious or otherwise, to the level involved in constructing the appearance of the object.

The levels involved in processing appearance are the primal sketch, the 2&1/2D-sketch and the 3D-model description. The primal sketch and the 2&1/2D-sketch probably equate with the surface qualities of appearance: its texture, colours, shapes, tones and patterns. The 3D-model description probably equates roughly with the design and structure of the object. In chapter two we identified the level of perceptual operations an experience of whose underlying processes constitutes aesthetic form as the 3D-model description. We could say then that an experience of the processes underlying the construction of the design and structure of the object, constitutes the perception of aesthetic form. While access, whether conscious or otherwise, to the level involved in the construction of the design and structure of the object is needed in order to perceive aesthetic form, a focus on design or structure does not necessarily give rise to the perception of aesthetic form.

However, by focusing on the design and structure of an object, we might be more likely to experience the aesthetic form of the object than if we focused on surface qualities like texture, colour and so forth. When we suspend the focus on the representational content of the object, it seems easier to focus on surface qualities than to focus on structure and design. Often a focus on surface qualities does precede the focus on design and structure or seems to accompany it. Remember that the 3D-model description begins to be matched with a shape description from the stored catalogue of shape descriptions, in some cases, before the 3D-model description is completely constructed. This is how the system judges whether the salient axes are in fact the principal axes. This means that the 3D-model description is very closely linked to object recognition or the construction of, what I have been calling, representational content. Perhaps, then, when representational content is suspended, it is easier to focus on surface qualities (the 2&1/2D-sketch and the primal sketch), than it is to
focus on design and structure. The design and structure of an object is perhaps more easily accessed via the lower levels of processing. Even so, the perception of surface qualities and design and structure do seem to be somewhat tangled together in experience. Perhaps this is because they all involve a suspension of a focus on representational content.

This is not to deny the fact that there are some cases of objects which when perceived give rise to the perception of aesthetic form immediately, with no apparent prior conscious attention to any particular focus. Such an experience must involve the arresting of the perceptual processing at the 3D-model description in order to experience the processes involved in the construction of visual form, even though we may not have become conscious of the design and structure of the object or of the surface qualities of the object, prior to perceiving the aesthetic form of the object.

To put it in the terms of the explanatory theory presented here, while we can consciously access the output of the interlevels of perceptual processing without experiencing beauty, we cannot experience beauty without accessing the interlevel of perceptual processing responsible for the construction of perceptual form. And the conscious access to the output of the interlevels of perceptual processing when they do not give rise to the perception of aesthetic form, I call aesthetic perception. Hence the perception of appearance, surface qualities and design and structure, I call aesthetic perception.

All objects can be voluntarily perceived in terms of appearance, including design, but they cannot all be perceived as aesthetic form. The popular meaning attributed to the term 'aesthetic' equates the aesthetic with all matters pertaining to appearance for its own sake. My concession to this is to list under aesthetic perception a focus on appearance, including design. We could say then, that while the perception of aesthetic form is a subset or a special case of aesthetic perception, aesthetic perception does not necessarily give rise to the perception of aesthetic form.

Hence what I have been referring to as the perception of aesthetic form is not just a matter of focusing on the appearance of the object which we can think of as the
perceptual content of the object. Focusing on aspects of the object's appearance might give rise to the perception of aesthetic form, but it might not. Whether it does or does not, depends, as was discussed in chapter four, on how the perception of the object employs the processes underlying the construction of perceptual form.

5.6.2 Ugliness

There is one more kind of experience that might be included in aesthetic perception. This is the perception of ugliness.

When an ordinary object is perceived aesthetically but does not give rise to the perception of aesthetic form, we do not then say that the object is ugly. So in this sense ugliness is not the opposite of beauty. However there is another possible explanation which would construe ugliness as the opposite to beauty. From what we have said above about the nature of the processes involved in the construction of perceptual form, we can think of these processes as having, in some sense, their preferred applications or preferences. Ugliness might involve the kind of violations¹ of these processes that also draws our attention to the processes underlying the construction of perceptual form, but uncomfortably so. Remember the Henry Moore sculpture discussed in 4.2.3, whose upper abdomen was carved away. I suggested then that this might violate the processes involved in finding the principal axes in the image. This hole made us feel uncomfortable but acted as the bitter antidote to the ease with which we processed much of the rest of the sculpture. Had the sculpture not had the other features which we identified as epitomizing the operations of the processes involved in the construction of perceptual form to act as compensatory aspects to those which violated these operations, we might have experienced the sculpture as ugly. Hence an object might be ugly when the perception of it involves the processes underlying the construction of perceptual form in such a way that their operations are violated, in which case we experience these processes, but uncomfortably so.

¹The idea that my central hypothesis might have explanatory power for ugliness and that, according to my central hypothesis, ugliness could be explained as when the processes underlying the construction of perceptual form were violated, was suggested to me by Dr. Karen Neander.
In this chapter I have demonstrated the explanatory power of the idea that the perception of aesthetic form and hence the experience of beauty is an experience of the processes which underlie the construction of perceptual form which are employed in the course of perceiving beautiful objects. I have demonstrated this by explaining the features of beauty identified in chapter one in a way which constructs a new understanding of beauty which avoids the contradictions which usually arise between our conceptual analysis of beauty and the features which characterize our experience of beauty. The fact that the explanatory hypothesis of an Interactive Theory of Beauty avoids these problems but accounts for each of the main features of our experience of beauty in a way which is consistent with its phenomenology, is strong support for it. Furthermore, in applying the central idea of this theory to explain aesthetic perception and ugliness, and, with some embroidery, to explain aesthetic ideas, all in a way which clarifies these experiences, I have demonstrated further its explanatory power.

In 5.3, I explained the variations in the way the perception of aesthetic form might be processed. Sometimes this involves the suspension of representational content after it has been processed, sometimes it seems to be independent altogether of representational content, while at other times, it seems to arise in part from the construction of representational content. The most controversial of these three variations is the third, which I referred to as type C aesthetic form. As the implication of relating aesthetic form to representational content in this way is that representational content can be relevant to the perception of aesthetic form in some cases, I am in effect, defending a possibility which has been neglected, and in some cases dismissed, by other philosophical theories of beauty. For this reason, I return to this topic in the following chapter.

If Marr's model is generally right and if I am right in contending that the experience of the processes underlying the construction of perceptual form when they are employed in the human perceptual processing of beautiful objects, constitutes our experience of beauty, then the experience of beauty would be universal and subjective,
and would be identified with the aesthetic form of the object. In trying to identify in which properties of the object this form might lie, it would be found that this aesthetic form was an ineffable but lawful property of the object. These are the features we identify with our experience of beauty and so the phenomenology vindicates my explanatory hypothesis for an Interactive Theory of Beauty.
Chapter 6  A Philosophical Implication

6.1 Type C Aesthetic Form: Perceptual and Representational Content

In chapter one, I identified, by considering the phenomenology of the perception of aesthetic form, three versions of the way aesthetic form can relate to representational content. In 5.3, I suggested how one might explain the difference in these versions according to the perceptual processing involved. In identifying type C aesthetic form, which was the type involving representational content, and by providing an explanation for it, I am in effect arguing that in some cases, representational content is relevant to aesthetic form. This is a controversial view to take within philosophical aesthetics. After all, unless the experience of beauty is taken to be a purely subjective matter, then the processing of the stimulus for the experience of beauty needs to result in a universal percept. As we have seen, only the processing which goes on prior to object recognition can be assumed to result in universal percepts, and hence it would seem that the construction of aesthetic form if it is to be universal must only involve those aspects processed prior to object recognition. But the processing involved in the construction of representational content does involve the processing of object recognition and would normally be assumed to incorporate personal experiences and knowledge and hence would preclude the resulting percept from being universal. The problem of admitting representational content into the notion of aesthetic form is that, in the way the relation between aesthetic form and representational content is normally construed (see 1.4), we would no longer be able to claim that such an aesthetic form would be universal. It would seem then that even though we might be very familiar with the phenomenology associated with type C aesthetic form, that there is no way to have a unified theory of beauty in which claims like ‘beauty is in the aesthetic form of the object’ and ‘judgments of beauty are universal’ are compatible with the idea that beauty supervenes in some cases on the representational content.
However, I have attempted to show in 1.4 and 5.3, that an Interactive Theory of Beauty construes beauty in such a way that both the claim that beauty is the experience of the aesthetic form of the object and the claim that in some cases beauty can supervene on the representational content of the object, are compatible. Furthermore, in 6.6 below, I argue that within an Interactive Theory of Beauty, cases in which aesthetic form supervenes on the representational content of the object need not be an exception to the rule, discussed in 1.3.3 and 5.2, that judgments of beauty are universal.

Probably the most controversial consequence for philosophical aesthetics in accepting my Interactive Theory of Beauty, is to admit that the experience of beauty can supervene at least in part, on an interpretation of representational content. For this reason I will draw my exposition of an Interactive Theory of Beauty to a close in this and the following chapter, by focusing on this issue. In this chapter, I explore the possibility of aesthetic form supervening on representational content from four perspectives. First, in section 6.2, I analyze my response to a painting with representational content, to show how the perception of aesthetic form can be experienced as dependent on the recognition of, and sometimes the interpretation of, representational content. Secondly, in 6.3, I suggest an explanation for this phenomenology by drawing upon Marr’s notion of what is involved in the construction of perceptual form within the visual system. Next, in order to support the explanation given here of this phenomenology, in section 6.4, I present two theories which support the feasibility of this explanation. That is, as I have explained aesthetic form according to processes involved in a perceptual operation, in order to argue that representational content might in some cases give rise to aesthetic form, I seem to be implying that representational content is somehow processed according to the same processes underlying the construction of perceptual form. While there may be other explanations for this phenomenology which do not employ my central thesis, for the sake of argument, I will present two theories about what can count as input to perceptual processes,
which, if true, would support my explanation for type C aesthetic form. In section 6.5, I present some criteria for scientific beauty devised by scientists and related theorists, as an example of how representational content might be perceived in terms of aesthetic form.

6.2 The Phenomenology

In this section I analyze my response to the beauty of a painting with representational content to show how the perception of aesthetic form can depend on a recognition of, and an interpretation of, representational content. In chapter one, we considered Hagberg's interpretation of Michelangelo's *Medici Tomb* as an example of this type C aesthetic form. The painting I choose here as my example is the well known painting by the seventeenth century Dutchman Jan Vermeer, called *The Milkmaid* (see Plate 10).

In this painting, we might notice that there is a calmness resulting from the equilibrium between light and dark, cool and warm colours. We might discern that the minutely detailed food-laden table on the bottom left-hand side is counterbalanced diagonally with the relatively large expanse of clear, bright flat colour on the top right side; that the carefully defined, small but rather sullen looking wooden box on the bottom right side is diagonally counterbalanced with the rough textured but tightly woven wicker basket hanging on the wall on the top left hand side. The inclusion of the copper pot hanging behind the basket is a purely formal device which, in echoing a similar shape and orientation to the wooden box, anticipates the move in our gaze from the basket down to the wooden box. The central and dominating vertical of the work consists of the rounded bulky forms of the woman in the centre. The whole painting is united, as in all Vermeer's work, by the use of light (the creation of the illusion of light) which gently gradates around and over the forms, falling into dark shadows here and great flat expanses of light there, with usually as its source, a window on the left
Plate 10 Jan Vermeer *The Milk Maid* 1660-1661
whose pane is broken up into small regular rectangles in the manner of lead light windows.

Now as we contemplate this gentle symphony of form, light and colour, we are focusing on the aesthetic form of the work; the aesthetic form which supervenes on the art object. But as we have seen, the discernment of aesthetic elements can depend on our recognition of the shapes as certain objects. For example, the balance between the wicker basket and the small wooden box is partly a balance between their respective relations to the main activity depicted in the painting: they represent a breadbasket and mouse trap respectively, poised in direct opposition. They exist as necessary accessories to the main task of a kitchen, and their functions are clearly set as the background to the maid's preparation of food. Furthermore, we are aware that the flow of the milk into the earthen pot creates a rhythm which continues down, over and around the bread rolls, and down through the falling drapery like a cascading waterfall; this is a compositional device which relies on the recognition of the vertical white strip between the two pots as flowing milk. Once this movement is discerned one can see that it begins in the shape of the woman's dress and body. The curve of the woman's once starched headdress, is echoed throughout her form, from her round broad forehead, the firm wholesome rotund shapes of her shoulders and bosom to the curves of folded drapery in her top skirt, and the strong line created by the movement of her arms towards the jug which is held by both hands. In the dark round hollow of the jug the movement is temporarily stopped so that for a moment all is completely still, silent, and empty. Then we enter back into the rhythms of the work through the light which cascades over the crisp and grainy bread.

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1 One can focus in such a way so that one perceives the forms only in terms of their formal characteristics; this is a necessary component of the technical repertoire of the artist who makes such a work, but it is only one component of the artist's involvement. In the perception of the aesthetic form of the work (as opposed to the technical making), the recognition of the objects depicted and their context can be an inseparable part of the properties which give rise to aesthetic form.
I have attempted to show by this critique of Vermeer's painting how the formal elements, for example our appreciation of certain balances, movements and rhythms, depend in part on recognizing the objects, and sometimes on interpreting their relationships to each other. I would not have picked up on the movement through the bottom left hand corner had I not known that it was liquid which was being poured; nor would I have appreciated the unifying effect of the lights and darks had I not equated them with a source of light. Furthermore, the movement and rhythms are accentuated and largely dependent on my reading of space into the design; of my appreciation of the contrast of textures in the fabrics, utensils, foodstuffs etc. There is much more I could say about the mood of the work, but this would bring us onto that accompaniment of beauty discussed in 1.6 and 5.5. The above critique was meant to illustrate that in some cases (identified as type C cases in 1.4 and 5.3.3), the aesthetic form which arises from an artwork, can supervene on both its perceptual and representational content (the distinction between these two kinds of content was made in 1.4 and further discussed in 5.3).

6.3 An Explanation

The critique of this painting above easily translates into an analysis at the level of the processes underlying the 3D-model description. The forms I have detected and the movement through, around and between these forms can all be expressed in terms of principal axes, volumetric primitives and shape primitives. The painting is perceived as the one 3D-model description, rather than as a series of separate ones side by side. Hence, the global axis unites the elements of the picture: and in a gradual descent into the finer scaled levels, the subsidiary axes are detected in relation to the global axis. The volumetric and surface primitives involve a range of kinds: elliptical, circular, rectangular, hollow and solid forms of varying sizes. Most of the primitives are solids and this is perhaps why the hollow of the milk jug draws us to it and holds our gaze for a moment.
The painting is so designed that axes can be detected which connect one side of the work with the other: that is, we construct principal axes through space (which we do not normally do when looking about us) because the arrangement of forms suggests that they are a part of the one global axis. For example, there is a dominant axis that runs parallel to the picture plane behind the woman's back, from the wicker bread basket to the wooden mouse trap. Then an axis which originates on the same plane as this one, runs from the top of the woman's head, curving down through her upper torso, round through her arms into and along the table creating a curved axis which swings dynamically towards the viewer through a number of planes, effectively defining a broad sweep through three-dimensional space. Another less dominant axis runs from the inwardly sloping window to the inwardly sloping plane created by the woman's upper torso and face.

Here is an example in which the way the processes underlying the construction of the 3D-model description are employed, are manipulated in such a way that we are led to construct the one 3D-model description for the painting. Normally when perceiving objects, the 3D-model description differentiates between objects because the kind of relationships that hold within objects, do not normally also hold between them. This is how the perceptual system picks out objects from their backgrounds. However, a painter like Vermeer, intuitively imitates the relations which hold within the one 3D-model description such that these same kinds of relations hold within the painting as a whole. This is why the perception of the painting employs the processes involved in the construction of perceptual form in such a way that we experience them or become dimly aware of them: or in other words, why the elements in the painting can be perceived as aesthetic form.

So far I have only discussed the perceptual content (even though I have referred to the shapes by the names of the objects that they represent for convenience). This may seem to contradict my claim that the aesthetic form supervenes on both the perceptual and representational content in this case. In my
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defence I must remind you that the phenomenology is distinct from the explanation, even though I devise and judge the latter to a great extent by considering the former. In 5.3.3, I gave an introductory explanation to what is involved in the perception of the type C aesthetic form. Here I will give a more extensive explanation.

On first viewing an artwork, one first perceives the representational content. If in so perceiving the work, the processes involved in the construction of perceptual form have been employed in an unprecedented way or in a way which epitomizes the work of these processes, then we experience some intimation of these processes or become dimly aware of them. This is what I claim is the equivalent to perceiving the aesthetic form of the work. In doing so we shift focus from the representational content. Now if we continue to inspect the work, our focus will involuntarily shift back onto the representational content, because perception is so designed that recognition is automatic, and so if there is something to recognize we are pulled back into this focus. Then, because the processes underlying the construction of the perceptual form are employed in extraordinary ways as explained above, we automatically shift focus again back onto the aesthetic form. In other words, we perceive and reperceive the work over and over. We swing backwards and forwards between the representational content and the aesthetic form, in a way which can create the overall impression that one is perceiving both the aesthetic form and representational content simultaneously.

Now in some cases, because the way the elements of the representational content are combined in a way which mimics those relationships perceived within the aesthetic form of the work, when we return to the representational content having absorbed the aesthetic form of the work, we begin to interpret the representational content in terms of the relationships inherent in the aesthetic form. Now in type A cases of aesthetic form, the same alternation would also happen but there would be nothing in the representational content which would suggest this apparently metaphoric translation and hence we keep the aesthetic form and the representational content
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In type C cases of aesthetic form, however, the nature of the combination of elements within the representational content suggest an interpretation such that these elements are related to each other in a way which mimics the aesthetic form of the work. Now even though my explanation treats the perception of the aesthetic form in the perceptual content as separate from the perception of the aesthetic form in the representational content, because they are so interrelated and intermeshed in experience, we can experience these processes as simultaneous, such that the impression is that the aesthetic form arising from the work arises from an engagement in both the perceptual and representational content simultaneously. Hence in the case of Vermeer's *The Milkmaid*, we experience the interpretations of the representational content as reflecting the same balance, harmony, and so forth, that we experience in the aesthetic form of the work: so much so that in experience the two levels become intermeshed as they did in my critique above.

Hence, in type C cases of aesthetic form, the perception of aesthetic form in the perceptual content prompts the perception of an equivalent in the representational content. They are two separate processes but they are experienced as simultaneous and unified.

### 6.4 Two Theories Regarding the Perceptual Processing of Nonperceptual Input

As has been suggested, the explanation for type C cases of aesthetic form, is more complex than the explanation for type A and B cases. According to my explanations given in 5.3, the perception of aesthetic form in type A and B cases, involves a focus on the output of the first stage in the internal processing of the object's content: that is, a focus on the perceptual content of the object. In type C cases, however, while the aesthetic form does emerge from the processing of the perceptual content of the object, it also in part emerges from the processing of the representational content as well. As explained above in 6.3, it is as though the relations which hold within the aesthetic form emerging from the perceptual content of the object, are mimicked in the relations which hold among the elements
of the representational content: and these relations among the perceptual and representational content are experienced as unified in the one aesthetic form emerging from the object.

The explanations given for the three types of relation between form and content rested on certain conditions concerning the relation between perceptual and cognitive processing. Specifically these conditions can be summarized as follows: (i) that perceptual processing can be arrested at the 3D-model description in a rerun of perception, given the right focus (type B); (ii) that the 3D-model description can be accessed after representational content has been processed (type A, and C); and (iii) that the relations which arise from the processes underlying the construction of the perceptual form of an object can somehow be mimicked in the relations holding within the representational content of that same object (type C).

According to what we have established about Marr's model, we can assume that the first two conditions listed here are satisfied as they are roughly equivalent to the second condition for an Interactive Theory of Beauty, discussed in 3.2. The condition regarding the mimicking of the processes involved in the construction of the perceptual form of the object in the relations holding within the representational content of that same object, however, requires some embroidery of Marr's model.

One explanation for this phenomenology, and the one I will explore here because it extends the explanatory power of my central thesis, is that the processes underlying the construction of perceptual form can be applied in more abstract form to representational content such that representational form can be grasped according to these processes. The problem which arises here though is that, given that I have identified the experience of beauty as the perception of aesthetic form which I have explained is an experience of the processes involved in the construction of perceptual form; then, how can representational content, which involves post-perceptual processing, be interpreted according to the processes underlying perceptual processing?
The solution I intend to offer regarding this problem is this: the perceptual processing system can operate on a stimulus that does not enter the perceptual system through the normal input channels; it can operate on a stimulus that reenters the perceptual system after it has been cognitively processed. Hence, representational content can be grasped in terms of the processes underlying the construction of perceptual form, or some equivalent of them: only in the case of representational content, these processes would be selecting or applying relationships to units other than, say, axes and generalized cylinders as they do in the case of visual processing, but rather to conceptual distinctions and contrasts. In other words, there may be a sense in which representational content can be perceived in terms of aesthetic form, albeit a highly abstract notion of aesthetic form. Given that the experience of beauty has been explained as an experience of certain processes underlying the construction of perceptual form in the course of perceiving beautiful objects rather than an awareness of the perceptual form itself, then the experience of beauty may not be limited to purely perceptual content.

In the following two subsections, I will present two theories which envisage the interaction between perception and cognition in such a way that the perceptual processing system can operate on a stimulus that does not enter the perceptual system through the normal input channels, but can operate on a stimulus provided by the output of cognitive processing which reenters the perceptual system. If the hypotheses presented by these two theories are right, they offer some support for my explanation of type C aesthetic form.

### 6.4. 1 Imagery and Perception

It is reasonable to assume that perceptual and cognitive processing is highly integrated, given the efficiency with which we perceive and interpret our environment. However, this integration is usually thought of, within the classical cognitive science model of mind, as based on a predominantly upward connection between perception and cognition. That is, processing, when it involves
perception, is usually thought to proceed from outside stimulus to perceptual processing, to object recognition and then onto higher processes like thinking, problem solving and so on. Normally, the only way a stimulus can enter the perceptual system is through the normal perceptual channels. The only information which these channels can pick up is perceptual information: visual in the case of visual processing, auditory in the case of auditory perception and so on. Hence, the classical cognitive science view of the mind is that, generally, cognitive processes are carried out in functionally separate and higher-level processes distinct from, and, in cases in which perception is involved, following on from, perceptual processes. Even though this view allows some backward flow from cognitive to perceptual processing in the case of object recognition, the main idea is that cognitive processes are high-level processes like thinking and problem-solving which are thought of as quite distinct from perceptual processes. Marr's model of vision generally fits into this model.

The idea that I wish to explore is that the output of a cognitive operation can be, not only incorporated into a perceptual operation, or that access to a percept of an object can occur after access to the representational content of the same object, but that a perceptual operation can be stimulated by and can operate on the output of cognitive processing. In this case, the output of cognitive processing that I wish to consider is the representational content. The point to considering this possibility is that it would allow us to envisage the experience of aesthetic form in representational content as a perceptual operation, without needing to account for the lack of a perceptual stimulus.

Now, one way to approach this possibility is to consider an example of a mental experience which seems ambiguously perceptual and cognitive, for which a feasible explanation has been suggested, to see whether the explanation entailed a connection between perception and cognition which might help us here. Such an example is mental imagery. Mental imagery is the term coined for those thoughts or ideas which we represent to ourselves mentally in the form of mental images.
Sometimes this is like conjuring up a mental picture of something from the memory we have of it, say, like imagining what the cathedral of Notre Dame looks like, while at other times it is not like a picture as such but feels rather like imagining a problem or a complexity of ideas analogously as shapes or structures which can be balanced or askew, unified or scattered, and so forth. It is important to note here that I am not suggesting that this phenomenology somehow involves an experience of the processes of the 3D-model description as in the experience of beauty. Rather, I am discussing mental imagery because it is an example of a mental experience which seems to involve perceptual processing without direct perceptual input: just as my explanation of the aesthetic form arising from representational content involved positing that certain processes of perception can operate on content which is not strictly speaking perceptual content.

Deborah Chambers and Daniel Reisberg conducted experiments which explored the links between the processes involved in conjuring up a mental picture of something and perceptual processing. They began from the premise that mental imagery employs perceptual processing, a premise which is not highly controversial. This premise does come close to a contentious issue in cognitive science: namely, the debate concerning whether the internal representations involved in perception and imagery are of a different kind to those kind of representations involved in cognition. However, this is not an issue on which my use of Chambers and Reisberg’s theory depends for verification or clarification and so I will not enter into it here. Chambers and Reisberg, instead, wanted to know specifically how the processes involved in conjuring up a mental picture of

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1 Imagery is a controversial issue among philosophers and cognitive scientists. The issue is whether the phenomenology of imagery reflects a different kind of internal representation from that involved in thinking in sentences. One side of the debate claim that they are both sentential. The other side claim that there are at least two different ways of internally representing information and that the imagistic phenomenology reflects a different way of representing to sentential representations. For example, imagery is isomorphic, while sentential representations are linear. The issue is usually discussed as though the question is, 'is there another kind of mental representation other than sentential representations?'. This does not overlap with my concerns. Both sides seem to agree that whether or not perception employs a different way of representing to sentential representations, perceptual and imagery probably share some of the same processes. My concerns are on another level. They concern whether we can have a perceptual-like experience from a stimulus which does not enter the perceptual system through the normal perceptual input channels.
something, differed from those processes involved in perceiving something. To this end, they tested whether subjects could reverse an ambiguous figure in mental imagery. They found that in three experiments the subjects could not reverse the image, even though immediately after this failure, they could draw from their mental image and then reconstrue the figure in their own drawing. Thus they could reconstruct the image when they were perceiving it, but not when they were imaging it. They concluded that while perception involves an interpretative process (not interpretative in the cognitive sense, but in the sense that perception transforms or constructs the image into an object-centred description), imagery involves drawing upon an already interpreted (constructed) image from memory. They write:

Perception, initiated by an external stimulus, is to a large extent concerned with the interpretation of that stimulus. Images, in contrast, are created as symbols of something and hence need no interpretive process (1985, p.317).

Thus imaging does not share the normal input and output channels employed in perception but can still employ certain perceptual operations from the later stages of perception. Imaging, in the words of Chambers and Reisberg

is, or at least draws heavily on, the top-down or anticipatory aspects of perceiving. ... imagery and perception will not share a number of aspects, including those associated with bottom-up processes or those resulting from the interaction of top-down and bottom-up events. (Construal, the process of finding what a stimulus is, presumably is one such interactive process.) At the same time, imagining [imaging] will share at least some of the top-down processes and will reflect the properties of those processes (1985, p.327).

If the Chambers and Reisberg hypothesis is correct, the explanation for the phenomenology of having a mental picture of something, is a case in which perceptual operations are employed in a operation whose input enters the perceptual system through channels other than the normal bottom-up input channels. That is, certain perceptual operations are employed in a process which does not involve an object directly perceived. I am not presenting this as a symmetrical explanation to the explanation for aesthetic form supervening on
representational content. Rather, I am presenting the Chambers and Reisberg hypothesis as support for the notion that aesthetic form, the experience of which is normally thought of as involving a response to a perceptual stimulus, might emerge from a perceptual operation performed on representational content, even though representational content does not constitute the typical input to perceptual processing, but is rather usually thought of as the typical output of perceptual processing.

6.4.2 'Reentrant' processing

In this subsection, I present Michael Posner and Marcus Raichle's hypothesis about the interaction between perceptual and cognitive operations. According to their hypothesis, the interaction between perceptual and cognitive processing is rather more extensive and interconnected than is normally thought by cognitive scientists.

Posner and Raichle draw together data from various psychophysical and neurological investigations. Their own experiments were conducted using Positron Emission Tomography (PET), a form of brain scanning. PET measures blood flow in the normal human brain.\(^1\) As blood flow indicates which parts of the brain are active, PET can measure and compare the parts of the brain employed for any particular task. Images of the blood flow in the brain before a task is begun is measured and is then compared to an image obtained when the brain is engaged in the task under investigation. Much of their work so far has centred on language-based tasks including the perceptual and cognitive components of these tasks.

As a result of their work in this area and comparing what they found with results from studies carried out at the cellular level and studies in clinical neurology, they hypothesized that an aspect of the traditional view of the mind was

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\(^1\) Radioactively labeled water, specifically, hydrogen combined with oxygen 15, is administered into a vein in the arm. As blood takes up oxygen, and the labeled water emits copious numbers of positrons as it decays, in just over a minute the radioactive water accumulates in the brain, forming an image of blood flow (Posner and Raichle, 1994, pp.38-39).
mistaken. This aspect was the view, discussed above, that mental processes were organized in a serial fashion going from sensory modalities (processed in sensory cortex) that involve elementary computations to the higher-level cognitive association areas in which the information provided by sensory areas is brought together. According to this scheme of things, language and thought are primarily the property of cognitive association areas and it is in these areas that new ideas are generated. However, the information Posner and Raichle gained from their PET scans in combination with the neurological and cellular studies conducted by others, led them to hypothesize that there are just as many neural connections devoted to bringing back information to sensory systems from higher centers (top down) as are devoted to bottom-up processing. This suggested to them, a somewhat different picture of how the mind is organized: different, that is, from the way it had been normally construed by cognitive scientists. Posner and Raichle hypothesize that aspects of cognition can take place in the sensory systems. They call this ‘reentrant’ processing by which they mean that a brain area that has already performed a function now receives a new signal fed from some higher level. In other words, a signal reenters the cortex that had handled the signal previously’ (1994, p.144).

Furthermore:

Attention can amplify computations within particular areas, but often appears to do so by reentering the same area that initially performed the computation, not by activating new higher-level association areas (1994, p.147).

The implication of this hypothesis for the concerns here is that to envisage a perceptual operation being performed on mental content which is generated by cognitive systems rather than input entering the perceptual system through the normal perceptual channels, is not unreasonable. Furthermore, it is quite possible that while the aesthetic form is perceived in the perceptual content of the object, the same relations are then picked up within the representational content, and hence give rise to a unified phenomenology of aesthetic form. The way this might
happen is that an experience of the processes underlying the processing of perceptual form could stimulate an experience of a manifestation of these same perceptual processes, only perhaps in a more abstract form, in the relations holding between the elements of the representational content. Hence the theories put forward by Chambers and Reisberg, and Posner and Raichle, suggest a way of envisaging an explanation for type C aesthetic form which draws upon the central idea of this thesis: that the experience of beauty is an experience of the processes underlying the processing of perceptual form during the course of perceiving beautiful objects.

6.5 Abstract Principles

To envisage representational content as being judged or grasped according to the same processes as those underlying the construction of perceptual form, we could look at those cases in which beauty is experienced in representational content: that is, cases in which beauty is claimed to be experienced quite independently from the perception of aesthetic form in perceptual content. This will not involve an example of the processes involved in the beauty of representational content on the level of the discussion of visual beauty in chapter four and in 6.3, which is the level of computational functions. Instead, in this section, I present the experiential criteria found to characterize the beauty of scientific theories, on a level equivalent to that involved in noting the balance, harmony, unity and so on, experienced in visual or musical beauty. My aim here, is to suggest how we might envisage the judging of representational content according to the same processes, albeit in more abstract form, as those underlying the construction of perceptual form. In this way, I hope to demonstrate how representational content can give rise to relationships between its elements which can be experienced in terms of aesthetic form.

In the fields of physics and mathematics, the notion of beauty is widely recognized as playing a significant role in the discovery and evaluation of theories.
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Arthur Koestler discusses the power of beauty in science and mathematics in the following passage:

it was Poincare who wrote that what guided him in his unconscious gropings towards the 'happy combinations' which yield new discoveries was 'the feeling of mathematical beauty, of the harmony of numbers, of forms, of geometric elegance. This is a true aesthetic feeling that all mathematicians know.' The greatest among mathematicians and scientists, from Kepler to Einstein, made similar confessions. 'Beauty is the first test; there is no permanent place in the world for ugly mathematics', wrote G.H.Hardy in his classic A Mathematician's Apology. Jacques Hadamard, [in his] ... pioneer work on the psychology of invention ... , drew the final conclusion: 'The sense of beauty as a "drive" for discovery in our mathematical field, seems to be almost the only one.' And the laconic pronouncement of Dirac, addressed to his fellow-physicists, bears repeating: 'It is more important to have beauty in one's equations than to have them fit experiment' (1975, p.329).

One would expect then, that scientists and mathematicians would attempt to draw up some criteria for judging the beauty of a theory. Steven Weinberg's list of criteria is a typical example of such attempts which I will consider in relation to scientific theories. He lists four criteria: symmetry (principles of invariance), simplicity, inevitability, and rigidity. It is important to note that beauty only occurs when a theory is judged to satisfy all of these criteria, simultaneously.

In the following sections I will analyze these criteria to see whether they resemble the kind of relationships we point to in an object when we are attempting to defend judgments of beauty, such as balance, harmony, unity-in-variety, and so forth.

6.5.1 Symmetry

Symmetry is a central principle in judgments of scientific beauty. It is the common feature which gives a theory its sense of simplicity and inevitability, and it is the base for judging a theory's rigidity. If something is symmetrical then it looks the same from certain different points of view. Weinberg points out though, that the symmetries that are really important in nature are not the symmetries of
things, but the symmetries of laws.\(^1\) The symmetry of laws means that changes in the point of view from which we observe natural phenomena do not change the laws of nature observed. To a nonphysicist this sounds banal, but in the context of theories developed this century like that of the general theory of relativity and quantum mechanics, it is highly significant. The fact that certain forces remain the same regardless of the speed of motion of the observer, is an example of the symmetry principle in the general theory of relativity. Such symmetries are often called principles of invariance. However, a theory which exhibits symmetry is not necessarily beautiful. For example, a theory which represented symmetrical laws but which was unnecessarily detailed and complicated would not be judged beautiful, which brings me to the next criterion.

6.5.2 Simplicity

One needs to bear in mind the principle of symmetry as explained above, in order to grasp the particular notion of simplicity as it is employed as an aesthetic concept in science. Weinberg writes:

> An elegant proof or calculation is one that achieves a powerful result with a minimum of irrelevant complication. It is not important for the beauty of a theory that its equations should have elegant solutions. The equations of general relativity are notoriously difficult to solve except in the simplest situations, but this does not detract from the beauty of the theory itself. 
>
> ... Simplicity is part of what I mean by beauty, but it is a simplicity of ideas, not simplicity of a mechanical sort that can be measured by counting equations or symbols (1993, p.107).

As an example of this, Weinberg points out that Newton's theory of gravitation included three equations about gravitational forces while Einstein's included fourteen. However, Einstein's theory is more beautiful because of the simplicity of his central idea about the equivalence of gravitation and inertia.

\(^1\) Remember, the processes underlying the 3D-model description are best understood as preferences for a kind of explanation underlying a configuration, rather than a preference for a particular kind of configuration.
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The simplicity, then, of a scientific theory needs to be grasped, rather than calculated. That is, it is not the kind of simplicity which can be defined as sufficient conditions in the sense discussed in 1.5. Simplicity as employed to judge the beauty of a scientific theory is employed as an aesthetic term. In order to understand more clearly what is meant by simplicity when it is used as an aesthetic concept in science, a consideration of the next criterion should help as it goes hand in hand with simplicity: that is the notion of inevitability.

6.5.3 Inevitability

The sense of inevitability that a theory may give us is another criterion for beauty in a physical theory, according to Weinberg. This quality needs to be considered in relation to both the symmetry and simplicity principles. In order to demonstrate what is meant by inevitability, Weinberg compares an aspect of our response to musical beauty with the same aspect in physics.

In listening to a piece of music ... one sometimes feels an intense aesthetic pleasure at the sense that nothing in the work could be changed, that there is not one note or one word that you would want to have different. ... The same is partly true (it is never more than partly true) of general relativity. Once you know the general physical principles adopted by Einstein, you understand that there is no other significantly different theory of gravitation to which Einstein could have been led. As Einstein said of general relativity, 'The chief attraction of the theory lies in its logical completeness. If a single one of the conclusions drawn from it proves wrong, it must be given up; to modify it without destroying the whole structure seems to be impossible' (1993, pp.107-108).

This sense of inevitability is again not a quality which can be judged according to hard and fast rules. It arises from a theory's symmetry and simplicity. However, not all theories which are judged to exhibit symmetrical laws and a simplicity are necessarily beautiful. A theory could be both and still be bland in that it was too general: such theories are not experienced as having that sense of inevitability. The last criterion listed by Weinberg is included to help pinpoint which symmetrical and simple theories are experienced as inevitable and hence beautiful.
6.5.4 Rigidity

Rigidity is a quality of beauty which is based on the law of symmetries. A theory judged to be rigid is one which presents its central ideas in such a way that the theory creates a distinct world view distinguishable from competing theories. An example of rigidity in a theory is the fact that Einstein's theory of general relativity, specifically his idea about the equivalence of gravitation and inertia, led to only one fairly rigid theory of gravitation and not to an infinite variety of possible theories of gravitation. Rigidity relates to inevitability, in that a rigid theory is one in which all the parts fit together in such a way that any changes would alter the whole picture. Weinberg writes:

The kind of beauty that we find in physical theories is of a very limited sort. It is, as far as I have been able to capture it in words, the beauty of simplicity and inevitability - the beauty of perfect structure, the beauty of everything fitting together, of nothing being changeable, of logical rigidity (1993, p.119).

The criteria presented here as characterizing scientific beauty are not presented as a formula to be followed in order to judge or develop a beautiful theory. They do not function like sufficient conditions for beauty because each of the four features discussed above cannot themselves be defined in terms of sufficient conditions. Instead, the principles identified as constituting scientific beauty point to a set of properties which in combination behave like aesthetic properties in that they are lawful, but ineffable (see 1.5.2). In Steven Weinberg's words:

There is no logical formula that establishes a sharp dividing line between a beautiful explanatory theory and a mere list of data, but we know the difference when we see it - we demand a simplicity and rigidity in our principles before we are willing to take them seriously. Thus not only is our aesthetic judgment a means to the end of finding scientific explanations and judging their validity - it is part of what we mean by an explanation (1993, p.118).
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If we try to compare these criteria to the principles of visual beauty discussed in chapter four, we find that it is difficult to separate the beauty of Marr's theory of the 3D-model description from the elements within visual processing identified as the explanation for visual beauty. That is, Marr's idea of the 3D-model description is an example of a theory which displays the characteristics of scientific beauty. It displays the laws of symmetry and exhibits simplicity, inevitability and rigidity. That is, the very principles which underpin Marr's theory of the 3D-model description, are possibly a more abstract version of the processes which underlie the 3D-model description. That is, the principles underlying Marr's theory might be an example of the principles of scientific beauty which I am attempting to envisage as an abstract version of the processes underpinning Marr's 3D-model description. Trying to untangle this is akin to performing brain surgery on oneself and reflects the tension underlining the latter part of this thesis: the tension being caused by the fact that I am attempting to identify processes which might play a part in the mental processes involved in my attempting to identify them. However to return to safer ground for a moment, we can compare the phenomenology of the aesthetic form of artworks with the aesthetic form of scientific theories.

The discussion above concerning scientific beauty, though brief, provides some idea of how the relations between the elements of representational content might be experienced as aesthetic form. Within an artwork, the relations arising from the representational content, relevant to the perception of aesthetic form, might be the same but they are experienced differently because the elements which give rise to these relations are not scientific ideas but interpretations of nonspecialised concepts in everyday use. Even so, the idea of the aesthetic form of an artwork displaying the symmetry, simplicity, inevitability and rigidity as they are meant in characterizing scientific beauty is not so difficult to imagine. The terms like harmony (inevitability), balance (rigidity), unity-in-variety (symmetry and simplicity) used to characterize visual and musical beauty, could be seen as a
rough equivalent to the criteria for scientific beauty. They seem to be addressing
the same processes: it is just that the instantiation of the processes in each case take
a different form and it is only the instantiations of these processes which we can
know for the reasons explained in 5.4. The phenomenology of scientific and
artistic beauty is sufficiently similar to treat scientific beauty as a case of aesthetic
form supervening on representational content, or so I will argue in the following
chapter. And if this is the case, it provides support for the possibility of type C
aesthetic form, which is my main concern in this chapter. I will explore some of
the other implications of treating scientific beauty as a genuine case of beauty in the
following chapter.

6.6 Universality

An issue which arises from the possibility that representational content
might be judged to be beautiful is that such judgments of beauty on the face of it
seem to threaten the universality of judgments of beauty. If aesthetic form is
influenced by representational content, then presumably it can be indirectly
influenced by information about the art object which is not immediately explicit in
the art object, because the interpretation of representational content is dependent on
experience, background knowledge, beliefs and so on. For example, historical
data about an art object might determine or help form the interpretation of the
representational content of the work. This in turn would influence the relations
arising from between these elements. In this way historical or cultural information
extraneous to the art object can become relevant to the aesthetic form arising from
that art object, by directing our attention to certain aspects of the work which might
influence how we interpret the representational content and thus the relationships
(the aesthetic form) holding within this content.

This may appear to fall into the intentional fallacy (see W.K. Wimsatt and
Monroe Beardsley, 1959, pp.274-288). According to Mary Mothersill, the
intentional fallacy is a special case of the genetic fallacy: the mistake of assuming
Plate 11  Claude Monet  *Rouen Cathedral at Sunset*  1893
that where a is the cause of b, hence distinct from b, the significance or value of b can be inferred on the basis of information about a (see Mothersill, p.16).

Whether or not this is always a fallacy is controversial. In an attempt to resolve this intentional fallacy debate, Elizabeth Anscombe wrote a paper in which she distinguished between causes and intentions (1959). Following on from this, Henry Aiken (1955) and Stanley Cavell (1969), in separate papers, argued that intentions that are evident in the work are relevant to the work of art and Beardsley, who with Wimsatt was the original defender of the intentional fallacy, conceded this (see Beardsley, 1958). Beardsley modified his original position by conceding that intentions evidenced in the work of art were evidence of what the artist had done: they were explicit and visible. A somewhat looser version of this view and one which I support is that historical and cultural information which bears directly on our grasp of the actual work can be relevant to the aesthetic form when the aesthetic form arises wholly or in part from representational content.¹ For example: learning that the artist painted a number of works on the same theme as the work being contemplated, that he painted these works at different times of the day aiming to capture the effect of the different strengths of sunlight on the colours of the image (think of Monet's various series like those of Notre Dame, the Houses of Parliament, haystacks etc.), might draw attention to certain properties of the work such as the subtle variations of colour produced by the weaker sunlight of dusk or dawn, compared to the brilliant contrasts produced by the midday sun (see Plate 11). Such an attention might depend on having this background knowledge and in this way could influence the nature of the aesthetic form arising from the work. The issue I wish to draw the reader's attention to, is whether by recognizing the role of representational content in the perception of aesthetic form and hence the experience of beauty, we are introducing cultural relativity into the equation. If there are cases in which the perception of aesthetic

¹ In Benedetto Croce's words such information can help connect the imagination with the work (1902, pp.118-127).
Plate 12 Claude Monet *Rouen Cathedral, Morning* 1894
form is culturally relative, then such cases do not constitute universal judgments of beauty.

Remember that it is the aesthetic form in the perceptual content which sets the tone and is then sought within the representational content. Hence in cases in which aesthetic form supervenes on both perceptual and representational content, it may be that cultural and other such differences might influence whether the aesthetic form is a case of type A or type C. That is, it may be that whether the representational content in some artworks can be interpreted according to the relationships inherent within the aesthetic form of the work, is dependent on some culturally specific interpretation of the representational content of the work.

Hence, my contention is that the nature of the aesthetic form arising from an object is always universal, but whether it is experienced as either type A aesthetic form or type C aesthetic form, might vary between people.

6.7 Summary

Remember that in 2.7, I construed the assumptions which according to Marr underlie perceptual operations, as innate preferences. I came to the conclusion that the perceptual system due solely to its very nature, without any influence of top-down knowledge, bias etc., is capable, in effect, of preferring certain constructions over others. One way of thinking about type C cases of aesthetic form, is that the kind of preferences which in effect are made by the perceptual system, can also be applied to representational content. In the case of representational content, however, the innate preferences are preferences for certain relationships among units other than those which figure in the perceptual modules. In the case of representational content, the units are representational concepts.

I have argued in this chapter that our notion of aesthetic form can be extended to include those experiences of aesthetic form in which aesthetic form supervenes on
both the perceptual and the representational content of the object. This argument has taken the form of an analysis of the phenomenology of type C cases of aesthetic form and a presentation of a way of envisaging how the central idea of this thesis could be extended to explain the beauty of representational content. Furthermore, it should be noted that when aesthetic form supervenes on representational content, the beauty experienced exhibits all the features, identified in chapter one, as characterizing beauty. This serves not only as a further example of the explanatory power of my central thesis, but also as a further suggestion of certain philosophical implications of an Interactive Theory of Beauty which will be returned to in the next chapter.
Chapter 7 An Additional Feature

7.1 The Beauty of Scientific Theories and Mathematical Equations

I include this last chapter to demonstrate that I do not want this thesis to be interpreted as simply an attempt to reconcile certain dominant and competing theories of beauty. Instead, this thesis has attempted to draw certain strands from these theories into a new way of thinking about beauty: a way of thinking about beauty which requires a paradigm shift, if you like, in our understanding of beauty. My hunch is that if we begin to explore the role of beauty in experience generally, freeing discussions about beauty from being necessarily entangled in discussions about art, and breaking the monopoly artists are often allowed on the subject, then an enquiry into the nature of beauty might offer some interesting insights into cognition. An image conjured up by Ellen Dissanayake in her book *Homo Aestheticus* (1992), comes to mind as an illustration of where enquiries into the nature of beauty are at present, in philosophical aesthetics. Dissanayake draws an image of baby ducks who, in the absence of their mother, dutifully follow in single file a single car tyre that someone has pushed along the road. She uses this example to illustrate that in the absence of the real thing, our innate needs and desires compel us to find substitutes. I relate this image to you as it offers an analogy for the diminished role that beauty has come to play in western culture. We seem to have replaced beauty with the idea of art. This means that in order to enquire into the nature of beauty, many aestheticians confine themselves to the study of our response to artworks. In fact, according to a contemporary aesthetician, Arnold Berleant, whose ideas I take to be representative of many aestheticians and art theorists, aesthetics is about the study of contemporary artworks (1991). He reasons then, that if contemporary artworks do not evoke, say, a disinterested pleasure, then this is evidence that such a response to artworks was a cultural invention (the invention not being in the artworks, but in the response to them), which he identifies with the eighteenth century. This kind of
reasoning, in conjunction with the idea that beauty is confined to artworks, leads to the idea that because contemporary artworks, by and large, do not evoke an experience of beauty, then beauty is a cultural invention which happens to be irrelevant to our culture. The consequence of limiting the concept of beauty to art, is that now that mainstream art, by and large, does not evoke the response to beauty, the concept of beauty is at risk of falling off the edge of our vocabulary. This is not to say that we cannot still experience beauty: it's just that we may be at risk of loosing sight of what beauty is such that when we do experience beauty, we have little chance of cultivating this sensibility. I argue in 7.6 that to cultivate our response to beauty, is not an idle aim solely for our pleasure, but that there may be an instrumental aspect to our response to beauty in the broader scheme of things.

In this chapter, I extend the enquiry begun in chapter six, to examine the possibility that beauty can supervene on representational content alone, without having to first involve the perception of aesthetic form in perceptual content. I do this by analyzing the anecdotal evidence available on the phenomenology of scientific and mathematical beauty.

In chapter one, I argued that the features historically identified as characterizing beauty were understood erroneously, because the understanding of the concepts employed to characterize beauty, was built in each case, on false assumptions. Throughout this thesis, I have suggested a new way of understanding the concepts involved. This new understanding is more consistent with the phenomenology of beauty and does not create logical inconsistencies or dichotomies between the way we understand the concept of beauty and the features recognized as characterizing the experience of beauty. Furthermore, in chapter six it was shown how this new way of thinking about beauty could account for the phenomenology of beauty supervening on both the perceptual and representational content of an object. In this chapter I will explore further the significance of thinking about beauty according to my explanatory hypothesis. I will demonstrate
that this new way of thinking about beauty allows that scientific and mathematical beauty are genuine cases of beauty: hence that aesthetic form can supervene on representational content alone. In 6.5, I discussed the criteria for scientific beauty so as to provide the reader with some idea of what kind of relations I had in mind as those which might be involved in the aesthetic form of representational content. That is, we considered the criteria for scientific beauty as a possible example of how the aesthetic form supervening on representational content might be experienced. In this chapter, I will argue for what was assumed in 6.5, that scientific beauty, and I will add to this mathematical beauty, are genuine cases of beauty, by showing that such beauty satisfies what was identified at the end of chapter one, as the features of beauty. Hence I show that scientific and mathematical beauty is characterized by a universal subjective response; is the experience of the aesthetic form of the theory or equation; and is characterized by a set of criteria which point to a property which is experienced as both lawful and ineffable.

I conclude this chapter by considering whether the central idea of this thesis can be extended to explain two crucial aspects concerning intellectual beauty. First, we need to explain what it is about certain representational contents which can stimulate the activation of perceptual processes and hence the perception of aesthetic form within them. We can draw upon the two theories presented in 6.4 to support the idea that perceptual processes can interpret representational content in terms of aesthetic form. However, given that the explanation for type C aesthetic form in 6.3, involved that the perception of aesthetic form in perceptual content stimulated the perception of aesthetic form in representational content, then in cases in which there is no perceptual content involved, how can we explain the perception of aesthetic form in representational content? I will suggest a possible explanation. The second crucial aspect to intellectual beauty for which an explanation is attempted here, is the additional feature which characterizes scientific and mathematical beauty, and which differentiates it from artistic beauty, namely its instrumentality. The explanation for
this instrumentality can be seen to round off the exposition of an Interactive Theory of Beauty, by also serving as an explanation for the particular subjective response which characterizes the experience of beauty.

From hereon, I will refer to scientific and mathematical beauty as intellectual beauty for convenience. It might be argued that the beauty of literature and poetry is an example of intellectual rather than artistic beauty. However, as you will see, I argue that the only difference between artistic and intellectual beauty is a difference in the units between which the relations arise on which aesthetic form supervenes. In the case of scientific beauty, these units will be propositions about the physical world: in mathematics, these units will be numbers or propositions about numbers: in the case of literature and poetry, they will be ideas or images: in the case of artistic beauty they might be ideas or perceptual elements. The instrumentality of scientific and mathematical beauty as opposed to artistic beauty is due to the nature of the units involved. For the sake of this discussion then, I will refer to beauty which is instrumental as intellectual, and that which is not, artistic. Intellectual beauty here, then, refers to scientific and mathematical beauty.

7.2 Intellectual Beauty: Universal Subjective Response

Apparently there is little disagreement among scientists and mathematicians about what constitutes a beautiful theory or equation. Furthermore, it has been found that the beauty of a theory or equation is a reliable indication of its application and instrumentality. These two features of intellectual beauty I will present as evidence of the universality of intellectual beauty. Its subjectivity, on the other hand, is evidenced in that judgments of intellectual beauty cannot be based on a set of stateable criteria. As all the participants in the following discussions attest, intellectual beauty must be grasped or perceived: one knows a beautiful theory or equation when one sees it, but its beauty cannot be reduced to
sufficient conditions. One knows a beautiful theory or equation by the response it evokes in one; a particular, subjective response.

The subjective response to intellectual beauty, like artistic beauty, is its judgment: that is, beautiful theories and equations evoke a feeling which can best be described as a feeling of clarity, which comes with the experience of that inherent order and pattern which seems to underlie all natural phenomena: this is the subjective response to intellectual beauty which is universal. The feeling of clarity is analyzed by the theorist of intellectual beauty as a sense of the symmetry, simplicity, inevitability and rigidity of the theory, just as in artistic beauty it is analyzed to be the perception of the balance, harmony, unity-in-variety, in the work. The response to intellectual beauty is evoked by theories or equations whose structures are felt to capture something universal, enduring and transcendent. This is the emotional response to intellectual beauty.

In this section, I will demonstrate through analyses of the reports of the experiences of intellectual beauty provided by scientists, mathematicians and related theorists, that beauty plays an instrumental role in scientific and mathematical discovery: and that it is characterized by a subjective response just as artistic beauty is. To demonstrate the latter, I draw heavily upon what Michael Polanyi, a chemist and philosopher, calls the heuristic passion of science.

7.2.1 Instrumentality

As an illustration of the instrumental role of beauty in scientific and mathematical discovery and judgment, consider that there have been many cases in which a beautiful theory, while not proven conclusively to be wrong, was at odds with available data, and yet the theory was upheld on the basis that it was beautiful. Paul Dirac, a physicist, considers the beauty of a theory to be a predictor of its usefulness. To illustrate this point, he recounts how Erwin Schrödinger through pure thought arrived at an equation for describing atomic events. Apparently, Schrödinger did not keep close to experimental data: instead
he looked for some beautiful generalization of previous ideas on the topic. His solution, known as Schrodinger's wave equation, he immediately applied to the behaviour of the electron in the hydrogen atom, but he found that his results did not agree with the experimental data. He thus published his first paper with only a rough approximation. However, since then it has been found that Schrodinger's theory was right and that the discrepancy between his solution and experimental data was only apparent, caused by the fact that at that time it was not known that the electron has a spin. Hence, by being guided by beauty, Dirac points out, Schrodinger overtook theories in physics. According to Dirac, this illustrates that:

> it is more important to have beauty in one's equations than to have them fit experiment. ... It seems that if one is working from the point of view of getting beauty in one's equations, and if one has really a sound insight, one is on a sure line of progress (1963, p.47).

There are other cases in which mathematicians have worked on a problem simply because it promised a beautiful solution, with no idea that the theory would have any application. Steven Weinberg, writing on the role of beauty in science, particularly in physics, writes:

> It is precisely in the application of pure mathematics to physics that the effectiveness of aesthetic judgments is most amazing. It has become a commonplace that mathematicians are driven in their work by the wish to construct formalisms that are conceptually beautiful. The English mathematician G.H. Hardy explained that 'mathematical patterns like those of the painters or the poets must be beautiful. The ideas, like the colors or the words must fit together in a harmonious way. Beauty is the first test. There is no permanent place for ugly mathematics.' And yet mathematical structures that confessedly are developed by mathematicians because they seek a sort of beauty are often found later to be extraordinarily valuable by the physicist (1993, pp.121-122).

The example of this given by Weinberg is the development of non-Euclidean geometry, developed initially in order to settle an historic question about the foundations of geometry, not because anyone thought it applied to the real world. A mathematician, Georg Frederick Bernhard Riemann, developed this further. Later mathematicians continued to work on Riemannian geometry because it was
so beautiful, without any idea of its physical application. However, much to their surprise, it turned out that this work had application to physical theories of gravitation. According to Weinberg:

> It is very strange that mathematicians are led by their sense of mathematical beauty to develop formal structures that physicists only later find useful, even where the mathematician had no such goal in mind (1993, p.125).

According to Weinberg, the physicist's sense of beauty helps not only in discovering theories of the real world but even in judging the validity of physical theories, sometimes ‘in the teeth of contrary experimental evidence’ (1993, p.125).

Dirac suggests that one can transcend the limitations of the conceptual framework of any particular period by using beauty as a guide. According to Dirac, attempts to think of a new physical picture may be hampered by the employment of inadequate physical concepts. He suggests that the only way to overcome the inadequacy of the discipline's present framework of physical concepts is to be guided by a sense of beauty. Dirac was writing in the 1960s but this could just as easily apply to the present: take for example, the problems between current physical theories, such as the incompatibility between the general theory of relativity and quantum mechanics (see Matthews, 1994). Dirac suggests that when the physicist reaches an impasse, the only way to proceed is to use mathematics to develop equations guided by beauty and explanatory power (1963, p.53). This is the ultimate example of the universality of beauty: that it is an experience which can be used as a predictor of the application of a theory or equation: that it is an experience which transcends our conceptual framework.

### 7.2.2 Subjectivity

In order to illustrate the subjectivity of intellectual beauty, I draw upon the analysis of science presented by Polanyi. Polanyi argues that it is a modern fallacy perpetrated largely by the followers of John Locke and David Hume, namely the logical positivists, that science is a purely objective field of enquiry. Furthermore,
he points out that the consequence of separating, in principle, mathematical knowledge from empirical knowledge, is that scientific theory is denied all persuasive power that is intrinsic to itself, as theory. That is, the way science is normally understood, it is denied the possibility of going beyond experience. When science is thought of in this way, the scientist is one who must be prepared to drop a theory the moment an observation turns up which conflicts with it. However, Polanyi argues that this is not the way scientific discovery actually proceeds. Instead, he claims that the scientist is driven by heuristic passion and that this passion is underpinned by a faith in the underlying rationality of nature. According to Polanyi,

The function which I attribute here to scientific passion is that of distinguishing between demonstrable facts which are of scientific interest, and those which are not. Only a tiny fraction of all knowable facts are of interest to scientists, and scientific passion serves also as a guide in the assessment of what is of higher and what of lesser interest; what is great in science, and what relatively slight. ... this appreciation depends ultimately on a sense of intellectual beauty; that it is an emotional response which can never be dispassionately defined, any more than we can dispassionately define the beauty of a work of art or the excellence of a noble action (1958, p.135).

He illustrates this fact by pointing to the role of beauty in transcending the present conceptual framework: an idea I introduced above through Dirac. According to Polanyi, two conflicting systems of thought are separated by a logical gap. Advocates of a new theory may not even get a hearing from persons relying on a former framework because advocates of a new theory must first teach the old guard a new language, and no one can learn a new language unless he first trusts that it means something. Polanyi writes:

Proponents of a new system can convince their audience only by first winning their intellectual sympathy for a doctrine they have not yet grasped. ... Such an acceptance is a heuristic process, a self-modifying act, and to this extent a conversion (1958, p.151).
And as Polanyi stresses, it is a process often initiated because of an extra-scientific element in the new theory, and this extra-scientific element he identifies as beauty.

According to Polanyi:

it is logically impossible to arrive at these [major discoveries] by the continued application of our previous interpretative framework. ... discovery is creative, in the sense that it is not to be achieved by the diligent performance of any previously known and specifiable procedure (1958, p.143).

Polanyi uses the circumstances surrounding Einstein's discovery of the theory of relativity, as evidence that the belief in nature's rationality underpins discovery in science. In particular, he uses the story of relativity to refute the purely objective view of science, although he acknowledges that this example is usually used to confirm the contrary view. Apparently Einstein's autobiography explains that he, Einstein, discovered relativity after ten years reflection, from a paradox which he had hit upon at the age of sixteen. However, text books of physics according to Polanyi writing in the 1950's, present Einstein as responding to an experiment carried out eighteen years prior to his discovery, in which certain discrepancies arose which Einstein set about solving by developing a new conception of space and time. However, according to Einstein, this experiment had no role in the foundation of his theory of relativity (Polanyi, 1958, footnote 2, pp.10-11). The theory was founded instead on a problem which had occupied Einstein from the age of sixteen concerning the consequences that would occur if an observer could keep pace with a light signal sent out by him. According to Polanyi, the problem and the solution of relativity were defined by the belief in the underlying rationality in nature: as Polanyi describes it, by seeking rationality in nature rather than setting out simply to solve an empirical problem, through empirical means. According to Polanyi, the concept of rationality is employed as a euphemism for beauty, in science. He argues that in fact, the scientist is guided by his or her subjective response to beauty.

It would seem then that what underlies advances in science is the belief in a pattern or an order which underlies nature. For example, when a scientist is
confronted with chaotic phenomena, even when there is no evidence to suggest that there is a pattern underlying the phenomena, the scientist proceeds as though there is a pattern there and it is just a matter of discovering it. The above reports suggest that the pattern searched for, is a pattern which is felt by the scientist to be beautiful: until the pattern acquires this character, it is felt the quest is not complete. Of relevance here, is that this beauty which is known through the subjective experience it evokes, is a beauty known by other scientists. The beauty which the scientist is guided by, is subjective, but the evidence would suggest, that it is also universal. Ironically, while the universality of artistic beauty has been argued for and against for centuries, there is no such disagreement among scientists. Perhaps the faith in beauty has been developed in the scientist through the stunning success that beautiful theories and equations offer in their applications. The disagreements regarding artistic beauty compared to the relatively broad agreement given by scientists and mathematicians to judgments of intellectual beauty is an issue to which I will return later in this chapter.

Above I have provided examples of theories which have been upheld because they were beautiful, even in the face of contrary evidence. I have also provided examples of mathematical theories which were developed because they were beautiful, with no idea of their possible application. Furthermore, I have provided examples of how theories which initially had only their beauty to recommend them, were later proven to have useful applications. According to the practitioners and theorists involved in discussions on intellectual beauty, these are not exceptional cases but are an example of the amazing instrumentality of intellectual beauty.

7.3 Intellectual Beauty: Form and Content

In order to understand how aesthetic form supervenes on a theory or equation, it is instructive to envisage the aesthetic form of intellectual beauty as a subset of the type $C$ aesthetic form, discussed in 1.4, 5.3.3 and in chapter six.
Type C aesthetic form, you will remember, were those cases of aesthetic form in which the aesthetic form supervened on both the perceptual and representational content of an object. In the case of intellectual beauty, the aesthetic form supervenes on representational content alone. To understand the aesthetic form of intellectual beauty as a subset of type C aesthetic form, militates against confusing the processing of representational content with the processes involved in perceiving aesthetic form within the representational content. The latter occurs after the representational content has been processed and is a separate process.

An example of this confusion can be found in a paper whose subject is the difference between the aesthetics in science and in art, by the philosopher, Gideon Engler. Engler attempts to differentiate between artistic and intellectual beauty on the grounds that the aesthetic form in art is a whole which ‘is more than the parts and is not deducible from them’. The aesthetic form in a theory or equation, on the other hand, according to Engler, is a whole which is more than its parts but ‘can be perceived only through the analysis of its parts’ (1990, p.27). Engler points out that in science, the ‘parts’ are of central importance. He writes that these ‘parts’ are physical ideas and concepts which are eventually expressed in mathematical relations. Now Engler presented this difference as an obstacle to the understanding of intellectual beauty and artistic beauty as simply two manifestations of the same kind of beauty. I argue, on the contrary, that by understanding intellectual beauty as a subset of type C aesthetic form, we can understand the difference between intellectual and artistic beauty as a difference in the way in which we come to know the base properties of the various manifestations of beauty. The base properties are the units between which relations arise on which aesthetic form supervenes. So for example, once we know the parts of a theory, the aesthetic form can emerge from the relations between these parts. Engler has confused the aesthetic form with the logical form of the theory. The aesthetic form involves an intuitive grasp of the whole emerging from the way the elements in the theory relate: intuitive, because the
aesthetic form is known through the subjective response it evokes, but cannot be defined according to sufficient conditions. The logical form, on the other hand, is the sum of the relationships which are known through an analysis of the way the elements relate. Consequently, even though in the case of intellectual beauty, the aesthetic form could be said to supervene on an analysis of the parts of the theory, an analysis of the parts of the theory does not itself constitute the aesthetic form of the theory. How one comes to know the actual parts or elements of the theory does not figure in the processes involved in the experience of beauty. That is, the aesthetic form of a theory or equation supervenes on the combination of relations holding between the elements of the theory or equation.

Another philosopher, James McAllister, points to this distinction when he differentiates between the logico-empirical or truth-related judgments made by scientists and the aesthetic evaluations they simultaneously make on their theories. He says that when it is a choice between competing theories which are equal in predictive power but possess some incompatibility, such as ‘radically different ontological commitments ... [which prevent] their being considered alternative expressions of a common theoretical substructure’ (a situation he refers to as ‘underdetermination of theory-choice’), the dilemma might be averted by making recourse to aesthetic criteria (1991, p.334). Aesthetic criteria, according to McAllister, are ‘disinterested’ in paying no heed to the likely empirical performance of the objects of the evaluation. McAllister defines 'disinterest' as non-utilitarian. Aesthetic perception, as he calls it, attends to the intrinsic merits of the object.1

It is the aesthetic form of the theory, then, which constitutes its beauty. For example, Dirac's theory of the electron was taken to be beautiful and proved very useful, according to Weinberg, in the development of quantum electrodynamics in the 1930's and 1940's. However, today it is known to be wrong and it turns out that its usefulness was due to the fact that by accident, it

1 He describes what he means by drawing upon Edward Bullough's essay on 'psychical distance' (1959).
gave the same results as the theory now deemed to be correct when certain processes were involved. Yet the mathematics of Dirac's theory is still relevant today and has survived the death of the conceptual scheme presented in Dirac's theory. The form and structure are retained, applied and continue to be found relevant, even though the content of the theory has been discarded. When a theory is judged to be beautiful, it is the form and structure when perceived as aesthetic form, which gives rise to the experience of beauty.

I will include here another example which illustrates rather intriguingly how aesthetic form can supervene on representational content, even though the example is not, according to our definition set out in the introduction to this chapter, a case of intellectual beauty. I must admit though, that apart from the fact that the example rings true to my own experience, I take this example as having some persuasive merit due to its author, Bertrand Russell, who was not one to acknowledge ineffable percepts, which is exactly what he implies about beauty in the following extract.

Everyone who has done any kind of creative work has experienced, in a greater or less degree, the state of mind in which, after long labour, truth or beauty appears, or seems to appear, in a sudden glory - it may be only about some small matter, or it may be about the universe. The experience is, at the moment, very convincing; doubt may come later, but at the time there is utter certainty. I think most of the best creative work, in art, in science, in literature, and in philosophy, has been the result of such a moment. Whether it comes to others as to me, I cannot say. For my part, I have found that, when I wish to write a book on some subject, I must first soak myself in detail, until all the separate parts of the subject-matter are familiar; then, some day, if I am fortunate, I perceive the whole, with all its parts duly interrelated. After that, I only have to write down what I have seen. The nearest analogy is first walking all over a mountain in a mist, until every path and ridge and valley is separately familiar, and then, from a distance, seeing the mountain whole and clear in bright sunshine (1961, p.138).

Russell adds that while he believes this experience is necessary to good creative work, ...it is not sufficient; ... [because] the subjective certainty that it brings with it may be fatally misleading. ... What seems like sudden insight may be misleading, and must be tested soberly, when the divine intoxication has passed (1961, p.138).
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The fact that Russell implies here that the 'whole, with all its parts duly interrelated' just occurs to him, suggests that he is talking about the aesthetic form arising from the combination of concepts with which he has been occupied. Interestingly, Russell identifies this whole with truth or beauty.

I have attempted to illustrate what it means for aesthetic form to supervene on representational content. I hope to have shown that the aesthetic form of theories and equations, shares the same characteristics as the aesthetic form of artworks.

7.4 Intellectual Beauty: Lawful and Ineffable

The most striking aspect of accounts of how judgments of intellectual beauty are made, which suggests that such judgments are genuine judgments of beauty, is the nature of the features identified as the criteria for intellectual beauty. In 6.5 Weinberg's criteria for intellectual beauty were listed as symmetry, simplicity, inevitability and rigidity. Engler lists the 'aesthetic concepts' employed in science as symmetry, simplicity, order, coherence, unity, elegance and harmony (1990, pp.29-30). Engler claims that these concepts 'must find their representation in mathematical forms and relations, whatever their degree of abstraction'. However, when Engler describes each of these concepts they all have, except for 'symmetry', the indeterminacy of aesthetic concepts per se. That is, they display the same features as those concepts which are inferred from simpler properties but which can be illustrated only by particular examples as they elude generalizations (lawful and ineffable: see 1.5 and 5.4). Thus the aesthetic concepts employed in science and mathematics share the same characteristics as the aesthetic concepts employed in art. Intellectual beauty and perceptual beauty are experienced as lawful and ineffable properties.
7.5 Beauty Versus Formal Attractiveness

I mentioned at the end of 7.2, that there is broad agreement among scientists and mathematicians about which theories and equations are beautiful. However, it must be possible for the individual scientist or mathematician to be mistaken at times when using beauty as a guide to solving problems. Russell refers to this possibility in the extract of his I included earlier. Polanyi addresses this possibility and points out that sometimes a theory which is merely formally attractive can be mistakenly judged to be beautiful. He points out that the ‘delicacy of the test between ... [beauty and formal attractiveness, is] so difficult that it may baffle the most penetrating scientific minds’ (1958, p.149). This idea of formal attractiveness provides us with a loophole. That is, if a theory formerly evaluated as beautiful were proven beyond doubt to be false, then it would be taken as an example of formal attractiveness having been mistaken for beauty. However, in the discussions concerning intellectual beauty it is implied that when there is general agreement about the beauty of a theory, this is a fairly fool-proof indication that the theory is beautiful rather than merely formally attractive, even without the hindsight of the theory’s success in application. Mistaking formal attractiveness for beauty is more a situation experienced by the scientist or mathematician working in isolation, when he or she is mislead by what Polanyi calls the heuristic passions. As Polanyi writes:

both Kepler and Einstein approached nature with intellectual passions and with beliefs inherent in these passions, which led them to their triumphs and misguided them to their errors. These passions and beliefs were theirs, personally, even though they held them in the conviction that they were valid, universally. I believe that they were competent to follow these impulses, even though they risked being misled by them. And again, what I accept of their work as true today, I accept personally, guided by passions and beliefs similar to theirs, holding in my turn that my impulses are valid, universally, even though I must admit the possibility that they may be mistaken (1958, p.145).
7.6 A Further Extension of the Explanatory Power of an Interactive Theory of Beauty

In this section I will attempt to explain two aspects of intellectual beauty which have emerged from the analysis and explanations above. First I will consider how it is possible that representational content can stimulate the perception of aesthetic form, without any prompting from perceptual content. Then I will examine a feature of intellectual beauty which differentiates it from artistic beauty, namely its instrumentality, to see whether the central idea of this thesis can be extended to account for it.

7.6.1 Aesthetic form and representational content

In 6.4, I presented two theories which, if true, would support the possibility that perceptual processes can operate on representational content. But what I am concerned with here, is what it is about the representational content of scientific and mathematical theories and other nonperceptual stimuli, that stimulates such a process. In my explanation of type C aesthetic form (6.3), the perception of aesthetic form in the perceptual content of an object was crucial in stimulating the perception of aesthetic form in the representational content of the same object. Hence, I need to account for how aesthetic form can be perceived in representational content without the prompting provided by the aesthetic form of the perceptual content of the object.

Could it be that because the theory or information has been studied and inspected under sustained concentration for a considerable length of time, that through a kind of mental exhaustion, much like the phenomenology of the Necker cube, we loosen our grip on the representational level of processing. When this happens, the theory or equation is interpreted according to the processes underlying the construction of perceptual form, and if this interpretation employs the processes in a way which epitomizes their operations, or employs them in an unprecedented way, but still results in a coherent whole (a combination of relations
which reflects what the perceptual system treats as the one coherent perceptual form description), then we experience these processes and hence, experience the theory or equation as beautiful. The construction of perceptual form would be a dominant function within perceptual processing. Remember also, that the level of construction of the perceptual form is closely tied to object recognition and hence, the level involved in the processing of representational content. The fact that the processes involved in the construction of perceptual form might be prompted into action by prolonged mental activity: that after intense mental activity in which they have not been directly employed, they spring into action once the mind slackens the employment of processes which are other than perceptual processes, is understandable, particularly if we accept that mental processing has evolved to perceive and recognize objects. That is, according to an evolutionary story, the construction of perceptual form could be understood as a predominant function of the internal processes. Hence, sustained mental activity in which they are not directly employed, might stimulate them once the grip on the other kinds of processes has slackened. The example provided by Russell which I cited in 7.3, suggests such an explanation, as do many other reports of scientific and mathematical creation (see Poincare, in Ghiselin, 1952). Such a theory might be easily tested by cognitive psychologists.

7.6.2 An explanation for both the instrumentality of, and the subjective response to, beauty.

In demonstrating that intellectual beauty shares the same features as artistic beauty, an additional feature of intellectual beauty emerges and this is its instrumentality. In this section I will suggest a possible explanation for this instrumentality, based on the central idea of this thesis. That is, if the experience of beauty is an experience of the processes underlying the construction of perceptual form which occurs in the course of perceiving beautiful objects, could the instrumentality of intellectual beauty be explained by this?
Remember that according to the theorists whose analyses of intellectual beauty were discussed above, a sense of beauty helps scientists invent physical theories and judge the validity of theories. According to Weinberg, ‘the search for beauty in physics was a theme that ran throughout ... much of the history of physics’ (1993, pp.105-131). According to Engler:

mathematical ideas have come to be pre-eminent in science for the reason that the mathematical approach is abstract, formal, susceptible to the imagination and is more effective than any other means, with regard to a synthesis of various aspects of reality (1990, p.28).

Engler points out that ‘the two major achievements in twentieth-century physics, general relativity and quantum mechanics, were built on speculative jumps of mathematical imagination’ (1990, p.28). The form of the theory or equation is what is judged to be beautiful and the form is provided by the underlying mathematics. The key to the explanation which I provide here for the instrumentality of intellectual beauty, is that the instrumentality of the form of the theory coincides with it being judged to be beautiful.

Before continuing, let’s just get this relationship between beauty and usefulness right. We cannot actually say conclusively why beauty and usefulness coincide concerning intellectual beauty. We can only speculate as to the reasons for the relationship. Now, an objection sometimes raised in relation to classifying intellectual beauty as a genuine case of beauty is that intellectual beauty is instrumental and artistic beauty is pleasurable. However, this objection misses a crucial point. The instrumentality of intellectual beauty does not replace the pleasure afforded by intellectual beauty: rather it is an additional feature of beauty.

For example, Weinberg suggests that perhaps the instrumentality of intellectual beauty and the idea that artistic beauty is motivated by pleasure reflects underlying differences between intellectual and artistic beauty. But this difference would only point to underlying differences if the beauty in science was judged by a theory's usefulness (in application) while in art beauty was judged by the pleasure
afforded by an object. This is wrong in both cases. First, the pleasure evoked by judgments of artistic beauty is a peculiar kind of pleasure which we call aesthetic pleasure because it is associated with aesthetic form. This is the same kind of pleasure which is evoked by intellectual beauty. Second, the judgment of intellectual beauty is not based on a theory's usefulness, but merely coincides with the theory's usefulness.

Taking up this second point, it does not follow from the claim that beautiful scientific theories are useful, that theories are beautiful because they are useful. A theory is not beautiful because it is useful; nor is it useful because it is beautiful. There is no conceptual link between beauty and usefulness. Rather, the claim is that in science the theory is useful when it is beautiful. The cause of its usefulness may be the same as the cause of its beauty (a possibility I will explore below) but even so, this would not show a causal link between scientific beauty and a theory's usefulness in application. Judgments of beauty are necessarily independent of the judgment of the object's usefulness. To apply aesthetic concepts as you would empirical concepts, is a contradiction in terms.

Engler unwittingly suggests the source of this confusion when he points out that many scientists have confidence in the guiding values of aesthetic concepts because they have seen that in the past such a confidence has paid off. Perhaps some scientists acquaint themselves with what beauty is through a study of effective theories. However, Engler points out that the 'great creative scientists' maintain these concepts on a different level. He writes that for them,

this confidence is apparently based on a certain metaphysical faith that nature is fundamentally beautiful and it is therefore no coincidence that nature presents itself persistently through forms that are perceived by the mind as aesthetically attractive. This faith was most notably held by Einstein (1990, p.31).

I take it as no accident that for the truly creative scientist beauty has intrinsic value. Perhaps the 'great creative scientists' owe something of their greatness to the fact that they know beauty in a way that the run-of-the-mill variety can only emulate.
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We saw that Polanyi believes that science makes contact with reality by recognizing what is rational in nature rather than impersonally observing or calculating ‘what is there’, or ‘what is just simply the case’. Polanyi suggests that the scientist is guided by underlying passions; not the type of passions that imply a personal bias, but the sort of passions that are underpinned by universal schemas; thus they are humanly biased. According to Polanyi:

Intellectual passions do not merely affirm the existence of harmonies which foreshadow an indeterminate range of future discoveries, but can also evoke intuitions of specific discoveries and sustain their persistent pursuit through years of labour. The appreciation of scientific value merges here into the capacity for discovering it; even as the artist’s sensibility merges into his creative powers. Such is the heuristic function of scientific passion. Scientists - that is, creative scientists - spend their lives in trying to guess right (1958, p.143).

According to Polanyi, the instrumentality of intellectual beauty is due to the fact that the form of the theory or equation reflects some truth in reality. He uses various examples from the history of the evolution of physics to establish what he says is the ‘power of intellectual beauty to reveal truth about nature’ (1958, p.149). While Polanyi emphasizes the personal response evoked by intellectual beauty, he juxtaposes this with what he recognizes as the objectivity in the form of intellectual beauty.

The notion of beauty which emerges from many of the accounts given of its role in science and mathematics, suggests that it is somehow a manifestation of our rationality: phenomenologically it seems to be situated in ourselves and in nature. Consequently, if we can tap into this sense of beauty in ourselves, we can tap into the underlying principles of nature. Polanyi writes:

At all these points the act of knowing includes an appraisal; and this personal coefficient, which shapes all factual knowledge, bridges in doing so the disjunction between subjectivity and objectivity. It implies the claim that man can transcend his own subjectivity by striving passionately to fulfill his personal obligations to universal standards (1958, p.17).
I have quoted Polanyi extensively here, because he makes some intriguing links between science, heuristic passion, rationality, objectivity and beauty: links which I think are maintained in the explanation I will offer for the instrumentality of intellectual beauty.

Let's pause to think about what we have found out about intellectual beauty so far. Dirac implies that the only way to make real advances in the sciences or mathematics is by using beauty as a guide, because this is the only way to transcend the conceptual framework which can prevent advances being made (1963, p.53). Beautiful theories, then, are effective and the beauty of a theory is the beauty of its aesthetic form. Consider for a moment what this means. When a theory is beautiful, its beauty indicates that it will have a useful application: if not now, then at some future time. The fact that it has a useful application indicates that something about it corresponds with something about 'how the world is': hence the beauty of a theory could be said to be an indication that something about the theory corresponds with certain underlying laws of nature. If, as the Interactive Theory of Beauty set out in this thesis argues, beauty is the experience of the processes underlying the construction of perceptual form during the course of perceiving beautiful objects: then, given the link between a theory's beauty and its usefulness, the processes underlying the construction of perceptual form could be said to reflect something of the physical laws underlying nature. Conversely, that an experience of the processes underlying the construction of perceptual form during the course of perceiving beautiful objects constitutes the experience of beauty and that these processes reflect something of the physical laws underlying nature, would explain the instrumentality of intellectual beauty. This, in a nutshell, is my contention. The rationality that, according to Polanyi, the scientist seeks in nature, is in fact, a pattern which the scientist imposes on the phenomena, which epitomizes the processes underlying the construction of perceptual form. The scientist, then, seeks to construe the perceived phenomena in a form which epitomizes the processes underlying the construction of perceptual form.
That perceptual processes might reflect something of the physical laws underlying nature is feasible from an evolutionary perspective. There would be a number of possible stories one could tell about this: such as that perception having evolved under adaptive pressures imposed by nature, evolved underlying principles which reflected those underlying nature. This explanation implies that we cannot perceive nature objectively as such, but only through and according to, the constraints imposed by our perceptual apparatus. This, while a controversial claim, is one which has its precursors and its contemporary defenders. I simply assume that it is the case but do not argue for it here.

In a sense, then, the experience of beauty is an experience of perceptual constraints. Of course, we do not experience them as constraints, but rather as an overpowering sense of clarity because we are in effect experiencing the processes which underpin perception and hence to a degree, cognition. According to Polanyi, scientific discovery is motivated by a belief in the rationality in nature. Perhaps what we know of as the rationality in nature, is the all pervasive sense of clarity which characterizes an experience of beauty. That is, we interpret the experience of beauty as if it reflected a clarity and underlying order existing in nature. Perhaps then, the experience of beauty instills in us a belief in the underlying order of things and this belief motivates the scientist. Thus, as noted earlier, even when the scientist is confronted with a chaotic phenomenon and even when all the evidence may suggest that there is no order inherent in the phenomenon, the scientist behaves as though it is just a matter of finding the right perspective from which the pattern underlying the phenomenon will emerge. If this is correct, I would be tempted to construe it as the ultimate irony of those policy shifts which assume that technological advancement can only come through teaching subjects in school which develop the future citizen's powers of reasoning and powers of empirical observation. The irony being that it is only through the

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1 Consider Kant's notion of the 'thing-in-itself' as opposed to how nature appears to us, as an example of a precursor to this idea. For an example of a contemporary version of this, see Jerry Fodor (1975 and 1983). Furthermore, Marr's theory of vision can be understood as an argument for, or at least as offering support for, this claim.
experience of beauty, that we can be led to a discovery of the physical laws and hence the principles, underlying nature.

In developing an explanation for the instrumentality of scientific and mathematical beauty, I have found that the subjective response to beauty, which I have suggested is best described as a feeling of clarity, is also explained. The fact that the instrumentality of beauty and the subjective response to beauty are served by the same explanation, strongly suggests that scientific and mathematical beauty are manifestations of the same process which is responsible for artistic beauty.

7.7 Summary

In summary, then, I have demonstrated that intellectual beauty is a genuine case of beauty. I have analyzed intellectual beauty and have suggested that there is a plausible link between beauty and the physical laws underlying nature. I have suggested that the experience of beauty is the basis of our route to discovering what these principles or laws of nature are. Hence, I hope to have planted in the reader's mind the seeds of a new understanding of beauty, in which beauty is understood as possibly a fundamental process of mind, an understanding of which might illuminate or contribute to the understanding of such factors as cognition and creativity. In addition, this new understanding of beauty, might inspire us to acknowledge that there are other more complex motivational forces behind our actions than the simplistic notion of personal gain which is increasingly coming to represent to the popular imagination, the sole source of motivation behind human behaviour.¹

¹ I refer here to the rather pessimistic view which has become fashionable in popular and sometimes in scholarly culture which has its source in the work of Freud and in simplistic interpretations of Darwin. That is, the assumption that the only factors which can motivate human behaviour can all be reduced to the satisfaction of basic human appetites.
Conclusion

My central hypothesis is that beauty is a relational property of beautiful objects. It is the property of being such that human perceptual processing of it will employ certain specific processes of whose operations the object makes us dimly aware. The experience of beauty can be explained as an experience of the processes that underlie the construction of perceptual form during the course of perceiving beautiful objects. The idea is that these processes are employed in such a way during the course of perceiving beautiful objects, that they arrest our focus and we become dimly aware of them (even though we are not aware at the time, of the source of the experience but instead attribute the aspects of the experience to the perception of certain properties in the object). For example, the perception of some objects might employ these processes in a way which epitomizes their normal operations, or might employ these processes in an unprecedented way, or in a way which violates these processes (the latter, on its own, it is suggested, would give rise to the perception of ugliness). I call this an Interactive Theory of Beauty.

I have argued for this theory by presenting its explanatory power. Of particular interest for aesthetics is that an Interactive Theory of Beauty resolves the opposition between the features identified as characterizing the concept of beauty and the features identified as characterizing the phenomenology of beauty. According to an Interactive Theory of Beauty, the features identified as characterizing beauty are as follows. Judgments of beauty are universal and evoke a subjective response. The subjective response is best described as a feeling of clarity. The experience of beauty is evoked by the perception of aesthetic form, and aesthetic form supervenes on content, either or both perceptual and representational content. Judgments of beauty can be defended by inferring beauty from more basic properties, even though beauty is ineffable. In the case of scientific and mathematical beauty, an additional feature of beauty is exposed: and this additional feature is its instrumentality. I have demonstrated how my central hypothesis can
be employed to explain each feature in a way in which these features are not construed in opposition but are complementary, and result in a unified theory of beauty. The explanation given for the instrumentality of scientific and mathematical beauty, in particular, highlights the cohesion of this theory, by drawing upon the very aspects of the theory which explain the universality of beauty, and by providing, at the same time, an explanation for the characteristic subjective response to beauty, which I have described as the feeling of clarity. This suggests that the notion of instrumentality is a feature of beauty, rather than an aberration: that is, in employing my central hypothesis to explain mathematical and scientific beauty, I am not overstretching the work that the concept of beauty can be reasonably expected to do, rather I am demonstrating that the Interactive Theory of Beauty relocates the concept of beauty’s ‘centre of gravity’ so to speak.

A further recommendation for this theory of beauty, is that it accounts for the full import of the phenomenology of beauty. That is, it accounts for the experience of beauty in perceptual and representational content. In all then, the explanatory power of the theory, its cohesion and the fact that it captures the phenomenology of beauty, all offer strong support for it.

The Interactive Theory of Beauty provides us with a new way of thinking about beauty and aesthetic form. In short, this thesis has attempted to prompt a paradigm shift in the way beauty is construed. The resulting notion of beauty and aesthetic form highlights the significance of beauty and aesthetic form for understanding certain aspects of perception and cognition. Through the explanation I offer for the instrumentality of scientific and mathematical beauty, I suggest a link between the perception of aesthetic form and the processes involved in creativity in all fields of enquiry. Hence, the experience of beauty and aesthetic form may play a more crucial and interesting role in cognition, than the traditional theories of beauty would suggest.
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