Chapter 3

INFORMATION AND PERCEPTION

Every mental phenomenon is characterized by what the Scholastics of the Middle Ages called the intentional (or mental) inexistence of an object, and what we might call, though not wholly unambiguously, reference to a content, direction toward an object (which is not to be understood here as meaning a thing), or immanent objectivity (Brentano 1874: 88).

3.1 Introduction

The task of sonification software is to provide a means by which listeners can acquire new ideas about the nature of the source of derived data. In so doing listeners can increase their knowledge of that source and thus improve the efficiency and/or accuracy of their decision-making based on that knowledge. In broad terms, sonification[1] can be considered to have four major ingredients: data, sound, listener and environment, as illustrated in Figure 3.1. In the current context, the term *listener* is used to mean a human being[2] without gross auditory system abnormalities, who, in various ways, engages in listening to sound[3] that is generated or manipulated by sonification software within an environment. *Environment* is used in a very broad sense here to mean a complex of intersecting fields that surround or encompass a listener physically, socially and psychologically.

The purpose of this chapter is to develop an understanding of what information is as a concept, as an ingredient in the acquisition of knowledge, and as something that can be communicated between its source and its (human) receiver in aural form and retained. Clearly, a complete philosophical and psychological overview is outside the scope of this thesis, however it is considered important, in the context of developing software that enables such communication, to have an understanding of some of the principles involved. Firstly, exactly what is meant by the term *information?* and secondly what are the characteristics of human sensation, perception and

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[1]   *Sonification* is used synonymously with *data sonification*, as discussed in Chapter 2
[2]   Much of what is said could equally apply to other organisms with functioning auditory systems, or perhaps, even similarly endowed machines.
[3]   Here, sound is understood simply as contractions and rarefactions of air-pressure that are detected by a listener's auditory system. The ontology of sounds is addressed in Chapter 4.

cognition that affect this transmission process? By restricting the inquiry to the phenomenal aspects (what appears to us as humans), a discussion of the mechanisms of *how* it appears is largely deferred until later in the chapter.[4] By way of simple example, understanding *what* melody is and that it appears to human beings to be invariant under certain types of transformations such as pitch transposition and temporal compression, is a different enquiry to *how* it occurs, both in terms of the physical production and transmission of energy in the environment, and the physiological mechanisms by which that energy is sensed by human beings.
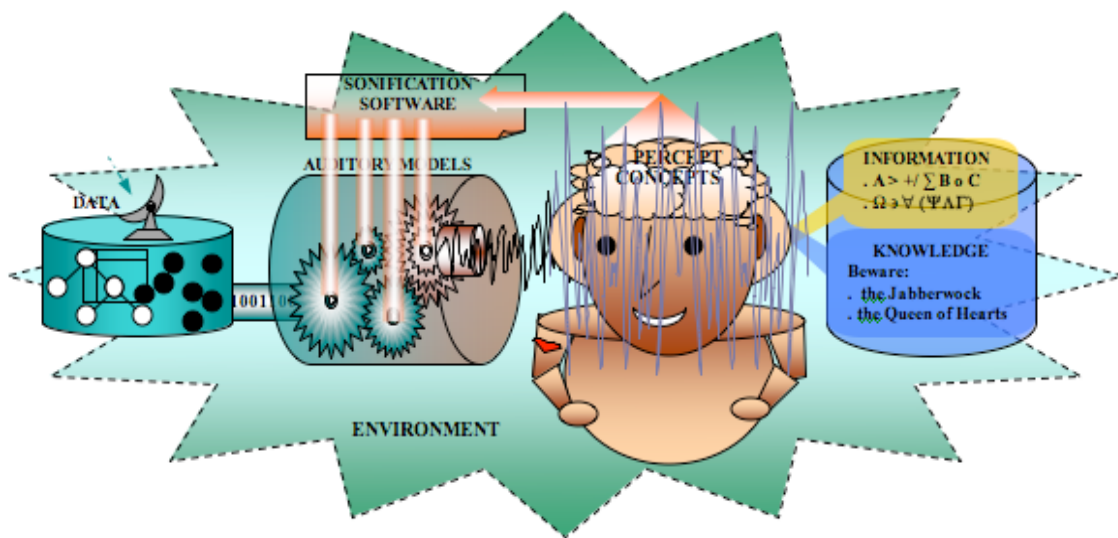

Figure 3.1. Four major ingredients of sonification: data, software, listener and environment.

The structure of this chapter is as follows. A distinction is made between information and knowledge and a contemporary understanding of information is presented. Then a quasi-historical epistemology of human perception and the types of information these epistemologies engender is followed by a discussion of the phenomenal nature of sounds and their ability to convey information of various sorts. A discussion of the means by which sounds is used to convey musical information is deferred to Chapter 4. This leads to some ideas about how sound can be more effectively used in the sonification of immanent phenomenal objects, such as those derived from multidimensional datasets, that don't have simple analogues in the material world.

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[4]   This is not to suggest that *what* and *how* are unrelated. In fact, they exemplify two principle aspects of knowledge: objects and of relations.

3.1 Information and knowledge

There is a distinction to be made between the terms *information* and *knowledge,* despite them being frequently used in common parlance to mean the same thing. Here, knowledge is considered to be *a theoretical or practical understanding of a subject* (AOED). Most often, knowledge is gained through the integration of new information to that already retained. In broad terms, *information* can mean the content of knowledge; new information can be added to a corpus, body of knowledge[5], but not the reverse. The process of 'adding to' is termed *learning* which is considered distinct from the *structure* of the corpus, as well as the *mechanisms* of knowing it, as enunciated by researchers in the cognitive science program at Yale (Galambos, Abelson and Black 1986). These terms become somewhat problematic if they are treated as definitions rather than descriptions and their meanings have changed over time. Such changes continue to occur as our understanding of the underlying perceptual and cognitive mechanisms, together with their environmental influences, evolves. Whilst it is important to understand the different processes by which knowledge is acquired, whether from information or not, it is not central to the theme of this chapter, so a succinct overview is provided in Appendix 1.

As a process of thought, metaphysics is less directed to providing conclusions than it of exploring a mental landscape, of organizing beliefs and experiences into holistic descriptions. Of the two principal divisions of metaphysics, epistemology and ontology, the focus of this chapter is epistemological. The objective in examining the epistemology of information and perception is to gain an understanding of the nature of certain types of mental states that are induced to reside in the minds of listeners on hearing a sonification. As will be argued, because of the directed or intentional nature of perception, such information is bound between the sounds of a sonification and the intentions of listeners.

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[5]   The historical use of the expression *corpus* 'a body of knowledge' is of interest in the light of the discussion of embodiment later in the chapter.

3.2 Information: some descriptions

Considering the current scientific, economic and social importance that is given to the concept of information, it is remarkable how unclear its meaning is in some contexts. Ronald Stamper, the founder of systems analysis studies at the London School of Economics, writes about his common experience of computers being used with great technical skill but with poor results. He argues that the overwhelming reason is that there is a lot of technical skill with information technology but little knowledge about the information it carries. Whilst there is a general agreement about the nature of data, information, he remarks,

> is a vague and elusive concept. … My greatest hope is that, one day, members of the information systems profession will stop talking about information as something 'obtained by processing data to produce meaning' (Stamper 1996: 349).

3.2.1   Information as quantity of improbabilities

Information Theory is an applied mathematical theory invented by Claude Shannon to assist in finding measures of the limits to compressing data and reliably communicating it within an existing telecommunications system (Shannon and Weaver 1949). In the mathematical theory, information is understood as an objective quantifiable entity, the information content of a message being a quantitative measure of its improbability. Information Theory

> ...provides a measure for how much information is to be associated with a given state of affairs and, in turn, a measure for how much of this information is transmitted to, and thus available at, other points. The theory is purely quantitative. It deals with amounts of information - not, except indirectly and by implication, with the information that comes in those amounts (Dretske 1981 cited in Hoffmeyer and Emmeche 1991).

In such quantification, the value of information in a statement (a message) reflects the statistical structure of the statement. The question of how information was created or what should be meant by the significance of information was not addressed through the theory. In human communication, most statements are only understandable at a semantic level. Information theory requires a finite set of possibilities, or it cannot assign precise probabilities to the possibility of any particular message. Thus

Khinchin (1957: 90), more properly calls Information Theory a theory of discrete information.

Sound spectra can considered as frequency encodings of information, with white noise, which contains no redundancy, at one extreme and a sine tone, which contains maximum redundancy, at the other (Moles 1966). One of the fundamental tasks that auditory systems are known to perform well is frequency spectra differentiation (Shepard 1999), and this capability can be used in data audification "to provide a measure of how much information is to be associated with a given state of affairs" by affording comparisons between the microsound qualities of spectra-encoded data and various recognisable encodings such as white, pink, blue, and Brownian noises. Experiments 1 and 2 in Chapter 6 articulate an experimental technique for the application of sonification to aurally identify the distinction between informationless sound (a uniform distribution) and one that exhibits correlational information.

In general, the concept of information as a quantitative measure of noise or redundancy is of little use in human-to-human sensible communication, since the statistical analysis of the probabilities to be ascribed to any definite statement is not only unfeasible, but also theoretically impossible. While totally unforeseen events are demonstrably a part of life, their eventual appearance makes it impossible to ascribe distinct probabilities to any event.

3.2.2   Information: general, scientific and pragmatic

The term *information* is commonly used synonymously for an instruction, an answer, a news message or announcement and, in general, people do feel that they are often *informed* through observation and conversation. The quantitative improbability definition of Information Theory does not account for this sense of information.

In empirical science the concept *information* is as a statement (Roederer 2005). It is known as the semantic aspect of information, because it answers a pre-formulated question, such as "what is the fundamental frequency of this wave?" or it indicates the specific outcome of known alternatives, such as "Did the viola section enter one measure too early or too late?" or "Is the next card the queen of hearts?"

Only *living* systems have the capability of engaging in information-driven interactions with each other and the environment. This aspect of information is called *pragmatic* (Küppers 1990) and is often used by such systems to counterbalance the otherwise normal course of physical events. Some important characteristics of this information are

- Information is the shape or pattern of something, not the energy or forces used to give it that pattern. These forces and energy may be necessary to effect the pattern but they are separate from, and subservient to the purpose for which the information was formed.

- Information always has a *purpose*: to cause specific *change* somewhere or at sometime that would not otherwise occur, except, perhaps, by chance.

- It is what information *does* that is important, not how the form in which it resides is textured, or sounded.

- The *form* in which information resides *expresses it*, but this expression is not the information. This idea is expressed differently later on in this chapter; for example in Husserl's 'bracketing' of the phenomenal world from the 'world–as–it–is' (§3.3.3.4) and in Korzybski's "the map is not the territory"(§3.3.7). Music, for example is not a score or a CD, or the compactions and rarefactions of air pressure in a sound wave, or the neural activity of the brain. It is the intended *effect* that ultimately identifies information.

- Altering the form in which the information resides may result in a different expression or may destroy the information. For example, rearranging the notes of a melody destroys the melody and the continuity of a glissando on a violin is not preserved when expressed by an oboe.

- There is no such thing as information in isolation. Information always requires

  - An origin, source or sender where the original pattern is located or generated,

  - A recipient, where the intended change is supposed to occur,

  - A transmission from one to the other. For the purpose of a specific change to occur, a specific information–processing mechanism must exist and be activated.

- <u>Information can be stored</u> and, providing it has not been corrupted, retrieved, either in the form of the original pattern, or of some transformation of it.

3.3 Forms of information and perception

3.3.1   Platonic Ideals

The elusiveness of the term *information* is embedded in its historical epistemologies (Hoffmeyer and Emmeche 1991). In the Middle Ages it was used in connection with a person being informed or educated[6]–to become aware of the form (of something), give shape to, fashion (ACOD). The concept of *form* extends back through Aristotle and Plato to at least Pythagoras who is responsible for adding it as a correlative concept to the Milesian's conception of 'matter'. (Burnet 1904/1981: 35). This shift of information in the mental sphere moving to the physical sphere of substance and action, is paralleled in the shift of Form as a Platonic Ideal to something physical in which

> [f]orms were induced on, not derived from substance. They reflected human or Godly will. Thus, to bring something into form presupposed a person in whom the idea of the form must first have occurred. And this occurrence, the idea, was the root of information (Hoffmeyer and Emmeche 1991).

Burnet traces this thinking though Socrates' Doctrine of Forms, and Plato's Ideals which assert that individual objects are but imperfect examples of universals, divinely given and residing in man's soul (mind):

> There is a sharp distinction between the objects of thought and the objects of sense. Only the former can be said to be; the latter are only becoming. …We know what we mean by equal, but we have never seen equal sticks or stones. The sensible things we call equal are all 'striving' or 'tending' to be such as the equal, but they fall far short of it. Still, they are tending towards it, and that is why they are said to be becoming (Burnet 1904/1981: 126-127).

In contrast to Plato's position, which held that particular things are deduced from these *a priori* Ideals[7] by contemplation, Aristotle held that particular things contained universal essences, and such Forms (ideas) were induced

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[6]   From L. *informationem* (nom. *informatio*) "outline, concept, idea," noun of action from *informare* (OED); L *informere* – in (into) + forma (form)

[7]   Greek ιδεα. Plato seems to use the term interchangeably with *eidos*, which serves to designate any of those primary realities that have come to be known as the Forms. The term takes on a significant philosophical meaning from his writings onwards that the term seems to develop an elaborate life of its own (Taylor 1911). See also Note 17.

from particular Category instantiations. He compares the act of perception to the pressing of a signet ring into wax:

> By a 'sense' is meant what has the power of receiving into itself the sensible forms of things without the matter. This must be conceived of as taking place in the way in which a piece of wax takes on the impress of a signet-ring without the iron or gold; we say that what produces the impression is a signet of bronze or gold, but its particular metallic constitution makes no difference: in a similar way the sense is affected by what is coloured or flavoured or sounding, but it is indifferent what in each case the substance is; what alone matters is what quality it has, i.e. in what ratio its constituents are combined (Aristotle 350BCE: BkII, Ch12).

Upon the reappearance of Aristotle's works in the west, this position was adopted by medieval Scholastics such as Thomas Aquinas, for whom the representation of an external object in the mind and the object it self was the same object in two different forms of existence. This is because, put simply, they held the same form, or *conformed*. Medievalist Henrik Lagerlund explains:

> This 'conformality' account of mental representation is for Aquinas embedded in a much larger, causal theory of the reception of these forms into the mind or intellectual soul, according to which forms are transmitted through the intervening medium between subject and object (the doctrine of the *species in medio* or 'species in the medium') and received in the external sense-organs and sense-faculty, which leads to the production of phantasms or sensible species and ultimately to the creation by the active intellect of a mental representation or intelligible species in the passive intellect (Lagerlund 2008).

3.3.2   Material Ideals

3.3.2.1   Early rational approaches to perception

In addition to the mental representations adopted from Aristotle, based on conformity and resemblance, the late Scholastics such as Ockham developed other notions based on causality and signification. Following the Scholastics, seventeenth century contemporaries Descartes, Spinoza and Leibniz continued to look for knowledge using rational thought including the continued development of logic, mathematics and Euclidian geometry.

René Descartes' starting point was his own experience (*cogito ergo sum*) and thought that the mind reached out to external objects themselves, with the sense organs and nerves serving as literal mediating links between the objects and the brain events that afforded the perceptual awareness of them. He is clear, however, that sensory awareness does not reach out to the

physical things themselves; that in veridical sensation, the mind's ideas are not the immediate objects of awareness:

> …whence I should forthwith be disposed to conclude that the wax is known by the act of sight, and not by the intuition of the mind alone, were it not for the analogous instance of human beings passing on in the street below, as observed from a window. In this case I do not fail to say that I see the men themselves, just as I say that I see the wax; and yet what do I see from the window beyond hats and cloaks that might cover artificial machines, whose motions might be determined by springs? But I judge that there are human beings from these appearances, and thus I comprehend, by the faculty of judgment alone which is in the mind, what I believed I saw with my eyes (Descartes 1641: II, 13).

3.3.2.2 Material or Perceptual Idealism

At the same time and in contrast to a rational approach, try-it-and-see empirical[8] heuristics developed out of the methodologies of occidental physicians and alchemists, as exemplified by William Harvey and Francis Bacon. Their increasing success led to attempts to apply such methods to understanding how we obtain knowledge itself. The Scottish physician John Locke is credited as the founder of modern Empiricism, as he took the crucial step of denying all *a priori* knowledge (Gregory 1981: 338-339). Locke asked, if our understanding of the physical world was not descendant from Ideas but induced in the natural world, how did we acquire such understanding? He thought that a child's mind was like a blank tablet (*tabula rasa*) and all ideas came from experience, and then later, from reflection:

> Let us then suppose the mind to be, as we say, white paper, void of all characters, without any ideas: How comes it to be furnished? Whence comes it by that vast store which the busy and boundless fancy of man has painted on it with an almost endless variety? Whence has it all the *materials* of reason and knowledge? To this I answer, in one word, from *experience*. In that all our knowledge is founded; and from that it ultimately derives itself. Our observation employed either, about external sensible objects, or about the internal operations of our minds perceived and reflected on by ourselves, is that which supplies our understandings with all the *materials* of thinking. These two are the fountains of knowledge, from whence all the ideas we have, or can naturally have, do spring. (Locke 1690: Book II, Ch.1)

Locke's concept of perception was simple: objects have characteristics, and perception reflects the world much as a mirror reflects objects. The Irish bishop George Berkeley went on to argue that if an empirical analysis of human knowledge was followed rigorously, it had to be admitted that all

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8   Empirical. First use recorded in 1569, from L. *empiricus*, from Gk. *empeirikos* "experienced," from *empeiria* 'experience', from *empeiros* ''skilled', from *en-* 'in' + *peira* 'trial, experiment'. Originally the name of a school of ancient physicians who based their practice on experience rather than theory [OLED].

experience is nothing more than experience, that the qualities that the human mind registers are ultimately experienced in the mind itself, and there can be no conclusive inference from this as to whether or not some of those experiences represent or resemble anything outside it.

> There was an odour, that is, it was smelt; there was a sound, that is, it was heard; a colour or figure, and it was perceived by sight or touch. This is all that I can understand by these and the like expressions. For as to what is said of the absolute existence of unthinking things without any relation to their being perceived, that seems perfectly unintelligible. Their *esse* is *percipi*, nor is it possible they should have any existence out of the minds or thinking things which perceive them (Berkeley 1710: Book II, Ch.3).

However, the similarity of individual's reported experiences of the world convinced Berkeley that these experiences indicated the presence of order that was not just subjectively determined by whimsical fantasy. He postulated that the order that inheres in the world depends on God. (Tarnas 1991: 335-336).

Faced with things considered unknowable, both Locke and Berkeley relied on the same resolution as the majority of their predecessors–to a universal mind that transcends individual minds, which, as Gregory (1981: 346) puts it, *takes away the interest of this account*. David Hume agreed with Berkeley's empirical arguments but saw no reason to accept the resolution of a universal mind. He reasoned that, because the intellect cannot deduce the veridicality of received sensations or the connection between these sensations and the Truths in the intellect, the only truths of which the intellect is capable are tautological, that is are not capable of producing new information. He goes on to argue that, not only can one not logically *deduce* the nature of things using reason alone, neither can one *infer* them from experience. The only thing that connects sequences of sensations together is the principle of causality, which relies on the experience of individual concrete events in temporal succession.

> When we look about us towards external objects, and consider the operation of causes, we are never able, in a single instance, to discover any power or necessary connexion; any quality, which binds the effect to the cause, and renders the one an infallible consequence of the other. We only find, that the one does actually, in fact, follow the other (Hume 1777: Book VII, Ch. I, §50).

Hume maintained that whilst one might recognize the regularity of perceived events, the acceptance of the necessity for events to follow each other is not based on logical certainty, but on habit.

> When we say, therefore, that one object is connected with another, we mean only that they have acquired a connexion in our thought, and give rise to this inference, by which they become proofs of each other's existence: A conclusion which is somewhat extraordinary, but which seems founded on sufficient evidence (Hume 1777: Book VII, Ch. II, §59).

The mind draws an explanation of experience from itself and it cannot know what *causes* a sensation because it doesn't experience 'cause' as a sensation. Further, he goes on to argue, the concreteness of these individual events cannot be logically asserted, so causality is made meaningless. If all human knowledge is based on empiricism, and induction cannot be logically verified, there can be no certain knowledge. So, Hume had begun by trying to eliminate the necessity for metaphysics in deductive rationalism to investigate man's reasoning by using the empirical experimental techniques employed so successfully by Galileo and Newton, and ended up like Berkeley, skeptically questioning whether objective certainty could ever be empirically achieved because inductive inference couldn't be logically justified. (Tarnus 1991: 340).

3.3.3   Intention: Transcendental ideals and phenomena

3.3.3.1 Kant's Transcendental Idealism[9]

Although Immanuel Kant admired Hume's reasoning that, in his own terminology, causal judgments are synthetic, involving an act of the mind that connects the cause and the effect, he was also convinced that the (empirical) experimental methods of Newton had really revealed generalised knowledge, so he set about the task of trying to unify the rational and empirical methods. In other words, to show how (scientific) knowledge is possible, how both reason and experience contribute to that knowledge, and in doing so, refute the skepticism of Hume's claim that experience and reason are extremely limited in the kinds of knowledge they can provide.

In *Critique of pure reason* (hereafter CPR), Kant proposed that the 'world' that science explained was a world already ordered by the mind's own cognitive apparatus. He begins by agreeing with Locke and Hume that there are two kinds of mental propositions: those in the intellect based on sensations and those in the intellect alone, based on relations between

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[9]   Transcendental Idealism is Kant's term for his doctrine that knowledge is a synthetic, relational product of the logical self (Runes 1942). Sometimes called Critical Idealism.

concepts. For him, it was the (internal, conceptual) relations between intuited sensations that constitute forms of appearance:

> The capacity (receptivity) for receiving representations through the mode in which we are affected by objects, is entitled *sensibility*. Objects are *given* to us by means of sensibility, and it alone yields us *intuitions*; they are *thought* through the understanding, and from the understanding arise *concepts*. …
>
> The effect of an object upon the faculty of representation, so far as we are affected by it, is *sensation*. That intuition which is in relation to the object through sensation, is entitled *empirical*. The undetermined object of an empirical intuition is entitled *appearance*.
>
> That in the appearance which corresponds to sensation I term its *matter*; but that which so determines the manifold of appearance that it allows of being ordered in certain relations, I term the *form* of appearance. (Kant 1787/1929: 65).

Kant suggests that there are two 'pure' forms of sensible intuition that serve as principle of *a priori* knowledge: space and time:

> That in which alone the sensations can be posited and ordered in a certain form, cannot itself be sensation; and therefore, 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.
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> I term all representations *pure* (in the transcendental sense) in which there is nothing that belongs to sensation. The pure form of sensible intuitions in general, in which all the manifold of intuition is intuited in certain relations, must be found in the mind *a priori*. This pure form of sensibility may also itself be called *pure intuition*. [For example,] if I take away from the representation of a body that which the understanding thinks in regard to it, substance, force, divisibility, etc., and likewise what belongs to sensation, impenetrability, hardness, colour, etc., something still remains over from this empirical intuition, namely, extension and figure. These belong to pure intuition, which, even without any actual object of the senses or of sensation, exists in the mind *a priori* as a mere form of sensibility. (Kant 1787/1929: 66).

Kant considers space and time to be the two forms in which sensibility occur because they are obtained not from sense data but by the actions of the mind in coordinating the sensations it receives. In other words, we intuit the (real-world) objects of our senses by the detection of the manifold presentation of sensations (from hearing, touch etc) of those objects by the two aspects of our minds that are not (empirical) sensations, namely space and time. Whatever is perceived is perceived as having spatial relations and/or temporal relations.

In CPR, Kant sought to determine, despite Hume's conclusion otherwise, if it was possible to expand knowledge by proving the validity of propositions that are true without reference to experience. In the process, he accomplished what he called a 'Copernican revolution' in philosophy, now

known as 'transcendental idealism': whereas philosophers had previously considered the mind to be a passive agent of knowledge of an objective world, he showed that the actual world cannot be known, but that the human understanding of reality is shaped by both our means of perceiving it (sensible intuitions) and pure (transcendental[10]) concepts which are available to us through our awareness of space and time. These transcendental concepts are derived from the translation of sensible Judgments of Quality, Quantity, Relation and Modality into transcendental Categories[11] (Kant 1787/1929: 104-119).

Having described the process of form perception, Kant asserted that all necessity is grounded in a transcendental condition and therefore, so must consciousness, which he calls transcendental apperception[12], *the synthesis of the manifold of all our intuitions* - the process whereby perceived qualities of an object are related to past experience, the inner self. Without transcendental apperception, the consciousness that is the foundation of the synthetic unity of experience, it would be impossible to think. Kant made a distinction between this transcendental apperception and empirical apperception which he described as the consciousness of the changing states of the inner self, or *[c]onsciousness of self according to the determinations of our state in inner perception is merely empirical, and always changing* and it is as a result of this mental plasticity, this openness of the inner self to change, that knowledge, *the final goal of the understanding in combining intuitions and concepts*, is possible (Kant 1787/1929: 136).

Kant answers the question of how synthetic *a priori* propositions of mathematics are possible, with his Transcendental Aesthetic and the doctrine

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[10] In Kant's philosophy, the adjective *transcendental* is applied to the condition of experience or anything related to it. Transcendental knowledge is possible, though transcendent knowledge is not (Runes 1942). Transcendental cognition is thus *a priori* knowledge. Kant description of the expression 'transcendental knowledge' as *all knowledge which is occupied not so much with objects as with the mode of our knowledge of objects in so far as this mode of knowledge is to be possible "a priori"* (Kant 1787/1929: 59), is the meaning used throughout the current work. Not to be confused with the use of the term by the New Englanders Emerson, Thoreau, Fuller and Ives etc.

[11] These categories are derived from Aristotle's Categories: Substance, Quantity, Quality, Relation, Place, Time, Position, State, Action, and Attention. *[O]ur primary purpose being originally identical with his, notwithstanding the great difference in the execution.* (Kant 1787/1929 113).

[12] The term *apperception* was introduced by Leibniz to denote the introspective or reflective apprehension by the mind of its own inner states, in contrast to *perception* as the inner state of representation of outer things. In psychology, the term came to be used for the process by which an individual's new experience is assimilated into and transformed by the residuum of their past experiences to form a new whole (Runes 1942).

of the transcendental ideality of space and time. He answers the question of how synthetic *a priori* propositions of natural (empirical) science are possible in his Transcendental Analytic, where he demonstrates the essential role the categories play in establishing the possibility of knowledge from experience. In attempting to refute Hume's idealism, Kant concluded that we cannot be certain of the knowledge of the objects of our sense experiences 'as they really are' (*Ding an sich*, *noumena*[13]); that *a priori* knowledge of them can only be transcendental.

3.3.3.2   Kant's refutation of material idealism

Kant identifies two type of material idealism: Dogmatic and Problematic. The Dogmatic idealism of Berkeley asserts that things in space are merely imaginary entities. Whilst Kant acknowledged that this position is unavoidable if space is interpreted as a property of things in themselves, he showed through his Transcendental Aesthetic, that space is an *a priori* pure (non-empirical) intuition in us prior to any perception of objects and thus does not represent a property of objects. (Kant 1787/1929: 70-71).

In holding the empirical assertion that *I am,* the Problematic idealism of Descartes is pleading our inability to prove, through immediate experience, any experience other than our own.

> The required proof must, therefore, show that we have *experience,* and not merely imagination of outer things; and this it would seem cannot be achieved save by proof that even our inner experience … is possible only on the assumption of outer experience (Kant 1787/1929: 244).

Idealism assumes that the only immediate experience is inner experience from which we can only *infer* outer things, and then only uncertainly. Turning the idealists assertion on its head, Kant argues that, given that I am conscious of my own existence in time, and an awareness of time requires something permanent in my perception against which I can observe the progress of time, this permanence cannot be *in* me, that is, cannot be a property of me, since it is only through it that I can be conscious of my existence in time. So, it follows that

> perception of this permanent is possible only through a *thing* outside of me and not through the mere *representation* of a thing outside of me; and consequently

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[13]   Many, most famously Schopenhauer, in his *Criticism of the Kantian Philosophy* (1844), consider Kant to have inappropriately appropriated the Greek word *noumena*, 'that which is thought', and used it to mean 'things-in-themselves'.

> the determination of my existence in time is possible only through the existence of actual things which I perceive outside of me. … [and *ipso facto*] the consciousness of my existence is at the same time an immediate consciousness of the existence of other things outside me (Kant 1787/1929: 245).

However, although *I am* immediately includes the existence of outer things, it does not follow that every intuition of outer things implies their existence, because a mental representation (thought) of them might have, for example, been imagined, dreamt or hallucinated. Kant thinks such (imagined etc) representations are the reproduction of previous outer perceptions (Kant 1787/1929: 247).

In showing the way reason and empirical enquiry fitted together, Kant demonstrated the role of the human mind in *constructing* reality and knowledge and his insight affected all subsequent epistemological enquiry. In the course of addressing Hume's skepticism, that the inherent nature of things (the so-called *thing–in–itself*) is always beyond the reach of our empirical capacity to know, Kant had divided the world between the *phenomenal* world of empirically unknowable things (the world measured by Newtonian physics, for example) and the ever-unreachable *noumenal* world of *things-in-themselves* which we know exists if we exist. A phenomenon, then, is an object of empirical knowledge that is conditioned by space, time and the categories.

3.3.3.3   Brentano's mental phenomena and intentional inexistence

The general view of post-deists was that consciousness was composed of simple or basic elements–experiential events–that combine to form complex experiences. Both Locke and Hume considered that such simple events were parts of experiences and must, given the seeming unrestricted possibilities for their recombination, have a certain independence vis-à-vis other parts with which they might be realized.

> When the Understanding is…stored with…simple Ideas, it has the Power to repeat, compare, and unite them even to an almost infinite Variety, and so can make at pleasure new complex Ideas (Locke 1690/1975: Bk.II, Ch.2, §2).

> [A]ll simple ideas may be separated by the imagination, and may be united again in what form it pleases (Hume 1739/1978: Bk.I, Part I, §IV).

The neo-scholastic philosopher and psychologist Franz Brentano (1838-1917) was widely influential as a teacher and mentor and his work is often

considered precursory to Phenomenology[14], a philosophy principally developed from his descriptive psychology by his student Edmund Husserl who used the term to mean

> the reflective study of the essence of consciousness as experienced from the first-person point of view (Smith 2007, cited in Wikipedia).

It became clear, largely through the work of Brentano and his students (principally Stumpf and Husserl), that such a strong form of independence among experiential parts is unnecessary; in fact, various kinds of dependency relations are possible. Brentano published the first volume of his large-scale work on the foundations of psychology, *Psychology from an Empirical Standpoint,* in 1874. He emphasized that all our scientific knowledge should be based on direct experience. However, for him, doing empirical psychology meant describing what one directly experiences in inner perception from a first-person point of view, in contradistinction to contemporary empirical science, which attempts to take a third-person approach. Brentano's aim was to provide a scientific basis for psychology which, in his *Psychology*, he defined as *the science of mental phenomena* (1874: 18), and which he distinguishes from physical phenomena because they are the exclusive objects of inner perception, they always appear as unities, and they are always intentionally directed towards objects (Huemer 2008). He later renamed his approach as *descriptive,* to distinguish this first-person analyses of subjective processes from the third-person *genetic* approach in which causal or genetic laws are developed to explain what phenomenology merely describes.

Brentano was essentially an idealist, in that he maintained that external, sensory perception could not tell us anything about the *de facto* existence of the perceived world, though we can be absolutely sure of our internal perception. When I hear a police siren, I cannot be completely sure that there is a police siren in the real world, but I am absolutely certain that I do have an internal perception, that I hear. External sensory perception can

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[14]   Not to be conflated with Phenomenalism, the doctrine that all human knowledge is confined to the appearances presented to the senses. See §3.3.4.4. Husserl's pupil Martin Heidegger believed that Husserl's approach overlooked basic structural features of both the subject and object of experience. He developed a more ontological approach to phenomenology that influenced the development of existentialism. Hegel also used the term to describe a dialectical phenomenology that begins with an exploration of that which presents itself to us in conscious experience (phenomena) as a means to finally grasp the ontological and metaphysical Spirit that is behind them. As already indicted, the ontological implications are beyond the scope of the current discussion and have been all but suppressed.

only yield *hypotheses* about the perceived world, neither the truthfulness of such perception nor the existence of the apparent external origin of such perception.

In considering the separability of experiential parts of consciousness, Brentano distinguished between *merely distinctional* and *actually separable* parts, the latter of which are either *one-sided* or *mutually* (two sided) separable. (Brentano 1891/1995: 15). An example of one-sided separable parts is in evidence in the way one can hear (notice) a sound without listening to the sound itself, but can't listen to a sound without noticing it. Multi-sensorial experiences have frequently mutually–separable parts. For example, the visual and aural experiential parts of a violin performance can be experienced separately, as can the aroma and sight of a banana.

Tracing the idea back through the Scholastics, Descartes and the Greeks, Brentano introduced the notion of the directed intention of mental objects into contemporary philosophy:

> Every mental phenomenon is characterized by what the Scholastics of the Middle Ages called the intentional (or mental) inexistence of an object, and what we might call, though not wholly unambiguously, reference to a content, direction toward an object (which is not to be understood here as meaning a thing), or immanent objectivity (Brentano 1874: 88).

Rather than developing a full and systematic description of intentionality, Brentano's goal was to outline the criteria for distinguishing mental and physical phenomena and he used the terms *mental or intentional inexistence* to refer to what today is know as a characteristic of consciousness: the mind's capacity to *refe*r or be *directed* to objects that existing solely in the mind. Although Brentano's formulation of intentional objects does not address their ontological status, this was addressed, at least to some extent, by his students, principally Alexius Meinong and Edmund Husserl. Meinong's concern was with the intentional *relation* between the mental act and an object. He maintained that such a relation existed even when the object external to the mental act towards which it is directed doesn't exist, such as Pinocchio, Orpheus, Unicorns and the Fountain of Youth. Earlier, Hume had considered the concept of non-existent objects contradictory, Kant and Frege considered it logically ill-formed and later, Russell adopts the idea (Reicher 2006).

These examples seem more like Platonic Ideals than non-existent objects. In data sonification, a dataset can be considered as a particular ('accidental')

object, so it seems reasonable to assume that an exploration of the rôle of non-existent objects in data sonification is only of relevance if can be reasonably concluded that sounds, or the other objects of data sonification software, cannot be ontologically accounted for in other ways.

According to Brentano's theory, mental acts cannot have duration. This brings up the question of how we can perceive temporally extended objects like melodies. Brentano accounted for these cases by arguing that an object towards which we are directed does not immediately vanish from consciousness once the mental act is over. It rather remains present in altered form, modified from *present* to *past*. Every mental phenomenon triggers an 'original association' or *proteraesthesis*, as he calls it later, a kind of memory which is not a full-fledged act of remembering, but rather a part of the act that keeps lively what was experienced a moment ago. When I listen to a melody, for example, I first hear the first tone. In the next moment I hear the second tone, but am still directed towards the first one, which is modified as past, though. Then I hear the third tone, now the second tone is modified as past, the first is pushed back even further into the past. In this way Brentano can explain how we can perceive temporally extended objects and events.

3.3.3.4 Husserl's transcendental phenomenology

The notion of intentionality also played a central role also in Husserlian phenomenology. Applying his method of the phenomenological reduction, however, Husserl addresses the problem of directedness by introducing the notion of *noema*, which plays a role similar to Frege's notion of *sense*.

Edmund Husserl (1859-1938) was the first to apply the term *Phänomenologie* (phenomenology) to a whole philosophy and his usage of the term has largely determined the sense of it in the twentieth century[15]. As the term underwent development since his early use of it, the present comments are derived from Husserl's own mature introduction (1927)[16] in which he outlines the two principal uses of the term: Firstly, in application to "a new kind of descriptive method which made a breakthrough in philosophy at the turn of the twentieth century, and secondly, a new psychological discipline parallel to the first in method and content: the a priori pure or

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[15] In contradistinction to Hegel's 1807 use of the word in his *Phänomenologie des Geistes* (Phenomenology of the spirit), in which is expressed a radically different concept.

[16] A summary of the historical development of Husserl's connotation of the term is available in Runes (1942).

"phenomenological" psychology, which raises the reformational claim to being the basic methodological foundation on which alone a scientifically rigorous empirical psychology can be established."

Husserl's aim was that the empirical approach, which he calls *an objective science of nature* and which, significantly, he considered as a branch or anthropology or zoology in that it was decidedly *egoical* (anthropocentric) and physicalist, would lead to a better understanding of philosophical phenomenology, which he calls *pure psychology*, after Brentano's *descriptive psychology*. While the term has fallen into disuse in favour plain of *philosophy*, it does exemplify the importance that early scholars involved in the burgeoning science of psychology placed on dynamic interplay between empirical investigation and its philosophical underpinnings (Husserl 1927/1971: §5). It is the contention here, as exemplified by the very existence of this chapter in the current work, that this relationship remains important, especially when creating, as we do with data sonification software, phenomena (objects, events) that need not conform to any resonating material Kantian thing–as–it–is.

Building on Brentano's outline, the notion of intentionality played a central role in Husserl's development of phenomenology. He understood intentionality as a fundamental attribute of subjective processes, maintaining that phenomenology must describe these processes, not only with respect to their immanent cognitive components, but also with respect to their intended (external) objects.

> In unreflective holding of some object or other in consciousness, we are turned or directed to-wards it: our *intentio* goes out towards it. The phenomenological reversal of our gaze shows that this *being directed* [*Gerichtet-sein*] is really an immanent essential feature of the respective experiences involved; they are "intentional" experiences (Husserl 1927/1971: §2).

Husserl describes how "a multiple and yet synthetically unified intentionality" arises from the phenomenological reflection on the synthesis of appearances of an object as orientation to in changes. In considering his example of a die, he mentions orientations of left-and-right, near-and-far, front-and-back. These orientations form an intentional structure comprised of the perceptions of the *actually-seen*, *undetermined* (such as the back side) and *unseeable* which has to be inferred because they are obscured. This 'directness

of appearance' formed the basis of Gestalt psychology, yet Husserl was thinking of more than the direct appearances:

> The intentional structure of any process of perception has its fixed essential type [*seine feste Wesenstypik*], which must necessarily be realized in all its extraordinary complexity just in order for a physical body simply to be perceived as such. If this same thing is intuited in other modes-for example, in the modes of recollection, fantasy or pictorial representation- to some extent the whole intentional content of the perception comes back, but all aspects peculiarly transformed to correspond to that mode (Husserl (op cit.).

He was also not restricting himself to visual phenomena:

> This applies similarly for every other category of psychic process … these constitute themselves, with fixed essential forms corresponding to each process, in a flowing intentionality (op cit.).

but was aiming to

> investigate systematically the elementary intentionalities, and from out of these [unfold] the typical forms of intentional processes, their possible variants, their syntheses to new forms, their structural composition, and from this advance towards a descriptive knowledge of the totality of mental process, towards a comprehensive type of a life of the psyche (op cit.).

It follows, then, that a phenomenal sound object is a *multiple and yet synthetically unified intentionality* whose appearance is revealed through time, and consists of *actually-being-heard*, *undertermined* (previously heard) or *unhearable*–a missing fundamental, for example.

Husserl's phenomenology was a starting point and major influence on Pierre Schaeffer's treatise on musical objects (1966) as objects in their "flux of modes of appearing and the manner of their 'synthesis'". Husserl's concern was to provide a theory of the purely phenomenal, psychical, multiple 'appearances' of objects; each appearance being a unit or component of meaning accruing to the phenomenal object as each of these appearances occurs. In order to do this he applied an attitude of 'self-restraint' (*epoche*) in which he 'bracketed-off' consciousness from the 'world-as-it-is' in order to develop what he later called an *eidetic* science of essential forms[17] that is, one that involves no assertion of actual material existence; pure, in the sense that

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[17]   Husserl calls these forms *Eide*, singular *edios*. Greek origin: "By *eidos* I mean the essence of each thing and its primary substance" (Aristotle, *Metaphysics*. The verb is *eido* 'to see' appears in the Latin verb *video*. The term is related to Sanskrit's 'veda', a cognitive activity like 'knowing', and the Old English *wit*, 'to know'.

pure logic is pure[18]. In constructing such phenomenological psychology it could be

> exclusively directed toward the invariant essential forms. For instance, the phenomenology of perception of bodies will not be (simply) a report on the factually occurring perceptions or those to be expected; rather it will be the presentation of invariant structural systems without which perception of a body and a synthetically concordant multiplicity of perceptions of one and the same body as such would be unthinkable. (op cit. §4).

While Kant's proof of the existence of things outside of him even though their nature was uncertain (§3.3.3.2); of the necessity for 'things as they are' as a chink in the Cartesian mind/body separation, had an impact on Husserl, his phenomenally pure psychology is still firmly bound to the mind. In his four criteria for the phenomenally pure psychology, there is no recognition of the body at all:

1. The description of the peculiarities universally belonging to the essence of intentional mental process, which includes the most general law of synthesis: every connection of consciousness with consciousness gives rise to a consciousness.
2. The exploration of single forms of intentional mental process which in essential necessity generally must or can present themselves in the mind; in unity with this, also the exploration of the syntheses they are members of for a typology of their essences: both those that are discrete and those continuous with others, both the finitely closed and those continuing into open infinity.
3. The showing and eidetic description [Wesensdeskription] of the total structure [Gesamtgestalt] of mental life as such; in other words, a description of the essential character [Wesensart] of a universal "stream of consciousness."
4. The term "I" designates a new direction for investigation (still in abstraction from the social sense of this word) in reference to the essence-forms of "habituality"; in other words, the "I" as subject of lasting beliefs or thought-tendencies-- "persuasions" --(convictions about being, value-convictions, volitional decisions, and so on), as the personal subject of habits, of trained knowing, of certain character qualities (Husserl 1960).

To some, he struggled, despite his protestations to the contrary, to separate his *eide* ('essential forms')[17] from Platonic Ideals. (Smith 2007, Martin 2007)

3.3.3.5   Gestalt psychology

Gestalt psychology arose from experimental findings of perceptual *gestalts*, just mentioned above, principally in the empirical experimentation laboratories established by another of Brentano's pupils, Carl Stumpf (1838-1946). This occurred at a time when what we now think of as experimental psychology was separating itself from philosophy into its own discipline. Max Wertheimer, Kurt Koffka, and Wolfgang Kohler were instrumental in the founding of Gestalt psychology (Hergenhahn, 1992). They considered

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[18]   Husserl described such eidetic phenomenon as *noetic*, that is, *noemata* (singular *noema*) conceived in the stream of consciousness (*noesis*) entirely by reason (*nous*).

perceptual gestalts as phenomena arising naturally and directly from the physical nature of sensation.

Although initially Gestalt theory began as a theory of perception, Wertheimer clearly recognized the fundamental epistemological issue, and Kohler and Koffka presented Gestalt theory explicitly on epistemological dualist grounds. Curiously, as Harvard cognitive-neuroscientist Steven Lehar (2000) indicates, the Gestaltists did not reference Kant as the originator of the idea of gestalts, possibly because of their confusion over his Idealist position. Lehar also suggests that one of the most controversial and pivotal aspects of Gestalt theory is Wertheimer's principle of isomorphism, which was elaborated by Kohler in 1924 as the hypothesis that every perceptual experience is "not only blindly coupled to its corresponding physiological processes, but is akin to it in essential structural properties" (Kohler, quoted in Lehar 2000) which, he suggests "is a direct consequence of the indirect realist foundations of Gestalt theory, whereby phenomenal experience is a direct manifestation of neurophysiological processes in our physical brain, and therefore it cannot help but be similar in structure, since they are identical in ontology."

Like Husserl before him, Ernst Mach (1838–1916)[19] was interested in the phenomenon of melody. Mach understood sensations to be not simply raw experiences but the interaction of experience with a pre-formed cognitive structure. For instance, when we hear a known melody, we recognize it no matter what its transposition or even mode. It can be hummed, whistled, or plucked from a harp. Furthermore, even if one or more notes are incorrect, we still recognize it. In *Analysis of Sensations* (1886) Mach asks, "What constitutes a melody?" It seems empirically incorrect, he argued, to say, as we must in recognition of the above, that a melody exists in our ability to recognize it and not in sounds; having been formed as an idealisation by experience of one or more examples of it. This idealization captures not the actual sounds, but the relationships of the sounds to one another. For Mach, this process is at the basis of all perception. Experience requires an a *priori*, but that *a priori* is itself formed by experience.

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[19]   Mach lends his name to the speed of sound and was considered by Einstein to be his forerunner on the theory of relativity (Einstein 1954: 26).

John Dewey[20] also thought that immediately felt or sensed experiences constitute by far the larger part of total human experience, but which are on a different level from the knowledge experience. Sensory qualities, he contended, "are not objects of cognition in themselves, … [but] acquire cognitive function when they are employed in specific situations as signs of something beyond themselves" (1938: 147). The French phenomenological philosopher Maurice Merleau-Ponty (1908–1961)[21] described the structure of perception as sensation and conscious awareness, between which phenomenology uncovered a 'figure-ground' invariant. As he put it: "To be conscious=to have a figure on a ground–one cannot go back any further" (1964: 191).

In the second quartile of the nineteenth century, the mathematical notion of the group was being discussed, though its full importance as an organising and clarifying principle was yet to be realised. According to the neo-Kantian philosopher Ernst Cassirer, the first attempt to apply speculations concerning the *concept of group* to psychological problems of perception was made by the physician and physicist Hermann von Helmholtz in 1868 (Cassirer 1944). Amongst his many enterprises, Helmholtz was interested in tracing Kant's philosophical theories in fields such as physiology and the newly emerging empirical psychology. He recognised that at the root of perception is the concept of the *constancy* of perceptual objects under changing sensory conditions; of relations that remain unchanged or invariant under transformation. He endorsed Kant's thesis of space as a "transcendental form of intuition" but for him this was the beginning of, not a solution to, the problem of finding the most general form of invariance, that is, in which systems of points in a multi-dimensional manifold may be displaced relative to one-another without changing their forms.

Henri Poincaré recognised the concept of the group as a fundamental *a priori* one derived from an intuition that is imposed on us "not as a form of our sensibility, but as a form of our understanding" (Poincaré 1913: 79), and as

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[20]   Humanist philosopher, educator and founder, with Peirce and the psychologist William James, of the Pragmatism school of philosophy.

[21]   A phenomenological philosopher strongly influenced by Husserl and Heidegger and closely associated with Sartre and de Beauvoir. He was the only major phenomenologist of the first half of the Twentieth Century to engage extensively with the sciences, and because of it, his writings have become influential with the recent project of naturalizing phenomenology as discussed in §3.3.6.

such precedes and underlies all experience. This leads him to conclude that the axioms of geometry and empirical statements derived from observation and measurement cannot be compared because there is an irreducible difference between them; they belong to entirely different objects. It is a characteristic of perception that it can never abandon the here–and–now (*hic et nunc*), since its task is to apprehend it as precisely and completely as possible. Helmholtz is similarly clear that laws cannot be responsible for the causes of natural phenomena; that explanations are the urge of our intellect (our intent, or what he calls "judgment") to bring our perceptions under its control. Further, that though the perceptual world does possess a structure, objective stimuli are not simply copied in perception, but are transformed in a certain direction.

Cassier understood, following Hering's inquiries into the sense of light, that perceptual content is characterised by the reduction of dissimilarity in objective stimulus rather than construction of similarity. Thus perception integrates the impressions of stimulii rather than being bound to their flux. His question (1994: 12) is whether it is a mere accident that the concepts of invariance and transformation belonging to group theory, recognised as a being fundamental to mathematics, appears in the exposition of psychological facts, even if the connection from such extrapolation is a "mediate" one. He concludes that relationship between the formation of invariants in perception and in geometry is an analogous one; that the differences may be characterized by an expression which Plato used to define the opposition of perception to thought in which all perception is confined to the "more or less"; that the realisation of perceptual constancy is never ideally complete, but always remains within certain limits and beyond these limits there is no further "transformation."

3.3.4 The immediate perception of objects through sensation

Most of the epistemological discussions that followed the idealists accepted a subjectivist or internalist explanation of perceptual experience; namely, that whilst the veridicity of perceived objects cannot be ascertained on the basis of sense data alone, the experience of *internal* representations of objects was such as to justify inferring the existence of the corresponding *external* objects. What

follows provides and overview of the principal non-naïve[22], non-sceptical[23] explanations for how immediate perception of physical objects and the physical world generally can be warranted on the basis of sensory experience: *perceptual subjectivism*, consisting of *phenomenalism*, *representionalism* (otherwise known as *indirect realism*) and *direct realism*, and less subjective *external* or *process reliabilism. Perceptual subjectivism* has a longer history and is widely accepted as the most justifiable (BonJour 2007), while *direct realism* grew out of Gestalt psychology, and the development of *reliabilism* began in the twentieth century and continues today.

Historically, a distinction has been made between sensations and perceptions: sensations are basic experiences elicited by simple stimuli, while perceptions are experiences elicited by complex, often meaningful stimuli. Being more complex, perceptions are often considered to be the result of the integration of simpler sensations. They may also involve other processes such as memory, thus ensuring the possibility of them being influenced by a knowledge of past experiences, and independent of the methods by which that knowledge is acquired, as discussed in Appendix 1.

The relationship between personal knowledge and perception has been extensively researched. For example, a faint tone is easier to hear if a listener knows what pitch to expect (Green 1961 cited in Sekuler and Blake 1985: 423) and comprehension is enhanced for native speakers of a language when they understand that someone is speaking with a strong foreign accent. Other examples include the increasing ease, on perseverance, in reading someone's scrawly handwriting and the ease, having acquired the skill, of reading music or riding a bicycle. On the other hand, existing knowledge can impair or mislead accurate perception through mistaken or inferential expectations and ambiguities.

The term *immediate perception* is use to denote the content of those propositions that arise in the mind directly from external sensation, as distinct

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[22]   The naïve position, know as *naïve realism* is that physical objects are directly experienced; rejected by a large proportion of the philosophers as discussed in the previous section.

[23]   The *skeptical* position is that sensible experience provides no evidence of external substances. Arising in the fourteenth century, it was used by those for whom the only certitudes are those of immediate experience and those of principles known *ex terminis* (by definition) together with conclusions immediately dependent on them. Most sceptics usually accepted a degree of probabilism, namely, that probability is the only guide to belief and action. Despite this lack of direct influence, the sceptical arguments of fourteenth century thinkers bear marked resemblances to those employed by Berkeley and Hume discussed earlier (Runes 1942).

from those that arise as a result of memoric reflection, for example; both types of which are (Kantian) phenomena. Also, the expression *public* is taken to mean external to the perceiver and *physical* or *material object* as a signifier to mean some *thing* with a non-virtual public existence in matter or energy, such as a table, a cloud or a violin tone.

3.3.4.1 The Sense-Datum theory of immediate perception

In the literature, the term *sense-datum* or sometimes *sensum*[24] is used to denote an immediate un-analyzable private object of sensation; a non-physical entity that actually possess the various sensory qualities that a person experiences. Sense-datum theory argues that the direct or immediate object of an experience is an entity produced at the end of a causal process and is thus distinct from any physical object, if any, that initiated the process. Examples of the veridicality of this distinction include seeing the light from a star that no longer exists, viewing a straight stick that is immersed in water and so looks bent, feeling an itch in a previously amputated limb and hearing the voice of a deceased friend. Epistemologist Laurence BonJour (2008) suggests such immediate experiences can be classified according to the following perceptual qualities:

- **Relativity.** What is perceived has different qualities under different perceptual conditions, even though the relevant physical object does not change;

- **Illusion**. Qualities are experienced that the relevant object clearly does not possess, and

- **Hallucination**. Qualities are experienced in a situation in which there is no physical object of the relevant sort present in the sensory field.

While it argues for the existence of sense-data, sense-datum theory doesn't account for the existent nature of it (its ontology), or the *relation* between it and the experiencing mind. The sense-datum is an object immediately present in experience and has the phenomenal qualities that it appears to have. The natural thing to say is that sense-datum somehow influences the state of mind of an individual in a way that reflects the sense-datum's specific character. It is this resulting state of mind that the adverbial theory describes.

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[24] Plural forms are *sense-data* and *sensa.*

3.3.4.2   The Adverbial theory of immediate perception

In contrast to the sense-datum theory, the adverbial theory:

> … has no need for such objects and the problems that they bring with them (such as whether they are physical or mental or somehow neither). Instead, it is suggested, merely the occurrence of a mental act or mental state with its own intrinsic character is enough to account for the character of immediate experience … I sense in a certain manner or *am appeared to* in a certain way, and it is that specific manner of sensing or way of being appeared to that accounts for the specific content of my immediate experience (BonJour 2007). (my italics).

The essential feature of adverbial theory is that there need not be an object or entity of any sort in the material world. They are objects of awareness, modes, or states of the mind and do not exist independent of it. To say that an idea is *an object of my awareness* is just a grammatically convenient way of saying that the idea is *that of which I am aware.*

In comparing the sense-datum and adverbial account of the contents of experience, BonJour thinks that the adverbial account is most likely to be more correct, because

> if sense-data somehow affect the mind in a way that reflects their character, then the resulting adverbially characterizable states of mind are really all that matter, making the sense-data themselves superfluous; and if they do not affect the mind in such a way, then their apprehension by the mind is difficult or impossible to make sense of. … any characterization of sensory experience that can be given in sense-datum terms can equally well be adopted by an adverbial theorist, simply by construing a comprehensive sense-datum description of one's sensory experience as characterizing the specific manner in which one is adverbially "appeared to" (BonJour and Sosa, 2003: 78-79, n3).

So the sense-datum and adverbial theories are just different ways of expressing the same idea, *sense-datum* being the nominal or objective way of expressing the subjective content of sensing, or *being appeared to*. The adverbial form is almost always more unwieldy in English, so for the sake of simplicity I will use the simpler *sense-datum* to imply both, unless a distinction is called for.

3.3.4.3   Representationalism (Indirect Realism)

Indirect, or representative realism is the hypothesis that there is a justification for believing that our immediately experienced sense-data, when taken with further beliefs that we arrive at on the basis of these sense-data, constitute a representation or depiction of realm of material objects independent of our sensing of them.

One striking contrast between the representative realist's explanatory hypothesis and the others considered here, is that under the representative realist view there is a clear intuitive sense in which the qualities of the objects that explain our immediate experience are reflected in the character of that experience itself in such a way that these, albeit indirect, experiences can be said to be of the qualities of the objects.

3.3.4.4 Phenomenalism[25]

Phenomenalism is a theory of a perceptual subjectivity that maintains that the characteristics and relations of sense-data is *all* that constitutes the content of propositions about immediate (unreflective) perceptual experiences of public material objects. The theory, more correctly labeled *ontological phenomenalism*, grew as a radical form of empiricism with roots in Berkeley and Hume's subjective idealism, as discussed earlier, and developed by Ernest Mach in the nineteenth century, to be later refined by Bertrand Russell and the logical positivists (Tarnas 1991: 383), and not confused with Kant's *epistemological phenomenalism* which doesn't deny the existence of objects not experientially knowable (*noumena*). Ontological phenomenalism maintains that to believe that public material objects exist is to believe that various sorts of sense-data have been, and/or would be experienced under certain specifiable physical conditions, such as those that would intuitively permit the public objects to be perceived; the (relatively) *permanent possibilities of sensation* as John Stuart Mill expressed it (Mill 1865: 225-232). Phenomenalists offer no reasons for *why* such sense-data is *permanently possible*, and on the assumption that it would be immediately available to the perceiver if they happened to be there then, they do admit sense-data that is confined to a specific time and place.

Because the claim of phenomenalism is that the content of propositions about perceptual experiences of public material objects is given *entirely* in terms of sense-data, the sense-data and of those environmental factors that are aspects of the order of the immediate experience must be premised by other sense-data. For example, being able to assert that there is a violin in the room from actual or obtainable sense-data from a violin in the room is premised on sense-data of the room, as well as the violin because the room does not exist to the perceiver external of sense data. The need for sense-data to be

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25   Phemonenalism is to be differentiated from Phenomenology, a philosophical movement initiated by Edward Husserl, as discussed earlier.

specifiable only in terms of other sense-data, as the phenomenalist position seems to imply, leads to an infinite regress, so it fails as a theory of knowledge. Further, an offer of a specified route to the location of the violin (sense-data), would require a guarantee that such a sensory route exists to that location, difficult enough in present ('now') time, but unfathomable about objects and events in the (distant) past. BonJour reports Roderick Chisholm's generalized argument that

> there is in fact *no* conditional proposition in sense-datum terms, however long and complicated the set of conditions in the "if" part may be, that is *ever* even *part* of the content of a material-object proposition. This is shown, he claims, by the fact that for any such sense-datum proposition, it is *always* possible to describe conditions of observation (including conditions having to do with the state of the observer) under which the sense-datum proposition would be false, but the material-object proposition might still be true (BonJour 2007).

A deeper problem is that our sense-data are obviously not random but it is not clear *how* they are ordered without any reference to public material objects. Lastly, it seems that, as the above discussion implies, phenomenalists, by only being able to infer knowledge of public objects by their own immediate experience of them, put themselves in the untenable solipsist condition that they cannot know of the existence of other minds or mental states. In addition, Kant's refutation of material idealism (§3.3.3.2), showed this position to be false.

3.3.4.5 Direct Realism and ecological psychology

The application of physicalism to psychology was the logical basis for the method known as of behaviorism and was used to support a theory of perception known as Direct Realism in which representations or ideas are not thought of as being themselves the immediate objects of awareness, but instead as directly constituting the act or state of awareness itself. Hence, at least in the case of veridical perception, the immediate object of awareness is the external thing itself and not a representation of that thing.

> Cognitive states [i.e., representations], are not cognitive relations with objects, nor are they themselves peculiar objects supposed to mediate the occurrence of cognitive relations. They are simply the perceiver's awareness of possible objects.

> The immediate object of awareness is always the ordinary object and not some special object, and that therefore, for example, 'Intuitions . . . are the immediate awarenesses of . . . ordinary objects', rather than themselves objects of awareness (Aquila 1983: xi).

The most important immediately preceding realist philosopher was the Scot Thomas Reid (1710-1792) who wrote with extreme common sense in trying to refute his countryman David Hume's scepticism. (Gregory 1981: 349-351). The psychologist James Gibson (1966; 1979) developed Direct Realism into a theory of perception founded on the understanding that the senses had developed in an environment that thus latently afforded actions, whether or not these affordances were recognised. In a thorough analysis of the metaphysical roots of Gibson' psychology, Lombardo notes that

> …over a 50-year period he came to challenge both mind-matter dualism in his ecological theory and the epistemology of indirect perception in his direct realist philosophy of perception. Gibson's theory of ecological reciprocity avoids both the absolute philosophical dichotomies inherent in Platonic thinking, and the one-sided treatments of reality in monistic philosophies. … In examining the growth of Gibson's ecological psychology, one can find numerous roots. Aristotle, as a single theorist, probably anticipates Gibson more than any one, and in modern times, functional psychology, process ontology, Gestalt wholism, and the evolutionary-ecological view of nature have all influenced Gibson's thinking. (1979: 4).

Gibson is one of the few people to explicitly defend a näive realist view of perception, however he was forced to make seemingly implausible assumptions about the perceptual process in its defence, including a denial of the general materialist view that the sensory organs transmit sensory information into the brain, where neurophysiological processes compute a perceptual representation of the external world. Instead, Gibson suggested that perception occurs somehow out in the world itself, rather than in the physical brain. Exactly how this occurs, or what this actually means however, he could never explain very satisfactorily.

While direct realism may be a useful model for some perceptual mechanisms, it does not seem to be a plausible model of the complete experience of material objects, and so cannot be the basis of a justification for believing that our immediately experienced sense-data constitute a representation or depiction of an independent realm of material objects.

3.3.5   Information as relations through signs

Fallibilism is the term the philosopher and scientist and founder of pragmatic semiotics Charles Peirce (1839-1914) used to describe the unreliability of such empirical methods to provide meanings truthfully stronger than probabilistic propositions outside of the mind:

> …the doctrine that our knowledge is never absolute but always swims, as it were, in a continuum of uncertainty and of indeterminacy. Now the doctrine of continuity is that *all things* so swim in continua (Peirce 1897).

One consequence of the exploration of idealism was the understanding that, although sensations are experienced immediately, sense perceptions are not ideas and they do not give an instant knowledge of things; they are simply non-cognitive natural events that are neither true nor false in–and–of–themselves. Sense perception only becomes informatively meaningful when it stands for, becomes a sign of, something more than or other than itself in some respect or other for somebody, as when the perception of a high pitched repeated tone comes to signify *bird* to a human in one context and *alarm-clock* in another. Such hypothetical inferences were labeled *abductions* by Peirce: "[T]he content of consciousness, the whole phenomenal manifestation of mind, is a sign resulting from inference" (1868)[26]. Peirce developed a *pragramatical*[27] approach to the study of semiotic frameworks–the relationships between signs and their impacts on those who use them.

Following Kant's *Categories,* Peirce developed a system of three existential Ceno-Pythagorean[28] categories:

- Firstness. Reference to a ground (a ground is a pure abstraction of a quality). Essentially monadic; Informally: Quality of feeling.

- Secondness. Reference to a correlate (by its relate). Essentially dyadic; Informally: Dependence.

- Thirdness. Reference to an interpretant. (An interpretant is the product of an interpretive process, or the content of an interpretation.) Essentially triadic; Informally: Representation.

According to Peirce, a sign is something that stands for something else in some manner or other for somebody. Thus, the sign relation is triadic involving

- A *causal relation* between a sign user and something (an Object) that stands for something else (a sign, or in Peirce's terminology, a "Representamen");

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[26] For a fuller explanation of abductive inference, see Appendix 1.
[27] A term Peirce invented to distinguish it from the more widely used *pragmatic*.
[28] The prefix *ceno-* is from the Greek word *kainos*, which means "new" or "recent" and Peirce calls them 'Pythagorean" because they have to do with number.

- A *semantical relation* between the sign and the something else it stands for; and

- A *pragmatical relation* between the sign and the thing it stands for, and the user (an Interpretant)–that is, the sign in the mind that is the result of an encounter with a sign.

- Peirce distinguished three different ways in which things might stand for other things in some respect or other;

- *Iconic relations*, in which things resemble other things; auditory icons and spearcons, for example;

- *Indexical relations*, of causes and effects; earcons, for example, and

- *Symbolic relations*, in which things are associated in essentially arbitrary ways; sounds and the letters of the alphabet, for example.

While iconic and indexical relations exist in nature whether or not anyone notices them, they can only function as signs when the relationships by which they can be associated is noticed by someone as standing for some associated properties of other things. For example, words such as "wind" and "pipe" do not resemble the forms of moving air or a cylindrical tube for which they stand, so the words are not icons; tree rings are an effect of the aging of tree but can only act as an indication of (an indexical sign) of this aging once the relationship has been observed.

Peirce's semiotics is dependent on his deep understanding of phenomenal experience. It is useful to recognise that he thought that all processes of consciousness, including perceptual consciousness, involve or are sign processes, that is, are relational. According to Innis, Peirce's central idea is that "the content of consciousness, the entire phenomenal manifestation of mind, is a sign resulting from inference…" (Pierce 1868: 53). Peirce emphasises that he thought "Thirdness, [that is law-governedness] pours in upon us through every avenue of sense…*There can be no perceptual object without a unifying factor that distinguishes it from the 'play of impressions'"* (Innis 1994: 13) [my italics].

This is an important understanding with respect to the perception of immanent abstract objects, such as the mental impressions resulting from the sonification of multivariate datasets that have no direct perceptual correlates

in the physical world. If it is necessary for such objects to have such a unifying factor, it bears some consideration how sonification can offer any possibilities in that regard.

3.3.6 Information in networks and connections

Cognitive science arose as an interdisciplinary research endeavour in the early 1960s around the idea that the brain could be identified with hardware, and on which cognition was computed. Because of its physical approach, direct realism has been very influential in the development of the application of neural networks and other connectionist models, in pursuit of environment-sensing robots capable of automatic navigation, for example. This has proved remarkably successful up to a point. In its broadest interpretation, cognitivism considers that the mind is rational, autonomous and independent of the body; ideas strongly valued in Western culture, as evidenced by the long-running fascination with talking dolls, robots and other automata (Wood 2002). However Cognitivism's identification of the individual as central to thought is currently being challenged by the growing body of evidence from artificial intelligence research that embodiment is important to cognition, perhaps more important than vision (Varela, Thompson and Rosch 1991, Hutchins 1995); that different sense modalities provide access to different types of information and even artificially intelligent agents require ontologically mediated schemata, as seminal artificial intelligence researcher Derek Partridge clearly infers. (1991: 171-227).

The connectionist models favoured by the cognitivists was in parallel with the composition modelling experiments of those computing composers who saw the connectionist paradigm as offering "a new and unified viewpoint from which to investigate the subtleties of musical experience. Connectionist systems employ 'brain-style' computation, capitalizing on the emergent power of a large collection of individually simple interconnected processors operating and cooperating in a parallel distributed fashion" (Todd and Loy 1991: ix).

Though it is still a very active field, *cognitivism*, no longer enjoys the limelight it once did. Computer scientist and editor of the *Journal of Consciousness Studies*, Joseph Goguen provides a succinct, if somewhat unbalanced, critique of cognitivism and its relationship to the emerging field

of consciousness studies (2002). As the approach continues to fail to deliver results beyond the elementary, there is a growing awareness that it will not turn out to be the hoped–for panacea. Goguen thinks the next step, developing a computational model of conscious awareness, will not be achievable without a more sophisticated model of mind. David Chalmers, currently one of the leading philosophers of consciousness agrees:

> The easy problems are those of finding neural mechanisms and explaining cognitive functions: the ability to discriminate and categorize environmental stimuli, the capacity to verbally report mental states, the difference between waking and sleeping. The hard problem is that of experience: why does all this processing give rise to an experienced inner life at all? While progress is being made on the easy problems, the hard problem remains perplexing (1992).

3.3.7   An attempt at integration

Of the various attempts to integrate the three main threads: Idealism, Realism and Information Theory, probably the most widely known is the work of the British anthropologist and semiotician Gregory Bateson (1904-1980), who coined the definition of information as "the difference which makes a difference." Bateson adopted Alfred Korzybski's concept that "the map is not the territory":

> But what is the territory? Operationally, somebody went out with a retina or a measuring stick and made representations which were then put on paper. What is on the paper map is a representation of what was in the retinal representation of the man who made the map; and as you push the question back, what you find is an infinite regress, an infinite series of maps. [T]he process of representation will filter [the territory] out so that the mental world is only maps of maps, ad infinitum. All 'phenomena' are literally 'appearances' (Bateson 1972).[29]

Bateson considered that the great dualist dichotomy of epistemology has shifted under the impact of cybernetics and information theory and that with the discovery of cybernetics, systems and information theories was a formal base "enabling us to think about mind and enabling us to think about all these problems in a way which was totally heterodox from about 1850 through to World War II" (op.cit.). In discussing the origins of "the map is different from the territory", he emphasised that the idea came out of ancient Greece:

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[29]   The original source of the quotation is from Bateson's Nineteenth Annual Korzybski Memorial Lecture entitled *Form, Substance and Difference*, delivered January 9, 1970, under the auspices of the Institute of General Semantics. and printed in the *General Semantics Bulletin*, No. 37, 1970. It was republished in Bateson (1972)

It all starts, I suppose, with the Pythagoreans versus their predecessors, and the argument took the shape of "Do you ask what it's made of—earth, fire, water, etc.?" Or do you ask, "What is its *pattern*?" Pythagoras stood for inquiry into pattern rather than inquiry into *substance*. That controversy has gone through the ages, and the Pythagorean half of it has, until recently, been on the whole the submerged half. The Gnostics follow the Pythagoreans, and the alchemists follow the Gnostics, and so on. The argument reached a sort of climax at the end of the eighteenth century when a Pythagorean evolutionary theory was built and then discarded—a theory which involved Mind. (op.cit).

He does not mean imply by this that he is supports traditional Cartesian dualism but a new approach in which the

individual mind is immanent but not only in the body. It is immanent also in pathways and messages outside the body; and there is a larger Mind of which the individual mind is only a subsystem. This larger Mind is comparable to God and is perhaps what some people mean by "God, but it is still immanent in the total interconnected social system and planetary ecology (op. cit.).

Bateson's overt aim is one of raising his listener's awareness of ecological issues, so perhaps his primary concern is best described as 'functional epistemology'. Suggesting that the resolution lies in the God Mind is a familiar way of collapsing the unresolved mystery back into itself and further emphasises that epistemology is a process of thought, less directed to providing conclusions than it of exploring a mental landscape, of organizing beliefs and experiences into holistic descriptions.

3.4 Summary

The relationship between our sensing of a variegated world and the way we interpret it has been a major theme in Western philosophy since its recorded beginnings. For Plato, all experiences of the world were understood by the extent to which they conformed to pre-existent Ideas that were 'received' at birth and ever-present in the mind of the perceiver. Aristotle's dissatisfaction with this 'unworldly' view led him to speculate about, and importantly experiment with, the structure and function of the world as he experienced it. On regaining Grecian scholarship from the Near East following the European Dark Ages, the Scholastics, began to question the received wisdom of the church, which many identified as a form of misplaced Platonism. For the sake of brevity, the insights of this period were not discussed in this chapter, important though some of them may turn out to be for an understanding the relationships between emotion and awareness that are currently engaging neuroscientists (Damasio 1995; 2003).

The uncertainty of obtaining reliable knowledge of the world through direct sensory experience that the idealists had exposed, undermined the Cartesian confidence in human reasoning about the perceived world as the foundation for truth and sent philosophers in various directions, including a search for new ways to underpin traditional rhetorically-based logic with mathematical foundations. At the same time as Hume demonstrated the unreliability of the senses and thus the unknowableness of the world, empirical methods were being used to increase knowledge *of* that world, and obtain power over its natural forces. Kant's resolution of this apparent conflict, by demonstrating the special relationship between space, time and perception, which he called *Transcendental Idealism*, was a lens through which later philosophical investigations were obtained.

According to Kant's understanding, what, exactly, is meant by *information* is embedded in relationships between the sensation, perception and apperception of phenomena; what he called *appearances*:[30] things as they are for humans, as opposed to things as they are 'in–or–of–themselves'. From this perspective, information can be simply characterized as phenomena, or thoughts about phenomena in the mind of some person. Brentano and Husserl developed their pure (contemplative) psychology of perception, known as phenomenology, by bracketing off the 'world–as–we–know–it', Kant's 'things–as–they–really–are' (*Ding an sich*, *noumena*), to try to determine whether or not the properties of phenomena were capable of being formally (that is logically) organized; firstly in the mind of the perceiver and secondly as sharable with others—a characteristic Husserl called *intersubjectivity*. His aim was to develop an *eidetic* science of essential, invariant phenomenal forms that involves no assertion of actual material existence, but he struggled to keep them conceptually separate from Plato's Ideas. Peirce thought that there can be no perceptual objects without a unifying factor that distinguishes them from the 'play of impressions'".

The success of methodologically rigorous empirical approaches in the natural sciences wedged the study of the psyche away from its purely first-person introspective philosophical roots. The most significant early discovery that resulted was that of perceptual gestalts, which their discoverers considered as phenomena arising naturally and directly from the physical

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[30]   *Erscheinungen* in German.

nature of sensation. Though the Gestaltists had found an important invariant, they were not able to extend the idea past the noumenal world. However, it is a characteristic of phenomenal forms (such as melodies) that their properties can remain unchanged when the objective stimuli upon which they rest undergo certain modifications (such as transposition). This phenomenon of identity is related to a much more general problem found in abstract mathematics; of invariances with respect to variations of the primitive elements out of which a form is constructed. The particular kind of identity that is attributable to apparently heterogeneous figures, because they can be transformed into one another using operations that define a group, exists in the domain of perception and permits us to grasp perceptual "structures". The mathematical concept of transformability corresponds to the concept of transposability in perception. So by accepting "form" as a primitive concept, Gestalt psychology made an attempt to free psychological theory from contingency on the mere mosaic of perceptions.

Without considering cultural differences[31], not all group-theoretic transformations of perceptual objects are equally cognised, nor are the same transformations as easily perceivable in different sense modalities. For example, symmetry group transformations of pitch and temporal structures, such as transposition, inversion and retrogradation, occur frequently in music though they seem not to be all equally evident to the casual observer; under non-extreme pitch transposition and tempo acceleration a melodic structure remains strongly invariant; pitch contour inversion and rhythmic retrogradation are common occurrences but not as strongly invariant, while rhythmic inversion seems not to be perceptually invariant or even generally defined.

Gibson reacted to the findings of perceptual gestalts by denying the existence or importance of the phenomenal. Instead, he based his direct realism theory of vision on an evolutionary approach whereby organisms and their environments develop reciprocities over genetic and diurnal time; their

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[31]   Which needs to be done cautiously. The structural characteristics of music from a wide variety of cultures seem generally comprehensible, suggesting that cultural differences are more likely to be of degree rather than kind. Assumptions need to be treated sceptically, however. Werker and Vouloumanos (2001) document many studies that indicate speech plasticity in infants is subject to cultural influences and in a classic study, Segall Campbell and Herskovits (1966) showed that the Müller-Lyer illusion is culturally not neurophysiologically determined.

senses develop in an environment that thus latently afforded actions, whether or not these affordances were recognised. While direct realism may be a useful model for some perceptual mechanisms, it does not seem to be a plausible justification for believing that immediately experienced "sense-data" constitute a representation or depiction of an independent realm of real material objects.

The connectionist/cognitivist approach has been to build sensing, then responding, then perceiving, then environmentally aware machines, in the hope that, given enough neural connections, zombies would appear that could function in the world around them with intent.[32] These models have failed to bridge the divide between the easy and the hard problems of consciousness (§3.3.6) and so researchers are beginning to explore other models of mind and the rôle emotions plays in intent.

If it is the *intended* effect that ultimately identifies information, as Küppers suggests (§3.2.2), and that intent is *by* the listener *of* a sonification, understanding what the principles are by which sonifications of abstract multivariate datasets can be made to reliably afford such intent, seems to require more, or something other, than what psychology, psychophysiology and the cognitive sciences have so far revealed about the processes involved. Yet music somehow continues to communicate non-verbally and so the next chapter explores some non-rational, even non-mental, aspects of music with a view to considering their possible usefulness for the intentional user's perception of immanent abstract phenomenal objects.

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[32]   According to Chalmers, "A zombie is physically identical to a normal human being, but completely lacks conscious experience. Zombies look and behave like the conscious beings that we know and love, but all is dark inside. There is nothing it is like to be a zombie." http://consc.net/zombies.html.