The Sense of Touch

by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy
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Abstract

My thesis presents a novel philosophical account of the sense of touch. The thesis begins by challenging the predominant view of touch, which holds that touch—because of its physiological and functional complexity—ought to be considered a multisensory form of perception rather than a single sense like vision and audition. I reject this view, and develop a nuanced hierarchy of multisensory involvement according to which touch is a single sensory modality. The view develops a particular notion of sensory assignment (or binding), showing that the constituents of touch, despite their diversity, assign features to the same set of tangible objects.

Touch, despite being unisensory in character, is unlike the other senses in displaying a duality of the proximal and the distal, since it informs us both of the condition of our own bodies and of the properties of external things. I defend an unorthodox account of this duality, arguing that we do not sense external objects in virtue of sensing the condition of our own bodies. Nevertheless, both forms of touch (proximal and distal) are legitimate forms of perception, and deeply connected by shared physiological systems and overlapping assignments of properties.

Touch is similar to vision in allowing us to experience objects and properties even when those properties are not in direct or apparent contact with our bodies. I develop an account of tactual reference—the idea that touch can represent or be about particular objects—according to
which touch, like vision, can refer to objects even when those objects are not in direct bodily contact with our sensory surfaces. Despite this similarity, touch is unlike vision in requiring some appropriate intermediary to connect us to distal objects. The nature of these connections is supported by a novel account of the spatial character of touch, in which the distal objects of touch are located at coordinates that we can access via exploratory action.

Another important element of touch is its diversity of perceptual objects. The so-called objects of perception are the intrinsic or basic features that comprise our immediate sensory awareness. Touch seems to possess a wider and more diverse range of basic features than the other senses: through touch we can experience hot and cold, heavy and light, rough and smooth, vibrating and still, solid and soft, along with an array of individual spatial properties. I defend a novel account of the structure and relations among these many properties, showing that the features experienced through touch are different from those that occur in vision and the other senses.

Touch also differs from vision in that it seems to essentially involve exploratory actions that occur over time. In this, touch is also very different from most other sensory modalities. In the final chapter, I argue that active forms of touch, which bring awareness of external objects and their features, essentially involve a systematic set of exploratory actions. This role is unique to touch, and differs in many important respects from the role of action in vision and the other senses.
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Introduction

_Necessity gives to the eye a precious power of seeing, and in the same way it gives a precious power of feeling to the whole body. Sometimes it seems as if the very substance of my flesh were so many eyes looking out at will upon a world new created every day._

-Helen Keller, _The World I Live In_

Humans are sometimes described as a “visual” species. Like many generalizations, this claim has much to support it. A substantial portion of the human brain is devoted to visual processing, and vision—with its vivid colors, textures, shapes, and vistas—plays a central role in our experience of the world. Yet is it another, often neglected sense, that may be our most immediate and powerful sense. The humble sense of touch lacks the fireworks of vision and the rich tapestry of sounds available to audition, but what touch lacks in thrills it more than makes up for in importance and priority. While many humans live comfortable, fulfilled lives without vision or audition, total loss of touch is both exceedingly rare and devastating for normal human development. The sense of touch may seem relatively basic, yet in humans it finds a level of sophistication that is striking in its complexity and usefulness. Touch involves our entire body, and offers awareness of a range of distinct and important features of the world. Through touch we are able to manipulate and interact with both small and complex objects, comfort and console one another, and use tools to expand our reach and abilities. Touch is also one of our primary conduits of pleasure and pain. Given these many roles, and its inherent complexity, the sense of touch offers a rich, fertile ground for philosophical investigation.

In the following five chapters, I develop a novel philosophical account of the sense of touch. This account in some cases develops as a reaction to previous views. For instance, D.M.
Armstrong (1962) offers an account of touch suggesting that all tangible features involve a spatial property (or some combination of spatial properties). Armstrong’s goal is to explain the nature of tangible properties and their structural relations. Similar, though more sophisticated, works in recent years have tried to do something similar with visual and auditory experiences. The assumption is that we can get a better understanding of a sense—its phenomenal character, representational content, and relation to other senses—by starting with some fundamental questions about the objects and properties that are available in that modality. While I fully support such projects, Armstrong’s spatial-reduction view is entirely implausible: it leaves out any account of the all-important thermal properties, and many of its supposed spatial reductions fail to go through. One of the goals of this thesis is to offer a more plausible, theoretically robust account of these tangible features.

I do not start with such an elaboration, however. More fundamental issues must be considered first. For, in addition to philosophical works, I also seek to engage the empirical literature on touch. Among psychologists and neuroscientists, there is a strong belief that touch is not a single sense at all. While it may seem obvious that touch is a single sense—after all it is always included among the traditional five senses—things are not so simple. While we commonly refer to “the sense of touch,” these words actually pick out a number of distinct physiological sensory systems and functional capacities. For instance, there are dedicated, and largely separate, cutaneous channels for mediating pressure, texture, and vibration. An altogether different system mediates thermal awareness. Also, most touch involves movements that activate stretch receptors in our muscles and joints, and involve inputs from our general system of bodily awareness (kinesthesis and proprioception). For these reasons, empirical investigators consider touch to be something other than a single sensory system—like vision and audition—and more like a multisensory collection of related but separate sensory systems. I begin my account of
touch by suggesting that this empirical assumption is misleading. While it is true that touch is more functionally complex than other senses, the many systems involved in touch are nevertheless importantly connected. What connects them are unified relations of sensory assignments: the many systems involved in touch work together to assign features to tangible objects. Thus despite their diversity, these many systems deliver a unified experience of the world.

The debate over the multimodality of touch occurs in a central area of concern in current cognitive science. In much recent cognitive science (and more recently still, in philosophy), researchers have shifted their focus away from isolated investigations of the individual senses to the connections and interactions between the senses. This shift can make the idea of focusing on a single sensory modality seem outdated and unwarranted. While I embrace the shift to a more interactive and multisensory conception of human perceptual experience, I think it is important not to abandon discussions of the individual senses—especially those that have received relatively little attention like touch and the chemical senses. The individual senses often have unique characteristics that are deserving of critical investigation. The unique relationship between touch and bodily awareness is one prime example.

Many previous theories of touch have held that touch strongly depends on bodily awareness, that we can only experience external objects and properties through explicit awareness of our own bodies (O’Shaughnessy 1989; Martin 1992). I think these views are mistaken. My view is that touch—like all of the other senses—involves an implicit bodily awareness; low-level bodily awareness shapes and structures our perceptual experiences. But externalized touch does not require any explicit awareness of our bodies; we need not directly experience our bodies in order to experience an object in the world through touch. Even so, touch
does possess a unique duality. Through touch we can experience external objects but also our own bodies. Part of my project involves explaining the relation between these two kind of touch. The relation between bodily awareness and touch is important for our general understanding of perception. Much recent work has focused on bodily awareness. For instance, detailed accounts of embodied and embedded theories of cognition have been developed which hold that our sensory experience is closely tied to our bodily interaction with the world (Varela, Thompson, and Roch 1992, Clark 2009, Rupert 2009). Other have also been investigating the nature of bodily awareness directly (Gallagher 2005, De Vignemont 2009). Here the focus is on a very fundamental question—the relation between bodily awareness and touch—that has the potential to further our understanding of these larger issues. Thus despite the recent move to more multisensory investigations, much can still be gained by looking at the unique aspects of the individual senses.

One more general issue should be mentioned. The nature of spatial representation plays an important role throughout the thesis. Touch seems unlike the other senses in requiring direct bodily contact with the objects of our experience. We can see objects located across the room from us, but we can only touch things that are pressing or rubbing against our bodies. This appearance is revealed in what follows to be too simplistic. Touch is often capable of delivering experiences of distal objects that are located away from the surfaces of our bodies. Distal touch comes in a number of distinct varieties, and I offer a unified account of these experiences rooted in the notion of perceptual reference—the notion that our perceptual experiences, like linguistic expressions, refer to or are directly about specific entities in the environment. That there are distal varieties of touch, and that they can be given a unified referential account is a surprising fact about touch. It means that the spatial representations involved in touch are unlike those involved in vision, but also different than those involved in pure bodily awareness. Part of my
positive account of distal touch involves providing an account of this intermediate range of spatial representation and the ways in which touch makes use of it to represent details and features in the distal environment.

Once we have an account of the general spatial character of touch, we can return to the question that we started with, and finally focus on the ontology of tangible features. When we investigate vision, the question that seems the most pressing for philosophers concerns the nature of the colors. With audition it is the nature of sounds. In touch, we have a number of distinct and metaphysically varied sensory features that require an account. These include vibration, hot and cold, solidity, weight, and many more. In the penultimate chapter I argue that tangible features are represented in two main classes. By showing the general structure of these classes and how they interact with one another, the quality space of touch is revealed. The tangible features interact, blend, and influence one another in important ways, and once these various interactions are determined, it allows us to compare the structure of touch with that of the other senses. This in turn helps us account for the content and character of such perceptual experience.

Another issue looms over the entire project, and should be mentioned before we begin. Touch is usually active and involves exploratory movements of the body. This raises an important question: what is the role of this movement in our touch experiences? Is action a part of the perception itself, or merely a causal element that is just necessary for tactual perception to occur? This is a specific instance of a more general question concerning the relation between action and perception, a question that has been the topic of immense discussion in recent years. Again, rather than engage in this debate directly, I focus on the relatively tractable, well-understand domain of action in touch. I suggest a unique and specialized role for action in touch, one that does not occur in any of the other senses.
Taken together, these individual examinations form a robust, coherent account of the senses of touch, one that offers important contributions across a wide range of current philosophy of perception. In some respects touch is more like the other senses than is often assumed. In others touch is entirely unique. The detailed considering of these various similarities and differences not only offers an account of touch, but provides a more accurate understanding of all perceptual experience.

Some important terminological background before we begin: the term *tactual* is used to refer to any form of touch experience. The more specific term *tactile* refers to perception mediated only by passive cutaneous stimulation, which includes sensitivity to temperature, pressure, vibration, and related features. The term *kinesthesia* refers to an awareness of our bodily movement and position; kinesthesia is part of a larger network that mediates many forms of self-awareness, from the orientation of our bodies to the amount of force applied to an external surface. *Haptic touch* involves cutaneous stimulations accompanied by kinesthesia (broadly construed to include external movements against our bodies and other forms of self-awareness). Haptic perceptions are what we usually mean by “the sense of touch.” The first challenge, to which we now turn, is to say whether or not haptic perception is a single sense at all, or instead a multisensory complex of different senses.

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1 “Tactual” as I use it excludes pains, itches, tingles, and other bodily sensations. My focus here is on the perceptual aspects of touch experience, in particular, the active exploratory form of touch known as “haptic perception.” Though I do not discuss pains and other bodily sensations in what follows, I believe that justification for setting them aside follows from my positive view: pains, unlike perceptual touch experiences, do not assign sensory features to external objects. I take up the distinction between perceptual touch and bodily sensation in detail in Chapter 2.
1.1 One Sense, or Many?

Touch is traditionally counted among the five external senses, along with vision, audition, olfaction, and gustation. When we touch something in the external world, like a coffee cup, it seems like we are using a single, coherent sense to experience that object. Unlike the other senses, however, touch seems to be a complex composed of many distinct sensory systems. Haptic touch especially—with its combination of diverse cutaneous receptors and coordinated exploratory movements—seems unlike the other senses in its complexity. Consider the extraordinary range of properties, including vibration, temperature, pressure, shape, and weight, that we feel through touch. These many features are all processed by distinct (but interacting) physiological systems. Thus despite its apparent uniformity, the typical touch experience is a complex occurrence, involving many distinct physiological systems. The seemingly simple act of grasping a coffee cup is not, it turns out, so simple.

Any account of touch must address the possibility that touch is fundamentally different from the other senses in being a complex, or multisensory, form of experience. Call this possibility the multisensory view of touch, and contrast it with the unisensory view. The multisensory view seems reasonable given the inherent complexity of haptic touch (and several leading researchers have claimed that haptic touch is multisensory, e.g., Loomis and Lederman 1986). While vision and audition seem unisensory, haptic touch seems to have an entirely different, multisensory structure.
Despite its plausibility, I believe the multisensory view of touch is mistaken. In what follows, I defend the unisensory view that haptic touch ought to be understood as a single sense. My argument is relatively simple: in haptic touch, the various cutaneous and kinesthetic activations are coordinated (temporally, spatially, and otherwise) through exploratory action, resulting in a unified perceptual experience of tangible objects. The unified representations that result are structurally similar to those found in vision and the other senses, and can be contrasted with the kinds of representations typical of multisensory experiences. Haptic touch thus turns out to be a single modality, its various constituent systems aligned much like those involved in vision, audition, and the other senses.

The argument for this account is complicated, however, by the fact that, at present, no established criteria exist for deciding whether an experience is multisensory or not. The intuitive conception of the senses—the view that the only major senses are sight, hearing, taste, smell, and touch, and that multisensory experiences arise from their various combinations—cannot be applied, since it both begs the question against touch and fails to distinguish problematic cases. In order to defend the unisensory account of haptic touch, one must show that unisensory experiences can be systematically distinguished from multisensory interactions.

I’ll try to motivate the idea that unisensory experiences involve a relatively simple structure, in which qualitative features are assigned to individual objects. Though not essential to my view, I shall characterize this assignment in terms of “feature binding,” and suggest that it is

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2 This role for exploratory action will be revisited in Chapter 5.

3 There are actually two closely-related questions here: (1) what makes an experience unisensory or multisensory? and (2) what makes a sensory system (or set of systems) unisensory or multisensory? These are distinct questions, involving different levels of explanation. Still, the questions are deeply intertwined, and cannot be independently answered; any account of unisensory experience must reference the systems that generate them, and vice versa. In what follows, I’ll move as needed between experiential and system-level explanations.
best understood as a kind of qualitative predication, where sensory systems are involved in the appropriate placement of sensory features.\textsuperscript{4} To be clear, my claim is not that \textit{all} unisensory experiences involve feature binding (there are many counter-examples). Rather, if a perceptual system (or group of systems) involves an assignment of sensory features to the same set of perceptual objects, that is sufficient for that perceptual system to be unisensory in nature.\textsuperscript{5}

While I am skeptical that there is any single criterion of multisensory awareness, or that multisensory interactions form a natural kind, multisensory experiences do seem to build on unisensory structure, forming a general hierarchy of sensory interaction. At the lowest level of the hierarchy are what I’ll call \textit{apperceptive unities}, which involve experiences connected only in virtue of belonging to the same subject (and nothing more). At a slightly more involved level are cases of genuine sensory interaction, which involve an \textit{associative relation} between distinct unisensory experiences (characterized by their unified predicational structure). An associative relation implies some connection between experiences, without specifying the nature of this connection. There are thus many ways of realizing such a relation. In virtue of such associations, experiences may suppress one another, or enhance one another, or one may dominate the other,

\textsuperscript{4} While this approach will be described in (mildly) conceptualist terms, it is compatible with non-conceptualism about perception. One could easily hold that some (or even most) perceptual contents are non-conceptual, so long as it is allowed that, at some level of perceptual experience, features are assigned to objects. If one denies that perceptual experiences have any such structure, then we have no means to of distinguishing unisensory from multisensory experiences (we end up with a “multisensory soup” view). There are many good sources for the conceptualist/non-conceptualist debate. The interested reader can start with the essays in Gunther (2003).

Similar accommodation can be made for adverbial and disjunctive accounts of perception. One could, for instance, give an adverbial account of seeing a table in terms of seeing it brownly, squarely, woodenly, and so on, where some binding-like connection exists between these various ways and the overall experience. For simplicity, I’ll describe my view in conceptualist, representationalist terms (that is, in terms of sensory predication); supporters of other views could nevertheless agree—with a bit of translation—that unisensory and multisensory experiences differ in the ways outlined.

\textsuperscript{5} The predications involved in touch do differ somewhat from those involved in vision and audition, however, for they arise largely from our exploratory interactions with tangible objects. (In this, touch is perhaps most similar to smell, which also involves a kind of exploratory binding grounded in active sniffing).
etc., and there is no reason to think that any single mechanism is involved in every case of multisensory involvement. The idea of an associative relation is intended as a general concept that can explain a wide variety of multisensory interactions, while at the same time providing a means of differentiating unisensory from multisensory experiences.

The motivation for this view arises from a tension in the multisensory view itself. As Lederman and Loomis (1986) write:

Although tactual examination of an object results in a phenomenologically unitary perceived object, the research literature acknowledges that what to the layperson is the “sense of touch” in fact comprises two distinct senses—the cutaneous sense and kinesthesis (31-2).

While the second clause claims that touch is comprised of multiple senses (i.e., is multisensory), the statement begins by acknowledging a certain phenomenological unity in haptic experience. This is suggestive. When we touch an object, we do not seem to have multiple overlapping experiences of the object (as we seem to when both looking at and touching the object). We seem to have only one experience of the object and its various features. One of my goals in this chapter is to characterize this unity, and to suggest that on its basis haptic touch ought to be considered a single sense.

Here is the plan for this chapter: in the next section, I’ll clarify the challenges involved in developing a criterion of multisensory experience, and offer some intuitively compelling examples to ground the discussion that follows. In § 1.2, I’ll offer negative arguments against three plausible motivations for treating haptic touch as uniquely multisensory. In § 1.3, I develop the claim that unisensory perceptual experiences have a unique structure that differentiates them
from typical multisensory experiences. In §1.4, I argue that haptic touch possesses this unitary structure; § 1.5 offers an initial account of the exploratory nature of haptic binding.

1.2 Clarifying the Challenge

Despite the recent surge in interest in multisensory experience, there are presently no adequate systematic accounts distinguishing multisensory from unisensory experiences. It would be an entire project in-itself to explain and catalogue the wide range of multisensory interactions, and offer necessary and sufficient conditions separating these many interactions from genuine unisensory experience. The philosophical goal of individuating the senses is closely related to such a project, and it has faced many difficulties (see, e.g., Grice 1962, Keeley 2002, Nudds 2004, Noë 2004). My goals here are more modest: to offer some plausible and empirically-grounded reasons for thinking that haptic touch is not multisensory.

Let’s start with some uncontroversial observations. We possess several senses through which we experience the world, and these senses work together, coordinating at many levels. Many of our perceptual experiences are thus legitimately termed “multisensory.” But the senses interact in a number of different ways, and there are many different kinds of sensory interaction. Consider having two unrelated perceptual experiences, such as looking at a red sphere while hearing a C# from the other side of the room. Intuitively, these appear to be two different sensory experiences. After all, the two experiences have a kind of independence; if one stops looking at the sphere, the auditory experience does not change, and vice versa. While both senses contribute to the subject’s overall experience, it is merely a coincidence of two otherwise unrelated

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6 For some recent empirical work on multisensory experience see Calvert and Thesen (2004), Spence and Driver (2000), Spence and Driver (2004), and Ghazanfar and Schroeder (2006). O’Callaghan (2008) is an excellent recent philosophical work on the subject.
experiences. They possess *apperceptive unity*—they occur in the same subject at the same
time—but little more. A It would be somewhat trivial to call such a mere conjunction a genuine
multisensory experience. Or at any rate, such a mere conjunction—that is, a conjunction of
experiences that have essentially no connection with one another—does not seem to be of much
interest to those who study multisensory experience.

Paradigm multisensory experiences seem to involve a different, stronger form of
interaction, which we can generally characterize as an *associative relation*. Suppose, for
example, that the red sphere is the source of the note. Now we would experience the note
originating from the same location as the sphere. If the sphere moved, the source of the note
would move as well. If we moved closer to the sphere, the note would seem louder and more
distinct. If the sphere is placed in a wooden box and thereby visually occluded, the sound would
become muffled and distorted. In this example, we have two distinct signals, one visual, one
auditory, providing reinforcing information about the same event: the sphere making a sound.
This associative relation provides information about the event that could not be attained through
any single sensory experience. The auditory experience seems to involve a sound that possesses
a set of auditory qualities (perhaps structured something like this: Sound[C#, location]). Nothing
in the sound alone shows that this visual object is the source of the note. That requires an
association between the visual and auditory experiences. Such associative relations occur
frequently in perceptual experience, and they are a plausible necessary condition on genuine
multisensory interaction, though there are a range of distinct mechanisms that relate sensory
experiences. Sometimes, when two sensory experiences become associated, an alteration in the

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7 This is similar to the “subjective unity” discussed by Bayne and Chalmers (2003).
8 Of course, there are some empirical contexts in which it might be useful to study such interactions. My claim is
that these contexts are not directly of interest to a certain class of multisensory experiences.
character and content of our sensory experience occurs. Such interactions by their nature involve more than apperceptive unity; they also often (though not always) involve precise temporal and spatial coherence and associations between contents.\(^9\) These influences occur in many paradigm multisensory illusions. Accidental co-occurrence with no interaction or association is one thing (and not very interesting); the truly interesting forms of multisensory awareness, at minimum, seem to involve an associative relation between different experiences. This notion of an associative relation is meant to be a general means of characterizing the structure of a range of distinct sensory mechanisms relating perceptual experiences.

We now face a difficulty: typical unisensory experiences also involve the coordination of information, often from different sources. We receive visual and auditory information from two eyes and two ears. Many different visual properties are associated with the sphere: a certain reddish color, a uniform spherical shape, a particular size, a smooth metallic texture, a motion. These features are all processed by largely distinct functional subsystems.\(^10\) The same visual object is both red and spherical and small and so on. Intuitively, there is an important difference between the multisensory case and the unisensory case, despite both involving the coordination of distinct sensory information. The question is this: in what way does the visual case differ from the C# and red case? What distinguishes the genuinely multisensory from the seemingly unisensory?

This is a difficult question to answer, but it must be addressed. We need some way of showing that haptic touch—despite its functional and physiological complexity—can be

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\(^9\) Cf. O’Callaghan (2008). Also, I should note that some multisensory interactions, notably those involving speech perception, occur even without precise spatial and temporal alignment (see Jones and Jarick 2006).

\(^10\) See for example Palmer (1999).
considered unisensory. The proposal outlined here is that haptic touch, like vision and the other major senses, possesses a simple unity grounded in its representational structure. Unisensory experiences involve a single assignment of sensory features, whereas multisensory experiences involve higher-level relations between these assignments. Before motivating this claim, I will consider and reject several plausible ways of defending the multisensory view.

1.3 Three Criteria for the Multisensory View

I will now consider and reject three plausible ways of defending the multisensory view of touch (I’ll reject two non-starters in passing). It does not follow that I take these characterizations to be of no interest for our understanding of perceptual experience generally. Sometimes we are interested in the functional or informational characteristics of a perceptual system, and it can be necessary to individuate things according to such criteria. My claim is that such criteria fail to capture the relevant distinction between unisensory and multisensory experiences (especially when it comes to haptic touch).

1.3.1 The Functional-Dissociation Criterion

Touch could be considered multisensory because—seemingly unlike vision and the other senses—it involves several functionally-distinct sensory systems.\(^{11}\) Jerry Fodor (1983) characterizes sensory systems as a special kind of functional system (a system that performs a certain function). According to Fodor, input systems—including the major senses—are modular, meaning (among other things) that they are domain specific, fast-encoding, hard-wired, and informationally-encapsulated. Input systems on this model are functionally dissociable, the

\(^{11}\) Lederman and Loomis (1986) seem to invoke a criterion like this when claiming that touch is multisensory.
primary operations (or functions) of the senses can be isolated from one another. Multisensory interactions can then be explained as interactions between these separate modules. This model of the mind has been highly influential in cognitive science and seems to be lurking in the background in many discussions of multisensory experience.

We can consider two systems to be functionally-distinct if the functioning of one system is (largely) independent of the other. The cutaneous and kinesthetic systems seem functionally distinct in this sense. One system supports surface sensory awareness, the other awareness of the location and motion of our bodies; they also involve distinct receptor populations, afferent information channels, and neural processing centers, so they satisfy Fodor’s modular criteria. A common means of establishing functional difference is the double-dissociation criterion: Two systems $A$ and $B$ are functionally-distinct if, and only if, $A$ can be maintained in the absence of $B$, and $B$ can be maintained in the absence of $A$. The fact that we can largely doubly-dissociate cutaneous awareness from kinesthesis is evidence that the two are functionally-distinct systems.\footnote{This is an idealization. We cannot doubly-dissociate the two systems because the cutaneous and kinesthetic systems are too deeply intertwined. A loss of cutaneous inputs would have a large negative effect on kinesthesis. Still, the systems are largely dissociable, for some imprecise conception of largeness, and this is certainly enough to motivate the multisensory view.}

The involvement of functionally-distinct systems at first appears to be a good criterion of multisensory experience. Such a criterion can be simply stated:

**Functional-Dissociation Criterion (FDC):** An experience $E$ is multisensory if it is produced by two or more functionally-distinct sensory systems. Two sensory systems are functionally-distinct if they can be doubly-dissociated from one another.
Despite appearances, such a criterion cannot be an adequate general account of multisensory experience. According to FDC nearly every perceptual experience is multisensory, from those with completely unrelated constituents to those that are seemingly unisensory. Every instance of apperceptive unity would trivially involve functionally-distinct systems, and unitary experiences themselves are generated by functionally-distinct subsystems. Visual motion and color are functionally dissociable: one can lose the ability to experience motion but retain color experience, and one can lose color experience but retain the experience of motion. Similar dissociations can be demonstrated in all of the perceptual modalities, across a wide range of features. Such a criterion would make being multisensory a trivial aspect of perceptual experience.

The FDC makes no distinction—as it seems we should—between mere apperceptive unities and experiences with some genuine coordination or association. For this reason FDC counts nearly any combination of sensory experiences as multisensory. This problem is compounded in the case of touch, since purely cutaneous, non-haptic touch experiences themselves consist of distinct receptor streams which are combined at higher levels of processing. The complex nature of such processing means that tactile sensing itself is highly dissociable, involving a complex range of interacting subsystems. If haptic perceptions are multisensory on the basis of the FDC, then tactile experiences are similarly multisensory. Analogous questions exist for kinesthesis, which is composed of cutaneous inputs, internal receptors, muscle feedback, and vestibular inputs. Similar reasoning could be applied to each of

13 See Lumpkin and Caterina (2007); there are even recently-discovered pleasure receptors in the skin, though the role of these receptors in haptic perception is unclear, see e.g., Löken et al (2009).
the other senses. In other words, according to FDC, all perceptual experiences are classed as
multisensory, down to the simplest constituent systems.

One might suppose that we can find some functional difference between touch and the
other senses. For instance, the constituent systems in touch are more independent than the
systems involved in vision and audition. While we do not usually have visual color experiences
without shape experiences, it seems we can have a purely thermal experience without roughness
(as when we bring our hand near an open flame). The appearances here are deceiving, however.
The functional connection between visual shape and color processing is strong, but so are the
connections between most tactual processing streams. When an object impinges on a passive
hand, the cutaneous signals are interpreted a certain way because the kinesthetic system indicates
that the hand is not moving. When we feel heat from a flame, it is associated with a distal object
(the flame) because there are no other signals indicating a solid object in contact with the body.
Even in these passive cases, kinesthesis and other systems play a role. We rarely have purely
passive touch experiences where movement or exploratory responses are not even possible.
When we feel an object in contact with our bodies, we move around, aligning and focusing our
receptors on the relevant properties of the object. In addition, cutaneous inputs provide vital
information about the position and movement of our bodies. Haptic touch is not a mere
conjunction of distinct sensory systems; its systems operate in a tightly coupled manner to
generate novel and robust percepts of individual objects in the world. We’ll return to this point
later in the paper. We should note, however, that there is a difference at work here, only it isn’t a
difference in the strength of the functional connections. Rather, it’s a difference in the nature of
the connections; whereas visual streams converge more or less automatically when we look at
the world, tactual features require active exploratory engagement. As we’ll see, this is a
difference in how the features are assigned to external objects, not a difference in the general structure.

We can easily diagnose where the FDC goes wrong: it’s formulated without any serious regard for the structure of the resultant experiences. Our conception of multisensory experience ought to be sensitive to more than just the number of physiological or functional systems involved in the generation of an experience. Vision may be dissociable into separate functional streams (or stronger, as implied by Goodale and Milner 1996), but it does not follow that visual experiences belong to multiple senses. The same is true of haptic touch. Like the other senses, touch involves a number of closely-connected sensory systems. Also like the other senses, these multiple systems share a strong form of unity grounded in the binding of sensory features.

1.3.2 The Shared-Content Criterion

Another conception of multisensory experience might justify the multisensory view of touch. An experience could be multisensory if it involves content (or information) delivered via two distinct sensory channels.14 Fred Dretske (1981) for instance, suggests that our perceptual systems (i.e., our senses) ought to be characterized as distinct channels of sensory information. As these channels feed into our overall experience of the world, the connections between them would seem to be ideal candidates for multisensory interactions. A similar view of sensory individuation (though more complicated in its details) is defended by Brian Keeley (2002). Keeley argues that the sensory modalities are evolutionarily appropriate routes into an organism that carry “information about the physical state of the world external to the central nervous

14 Philosophers prefer to talk of contents that can be shared, whereas psychologists more often speak of information from distinct sources. I ‘m assuming that these two ways of speaking largely amount to the same thing.
system” (6). Sources, on these views, represent distinct aspects of the external world to which our nervous systems are sensitive. On both views, informational channels play an important role individuating the senses, and multisensory experiences can be explained as arising from interactions between these channels.

A recent paper by Casey O’Callaghan (2008) offers additional philosophical justification for this view (though O’Callaghan himself does not suggest or endorse such a view). O’Callaghan argues that cross-modal illusions—where one sensory experience has some illusory influence on another—require that there be some shared content between the different modalities. The basic reasoning is that if one sensory system is to influence the character of another, then information must be passed between the modalities. One might suppose that multisensory experiences just are those that combine content from different sources. Consider the McGurk Effect (discussed by Spence and Driver, 2000). This illusion occurs when we perceive a phoneme that has been altered by being associated with a mismatched lip movement. For instance, if the sound /ba/ is produced along with the lip movements that typically make the sound /ga/, it results in an auditory experience of the sound /da/. The visual information about the source of the sound alters the aural character of the sound. In order for this to occur, there must be some content shared between the two modalities. As O’Callaghan writes:

[I]t requires recognizing both a component of experiential content and an aspect of perceptual phenomenology that are shared by distinct perceptual modalities. Perceptual experience thus cannot be understood exclusively in modality-specific terms (317).16

15 Or there is a common code shared by all the senses. This would seemingly lead to the view that there are no individual sensory modalities.

16 While this admonition against understanding perceptual experience “in modality specific terms” comes close to the radical rejection of the individual senses mentioned earlier, the general point seems correct.
The claim that multisensory experiences involve information from distinct sources is also made in the empirical literature (for instance, multimodal neurons are those whose receptive fields are sensitive to more than one source of input) (cf., Ghazanfar and Schroeder 2006). It is a short step to the conclusion that such shared information characterizes multisensory experience. This criterion can also be simply stated:

**Shared-Content Criterion (SCC):** A perceptual experience $E$ is multisensory if it has content $c_1$ (or information $i_1$) from source $m$ via channel $x$, and content $c_2$ (or information $i_2$) from source $n$ via channel $y$, where $x$ and $y$ are distinct channels.\(^{17}\)

According to SCC, touch could be construed as multisensory inasmuch as the experience involves content or information from the surface of our skin as well as content derived from kinesthesis about the movement and location of our limbs. These two sources seem to involve distinct sensory channels, and these channels carry distinct information about the distal environment. For this reason, the overall haptic experience counts as multisensory.

The general claims leading up to SCC are fine as far as they go; the senses clearly interact with one another and genuine multisensory experiences surely involve contents or information from distinct sources. One serious problem is that the senses seem less separated than this criterion might require; rather than isolated channels of information, the senses seem to interact at many levels of processing. Thus, when embraced as a means of *defining* multisensory experience, it supports the conclusion that *all* (or nearly all) perceptual experience is multisensory. The SCC thus fails for many of the same reasons as the FDC (in fact, if channels are defined functionally then the two views essentially collapse into one another). Consider again

\(^{17}\) While sources will typically differ as well, what individuates the senses on this view are that the contents arrive via distinct channels.
the red sphere and C# case. The overall experience involves contents from distinct channels, and would thus count as multisensory. Not only are the apperceptive unities classed as multisensory, but once again supposedly unisensory experiences are as well. A typical visual experience seems to involve processing along many distinct channels, from the individual eyes and the different subsystems responsible for processing motion, shape, texture, color, and so on.

One obvious way to avoid the application of this criteria to seemingly unisensory experiences is to claim that the various subsystems in vision and the other senses count as a single channel, and that multisensory experience involves shared contents between these sensory channels (or functional subsystems above the level of a single modality). By itself, this is an appeal only to the intuitive view of the senses. But one cannot simply stipulate this; an independent argument is needed for such a claim. Besides lacking sufficient warrant, such a stipulation begs the question in the case of touch. We want to know whether touch is multisensory, and it hardly settles the issue to just stipulate the answer.

One might similarly think I’m pushing too hard against the “radical view” that all of the sense are multisensory. It is worth reflecting on this point. Multisensory interactions are certainly more common than previously thought, and many of our perceptual experiences are multisensory. It would be a mistake, however, to completely throw away the concept of the individual sensory modalities. The individual senses have a special structure and importance that ought to be preserved by our best theory of perception. I won’t say much in defense of this

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18 I envision several ways this argument could be made (by appeal to attention, subpersonal vs personal processing, etc.) While I do not pursue it here, my positive view easily could be appropriated in defense of such a claim as well. The essential idea is that whatever relation unifies the visual channels would apply equally to the other senses, including haptic touch.

19 See Nudds (2004) for a discussion of the significance of the senses.
claim here, except to note that if all of the senses are themselves multisensory, then (1) we would lose the ability to differentiate between perceptual experiences that appear different, and (2) it would completely undermine the multisensory view of touch (which again, is the view that touch is uniquely multisensory). The multisensory view hinges on the fact that touch is importantly different from the other senses in virtue of its unique physiological structure. This is partly right; the systems involved in touch do function in a manner unlike those involved in vision and audition. But it does not follow that touch is multisensory. The motivation for this claim likely stems from deep pragmatic considerations in the empirical study of touch, and is probably not intended as a robust theoretical construal of multisensory experience. While we have made great progress understanding the physiology of vision and the other senses, we still know relatively little about the cutaneous receptors, and much less about the complex interactions that occur in haptic perception. The multisensory view of touch may be primarily intended as a means of emphasizing this fact. Nothing in what I say here is meant to minimize or undercut the complexities involved in the study touch, or to deny that touch involves a number of different functional systems operating in concert. My point is that such facts do not constitute a robust general conception of multisensory experience, nor do they show that touch has a multisensory structure unlike that of the other senses.

1.3.3 The Multiple-Stimuli Criterion

Let’s consider one final attempt to defend the multisensory view of touch: The Multiple-Stimuli Criterion (MSC). Multisensory experiences seem to involve coordination and associations between different kinds of stimuli. Vision, for instance, seems to involve a single kind of

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20 See especially the discussion in Chapters 2 and 5.
stimulus (light). Audition involves vibrations through a medium. Touch, on the other hand, involves more than one kind of stimulus. Kinesthetic inputs involve stimulations from dedicated receptors in our joints and stretch receptors in our muscles, temperature perception involves a distinct set of thermal receptors in our skin, and there are a range of unique receptor streams that code for features such as pressure and vibration. It may be that touch is multisensory because it involves the coordination of such disparate stimuli.

This view can easily reduce to one of the previous criteria. If we define stimuli by the receptors, we’re essentially invoking a functional criterion. If we instead define the stimuli via their resultant contents (one for each stimulus), then the view becomes a variant of the SCC. It is also not simply the claim that touch, or any other mode of experience, is multisensory because it represents a range of distinct properties, as the other senses also represent a range of distinct properties. Properly understood, however, the MSC promises a novel means of characterizing sensory experiences. The idea is that there is a certain unity of the stimulus in vision and audition that isn’t present in touch. While visual inputs all begin as a distribution of light on the retina, and audition begins with vibration through a medium contacting our auditory transducers, touch seems to involve a wider range of distinct stimulating inputs.

The main problem with the MSC is that we cannot even use the stimuli to say that two sensory modalities are different from one another, much less use it as a criterion for dividing unisensory and multisensory experiences. The problem is generated by so-called “sensory substitution systems,” which replace the functioning of one sensory modality with inputs typical to another. For example, a tactile-visual substitution system (TVSS) uses a vibrating plate attached to a video camera to simulate visual inputs. Subjects who are trained in the use of such a system are receiving only tactual inputs, but the nature of the inputs (and their reactions) seem to
be visual in nature. Subjects seem, for example, to be sensitive to looming and other vision-like effects (see Kaczmarek, et al 1991; also findings discussed by Noë 2004). It is difficult to say whether or not the resulting capacity/experience ought to be considered tactual or visual (Noë 2004 argues that we ought to treat such capacities as vision-like; see Prinz 2006 for criticism). This suggests that stimuli are not what individuates the senses (or it would be obvious that TVSS was a kind of touch full-stop).

Still, one might think that substitution cases are irregular, and difficult to judge. Unlike vision and audition, touch certainly involves a range of distinct receptors, unevenly distributed through our bodies. And these receptors do seem to code for distinct stimuli. Temperature and weight and roughness are after all different. Two additional points can be made to resist MSC as a way of motivating the multisensory view. First, the various stimuli processed by touch are connected to each other in a way unlike the connections between tactual stimuli and those involved in the other senses. They seem to have a special kind of connection grounded in their deep physiological connections. The stimuli involved in touch all arrive through the skin, where the various receptors code each signal. Almost immediately these various stimuli are combined and blended in various ways, leading to complex, novel signals at later stages of processing (Lumpkin and Caterina 2007). For this reason, we can think of touch as involving a tangible stimulus arising from our contact with external objects and their surfaces. This connected stimulus involves a range of distinct individual signals that combine to generate a unified experience of complex tangible properties. For example, if we touch a surface that is a cool with low friction then we will often experience that surface as wet. Similarly, our experience of material composition (whether something is wooden or metal) depends on the interactions between a range of distinct external stimuli. Such touch blends show that the different sensory stimuli strongly interact, leading to novel tactual experiences (cf. Katz 1926/1989).
The second point is that, like haptic touch, taste and smell also seem to involve distinct external stimuli, namely a range of distinct chemical properties which lead to distinct perceptual experiences. The sugar we taste as sweet has a chemical property unlike that found in the coin we taste as metallic. The different taste buds by their nature are sensitive to distinct external chemical properties. A similar situation occurs in smell. These distinct stimuli involved in sensory experience are not completely separate channels of information, but an interacting network of specialized transducers working together to produce a unified percept. It is thus once again difficult to isolate touch from the other senses in any strong manner (instead, we seem to have vision and audition on one side, and touch, smell, and taste on the other).

Many of these failures follow from the many challenges faced by those trying to individuate the senses. One of the strongest recent attempts to individuate the senses, that of Keeley (2002), involves aspects of all three criteria considered here (with some additional evolutionary considerations). According to Keeley, a sensory modality is a dedicated physical channel (FDC and SCC) that has adapted to pick up information in the distal environment (MSC). While I think this account is useful for its intended purpose (which I take to be offering an empirically-salient means of individuating sensory modalities in humans and other animals), it does not consider the implications of the deep interconnections between the senses so constructed, such that we can say of one perceptual experience that it is unisensory, and of another that it is multisensory.

To conclude with these inadequate attempts, it should be pointed out that a phenomenal characterization of multisensory experience is a non-starter, and cannot be invoked in defense of
the multisensory view. Most paradigm multisensory interactions have no identifying
phenomenal character. We simply cannot tell from the phenomenal character alone whether or
not an experience involves some strong association or alteration in character stemming from
association with another experience.

1.4 The Structure of Unisensory Experience

My view is that haptic perception is unified in virtue of the fact that all of its physiological
systems work together to assign sensory features to the same set of objects. The relationship
between the functional subsystems in haptic touch is thus much like that found in the other
sensory modalities, and contrasts with the structure found in paradigm multisensory experiences,
which involve associations or coordinations between individual sensory features. My proposal is
that unisensory experiences involve the direct assignment of features to perceptual objects,
whereas multisensory experiences involve some higher-level relation between separate
experiences. While it is beyond the scope of this chapter to fully defend the claim that a
distinguishing feature of unisensory experience is its binding structure, the fact that such a view
accords well with the empirical literature while offering a robust account of the difference
between unisensory and multisensory experience lends a great deal of support to the idea. What
follows is an attempt to show how such a view, if correct, offers a way of getting beyond the
challenge posed by multisensory experience and of showing that haptic touch, despite its
complexity, shares a special kind of unity with the other senses.

21 Keeley (2002) also argues that phenomenal character cannot help even in general sensory indviduation.
22 The claim that perceptual experiences are the kinds of things with robust structure is not uncontroversial. Others
who hold a similar view (that perception is predicative or “feature placing”) are Austen Clark (2000) and Matthen
(2005); possibly Burge (2009).
Most unisensory perceptual experiences involve multiple physiological systems and sources of content. Nevertheless, unisensory experiences have a strong form of unity called “feature binding.” Feature binding, as I understand it, involves the predication or assignment of distinct features to perceptual objects. The features are bound to objects, not each other. For this reason, feature binding is object-involving, and closely tied to our ability to perceive, segment, and group objects and events. Our knowledge of objects and their properties relies on this close association of features—we can distinguish a tennis ball from a baseball through sight because each has a certain set of distinct visual features. Further, the binding of features often generates experiential novelty; seeing a visual object does not seem to involve the mere co-occurrence of separate experiences (one for each distinct sensory feature).

The claim that feature binding is object-involving needs to be kept distinct from similar sounding claims about the mechanisms of such binding. While I believe that space-based accounts of perceptual binding—the idea that spatial locations serve as the bearers of perceptual properties—are not as plausible as object-based accounts (see, e.g., Matthen 2005 for criticism of the space-based account), this is a debate about the mechanisms of sensory binding, not about the structure of bound experiences. Even if one thinks that spatial locations play a central role in sensory binding, it does not undermine the claim that when sensory features are bound what we experience are objects that possess a range of sensory features (e.g., we do not experience spaces as possessing certain features).

Further, I’m merely highlighting a distinguishing feature of unisensory perceptual experiences, not positing a necessary condition on them. There are many possible counter-examples to the necessity claim, for instance when one sees a ganzfeld—a uniform color field lacking any distinguishing visual features—it is highly likely that no sensory binding as I’ve
described it occurs, yet we would consider such an experience unisensory (that we quickly go blind when exposed to such a field might support the view that sensory binding is a central aspect of visual experience, however). I’m claiming that feature binding is at best a sufficient condition on unisensory experience. When an experience possesses a simple structure whereby sensory features are assigned to individual perceptual objects, without any further associative relations with other experiences, then we can consider that experience to be unisensory in nature.

While binding is most typically discussed in vision, some form of binding occurs in all of the senses. Auditory scene analysis, for instance, involves binding particular auditory qualities onto distinct auditory objects. When different sounds are heard, each of the many auditory features—distinct pitches, timbres, rhythms, locations, etc.—must be correctly associated with the correct sound (see e.g., Griffiths and Warren 2004, Hall et. al 2000). When we hear a trumpet sound to our left, and a drum sound to our right, auditory binding occurs. We associate certain auditory features—again, pitch, timbre, loudness, rhythm, etc.—with each instrument’s sound. Olfaction also involves binding features onto smells or odors, which seem best understood as distributed objects. When we smell several distinct odors, we must be able to correctly assign the various olfactory qualities to the appropriate objects. This is done by correctly assigning distinct chemical inputs to generate a single odor representation (Wilson and Stevenson 2008). Such binding allows us to distinguish the sour odor of the lime juice from the earthy bite of chopped garlic in a single odor-experience. As in touch, the segmentation of odors onto distinct olfactory objects often involves a kind of exploratory action: we often sniff over a range of space in order to properly bind the many olfactory features to distinct objects.

Of course, it is possible that even a ganzfeld involves something like binding. Maybe the surround itself is assigned a uniform color. At any rate, such experiences are highly unusual. See Avant (1965) for some background on the Ganzfeld Effect.
For simplicity, I wish to characterize the claim that unisensory experiences involve the direct assignment of sensory features in terms of predication. According to this view, sensory features are “placed” or assigned to objects in the world. In vision, a set of unique features—including color, shape, texture, and motion—are all predicated, or bound, to visual objects. In audition, a range of auditory features are assigned to individual auditory objects, typically thought to be sounds. In olfaction, features or qualities are predicated of odors. We can characterize this structure in various ways, but the following simplified structure seems appropriate:

**Unisensory:** Visual-Object[texture + color + size + shape + motion, etc].

Here we have an experience an individual object that possesses a range of features. When we have a complex visual experience, we might perceive many visual objects with a unique distribution of visual features. These features do not take a single value, but form a distribution over the object (or set of objects). For instance, a visual object may be bluish in one region and greenish in another, or possess differently-shaped parts. We might see a blue object in front of a red one. Visual binding just is the process by which these distributions are properly assigned. The structure above is thus highly simplified, but captures what is essential about these kinds of experiences. One form of evidence for such a predicative structure is the experience of change. When we see an object change color or shape, it is the same object that so changes. We

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24 Of course, we could use different ways of notating the structure (“o is F and o is G” or “o[F and G]” etc.). I use the following only as a representative means of discussing the cases. More complex unisensory experiences would involve a distribution of objects: V-O₁[x,y,z, location], V-O₂[x,y,z, location], etc.

25 The details of how these feature distributions are actually bound to perceptual objects are not important here. This is, essentially, the binding problem, and is not the concern of this paper. I’m merely describing the salient characteristics of feature binding, not proposing an account of how it occurs.
experience the same object as now possessing a different range of phenomenal properties. When an associative relation changes, we experience a change or alteration between distinct objects.

Multisensory experiences do not involve the direct predication of features onto individual perceptual objects. Instead, there is an association between bound experiences. These associations between sensory experiences are different in kind from unisensory experience, and facilitate tracking, attentional directedness, and reinforce our knowledge of objects and events in the world. This sort of coordination between the senses is revealed in a number of well-known multisensory illusions. Consider a representative example, the motion-bounce illusion (Sekuler et al 1997). When two visual targets on a screen start at the top corners and move to the opposite bottom corners, we experience the visual targets as crossing in the middle, tracing an X on the screen. If an auditory click occurs at the moment the two targets cross, then we are more likely to experience a collision, to see the two targets rebound away from each other in the middle, tracing a \( > < \) shape. The precise, coordinated operation of the two senses dramatically influences our perceptual experience, informing us that what could be seen as a crossing is more likely to be a bouncing. This motion-bounce illusion is just one of many examples of how the association of sensory information can influence and alter our perceptual experience.

The coordination involved in the auditory-visual case is often (though not always) sensitive to temporal and spatial continuity. A small divergence in timing or spatial location can often undermine the association and experiential effects. If the auditory click in the motion-bounce illusion were to occur much before or much after the visual targets cross, then we will not experience a bounce, and the auditory click would not alter our visual experience. What we experience is a higher-order association between sensory experiences. Genuine multisensory experiences involve some association between individual experiences. If an auditory experience
is temporally and spatially aligned with a visual experience, for instance, it can result in an associative relation between the experiences:

**Associative Relation:**  
\[
\text{Sound[C#, loud]} \quad \text{and} \quad \text{Visual-Object[red, sphere]}
\]

Here the “and” represents an associative relation between the experiences. The red sphere is experienced as the source of the note, leading to a range of perceptual consequences. The relation is thus realized at many levels, and most likely through overlapping but distinct mechanisms of association. The two experiences share a relation that cannot be reduced to any of the individual constituents, but that exists between them (we could not tell that the sphere was the source of the note from sound or sight alone). Sometimes the associative relation leads to an alteration in the content and character of the of one of the constituent experiences:

**Associative Relation:**  
\[
\text{Sound [click\textsubscript{1}]} \rightarrow \text{Visual-Object [bounce\textsubscript{1}]}
\]

This is a case experiential dependence. The character of the visual experience depends on the precise alignment of the auditory signal. The particular associative relation realized here between the auditory and visual inputs has played a role in determining the precise content and character of the visual experience; it has influenced the interpretation of the visual input as a “bounce” rather than a “crossing.” This appears to be the representational structure involved in the Motion Bounce case, and a similar structure occurs in many other paradigm multisensory experiences. Associative relations are subserved by many different mechanisms, from multisensory integration, super-additive responses, and sensory suppression. It is also likely that such relations are not discrete, but rather form a continuum. My account leaves open the possibility that some experiences are more strongly associated and mutually influencing than others.
One immediate concern about this account is its appeal to distinct perceptual objects to explain sensory binding. There appears to be a troubling circularity to the claim that sensory binding involves predication to a perceptual object, if that object is simply a bundle of bound features. To avoid this suspicion, let me be clear that I take perceptual objects to be ontologically robust, objective entities. It is true that such entities are experienced in a certain way, via certain represented features. Sounds, for instance, are most likely (though not necessarily) events of some kind, leading to the generation of air waves (O’Callaghan 2007, Matthen 2010). Sounds on this account are thus real entities in the world, though distinct from the objects that generate the sound. When we experience sounds, we do so by assigning a range of auditory features—pitch, timbre, loudness—to the auditory object (to that event). The same is true of visual and tangible objects, which are just material objects and their surfaces (albeit represented in a particular way, a crucial point). A tangible object is a real object, one to which we predicate a range of distinct tangible features. In other words, they are external objects that we experience through a range of perceptually salient features. Such objects are thus not merely the bundle of such representations, but the bearers of those features.⁴⁶ Objects thus construed are not what Aristotle called “proper sensibles.” For instance, Aristotle took the proper sensible of vision to be color (De Anima bk 2). On the view sketched here, however, colors are properties or features of visual objects, not themselves the objects of perception. Similarly, what Aristotle called the common sensibles—features shared between the senses, including number, movement, shape, and size—are properties possessed or assigned to perceptual objects, not themselves objects or bearers of

⁴⁶ See Pylyshyn (2002) and Matthen (2005) for background on this line of thought regarding perceptual objects.
properties (it makes little sense to think that number or size are the kind of things to which sensory qualities can be assigned).  

The alternative view is that perceptual experiences either lack structure entirely or they have some different structure. If we suppose perceptual experiences to lack structure, then we have no means (other than abstraction) of distinguishing between unisensory and multisensory experiences. Our experience of the world would be a “multisensory soup,” with haptic touch merely one of the constituents. And in the preceding, I have taken pains to show that other means of dividing the cases fail to properly distinguish unisensory from multisensory, or to separate haptic touch from the other senses.

1.5 Haptic Unity

Let us turn now to the claim that haptic touch, with its many receptors and constituent systems, is much like vision and the other senses in (what I’m calling) its predicative structure. My view is that haptic touch, like the other senses, involves assigning a range of features onto individual perceptual objects. This structure is like that found in the unisensory case. Defending this requires two things. First, it needs to be established that such an assignment of features—binding—occurs in haptic touch. Second, the nature of this assignment needs to be more clearly distinguished from visual binding, since both senses seem to assign features to the same class of objects.

While sensory binding has been studied extensively in vision, and more recently in some of the other modalities, feature binding in haptic touch has not yet been studied in any detail. For

27 The more plausible possibility that locations serve as the bearers of sensory qualities is discussed above.
this reason, there are few studies on the relationship between haptic features. Some evidence comes from the work on exploratory procedures done by Susan Lederman and her collaborators (see especially Lederman and Klatzky 1987). These studies show that there is a close relationship between our exploratory movements and the set of features that are assigned to external objects. Some movements allow us to experience a range of features at once, while more complex movements generate more robust representations of objects and their features.

Consider a haptic interaction with a small metal sphere. This involves reaching out and picking it up, rolling it around in your hands, squeezing it, supporting it on your palm, pressing against it with your fingers, tracing its outline. Through these actions, a number of tangible features come to be predicated of the object—solidity, smoothness, coolness, hardness, spherical shape, weight, and size. If the sphere changes in some way, if it were to heat up, then we experience a change in the very same object, not a change in two different objects (while I am appealing to introspection here and in what follows, there is nothing mysterious about the examples cited. Of course, I would prefer evidence from careful empirical studies on haptic binding, but until such studies are conducted, examples like this will have to suffice). The structure of predication involved here is similar to the visual case, and different from most multisensory experiences. Touch, like vision and the other major senses, does not involve any associative relation. It involves the direct predication or binding of sensory features onto individual objects:

**Haptic:** Haptic Object [texture + shape + roughness + hardness + thermal + etc.]
Even though the features involved in touch are largely processed by different sensory channels, they are assigned to the same tangible objects.²⁸

Haptic touch thus does not seem, at least to introspection, to involve association between separate experiences (with their own perceptual objects). This follows from how we normally type experiences, in terms of their unity or content. For instance, when one has a visual and auditory experience, the two experiences can be characterized individually along many dimensions: qualitative differences, different contents, different objects, etc. One can easily abstract out the auditory part from the visual part. When one has a complex haptic experience, one does not seem able to distinguish the various parts in the same way. There does not seem to be a separate kinesthetic experience independent and distinguishable from a pressure experience, both of which are different again from the thermal experience, etc. Instead, one has a unified experience with different constituent elements, as occurs in vision. (Just as one does not have a motion experience separate from one’s color experience, one does not have a thermal experience separate from one’s texture experience). In other words, a haptic experience does not involve a purely cutaneous experience that becomes associated with or (or altered by) a kinesthetic experience.

One line of evidence for these claims comes from the kinds of blending that occurs in typical haptic experiences. When an object feels cold to the touch, we are more likely to experience it as metal than wood. The thermal features become associated with the other tangible features, allowing for more accurate identification of, among other things, material composition,

²⁸ This is not to deny that there are interactions between the systems involved in touch, for instance, motor activations involved in kinesthesia are known to suppress some cutaneous receptors. This effect does not seem multisensory, but rather like the kind of effects that occur between the ocular motor system and other visual systems.
which plays a central role in our identification of objects through touch (Klatzky and Lederman 2003). An important element of this view is that the binding found in haptic touch is continuous with, and not separate from, the binding found in passive cutaneous touch. That is, haptic perception involves the assignment of distinct features to the very same external objects felt through cutaneous touch. Haptic touch is thus not a separate form of experience, but rather an extension of cutaneous touch mediated by novel inputs provided by kinesthetic involvement. (For this reason, we could more accurately refer to the “unity of touch” in this chapter).

While it has already been argued that associative relations and sensory binding are distinct kinds of sensory interactions, this point was established largely by appeal to clear cases where the objects involved not only differed, but differed in kind (the C# and red sphere cases). There are strong philosophical reasons (dating at least to Berkeley) for supposing sounds to be distinct from the objects that produce them, but the objects of touch seem identical to the objects of vision. This poses a serious challenge to my account.

To see why, consider seeing and touching an object (sphere) at the same time. When we touch the sphere it seems we are binding several tangible features to it, but when we look at the sphere we seem to be assigning visual features to the very same object. The bearers of the properties seem to be the same. If this is right, then my account would seem to characterize visual-tactual experiences as unisensory, though they are paradigm instances of multisensory awareness. That is, the following would be possible:

**Haptic-Visual** Material Object [visual features + tangible features]**
This seems possible because it seems that Visual Object = Haptic Object, and since both sensory systems assign their features to the same objects, they will count as a single sense modality.29

This worry has its roots in one of the classic philosophical discussions of touch: Molyneux’s Question.30 The question that vexed Molyneux in his letter to Locke concerned the relationship between visual shape and tangible shape, specifically whether an object like a sphere, known through touch only, could be recognized through vision (if a blind person were to have their sight suddenly restored, for instance). While not exactly the same issue, here the question concerns the relationship between visual and tangible features generally and their objects (we will return to this issue again in later chapters). Fortunately, there are good reasons for thinking that visual and tangible features are not bound to the same objects.

It simply doesn’t follow from the objective identity of visual and haptic objects that both sensory systems recognize and assign their features to these objects as though they were one and the same. In fact, the empirical evidence demonstrates clearly that the two sensory systems assign unique sets of features to these objects in different ways. What distinguishes visual objects from tangible objects, then, are large differences in the features assigned to them. And it is the difference in the assigned features and their unique relations—not the identity of the underlying objects—that distinguishes the two senses from one another. It is true that some of the features overlap—both senses can assign shape and sizes to objects—but these assignments bear unique relations to other features and differ in their represented qualities. For instance, when you close your eyes, visual shape and a range of other visual features disappear together, in a

29 Similar worries can be raised in taste-touch experiences, and can be addressed in similar ways.
30 For some background on this central puzzle in the philosophy of touch, see Morgan (1977), Evans (2002), and Campbell (1996).
coherent, connected fashion. If a single property—shape—were assigned by both senses then we would have no account of these systematic assignments.

The properties are not exactly the same, anyway. Visual shape is not experienced in the same way as tangible shape, and the overlapping assignments are often in conflict. When you both look and touch an object at the same time, you may be assigning visual shape and haptic shape to the same object, but there are often large discrepancies that need to be worked out by the two systems. These differences lead to cases of sensory dominance and suppression, both paradigm multisensory interactions (Calvert and Thesen 2004; Ernst and Newell 2007). For example, geometrical features are processed more slowly in touch, and they play a diminished role in object recognition. The notion of an associative relation is meant to offer an empirically-plausible and unified account of such interactions. While tangible shapes are determined largely by our manipulation and exploration of external objects, visual shape arises from distinct processes (shape from shading, for example). So tangible and visual features differ in their phenomenal character, in the systems that process them, their mechanisms of binding, and their relations to other sensory features. It is simply not plausible that the two systems assign their features in the same way to the same objects. While the objects are the same, in the sense that they are the same objective entities in the world, these two sensory systems treat these objects in different ways, as though they were separate entities. Only later in processing, at higher-level areas of integration, are these two representations connected, leading to complex multisensory interactions like facilitation, suppression, and dominance. While this is, in a way, an invocation of distinct modes of presentation, this proposal is not in any way circular, for the distinction between tangible and visual objects is grounded in legitimate, objectively-measurable differences between the two sensory systems and how they assign features to objects.
1.6 Exploratory Binding

I have argued thus far that the predicative structure of touch is similar to that found in the other major senses. We can say a bit more, however, about the mechanisms underlying this predicative structure. In particular, we can explain the systematic connection that exists between the classes of tangible features and the interactions among sensory features, as well as the way this structure arises by appeal to the unique role played by exploratory action in touch.\(^{31}\)

The role played by action makes sensory binding in touch unlike that in vision and audition. While visual features are bound whenever we look at the world, in touch we must reach out and investigate with our bodies in order to determine which features belong to which objects. It is through our exploratory movements that we are able to correctly segment and then identify the keys from among the many other objects in our bag, for instance. By grasping and pulling on one object, we can feel that it is coherent and individual, not part of some larger object. Once separated, we can actively explore each individual key, feeling for the right one. We can do this because a set of features—shapes, textures, sizes, materials, thermal profiles, compliance properties, and more—are correctly associated with the distinct objects. We have to actively explore an object in order to feel its various features (where “exploration” includes cases where an object actively moves relative to our bodies). Since exploratory action is necessary for our awareness of many tangible features, the predications in haptic touch are more dependent upon our current exploratory activities than they are in vision. If, for instance, we do not actively explore an object with our hands, then we cannot predicate the full range of tangible features to that object.

\(^{31}\) The discussion here will concern only the role that action plays in assigning sensory features. The deeper questions about the relation between action and perception will be addressed in Chapter 5.
Our exploratory movements determine the range of tangible features that become connected. If I lightly touch an object with the tip of my little finger, I cannot feel its heft, or global shape, or overall size. I would feel other features, perhaps thermal properties and hardness. A different action, like grasping the object or enclosing it in my hands, would predicate additional features to the object. By stringing together a number of complex movements, a robust representation of the object can be generated. Despite this unique role played by exploration, the resulting structure of feature predication is the same as that in visual and auditory binding: a range of distinct sensory qualities are predicated to a individual objects, with no overarching associative relations.

Susan Lederman and Roberta Klatzky (1987) have described haptic touch as possessing six to eight stereotypically performed exploratory movements, which they called exploratory procedures (EPs). These EPs perform two central roles. First, they allow for novel sensory activations. Lateral movements against the skin, for instance, create a unique shearing motion, activating otherwise silent receptor populations. Many similar activations occur only during properly coordinated movements. Second, EPs ensure the strong temporal and spatial coherence of the systems included in the tactual system. When we move our hands across a surface the motor feedback, feelings of agency, awareness of body position, and the cutaneous stimuli all become highly coordinated. The coordination of these many elements is achieved naturally by the coherence of our exploratory actions. When we grasp an object we immediately feel its many features, and this feeling is a direct result of our grasping action. By pulling and pressing again several objects, we can properly segment and group them, predicating the appropriate features to the correct objects. Attention certainly plays an important role here, as it does in visual binding. Our exploratory actions allow us to attend to the many different features of tangible objects. When exploring a object with our hands for instance, we can shift our attention to its shape, size,
or temperature, and feel that these features all belong to the object. Any fully-developed account of haptic binding will need to consider the role of attention in the assignment of sensory features (as well as in object segmentation and grouping).

It is not merely our outward actions that cause the close alignment of the tactual system. The many channels and subsystems involved in touch are also closely aligned and connected neurologically. Recent studies have revealed close associations between motor areas in the brain and the sensory areas involved in tactile discrimination. Catania and Henry (2006) give a good overview of the close associations that exist between different regions of somatosensory cortex, showing the close functional relations between the areas that code for different properties (see also Kaas 2004; cf. discussion in Chapter 5). Large areas of feedback and interdependence actually support our capacity for active exploration through touch. These systems have become deeply connected, generating unified perceptual experiences from the coordinated inputs of many distinct processing streams. In other words, the motor system and the various cutaneous receptor systems have evolved in primates to produce a tightly coupled processing system, one perfectly tuned to the predication of distinct features onto perceptual objects.

One might still worry that exploratory actions merely associate distinct experiences, as occurs in typical multisensory cases. This worry is unfounded, however. To perceive an object through touch we must move our hands and actively explore its features. These movements generate novel inputs, from the stretching of the sensory surfaces, muscle-feedback, and active manipulation of the object (like shaking, scratching, and tapping). The experience involves a high degree of novelty; it feels unlike any individual cutaneous or kinesthetic experience. It is not as though our action merely alters or influences another of our experiences (as in paradigm multisensory experiences). Haptic perception involves a robust and novel form of experience,
available to us only through coordinated exploratory actions (cf., Lederman et al 2007). This is part of what it means to say that haptic experience has a unisensory character; while it involves a number of systems, they work together to generate a coherent, unified experience of the world.

1.7 The Unity of Touch

To recap: there seems to be a hierarchy of perceptual unity. Seeing an object while hearing or smelling something completely unrelated involves only apperceptive unity; the experiences just happen to occur in the same subject at the same time. Two experiences can become associated with each other, however, leading to a genuine multisensory experience. Seeing an object while hearing it sound a note involves such a relation, which cannot be reduced to any single perceptual experience. Sometimes, these associative relations result in alterations in the character and content of the constituent experiences. Such cases involve a kind of dependence or entanglement between the two experiences. Unisensory experiences do not involve any associative relations or experiential dependence: they have a relatively simple structure involving the predication of sensory features onto perceptual objects. A visual experience, for instance, involves a range of features appropriately bound to individual visual objects. Haptic touch also involves the predication of features onto individual tangible objects, but unlike vision, this process occurs in virtue of our exploratory activities.
Chapter 2: Touch and Bodily Awareness

2.1 The Role of Bodily Awareness

According to the arguments of the preceding chapter, touch possesses a strong form of unity grounded in sensory binding. According to this view, the many distinct receptor systems involved in touch are all part of a single sensory modality. Touch is as much a single sense as vision, audition, and the other senses. Nevertheless, touch differs from the other senses in several important respects—especially in the role of the body itself as the primary sensory organ, and the involvement of kinesthesis and proprioception. In this chapter, we consider the unique role that bodily awareness seems to play in touch.

While the skin contains a variety of specialized tactual receptors, touch involves all parts of the body. “Every atom of my body is a vibroscope,” wrote Helen Keller (2003; 34). She was right. Nearly the entire surface of our body, and many parts deep within—like stretch receptors in the muscles and joints—are involved in tactual experiences. As described in the previous chapter, when we touch, we typically engage in active exploratory movements using our hands and arms, but we also touch with our legs, torsos, feet, lips, and tongue. It should not be surprising, then, that there seems to be a strong connection between touch and bodily awareness. When I press my hand against the table in front of me, I can feel the solidity and coolness of the table, but I can also switch my attention to something that is happening to my hand. Since all touch seems to involve the body in this way, it seems that bodily awareness must be an essential component of our tactual experiences.
Unfortunately, most thinkers who take touch to involve bodily awareness have conflated two different kinds of awareness (an exception is Ratcliffe 2008). One notion of bodily awareness can be termed *implicit bodily awareness*, in which a subject’s body influences or structures a perceptual experience. This form of awareness is largely a background element of our perceptual experience, grounding the subjective, embodied, and perspectival aspects of perceptual awareness. Implicit bodily awareness, I’ll argue, is not unique to touch, but is an important element of all perceptual experience. This notion can be contrasted with *direct bodily awareness*, in which the body itself becomes an object of experience. This can be described as awareness of our bodies. The mistake in previous accounts is to suppose that direct awareness of our bodies—rather than implicit awareness—is a necessary constituent of all touch experiences. That is, to suppose that our experience of external objects through touch involves a direct awareness of our bodies.

The main purpose of this chapter is to show that, while externally-directed touch experiences, like nearly all perceptual experience, involve implicit bodily awareness, they do not require direct bodily awareness. In addition to externally-directed touch, however, there is a special form of touch that does involve direct bodily awareness. This *body-directed touch* (as I call it) is a special form of tactual perception. Among the senses, touch alone possesses a unique duality: we experience external objects like tables and chairs through touch, but we also experience our own bodies directly, as a special kind of object. This chapter thus has two primary goals: (1) to argue that externally-directed touch does not require direct bodily awareness (an argument that will be extended and developed in the next chapter) and (2) to offer an account of the body-directed touch.
It may be helpful before we begin to clarify the two distinctions at work in this discussion. First is a distinction between two forms of bodily awareness:

**Implicit Bodily Awareness**: a form of bodily awareness in which no intrinsic sensory feature is directly assigned to the body.

**Direct Bodily Awareness**: a form of bodily awareness in which an intrinsic sensory feature is assigned directly to the body.\(^{32}\)

The second is a distinction between two kinds of touch:

**Externally-Directed Touch**: The experience of external objects through touch

**Body-Directed Touch**: The direct experience of the body through touch

On my account, *both* forms of touch involve implicit bodily awareness, since a subject’s body plays a role in structuring and influencing our tactual experiences (indeed, all of our perceptual experiences). Only body-directed touch, however, involves direct bodily awareness. Indeed, body-directed touch just is a form of direct bodily awareness—what makes this form “touch” will be addressed in what follows.\(^{33}\)

Even if we grant that direct bodily awareness is not involved in all touch experience, we still require an account of the two kinds of touch. My proposal is that body-directed and externally-directed touch differ in their sensory assignments: body-directed touch assigns features directly to the subject’s body, represented as such. Externally-directed touch, while it

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\(^{32}\) Objective bodily awareness is essentially what Brian O’Shaughnessy (1998) calls “introspective proprioception.” As we’ll discuss shortly, Shaun Gallagher (2005) makes a related distinction between bodily awareness that is explicitly *phenomenal* and what he calls “pronoetic,” which involves a preconscious influence on the structure of our bodily experience.

\(^{33}\) Strictly speaking, only body-directed touch *requires* objective bodily awareness. I leave open the possibility that some externally-directed touch experiences involve objective bodily awareness; my claim is that such involvement is not necessary or constitutive of externally-directed touch.
involves a relation between our body and external objects, assigns intrinsic sensory features only to objects represented as external to the body. Both forms of touch involve perceptual awareness of objects; they simply differ in the objects they represent. The differences between these objects best explains the range of other differences that exist between the two kinds of touch. Body-directed touch is special because it assigns features directly to our own bodies, and our bodies are represented in a special way.\textsuperscript{34}

Characterizing body-directed touch as a kind of direct bodily representation allows us to appeal to several unique aspects of such representation. For example, we represent our body as \textit{ours}; it is possessed by us in a way that external objects are not. When we feel a pressure on our hand, we feel our hand being pressed. In addition, our bodily experiences—which plausibly include pains and even emotional awareness—seem to possess a distinctive affective character. Many of our body-directed touch experiences are highly pleasurable or unpleasant, in a manner unlike that found in external touch (and the other externally-directed senses). And finally, bodily representations have a unique spatial character. We seem to represent the spatial properties of our own bodies differently than the features of external objects. These aspects allow for a robust characterization of body-directed touch as fundamentally distinct from externally-directed touch. Yet, as the difference is essentially in the objects represented (and their distinct sensory assignments), and not a wholesale difference in modality, we can explain both forms of experience as \textit{touch}, as belonging to one and the same sensory capacity.

One of the central issues motivating this account is the relationship between externally-directed perceptual experiences and our awareness of our own bodies. In the other senses, this

\textsuperscript{34} See Chapter 1 for a defense of the claim that unisensory perception involves sensory assignments.
distinction does not matter so much, for it is hardly doubted that a visual experience, for instance, represents external objects and their properties without directly representing some bodily feature in the process. In the case of touch, however, it has long been supposed that our awareness of external objects and their properties is constituted (in part) by our bodily awareness. The account I will forward offers a novel and robust means of accommodating these intuitions, while showing that our tactual experiences bear a stronger resemblance to vision and the other senses than often supposed. Consider this self-report of Helen Keller, who was blind and deaf: “in all my experiences and thoughts I am conscious of a hand.” (Keller 2003; 10). This quote reflects, I think, the strong intuition that direct awareness of our bodies plays an essential role in our experience of the world through touch. This intuition, however strong, is not enough to demonstrate the precise relation between touch and bodily awareness. The connection between touch and bodily awareness thus deserves further critical evaluation.

My plan is as follows: I will begin with the distinction between implicit and direct bodily awareness. I aim to show that all perception involves an implicit bodily awareness. Next, I argue that touch nevertheless represents the body in a special way, that it involves a strong form of direct bodily representation. The rest of the chapter offers a positive account of this form of bodily representation.

2.2 Strong Bodily Dependence

Many have claimed that the sense of touch involves bodily awareness.\(^{35}\) Brian O’Shaughnessy states this explicitly for external spatial properties: “it remains true that awareness of the external

\(^{35}\) Brian O’Shaughnessy (1989, 1998), Michael Martin (1992), Michael Scott (2007) and D.M. Armstrong (1962) all seem to hold (in very different ways) that externally-directed touch depends on bodily awareness.
spatial property only occurs through the mediation of a body-awareness with a matching spatial content” (O'Shaughnessy 1989; 46). On his view, we experience spatial features of external objects only in virtue of having some direct, spatial bodily awareness. As he states in another paper (emphasis in original): “in absolutely every instance of tactile perception an awareness of one’s body stands between one and awareness of the tactile object. And so the sense of touch must depend on proprioception” (O’Shaughnessy 1998; 176). Michael Scott makes a similar claim:

In touching the flat surface of a tabletop or perceiving the round surface of a tennis ball, one also feels (and can selectively attend to) the flat and round positions that one’s hand assumes to detect these properties. In general, the tactual perception of the ‘distal’ properties is coupled with a perception of ‘proximal’ properties of the position and whereabouts of the relevant region of the body (2007; 261).

According to both Scott and O’Shaughnessy, our perception of distal spatial properties through touch involves an explicitly matched instance of bodily awareness. Our hand has to be directly perceived as having a range of spatial properties in order for the external object to be perceived as having a particular shape. (It isn’t clear if Scott thinks this is a necessary component or merely accompanies the distal experience, but since he describes touch as a “dual-aspect” form of perception, we can assume that he takes the bodily awareness to be an important element of touch generally.)

Michael Martin’s (1992) view is similar, and the following quote is worth examination:

This feature of bodily awareness, the contrast between inner and outer, provides what we need for a sense of touch. The model of touch here is that of the body as a template. We are embodied in a world which contains potentially many other bodies. We can come into contact with other bodies, and they can impede our movement and distort our shape. Such physical impingement on us is reflected in the awareness we have of our bodies…In
being aware of one’s body, sensing how it is disposed, where it can and can’t move, and where one has sensations, one can attend to the objects in virtue of which these are true. One measures the properties of objects in the world around one against one’s body. So in having an awareness of one’s body, one has a sense of touch (203).

Here, as for O’Shaughnessy, the view is that the body is a “template” with which other objects come into contact, and we experience this contact through an experience of our bodies.36

While these views differ in their details (differences that do not concern us much here), each holds that externally-directed touch experiences depend on direct bodily awareness. That is, all externally-directed touch experiences depend on an explicit experience of the body, either through a matching of (or relation between) the bodily and external experiences or through an identity between the two. Borrowing a construction used by Evans (1983; 112, 179ff), we can characterize the views above as defending the following:

**Strong Bodily Dependence:** To experience some external feature $F$ through touch requires directly experiencing some matching bodily feature $G$ (along with the awareness that $G$ implies $F$).

For example, to experience a table as solid might require that I experience a strong depression on the surface of my body, or experiencing the top of a wine glass as circular might require that I directly experience a circle of contact on my hand. This view of touch is similar in many ways to a model of perception that Roderick Firth (1949) once described as “Discursive Inference

36 In criticizing these views, Michael Scott (2001) has referred to both Martin and O’Shaughnessy as holding a “template view” of touch. I think this is an appropriate label.

A somewhat related view of touch is held by David Armstrong (1962). He claims that all experiences of external objects through touch result from an experience of a special relation between an external object and our bodies (one that does not hold of the other senses). I actually agree in general with this relational aspect of touch—through touch we do (implicitly) experience our bodies interacting with the external world—but I think the view holds equally well of all the senses. When we see or hear an external object or event, we experience that object or event in relation to our present bodily location and orientation, etc.
Theory” (except visual sense-data have been replaced with direct bodily awareness). As Firth characterized it, the view holds that the experience of an external object involves two states of mind, one state of direct awareness (in this case of the body), and another state consisting of an inference or judgment. Perception of the external objects involves both kinds of state. Strong Bodily Dependence is discursive in Firth’s sense; it holds that our experience of external objects requires both a direct form of bodily awareness, along with some shift in attitude or cognitive judgment that delivers awareness of the external object. My view is that Strong Bodily Dependence is wrong. At best, I think that to experience an external feature through touch requires no direct assignment of features to the body. Our external tactual awareness is largely automatic, sub-personal, and transparent. The main argument against strong bodily dependence will occur in the next chapter, where I outline and defend an account of distal touch. In this chapter my primary concern is characterizing the difference between body-directed and externally-directed touch. It is enough for now, however, to note that the evidence cited in support of Strong Bodily Dependence rests almost entirely on two mistaken assumptions: (1) that all forms of bodily awareness in touch are direct in nature, and (2) that direct bodily awareness is required for us to experience external features through touch. Without these underlying assumptions, Strong Bodily Dependence is an untenable position.

The argument for Strong Bodily Dependence assumes that all bodily awareness is direct, and since touch clearly involves bodily awareness, the argument concludes that it too must be direct. But this assumption is wrong: bodily awareness is not a simple, uniform notion, and minimal forms of implicit bodily awareness play a role in all of our perceptual experiences. This has been underappreciated in the literature on touch. Even those who acknowledge different

forms of bodily awareness mistake evidence for implicit bodily awareness in touch as evidence for strong bodily dependence. Brian O’Shaughnessy (1998), for example, clearly distinguishes between different forms of bodily awareness, though he thinks the differences are merely between different levels of bodily awareness, with proprioception residing at a lower level of processing than more explicit forms of bodily awareness. Matthew Ratcliffe (2008), however, suggests that there might be stronger differences between forms of bodily awareness. As he says, “when reaching out to take a cup of hot coffee from someone, my hand is not conspicuous as an object; it is experienced as that through which an object is to be grasped. But if I reflect on the act whilst performing it, my hand might become more conspicuous, object-like” (307). He adds: “when the touching becomes the touched, the bodily side is not felt in the same way that it was previously. In making the bodily aspect of touch available as a perceptual object, we change the way in which the body is perceived” (308). In these passages Ratcliffe highlights the difference between the implicit aspect of bodily awareness, where awareness of the body is in the background, a background element of our perceptual experience, and direct awareness of our bodies, in which we experience the body in an object-like manner. Ratcliffe is surely right that we experience our bodies in different ways, and that if we are to understand the relationship between touch and bodily awareness we ought to be very clear about what sort of bodily awareness we mean.

There isn’t anything particularly radical about the involvement of implicit awareness, since such awareness is involved in all perceptual experiences. Shaun Gallagher (2005) has documented in detail the many ways in which bodily awareness influences the structure of our conscious experience. Many of these ways of structuring are what he calls prenoetic, they occur
below the level of explicit conscious awareness, playing a role in how we experience the world around us.\textsuperscript{38} When we look at the world, there is an implicit awareness of our bodily location relative to various objects. This bodily location plays a role in how we see the world. We must also be aware (at some level) that the movements of our heads and eyes are movements of our bodies, and not of the scene before us (Crowell \textit{et al}, 1998). To perceive at all is to perceive from somewhere (Evans 1983, Peacocke 1992), using sensing organs that themselves play a role in the constitution and character of our experience. Many thinkers have explored the nature of this bodily involvement in perception.\textsuperscript{39} There is no need to posit or defend any particular account of implicit bodily awareness here. It is enough to note that perception involves some fundamental awareness of our bodies, how they are oriented, moving, interacting, etc. The claim that touch involves bodily awareness appeals to many of these implicit forms of involvement, but these considerations do not show that touch involves direct bodily awareness.

Externally-directed touch does not require direct bodily awareness. Body-directed touch, on the other hand, just is a form of direct bodily awareness; it essentially involves the direct experience of the body. Previous accounts of touch have made many simplifying assumptions about the nature of bodily awareness (and of touch itself). Before showing why Strong Bodily Dependence is mistaken, we should get clear about the distinction between externally-directed and body-directed touch.

\textsuperscript{38} See also Varela, Thompson, and Rosch (1991) and Clark (1997).

2.3 The Duality of Touch

While touch is not unique in involving implicit bodily awareness, it does seem to possess a unique form of direct bodily awareness. When one presses a hand against a table, one can feel both the table, and something happening to one’s hand. Consider the following, even more vivid example:

**Cross Moving Hands:** Place your hands one above the other, palms facing each other. First move the top hand slowly back and forth across the bottom hand (keeping the bottom hand still). Then stop the top hand, and move the bottom hand back and forth across the top hand, using the same surfaces of the skin. Notice that when moving the top hand, the experience tends to be one of touching the bottom hand, while when moving the bottom hand, the experience is one of touching the top hand. As you switch moving hands, the object of the experience switches. Notice also that there is also a feeling in the passive hand, a feeling of being touched, an experience of the present state of the passive sensory surface.\(^4\) When both hands are not moving, just pressed together, one seems to experience two body-directed experiences of the two hands.

This is a simple illustration of a phenomenal shift in tactual experience between directly experiencing one’s body and experiencing an object *with* one’s body. The shifted experiences feel different, and they seem to have different contents. One is an experience of the passive hand; the other is an experience of our passive hand being touched. The example is doubly interesting, in that it involves two different ways of representing our bodies: as an external object (inasmuch as this is possible in this case) and directly, from the inside. In both cases the surface sensory stimulation remains essentially constant—there is a sliding motion of one surface against the other, in the same direction and intensity. This is a crucial point: the difference between

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\(^4\) A similar observation is made by Merleau-Ponty (2002).
externally-directed and body-directed touch experiences cannot be reduced to a difference in cutaneous activations, since essentially nothing changes on the skin’s surface.\textsuperscript{41} This is an important point, since one might suppose that direct bodily awareness would accompany any stimulation of the skin. But this is simply not so: from the fact that the skin on our hand is stimulated it does not follow that we have an direct experience as of the hand. If this were so, then there would be no difference between the two cases in Cross-Moving Hands. Nor is it merely a shift in conscious attention from one hand to the other, since one cannot easily override the experience by trying to voluntarily change one's attention.\textsuperscript{42} Of course, attentional shifts play an important role in mediating these experiences, and we will come back to this issue momentarily. This example suggests that there are highly complex interactions between these two sorts of touch, involving our sense of agency and exploratory action. Voluntary exploratory movement of the hand tends to elicit an externally-directed experience of an object, which in this case just happens to be our other hand. The passive hand meanwhile has a body-directed experience. The experiences are reversed the moment the hands change direction.

Cross-Moving Hands vividly demonstrates the duality of touch, but it also reveals the inherent complexity of this duality. There seem to be two different experiences, with different contents, different phenomenal characters, and with complex (and unique) relations to our exploratory movements, affective responses, and feelings of agency. Yet these experiences are generated by similar cutaneous stimuli.

\textsuperscript{41} Nothing changes in terms of the external stimuli, but there are several changes in the way these signals are processed, depending on whether or not we are moving one way or another. For instance, voluntary motion of the hands produces a suppression in the activation levels of cutaneous inputs on the skin of the palm (Jones and Lederman, 2006). This is one of several differences in terms of signal processing, part of what leads to the same external stimuli being classified in two different ways.

\textsuperscript{42} This is not to say that attention is not a crucial factor, only that it isn’t the whole story. We will discuss attention in more detail shortly.
Thermal properties can exhibit a similar structure. Consider the experience of dipping a finger in warm water:

**Warm Water:** Place an index finger in a glass of warm water. One experiences at first the *warmth of the water*, an externally-directed experience. One could also, after a short time, experience *one’s finger being warmed*, a body-directed experience.

If the finger is kept still in the water, the experience may become entirely body-directed, with our attention entirely directed on the present state of our finger. Wiggling one’s finger around a bit in the warm water seems to strengthen the externally-directed character of the experience, causing attention to shift to the temperature of the water. This relation between action and bodily awareness has been underappreciated in the literature. The externally-directed nature of the experience also seems to be stronger when the finger is first placed in the water, and tends to fade the longer the finger sits in the water. There are thus many reasons for treating these two kinds of touch as distinct. The two kinds of touch differ phenomenally; experiencing the warmness of the water feels different from feeling a warm finger. The contents of these experiences differ; one is about the warmness of the water, the other is about one’s finger warming up. And finally, there are differing relations to our exploratory movements.

The distinction between the two kinds of touch is not exotic; we all seem pre-theoretically disposed to recognize the difference between body-directed and externally-directed touch. The issue is how best to account for this distinction. My proposal is that what differs between the two cases is the (kind of) perceptual object. In the externally-directed case, we experience and assign features to an external object (or an object represented as such). In the body-directed case, we experience and assign features to our own bodies. And our bodies and external objects are not represented in the same way. What shifts between the two experiences in these cases is thus a shift from one kind of representation to another. There are thus not two
poles of touch experience—say between subjective and objective—but rather one kind of perceptual experience that takes two different kinds of perceptual object.

2.4 Against Strong Bodily Dependence

Consider the following experience:

**Cool Breeze:** Imagine standing under a warm sun, feeling the skin on your face warming. Then you briefly feel a light cool breeze come by. At that moment, you are having a body-directed experience of your skin becoming warm under the sun, while having an externally-directed experience of the breeze, that the breeze is cool.

Cool Breeze is similar to Warm Water. It seems perfectly plausible to suppose that you feel both of these experiences at the same time, that you recognize and treat these as two distinct perceptual experiences. You are not having the experience of the cool breeze in virtue of experiencing your skin cooling, because you are explicitly not having such an experience. In fact, you are having the exact opposite experience. This is a case where two different experiences are being mediated by the skin of your face. While it might be that you feel the breeze as cool because it has a certain causal effect on the thermal receptors on your face, this does not support the claim that you feel the coolness of the breeze in virtue of feeling your skin becoming cool—in fact you feel your face warming. This is, like Warm Water, a case where there seem to be both a body-directed and an externally-directed experience at the same time. The externally-directed experience cannot be reduced to the body-directed one, since they have completely different contents, characters, and objects.

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43 Of course, if the cool breeze is sustained and cool enough, eventually you may come to experience your face cooling. But this should not be surprising, such occurrences are typical of transferable properties. The fact remains that at the moment of the cool breeze, you experience and assign a property to the breeze which cannot be accounted for by appeal to a complimentary body-directed experience.
Similar considerations arise for purely spatial properties. Consider holding a pen in your hand. You can feel the shape of the pen, and you can easily identify the object as a pen. If you carefully remove the pen with your other hand, however, without altering your holding hand, you no longer have an experience as of something pen-shaped. More importantly, you do not experience your hand as appropriately oriented and sized to the shape of a pen. There is no apparent connection between the shape of your hand and the particular object you were holding. The presence of the pen, its heft, solidity, texture, and so on, play an important part in the classification of the spatial inputs. The key point here is that when we have an experience as of a pen, we do not have any corresponding experience of the matching spatial state of our bodies. If we did, then the experience of the orientation of our hand would remain the same whether pen were there or not (that is, I would experience my hand as shaped and sized appropriately for a particular pen). Of course, one could hold that only when present does the pen elicit the appropriate matching bodily experiences. Bodily awareness of spatial orientation alone might be insufficient for an experience of the pen. This possibility is undermined, however, by considerations of perceptual constancy.

We simply do not infer the shape from the myriad changes the pen makes to our bodies. As noted by A. D. Smith (2002), the fact of perceptual constancy reveals that external touch cannot depend upon direct bodily experience. This is because in typical touching the subjective experiences are constantly shifting and variable, while our experience of the object remains fixed. In this, touch is no different than vision. While our hand is being stimulated in all kinds of ways when I explore and manipulate a pen, my perceptual experience of the pen is of a fixed, 

44 Though not, it should be noted, primarily in virtue of its shape. Such recognitional capacities will be discussed in Chapter 4.
stable object. If I were experiencing the pen in virtue of experiencing the changing state of my body, there would be no sense to be made of the stable, unified percept of the pen.\footnote{Both A. D. Smith (2002) and Michael Scott (1999) have offered compelling arguments against dependence views like Martin and O’Shaughnessy’s. But both seem to understand body-directed touch to be a kind of sensation, and their arguments thus amount to the claim that externally-directed touch does not reduce to sensations. We’ve already rejected the sensation view, however.}

Consider a final example:

**Table Top**: Imagine touching a table top with two separated fingers, and sliding your fingers down cross the table. You experience the surface of the table as a single, unified perceptual object. You do not experience two different objects or surfaces, one for each finger.

Table Top cannot involve a direct experience of our matching bodily state, because the external experience and the body-directed analogue pull apart. What we feel when we touch a table top is a single, unified object—the table—but our body is in contact with the object at multiple points at the ends of our fingers. What we feel is precisely not the separate bodily states of our fingers in contact with multiple points on the table, but a single, connected perceptual object, with objective, stable properties. The experience does involve a relation between my body and the table, but this does not require that I represent the state of my body directly when involved in that relation. Martin (1992) draws the wrong conclusion from such cases. He supposes that because we feel the circular shape of a wine glass, we must also feel the five points of contact on our fingers aligned in a circular manner. That is, he thinks we feel the circular shape of the glass in virtue of having a body-directed experience of our fingers aligned in a certain way. But this conclusion does not follow. Having our fingers so aligned does not elicit the feeling of an
external object with a certain shape. When in contact with the glass we do experience its shape, but directly, not via matching features assigned to our bodies.

Strong Bodily Dependence treats touch as a kind of passive reception. This encourages the idea that touch consists entirely of body-directed experiences, or that such experiences play a constitutive role in the mediation of externally-directed touch. But touch is not typically passive, but almost always active and exploratory, and our experience of the objects and properties in our surrounding environment does not usually involve a direct, explicit experience of the body. The focus on passive touch leaves externally-directed touch oddly dependent upon our experience of our own bodies. The Object-Based View defended here is a more plausible account, holding that while touch does sometimes involve an implicit awareness of the sensing body, only sometimes do we assign features directly to our bodies. This view also offers a robust account of how we come to shift our experience between external objects and our own bodies. Let us start filling in the positive elements of this view.

2.5 The Object-Based Account

My view is that the primary difference between body-directed and externally-directed touch is a difference in their perceptual objects: body-directed touch is a direct experience of our own bodies, from the inside, whereas externally-directed touch is an experience of external objects. This is not as simple as it sounds, for the representation of the body through touch is a special kind of representation. It should be noted right away that there are likely many different kinds of bodily representation, from long-term body images to short-term body schemas used to guide

\footnote{There is a vast literature on bodily representation. Those interested in details beyond the cursory examination here should first consult the papers in Bermudez et al (1998); see also Gallagher (2005), O’Shaughnessy (2003) and De Vignemont (2007, 2009).}
movement and exploratory action. It is also true that we can experience our body indirectly through touch and the other senses, like any other external object. We can represent properties of our body simply by looking at it, for instance. But in doing so we do not experience our bodies as anything special or different from external objects. Michael Martin (1992), when talking about touch, suggests that our thumb is an object like any other, and can be experienced as such. This is right, in one respect; the thumb is a material object, experienced as any other. But that is not the only (or in fact, usual) way we experience our thumb. Our representation of our thumb is not at all ordinary. A set of unique characteristics signal the special nature of direct bodily representation. The first characteristic is possession (or ownership)—our body is experienced to belong to us in a way that external objects do not. Second, the body is represented as having a special spatial character; locations on the body are not represented as located in some objective spot in external space. And finally, bodily representations tend to have particularly strong, modality-specific affective characters. My claim is that in body-directed touch we predicate various features, such as being hot, cold, pressed, moving, and so on, directly of this special bodily representation. I will first show that body-directed touch experiences all possess these

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47 For a good recent examination of the body-image/body-schema distinction see De Vignemont (2009). Discussions of different forms of long and short-term bodily representations can be found in O'Shaughnessy 1998. In what follows, I do not consider the nature of these various representations in much detail. My purpose is rather to suggest that touch involves a special, objective level of explicit bodily representation that is not found in the other major senses. In all likelihood, this level of representation plays a role in both long-term body image construction and maintenance, but also in short-term action guidance.

48 Cf. Aristotle: “A man who is a doctor may cure himself. Nevertheless it is not in so far as he is a patient that he possesses the art of medicine” (Physics, Bk. II: Ch1, 192b23-25).

49 This is a bit of an over-simplification. Visual feedback can play an important role in regulating the body image and even in kinesthesis (cf. De Vignemont 2009). This is because visual information can be appropriated for our internal bodily representations. Still, when we look at our bodies, or touch a completely numb part of our body with our hands, it is a different kind of experience than what occurs in body-directed touch, where our body is experienced directly.

50 Martin is aware of the special nature of bodily representation, but he seems to think the difference is only epistemological: that we a special kind of access to our bodies that we do not have to external objects. I think this may be true, but also that the way we represent our body is quite different from the way we represent external objects.
three bodily characteristics, defending the claim that the represented body is the object of our experience. I will then suggest some reasons for treating this body as the bearer of these tangible properties.

Touch, of course, is not the only form of bodily representation. We are aware of our bodies in a number of ways, through various forms of interoception (feeling hungry, thirsty, or tired), various direct bodily representations (proprioception, kinesthesis, vestibular awareness), and through pain and other sensational qualities that have a clearly non-tactual nature (internal throbbing and aches). We have a special, direct awareness of our body that differs from our relationship to external objects. The claim of the object-based view is that some of these direct forms of bodily awareness count as touch; where the body is directly represented as our body. Externally-directed touch is focused on the world, directed at external objects and their properties. It is a form of external perception that gives us knowledge about the things around us, allows us to act and move with respect to a varied and changing environment, and is often coordinated with the other external senses. Body-directed touch is directed inward, at the present state of our own bodies. Through the latter form of touch we are alerted to critical changes in our body, to pleasurable or unpleasant stimuli on our skin, and to our current bodily thermal state. This form of touch is strongly coordinated with other systems of bodily representation, from the nociceptive systems underlying pains to complex emotional responses. According to the Object-Based Account I am defending, the difference between the two kinds of touch can be explained by the difference in their objects. Body-directed touch represents the body as a special kind of object, unlike an ordinary external entity. I start by describing three components of bodily representation, all of which are involved in body-directed touch.
2.5.1 Possession

One of the main differences between the tactual experience of external objects and the experience of our own bodies is that our body-directed experiences involve an experience of bodily possession. That is, when we have a body-directed experience, we experience a part of our bodies being touched. When my finger is being warmed in the water, it is my finger that feels to be warmed. When I experience the properties of the water, the water is explicitly not experienced as a part of my body, it does not belong to me. For instance, if I briefly touch a hot pan, I can experience that the pan is hot without coming to experience that my finger is becoming warmed. The heat of the pan is not my heat; it is entirely external to me, possessed entirely by the pan. Now, if I hold my finger to the pan for a length of time, my finger will start to warm up (hopefully not too quickly), and I will experience this property of my finger. This sort of direct, bodily thermal awareness occurs often, when our fingers feel cold in the winter, or when our head feels warm when we have a fever. In these cases the object that has this thermal quality belongs to me: it is a part of me that is heating up or cooling down.

As we’ll see in more detail momentarily, we seem able to switch our attention between body-directed and externally-directed touch experiences. The bodily experience is one which seems to have a strong possessive character. When we feel some pressure or change in temperature on our body, it is not some object in the external world which seems to possess the feature, but our own body. This partly explains bodily touch being an experience from the inside. When we experience our bodies in this way, we experience our bodies not merely qua subject of experience, but as the direct object of our experience. When we experience our own bodies, we do so directly, by focusing our attention onto changes in the body rather than onto objects in the external world. We can better understand how such bodily predications occur by appeal to the
rubber-hand illusion. This illusion occurs when a subject’s real hand is hidden from view, and a felt cutaneous stimulus, occurring at the same time as visible stimulations of the rubber hand, is assigned to the visible rubber hand, which is taken to be a part of the subject’s body (see Tsakiris et al 2007 and De Vignemont 2007). In this illusion, an external object, normally experienced as such, is experienced directly as part of the subject’s body. While the rubber hand is an external object, and not actually a part of the subject’s body, it is represented as a part of the body (Tsakiris et al, 2007). When properties are assigned to this object, they bring with them a certain possessive character (as well as unique spatial and affective characteristics). While illusory in this case, these experiments demonstrate how bodily representation can explain the differences between the two kinds of touch.

We can further strengthen the claim by appeal to the opposite kind of case, where the sense of bodily possession is lost (see De Vignemont 2003, 2007). In some pathologies, such as alien hand syndrome, a subject can lose the ability to experience a part of the body as a part of his or her body. In alien hand syndrome, a subject might still experience a touch on the alien hand, but she does not experience it as a touch on her hand. There are sensations or feelings in the alien hand, but these feelings are not felt to be the subject’s own. They are felt to belong to someone or something else. The subject feels the stimulus, but it is not assigned to her body. Alien hand syndrome is thus best understood as a failure of bodily representation: the subject in these cases—where possession is lost or disturbed—is not actually assigning features to the represented body as such.

2.5.2 Spatial Character

Another important aspect of bodily representations are their unique spatial characteristics. When we represent the spatial properties of external objects we represent objects and properties as
located outside of the body, in relation to other such features. (In fact, we can represent objects
and features as located some distance from the body. The argument for this claim occurs in the
next chapter). These external locations are stable, objective, and located somewhere in
allocentric space. When I reach for the cup in front of me on the table, for instance, the spatial
layout of the table and the relations between the cup and other objects on the table play an
important role in my successfully grasping the right object. Susanna Millar (2008) has
convincingly shown that in external touch, as in vision, we can and do make use of only external
reference cues—objects or landmarks in the distal environment that serve as guides for spatial
processing. This means that touch is sometimes like vision in representing spatial features
relative to one another in an external frame of reference. Subjects forced to use external cues
performed equally well with vision and touch in certain navigation tasks. While touch more
commonly relies on body-based cues (such as next to my hand, or in front of my face), it does not
rely on them exclusively. The fact that touch can make use of external spatial cues is not
something many philosophers have incorporated into their views. Michael Martin (1992) and
Brian O’Shaughnessy (1989; 1998), for instance, seem to assume that touch makes use only of
body-based spatial cues. Part of their project after all is to say how external touch gains spatial
content from bodily reference alone. For example, Martin suggests that we experience the spatial
properties of external objects only in virtue of experiencing the matching spatial properties of our
own bodies (Martin 1992). But this is not the case (we’ll consider and reject this view in more
detail in the next chapter). The table is out there in external space; when I touch it, I feel a stable
and grounded object located in a particular location outside of my body. If I move my hand
around the table, the table appears to stay in the same location, and its various features remain in
the same relation relative to each other. This stability allows for easy navigation and exploration of the objects in our immediate environment. 51 The spatial properties of the table are largely independent of my particular bodily movements. Externally-directed touch can represent features at some distance from the body (I’ll argue for this claim at length in Chapter 3, see also Lederman and Klatzky 1999; Millar 2008; and Katz 1925/1989). My body-directed experience is not like this. If I feel my arm warming up, I am representing the state of a part of my body located with respect to the rest of the body. My left arm is located and identified with respect to the rest of my body, not as located somewhere in external or peripersonal space. The difference between these ways of representing our bodies is stark. When our foot falls asleep, for instance, we can lose our ability to locate our foot directly with respect to the rest of our body. And thus we can have difficulty appropriately moving the foot, because we have to locate and move it using our external modes of spatial representation.

Bodily-directed touch, as one might expect, always feels to be located somewhere on the body. A tangible property is being predicated of a body part, and so it follows that the location of the predicated property is always a location on the body. Consider that as I move my body around in space or move my hand from one spot on the table to another, I can still represent the same state of affairs with respect to my hand (that my hand is heating up, say). The changing external location does nothing to move or alter the felt location of the property assigned to the hand, since that feature is located in the hand, not to any external location where the hand happens to be. That is, if I feel a pain in my finger, and I slowly move my hand around in space, I do not feel that the pain is moving at all. Similarly, while my hand is completely still, a pain could be felt to move up the arm and into the shoulder. This is a change in the felt bodily

51 This is a little simplified; according to Millar touch can operate in this manner, but it can also make use of bodily reference cues as well.
location of the pain. The location of pains and other bodily sensations is always grounded in
some location on the body, not in external space (pains are not experienced *out there*). Bodily
representations involve the assignment of features directly to locations on a body map, not
predicated in relation to other objects in external space. The fact that body-directed touch
involves such bodily locations (and the fact that externally-directed touch need not) further
supports the claim that body-directed touch involves a strong form of direct bodily
representation.

### 2.5.3 Affective Character

Another component of bodily representations is a powerful affective character. Our direct bodily
awareness includes pains, itches, various forms of interoception (hunger, thirst, etc.), and quite
plausibly, even emotions. These forms of awareness possess a powerful affective character
associated directly with the experience. The affective characteristics of bodily representation are
different from the affect involved in the other externally-directed senses. All of the senses can
involve affective responses, closely associated with reward and aversion. But the affective
character involved in our bodily representations are both more immediate and not easily
separated from the mode of awareness. For instance, pains and itches almost always have a
strong affective component (the lack of which underlies some unusual pathologies). Touch, and
somatosensory representations generally, seem to have a similar strong affective component.
That is, there seems to be a difference in the affective character of externally directed touch
compared to bodily touch.

It is difficult to say how the affective character of touch, and bodily representations
generally, differs from such responses in the other senses. After all, even external touch can
involve a strong emotional or affective response. If I reach into a friend’s bag and unexpectedly
feel a handgun, I might have an immediate affective response, even pulling my hand away quickly. This response is not tied directly to the character of the tactual experience, however. I might have had a similar response from seeing the gun instead of feeling it. In other words, the affective response does not seem to be strongly connected to the particular form of the experience, but rather to the information contained in the experience. It is thus an amodal response. In fact, I could have a similar emotional and affective reaction if my friend just tells me that she has a gun in her bag. The affective character of bodily representations, on the other hand, seems to be closely tied to the mode of the experience. As noted, pains and itches seem to lead directly to strong affective responses that cannot be easily separated from the form of experience. Body-directed touch, like other forms of bodily awareness, seems to involve a strong affective component, one directly connected to the perceptual experience itself. This is especially true for pleasurable touch experiences. When we have certain bodily-directed experiences they are felt to be highly rewarding and pleasurable, in such a way that cannot be easily separated from the mode of the experience.

Ample neuro-physiological evidence exists for such an affective component in bodily directed touch. Francis McGlone and her colleagues (McGlone et al 2007; Loken et al 2009) have recently isolated a separate tactile channel mediating the pleasurable aspects of cutaneous touch. They call this the CT channel, which involves a highly myelinated C-fiber found on the hairy skin of the body. This channel codes for the pleasant aspects of touch, especially soft stroking motions of 2 to 4cm per second along the skin. This channel is not found in the glabrous skin—the sensitive skin found on the palms, fingers, and lips—typically used for externally-directed touch. While we can have pleasant experiences when touching external objects, the pleasurable aspects of the experience are not assigned to the external objects, we do not think
there is anything pleasant in the object itself. The pleasantness is a special feature attributed directly to the body.

The affective component of bodily-touch seems to be a hedonic value assigned to certain bodily-directed touches. Like touch generally, the operations of this component are highly dependent on context and a range of interacting sensory systems. For instance, being stroked with a feather by your sworn enemy will likely have a different affective aspect than being similarly stroked by one’s partner. There also seems to be a strong difference between being touched by another person or living thing—which is sometimes called affiliative touch—and being touched by an external object (McGlone et al., 2007). These are important interactions that are still not fully understood. The important element for the purposes of this chapter is that bodily-directed touch seems often to involve a strong affective component attached to the experience. This component does not undermine the claim that body-directed touch is objective in nature. When we feel certain tactual properties predicated to our bodies—warmth, soft pressure, and the like—these experiences take on a certain hedonic (or pleasant) value. This assignment is probably due to the dedicated affective channel that is activated by a range of cutaneous stimuli. The activation of this channel causes certain classes of bodily touch to be deemed pleasant. This makes good evolutionary sense, because these endogenous networks are principally involved in the protection and flourishing of the organism. The fact that body-directed touch involves such strong affective responses is good evidence that such touch is involved in the direct, endogenous system of bodily representation. Body-directed touch takes on a strong hedonic value, which along with its other characteristics, is a strong indicator of a special bodily representation.
Body-directed touch has a possessive character, unique spatial profile, and also involves a strong affective response similar to that involved in other forms of bodily representation like itches, tickles, etc. These three characteristics are important indicators of direct bodily representation. Together, these three elements demonstrate that body-directed touch represents the body in a special manner, similar to the other forms of direct bodily awareness. To be clear, the claim is not that all forms of bodily representation are the same in nature. Bodily experiences are highly varied, with different structures, contents, and qualitative aspects. Pain, itches, proprioception, hunger, and anger are all different from one another. Rather, the claim is that our direct bodily representations all seem to involve a possessive character, unique body-based spatial profile, and they play an important role in modulating and controlling our current affective state.

2.6 Attention

According to the object-based view, what changes between a bodily-directed and an externally-directed touch experience is the nature of the perceptual object to which we predicate or assign tangible properties. Since what differs between the two kinds of touch is simply the object of the experience, we are able, to a limited extent, to shift between the two kinds of experience by selectively attending to one object rather the other. For instance, in Warm Water, we can attend to the properties of the water, but we can also attend to the rising temperature of our finger. Attention then seems to be a critical component of certain bodily representations. As noted by Brian O’Shaughnessy (1998), typical bodily awareness does not seem to tax our attention. What I’m calling direct bodily awareness, however, requires attention. In order to assign properties to our bodies in touch, in order to experience our bodies directly as the objects of tactual experience, it seems required that we direct our attention to our bodies in a special way. That is,
it seems we must direct or shift our attention onto our bodies as the bearers of certain tangible properties.

The shift is similar to what occurs in Gestalt experiences like the Necker cube, but in the case of touch, what kind of object we attend to is influenced by a range of other limiting factors, like our current motor activities and feelings of agency. When we are actively moving and exploring with our hands, our experiences almost always tend to be externally-directed. Similarly, when we are being passively touched we tend to have a direct experience of our own bodies. In addition, it seems that we are able, at least to a limited extent, to experience both objects at the same time. We seem capable of experiencing our fingers warming up while also feeling the warmth of the water in the glass. There does seem to be a kind of phenomenal shift as we selectively attend between the two objects, but, unlike Gestalt, it is not implausible that we could have both kinds of experience at the same time (within the constraints of selective attention). Externally-directed touch is an externally-directed form of tactual awareness, and thus matches up nicely with the other senses, like vision and audition, which are also externally directed. Body-directed awareness is unique to touch, and makes it different from the other senses.

It seems that we can, at least sometimes, shift our attention from an awareness of an external object to awareness of our own bodies. This shift is, as I’ve said, similar in general structure to what occurs when we shift between the two different possible views of the Necker Cube. There are two objects, two different cubes, that we could see. When we shift views, it is a shift from one visual object to another. The same is true of touch. When someone touches a cup she can focus on one object (the cup) or another (her hand). The ability to shift focus in this way is best explained as a shift between two different objects. Just as the two views of a Necker cube
are two different visual experiences of two different visual objects (despite the identical visual inputs), so too are the there two different touch experiences with two different tangible objects (despite the identity of the external stimuli). What occurs during the attentional shift is a shift of attention from an external object to the body itself. The ability to shift in this manner from external objects to the body itself is not found in vision or the other senses. When we look down at our arm, we simply see our arm as another object. We cannot shift from seeing the arm as an object to seeing it directly, from the inside. Even within vision, it is not clearly possible to shift from seeing an external object to experiencing the present state of our eyes (though such facts may be inferred). We simply cannot shift between an ordinary visual experience of our arm and another, privileged visual experience of our arm. The same is true of the other major senses. In touch alone we seem capable of shifting from external awareness to a direct, special form of bodily awareness.

Consider again Cross-Moving Hands. Here we seem to be able to alternate between the two kinds of experience, and nothing in the peripheral cutaneous transducers seems to change. This is certainly a simplification, because the two cases do differ in many important respects, from the motor feedback we receive from the moving hand, subtle alterations caused by our intention to move one hand with respect to the other, and so on. These differences certainly play some role in the categorizations that occur after the peripheral, cutaneous inputs, whether they are assigned to an external object or to our own bodies. The important point here is that there

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52 This claim is compatible with the notion that body-directed touch is always present, but simply not attended to. The preceding arguments were meant to establish that body-directed touch is not present, whether attended to or not. As we’ll see in the next chapter, attention seems to play a strong role in grounding demonstrative thoughts about objects, and given this connection, it seems plausible to hold that without directed attention, we cannot directly experience the intrinsic properties of our bodies. But this is a discussion that must be held off until the next chapter.

53 There are many recent works on attention worth citing here; the interested reader should consult Wu (forthcoming) and De Brigard and Prinz (2010).
seems to be an important form of categorization occurring. We have a cutaneous stimulation that could be used to inform us about the world or about the present state of our bodies. These transducer networks thus serve something of a dual purpose, and can be put to both uses. Whether they are used one way or the other is determined by a range of important, interacting factors, such as whether we are actively moving our bodies or not. For instance, voluntary motor commands create a host of differences in how external stimuli are processed, most noticeably a suppression in certain cutaneous activations.

The connection between the two sorts of experience is thus sophisticated, involving a number of complex elements, including motor action and exploratory behavior, conscious control of our movements, and various mechanisms of top-down selective attention. These elements can lead to a particular stimulation being classed as externally-directed or not. A range of contextual factors play a role in mediating the nature of these touch experiences. These mechanisms together help our tactual system to classify the stimulations, as either externally-directed or body-directed. And the physiological mechanisms that mediate these classifications are far upstream from our surface transducers. For instance, my experience of choosing to move my arm requires activations of my brain’s planning centers, motor areas, and involves sophisticated feedback from the periphery. These interacting elements are robust; without a voluntary motion I might feel a pressure on my arm, but with voluntary motion I might feel the solidity and smoothness of a surface. The involvement of these higher-level systems makes a crucial difference to how we experience different tactual stimuli. The involvement of these systems, along with many others, help explain why the phenomenology and content of our different tactual experiences can vary so wildly. It is precisely not that we are attending to different aspects of the same experience; while the stimuli might be the same, which experience is generated depends upon how that stimuli is interpreted and sorted by our overall tactual
system.\textsuperscript{54} While body-directed touch is typically inactive and passive, this is not always the case. Sometimes passive, purely cutaneous experiences can be classified as externally-directed. For instance, an insect crawling up your arm can feel much like an external object moving on your body. People sometimes even experience a vivid feeling of an insect crawling up their arm when no insect is there, an experience known as formication. Even though formication is cutaneous and endogenously generated, it is classified (falsely in this case) as an external object moving along one’s body (cf. discussion in Chapter 5).\textsuperscript{55}

2.7 Touch and Bodily Sensation

I have proposed that body-directed and externally-directed differ in their objects. An alternative view, seemingly held by Reid, is to hold that what differs between the two sorts of experience is that one is a mere sensation, while the other is a genuine form of perception. On this view, body-directed touch would be akin to pains, itches, tingles, and the like, a mere qualitative sensation. These would be contrasted with the perception-like nature of externally-directed touch. As conceived by Reid, the distinction between perception and sensation is that perception involves an experience of some external object, whereas a sensation has no object (other than itself).\textsuperscript{56} A paradigm sensation on Reid’s account is pain: to have a pain is simply to experience a feeling with a certain (noxious) quality. The pain just is the feeling. While something perceptual might be triggered or accompanied by a sensation or feeling, Reid held that perception proper involves

\textsuperscript{54} See Mohan Matthen (2005).

\textsuperscript{55} In fact, frequent experiences of formication can lead to a very disturbing disorder: delusional parasitosis. See Jafferany (2007) for discussion of this and related cutaneous pathologies.

\textsuperscript{56} It’s unclear exactly how to understand the distinction in Reid, for he may intend sensations to take no object whatsoever, or to take no object other than themselves. See Van Cleve (2004) for discussion.
only three elements: that we conceive of the object perceived, that we are convinced of the object’s presence, and that the conception and belief are immediate (not the result of reasoning). 57

One reason to think that body-directed touch is only a bodily sensation (and a constituent in externally-directed experiences) is because such experiences do not involve awareness of any external object, and they are also closely related in many respect to paradigm sensations (like pains and itches). Externally-directed touch by definition takes an external object, and would thus be classed as genuine perception on Reid’s account. While this way of thinking about the dual structure of touch seems plausible, body-directed touch cannot be a mere bodily sensation. Touch does involve bodily sensations. Like most forms of perception, it seems to involve feelings or sensations of a certain kind. But tactual feelings—like tickles or twinges and the like—are not at all what I mean by body-directed touch. Mere bodily feelings lack an object other than themselves, but body-directed touch clearly involves an object: it is an experience of a tangible features being assigned directly to our represented body. It makes sense to think that we cannot separate the pain from its sensation—a pain may be nothing more than a hurtful sensation. But we can and often do separate our body-directed experiences from the external properties of which we are aware. For instance, feeling my hand warm up is separable from the state of affairs of my hand warming up: my hand can get warmer without my becoming aware of it, and I can experience my hand warming in the absence of any actual warming. For this reason, it makes sense in the case of body-directed touch—but perhaps not in the case of mere bodily sensation—to speak of false and veridical representations. And because we are assigning objective properties in the case of touch, there seems to be something to which we are assigning

or predicating these properties, namely, our bodies. If this is so, then by Reid’s own criterion we ought to class body-directed touch as perceptual in nature, since there is a genuine object of the experience besides the experience itself. A body-directed touch is an experience of the present state of our sensitive bodies, of our skin being warmed, of our legs feeling pressed. These experiences may involve having sensations, but they are not themselves sensations or feelings as such. They are a special kind of touch experience that takes the body as object. It is not the feelings themselves that are the objects of such experiences, but rather the body.

Gilbert Ryle, in *The Concept of Mind*, noted the unique character of what I’m calling body-directed touch. Ryle grudgingly allowed that perceptions might involve having sensations, but this is a special, technical sense of “sensation.” He suggested that such technical uses referred to things such as “dazzles in the eyes and stings in the nose” (200). But this is not our ordinary use of the terms “feeling” and “sensation.” Ryle suggests that, “We ordinarily use these words for a special family of perceptions, namely, tactual and kinaesthetic perceptions and perceptions of temperatures, as well as for localizable pains and discomforts” (200). As Ryle goes on to note, “Seeing, hearing, tasting, and smelling do not involve sensations, in this sense of the word, any more than seeing involves hearing, or than feeling a cold draught involves tasting anything” (200). While I might, for reasons shortly to be discussed, remove localizable pains and discomforts from the list, I certainly agree with Ryle that these experiences are different from the notion of sensation typically invoked in philosophical discussion. Through touch itself we are able to directly experience the present state of our bodies. We can feel our fingers warming and our skin being pressed on. These sorts of tactual experiences are not mere sensations. They are a legitimate perceptual experience, one that fits within an overall network of

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58 This was also noted by Diogenes Allen (1969).
body awareness. As Ryle concluded, “in its familiar, unsophisticated use, ‘sensation’ does not stand for an ingredient in perceptions, but for a kind of perception” (201).

2.8 Assignment Constraints

The unique aspects of certain tangible properties have been mentioned several times now. These properties seem to be assignable to both external objects and our own bodies. In chapter 4 we will discuss the ontology of tangible properties in far greater detail. There I will focus on external tangible properties—those properties like roughness, shape, temperature, vibration, and solidity—and argue that such external properties fall into two general classes. For now, I want to explore the fact that tangible properties also differ in their relations to the body. Not every externally-directed tangible property can be assigned to the body, and not every bodily property can be assigned to an external object. This allows for a robust account of what does, and does not, count as touch proper. Body-directed touch experiences are those that involve direct assignment of properties to our bodies that could also be assigned to external objects. Those experiences that involve only bodily features—like pains, twinges, tickles, aches, and the like—are thus excluded from touch proper. We start with the features shared between the two kinds of touch.

An important aspect of the object-based account is that it treats both forms of touch as involving an objective class of tangible properties. What sort of properties are involved in tactual experiences, such that we can shift (sometimes easily) from experiencing external objects to experiencing our bodies directly? Since these attentional shifts involve moving our attention from one to another perceptual object, there must be a class of properties that can be predicated of external objects as well as our bodies. Let us call this class of properties the transferable
features. Only bodily experiences involving transferable properties ought to be counted as part of touch proper.

When we come into contact with a vibrating surface, we can feel our *body being vibrated* as well as *the surface vibrating*. Here we seem able to consciously attend to one or the other sort of experience. The properties are the same; what differs is the object of which they are predicated. Pressure is also closely associated with the external qualities of solidity and rigidity. But pressure is also often a quality of the body, a felt impingement on our sensory surfaces. But through our ability to detect and represent pressure we are able to experience both an impingement on our bodies as well as the solidity of external objects. Transferable features can be assigned to both external objects and to our own bodies. These features are genuine, objective properties that have defined satisfaction conditions. Such properties can be involved in both externally- and body-directed experiences, sometimes at the same time. Pressure, vibration and thermal qualities are paradigm examples of transferable properties. The most interesting, however, are hot and cold. We often experience our bodies being warmed and cooled. But we also attribute thermal properties directly to external objects: we feel that the ice cube is cold, or that the pan on the stove is hot. These are all properties that can be equally predicated of both our bodies and of external objects.

In addition to the transferable properties, there are features that can be attributed to the body, but that are not transferable. For instance, *in burning pain* and *itchy* can be assigned to parts of our bodies, but can never be assigned to external objects. While a needle may *cause* pain, we never predicate the pain itself to the needle (perhaps a related objective property, such as *sharp*). The pain or the itch are simply not the kinds of properties that can be experienced as properties of an external object (though in pathological cases like alien-hand-syndrome such
deviant experiences do occur). In other words, there is no possibility of a phenomenal shift for pains like that which occurs in Cross-Moving Hands. Call these sorts of features *bodily features* (cf. Armstrong’s 1962 “intransitive properties”). I think that good reasons exist for treating bodily features as separate from body-directed touch. While some people lump pains, itches, and the like as part of touch, there really is no good reason (except for their mediation through the skin) for treating these as part of touch. Not only are pains and itches subserved by distinct sensory channels from discriminative touch, but the assignments involved (if they are assignments) differ greatly in their structure. While there has long been debate about the possibility of illusory pains and the perceptual nature of such experiences, none of these concerns find any traction when it comes to externally-directed touch. These touch experiences have definite satisfaction conditions and seem robustly perceptual in nature. These distinctions mirror the important structural difference between the classes of transferable and bodily features.

The distinction between these classes of tangible features has sometimes been used to support the claim that externally-directed touch depends on a direct awareness of our bodies. The claim is that the features assigned to external objects depend upon the assignment of matching or co-related features to our own bodies. For instance, to feel a surface as solid is supposed to involve feeling one’s body become depressed during contact with the surface. The feeling of the external feature is thought to necessarily involve feeling a bodily feature with a matching character. In other words, we attribute tangible features to external objects in virtue of the features our body is felt to have (Armstrong 1962, O’Shaughnessy 1989). The motivation for this thinking is that, because our sensory receptors are all located in our bodies, only by feeling a change in our bodies can we experience through touch a feature of an object located outside of our bodies. This view, however, is not plausible. We do not experience the properties of external objects in virtue of experiencing a related bodily feature. If this were the case, then we could
only attribute properties to external objects that our bodies were capable of possessing. But this is not the case: there are many tangible properties that can only be assigned to external objects. This third class of tangible, distinct from the bodily and transferable classes, demonstrate that external touch cannot depend on a matching body-directed experience (this is in addition to the reasons already surveyed, and others to be discussed in the next chapter). To cite just one example, only an external object can be experienced as *pen-shaped* (of course, barring extraordinary hallucinations or futuristic cyborg writing technology). My hand, given its actual and represented shape, is simply never felt to be *pen-shaped*.

### 2.9 The Account So Far

I can now offer a tentative suggestion for how we move from body-directed to externally-directed touch. I propose (following the arguments of Chapter 1) that we have externally-directed touch experiences when tangible properties are assigned to—that is, bound to—an external object (or an object represented as such). When we move our finger over cool metal, the exploratory nature of the movement (and a range of other factors) focuses our attention onto the features of the external object: its solidity, smoothness, dryness, and so on. The coldness of the metal is, along with these other features, bound to the object. A complex system of sensory classification assigns the features either to our bodies or directly onto an external object. Both forms of experience involve an implicit awareness of our sensing body. The thermal stimulation is felt as externally-directed because the coldness has been attributed to an external object. After touching the metal for a while, once our finger begins to cool down, we may attribute the coldness not to the object but to our hand. This requires a special attentional shift. We assign the coldness to the hand. The experience in both cases is perceptual in nature: there are separate perceptual objects and genuine accuracy conditions associated with the experience. There is a
fact of the matter about whether or not our hand is cold. Whether an experience of a transferable property is classified as externally-directed or body-directed depends on the object to which that feature is predicated. When the feature is predicated to an external object, the transferable property is externally-directed, when predicated to our own bodies, it is body-directed.

We can see now that there is a strong connection between the two kinds of touch, even though they are not continuous. The fact that we can sometimes switch our attention from one kind of object to the other explains why the relation has often been taken to be continuous. One and the same property or feature can be assigned both to our bodies and to external objects. Often these features are detected and processed by the same set of peripheral transducers. Consider Cross-Moving Hands again. Moving one way generates an experience of our hand being touched and moving the other generates an experience of touching our hand. The existence of transferable tactual features explains the relation between body-directed and externally-directed touch, and also helps explain the quality space of touch (to be discussed in Chapter 4).

There is a reason why feeling the warmness of water so often involves and becomes confused with feeling the warmness of our hands. The two kinds of experience are actually closely connected in virtue of both involving the same tangible features, in this case heat, transduced by the same peripheral receptors. But the way in which this property is attributed differs greatly between the two experiences. In the one, we attribute the temperature to an external object. In the other, we attribute a temperature to our hand. Action, movement, and a range of other mechanisms help classify and mediate between the two kinds of tactual experience, helping determine how a particular stimulation ought to be classified.

There is nothing unusual about two different forms of sensory awareness sharing initial transducers. Another example might be sound and speech perception. When we hear a language
that we do not understand, we hear the sounds of the speech but not the phonemes or meaning. When we hear a language that we understand, however, we hear the meaningful parts of speech in a highly specialized manner. What changes in such cases is the way in which the auditory inputs are analyzed and classified. Even though we initially hear both sounds and speech with our ears, differences in later stages of processing lead to very different forms of experience.

There is something different and special about the representation of speech—speech sounds are a special kind of auditory object. The same is true of touch. We initially process the external cutaneous stimuli with the same sets of receptors, but how these signals are classified depends on what happens in later stages of processing (and the context in which they occur). And in touch, it is the bodily representation that is special, taking on a host of interesting properties.
3.1 The Distal Character of Touch

To see a cup on the table is to see a particular individual—*that very cup*—with its various individual qualities, located in relation to other objects and properties. Perceptual experiences like these seem to possess *demonstrative content*; the experiences seem to be about or refer to particular individual objects.

Visual and auditory experiences can be about or refer to objects (or events) even when those objects are located very far away from our bodies. In addition, these modalities seem to directly represent distal objects, without representing any intermediary connecting us to those objects. These modalities can be described as *teleosenses*—they can represent distal objects without requiring that we represent something else connecting us to those objects. Both vision and audition represent objects and their features as located at a distance from our bodies, and neither involves direct bodily representation or direct contact with the objects of our distal experience. Touch is not a teleosense. Whereas we can see an object from across the room, or hear a voice calling out from a distance, touch seems to require direct contact with the objects of our experience. We seem incapable through touch of reaching out beyond the limits of our bodies, of experiencing the world beyond our skin. We find a quarter in our pocket by feeling the contact it makes with our fingers. We turn on the light in the closet by feeling around until our

59 I am grateful to Mohan Matthen for suggesting this terminology.
hand makes contact with the switch. Indeed, one meaning of “touch” is just to have our bodies come into contact with something, even if it does not elicit a perceptual experience.

It might seem obvious, then, that to experience an object through touch requires that we come into direct bodily contact with it. Despite the intuitive appeal of such a view, the claim that to experience an object through touch requires direct bodily contact is implausible. The main argument of this is chapter shall be that, like the teleosenses of vision and audition, touch often represents objects that are far removed from the surface of the body. Even though distal touch experiences require that something make contact with our sensory surfaces, it does not follow that the objects of our tactual experiences—those objects or properties to which our tactual experiences refer—themselves need to be in direct contact with our bodies.

What follows is an account of perceptual reference through touch. It is an account of the relation that holds between touch experiences and the objects of those experiences. I argue that in touch, as in vision and audition, we can and often do perceive objects and properties even when we are not in direct or even apparent bodily contact with them. Unlike those senses, however, touch experiences require a special kind of mutually-interactive connection between our sensory surfaces and the objects of our experience. I call this the Connection Principle. In other words, tactual reference to an object requires an appropriate connection to that object, either directly or through some connecting medium. Touch on this view is something of an in-between sense, not a teleosense, but also not a contact sense. Rather, it is a connection sense: we can experience distal objects through touch, but unlike the teleosenses, we can do so only if there is an appropriate connection between our bodies and the external object. This view has important implications for the proper understanding of touch, and perceptual reference generally. In particular, spelling out the implications of this principle yields a rich and compelling picture of
the spatial character of touch. We begin with some background on the notion of perceptual reference.

### 3.2 Perceptual Reference

I want to motivate briefly the idea that perception has a kind of referential character (much as language, beliefs, and thoughts do). This is not a radical view of perception. As John Campbell (2002) has argued, there is a natural connection between consciousness and reference, but the connection has not always been recognized. To experience the world involves reference to the objects of our experience, as Campbell states in his introduction:

> When we think about demonstrative reference in particular—that is, reference made to a currently perceived object on the basis of current perception of it—it seems that reference to the object depends on attention to the object. So we should expect that philosophical problems about reference and psychological theorizing about attention should be capable of illuminating one another (2002; 2).

Campbell argues that attention, a determinant of our perceptual experience of the world, plays an important role in securing and grounding reference to the objects of experience.

Campbell’s view is not a departure but a continuation of longstanding philosophical theory. Philosophers have traditionally recognized a distinction between intentional states and phenomenal states. Beliefs and thoughts are paradigm intentional states, as they are about states of affairs in the world. Perceptual experiences are paradigm phenomenal states, as our experience of the world has a particular phenomenal character. There is something it feels like to hear or see or taste. While some philosophers have recently argued that phenomenal states just are intentional states of a certain kind (e.g., Dretske 1995, Tye 1995, Byrne 2001), nothing so radical is required for perception to admit of a referential character. For one, perceptual
experiences seem completely intentional in Brentano’s sense: like beliefs and thoughts, they are about things in the world. When we see a red apple on the table, our experience is representing a certain state of affairs. This is a basic sense of representation that most would agree on. (It does not, for instance, require an explicit, fully-detailed mental representation of the state of affairs, nor does it require that the phenomenal content be exhausted by representational content).

We can add two lines of support to this initial characterization, one involving the close relation between perceptual experience and referential language, and another stemming from our best account of the mechanisms of perception. We’ll start with language. Gareth Evans (1983), for one, takes perception to be a part of the information system (along with various forms of communication and memory). For him, perception involves seemings, meaningful events that can influence our actions and ground demonstrative thoughts. These seemings carry information from distal sources, and thus come to be about distal objects. On his view, the informational content of perception grounds our ability to have direct thoughts and experiences of the objects in our environment.

The close relation between perception and demonstrative thought is one of the primary motivations for treating perception as referential in character. As Susanna Siegel (2002) writes: 

We perceive facts about our surroundings by perceiving things; we can state facts about our surroundings by demonstratively referring to things. Perception can anchor uses of demonstratives to, say, a baby when it represents contrasts between the baby and its surroundings. (2002, 4).

Language involves reference to objects and events, but since perception can ground such uses, it too seems to have a referential character. It’s difficult to see how perception could ground such
utterances if it did not have itself some kind of referential character. A similar claim is made by Campbell and Martin (1997):

Propositional content involves reference to objects. There are many ways in which we can refer to concrete objects, but the most basic sort of reference is when you can see the thing, or perceive it somehow, and refer to it on the strength of that perception (55).

According to these accounts, perception, like language and other cognitive states, has a kind of referential character. As Campbell himself explains, knowledge of a demonstrative reference depends on perceptual attention (2002; 7-10). It is thus natural to think that such states of attentive perception themselves have a kind of referential character, picking out and determining the objects that we are thinking and talking about.

In addition to its relation to language, there are reasons internal to perception for thinking that such experiences have a referential character. Consider the account of vision put forward by Mohan Matthen (2005):

[O]ur visual states present us with an assembled message, a message that has a descriptive element as well as a referential one…This referential element of visual states constitutes a kind of direct connection between perceiver and distal stimulus (305).

According to Matthen, vision is feature-placing, it picks out objects from the visual inputs and assigns the appropriate features to these objects. In order to accomplish this, it must have a kind of referential structure. The referential element is not merely some sub-personal mechanism that helps generate our visual experience; it is something that plays an explicit role in that experience. The fact that our visual experiences directly refer to real objects in our environment—objects

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60 Campbell usually speaks in his (2002) of “visual attention,” but I believe his view is intended to apply to all forms of perceptual attention.
that we could touch and interact with—changes the quality of the experience. Such an account accords well with the view put forward by Zenon Pylyshyn in *Seeing and Visualizing*:

>[I]f the visual system is to do something concerning some visual object, it must in some sense know *which* object it is doing it to...So there must be a way, independent of the process of deciding which property obtains, of specifying which objects are being referred to (2004, 201).

Vision does many things with visual objects—tracks them, groups them, assigns features to them, identifies them, etc.—and it requires some means of picking them out (i.e., referring to them). Touch also does many things with tangible objects, but unlike vision, touch seems restricted to objects in direct contact with our bodies. In what follows, I’ll show that this view is mistaken, and that touch experiences can and often do represent objects not in direct or even apparent contact with our bodies.

### 3.3 The Contact Thesis

The most obvious, and seemingly plausible, account of tactual object reference is that it requires direct bodily contact. Call this view of tactual reference the *Contact Thesis*:

**Contact Thesis (CT):** Tactual object perception occurs only at the surface or limit of the body; reference to an external object in touch occurs only when the object is in direct contact with the body.

CT seems plausible at first. After all, our touch receptors are located on our bodies and do not appear capable of delivering information about distal objects or events. It does seem as though we perceive objects through touch in virtue of bodily awareness caused by such contact. For instance, it seems as though I experience a cup through touch in virtue of experiencing my hand
as it makes contact with the cup. The bodily sensations caused by the contact seem to mediate my experience of the external object.

Appearances are deceptive, however. It is relatively easy to find touch experiences that violate CT. Whenever one touches an object while wearing gloves, for instance, one perceives an object that is not in direct contact with the surface of her body. When one picks up a pencil while wearing gloves, one still has a tactual experience of the pencil, not of the glove and nothing beyond. Such examples are not restricted to something as thin as latex gloves (which one might think are barely registered by our tactual receptors). One can feel the surface of the floor through one’s socks and shoes, feel the keys in one’s pocket by pressing on the outside of the fabric, or feel the movements of a puppy wriggling under a blanket. CT is even more clearly false if we define the limits of our bodies as the limits of our sensory surfaces (the specialized transducers within the glabrous and hairy skin). Most touch receptors lie deep within the dermis, under many layers of dead cells in the epidermis. All touch experiences would thus seem to occur through some mediating material that lies beyond our actual receptors (see e.g., Lumpkin and Caterina, 2007 and Moll et al., 2005). In addition, touch mediated by fingernails would violate CT, even though our ability to perceive a range of tangible properties through our nails is generally quite good. We have not even mentioned the wide variety of complex touch experiences involving tools and other intermediary objects that would also violate CT.

61 This seems to be the view of Aristotle, cf. De Anima bk 2, ch 11.

62 See Lederman and Klatzky (2004) for an excellent study and review of our ability to perceive objects through an intermediary, what they call “remote” touch. Their findings indicate that the loss of texture and other material information when using a rigid probe, for example, negatively impacts our capacity for haptic object-recognition. Even so, we are able to experience distal objects, for instance through the use of fingernails, also discussed at some length by Katz (1925/1989).
3.4 Mediated Contact Thesis

The contact thesis is an implausible account of tactual reference. We can modify it slightly, however, to generate a more plausible version. This modification removes the implausible claim that the object of the experience be in direct contact with our body, requiring instead that we first experience \textit{some other object} that is in direct contact with our body. Call this modified version the \textit{Mediated Contact Thesis}:

\textbf{Mediated Contact Thesis (MCT):} Tactual object perception occurs only in virtue of an experience of some object that is in direct contact with the body.

MCT allows that we experience distal objects through touch even when they are not in direct contact with our bodies, by maintaining that such experiences require a referentially-grounded experience of some object that is in direct contact with our bodies. While one may be able to feel some distal object through a stick, MCT holds that this occurs only in virtue of experiencing the proximal end of the stick that \textit{is} in direct contact with the body. Brian O'Shaughnessy (1989) has defended a view—which he calls “tactile representationalism”—that is much in line with MCT. As he states it:

\begin{quote}
What must be emphasized about touch is that it involves no mediating field of sensation…In touch a body investigates bodies as one body amongst others, for in touch we directly appeal to the tactile properties of our own bodies in investigating the self-same tactile properties of other bodies (1989; 38).
\end{quote}

According to O'Shaughnessy, our experiences of external objects through touch always involve a direct awareness of our own bodies, so we can experience objects only when something impinges upon the body, and (importantly) we are aware of that impinging. We experience external objects via an awareness of our own bodies, and this requires contact. Vision and the
other distal senses involve no mediation through bodily awareness; we can easily see an object located some distance from our bodies without becoming explicitly aware of some change or impinging on our retina. This account is taken to be especially true for spatial properties. As O'Shaughnessy remarks, in touch “it remains true that awareness of the external spatial property only occurs though the mediation of a body-awareness with a matching spatial content” (O'Shaughnessy 1989; 46).

MCT is a more plausible account of tactual reference; however, it too fails to handle paradigm cases of distal touch. Consider two cases: feeling the roughness of paper through a pencil, and touching a table with one’s fingernails. In the first case, we simply do not experience the paper in virtue of experiencing the pencil in contact with our fingers (as argued in the last chapter). There can be some implicit bodily awareness of our fingers (as the subjects of experience), but our fingers themselves need not become the direct objects of experience. We might fail to attend to this point of contact entirely, and experience only the paper at the distal end of the pencil. Similarly, we cannot experience the table in virtue of experiencing our nails in contact with our bodies, since we seem to have no such experiences of our nails impinging on our bodies. We simply experience the table directly, without any more proximal awareness.

One might respond that I’m conflating experience with attention or some other form of awareness here. The suggestion might be that while we do not attend to or become aware of our direct bodily experience, such an experience must be present in order for us to have the distal touch experiences we do. But as we’ve seen, this is only an implicit bodily awareness, not direct awareness of our bodies. I’ll ultimately suggest that the proximal point of contact plays an important role in mediating our distal touch experiences, through an implicit form of awareness. Thus, in criticizing MCT, I’m not denying that we have some bodily awareness when we have a
distal touch experience. I’m denying the claim that we experience distal objects in virtue of an explicit, demonstratively-grounded experience of a proximal object. I deny that our tactual experiences need to refer to the proximal points of contact in order to ground reference to a distal object. There is a way of making this distinction clear. If a perceptual experience involves reference, then it should be able to ground demonstrative utterances about the contents of our experiences. For instance, if my perceptual experience is of a red box on the table, such an experience should ground the demonstrative utterance “that red box on the table” (cf. Siegel 2002; Campbell and Martin 1997). If distal touch experiences occur in virtue of tactual reference to the proximal object, then any experience of a distal touch object ought to ground reference both to the distal object and to the proximal object. So an experience of the paper through a pencil should ground the utterance “this pencil” as well as “this paper.” But it seems clear that I can experience the distal object (the paper) without being in a position to utter something about the proximal object (the pencil). Attention seems to be a critical factor in the grounding of perceptual demonstratives, and while we may have some implicit experience of the proximal points of contact, we almost never attending to such experiences, leaving them unable to ground perceptual reference.

3.5 The Apparent Contact Thesis

We can find a more plausible version of CT suggested in a paper by Michael Martin (1992). Rather than appeal to the actual limits of the body, Martin suggests that we appeal to its apparent limits. Martin appeals to the well-established fact that our body schema is malleable: our body is felt or experienced as ending is not necessarily where it actually ends (1992, 201-2). Thus bodily feeling need not occur within the actual limits of one’s body, but only within the apparent limits of the body. This leads to the following modification of CT:
Apparent Contact Thesis (ACT): Tactual object perception occurs only at the apparent surface or limit of the body; reference to an external object in touch can occur only when the object is in direct contact with the apparent limits of the body.

While similar sounding, this argument is largely independent from the dependence claims discussed in the previous chapter. Martin’s argument is that whatever one feels always feels to be a part of one's body. From this it follows that all sensation or feeling caused by touch must occur within the apparent limits of the body. Any space beyond our body simply could not be a possible location for a bodily sensation: “the apparent limits of the body are the apparent limits of possible sensation” (202). On this view, we could never have a genuine distal touch experience. We could never represent an object in touch as located beyond the limits of the body, for in experiencing an object through touch we would be experiencing a sensation or feeling that must appear to occur within the limits of the body. Consider some bodily sensation. If touch requires such sensations (plausible), and these sensations can be felt only on the body, then it follows that our experience cannot extend beyond the apparent limits of the body.

Consider an example. Martin claims that when we grasp the rim of a wine glass with our outstretched fingers, we make contact only with five points on the rim, and thus have only five discrete points of tactile sensation. Since we come to experience the glass as circular, this experience depends upon the sensations at the fingertips; “one comes to be aware of the glass by being aware of the parts one touches” (1992; 200). This quote suggests that we are aware only of the parts being touched. We have no experience of what lies between the fingers or of the glass as a whole; the points of contact are the only locations of which we have an experience. For Martin, all touch experiences, even experiences of external things, involve an explicit experience of the body, from which we are able to generate an objective percept. The experience of the body is said to be that which reveals or makes manifest the properties of the impinging object. As
Martin says, “One measures the properties of objects in the world around one against one's body. So in having an awareness of one's body, one has a sense of touch” (203). I think that something different is true, that we can and do have tactual experiences of external objects which are not experienced at the limits of our bodies. That is, the experience of our bodily sensations is not identical to, or constitutive of, the experience of the distal object. While I think touch does involve some contact with the world, the idea that a touch experience of an object requires that the object be experienced as in contact with the apparent limits of our bodies is surely false.

3.6 Problems with ACT

My claim is this: we often have touch experiences of objects and properties with which we are not in direct contact, and these objects are not experienced at the apparent limits of the body. If this is correct, then ACT is false. I propose to defend my claim by offering a range of distinct cases in which we tactually experience objects that are not in contact with the apparent limits of the body. This fact about touch reveals that the necessity of apparent bodily contact must be wrong; rejecting this supposition will greatly improve our understanding of touch.

I start with the observation that most discussions of touch oversimplify tactual experience. Our theories of touch ought to acknowledge and incorporate the full depth of tactual experience. Touch involves cutaneous stimulation of our fingers and hands, but it also involves surface activations across the entire body, along with proprioception, vestibular information, motor and muscular feedback, and our sense of agency. Prehension and grasping, for instance, are highly complex motor actions that involve the coordination of many distinct subsystems.63

63 Jones and Lederman's recent book on the hand (2006) provides a very detailed neuro-psychological account of such interactions in hand-based tactual perception.
Haptic touch involves complex interactions between a number of distinct sensory systems, encompassing a range of distinct transducers, motor skills, body maps, and phenomenal properties. This means that a range of touch experiences can be produced that violate ACT. Consider the following example:

**Driving:** You are driving a car. You notice, through your tactual experience alone, that the road changes from smooth asphalt to gravel. You may even think to yourself, *this section of road is rough.*

This is a case of a tactual experience—mediated by vibration and pressure on the sensory surfaces of the skin—which represents a property of the road, its being rough. Your experience is *of the road,* it is not an experience of the wheel or the car frame, and certainly not *of the seat.* It is an experience of the road upon which you are driving, the road is the object of your experience. This experience, I would argue, is not a bodily (or even bodily-directed) experience, for instance of your body vibrating against the seat, but an experience of the road. The externally-directed experience of your back against the seat is a different experience, in both its phenomenology and its content, from the experience of the road. The bodily awareness in such an experience is largely implicit and in the background. That is, we need not assign any intrinsic sensory quality directly to the body. The relation between these experiences was discussed at length in the previous chapter. The upshot is that we can have an experience of the road which is not at the same time an experience of our own bodies. We might not notice or experience anything about our own bodies while driving, yet be completely aware of changes in the road.64

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64 For a similar point see A. D. Smith's (Smith, 2002) discussion of perceptual constancy, p. 170ff. The idea there, supported in the empirical literature, is that some perceptions of external objects remain constant throughout changes in subjective sensations. In the present case, our constant experience of the road through changes in our
In such cases, it is the road that is the object of the experience. This is a case of a projected tactual experience; we project our tactual experience beyond the proximate stimulus (the vibration of the seat) to the object causing the vibration (the road). Consider another example: the experience of lying on a bed very early in the morning, barely awake, with your eyes closed, when, as happens all too often, your cat leaps onto the foot of the bed, and begins the steady march toward your face. Even if the cat does not touch your body directly, you have no difficulty following the cat’s progress. You can feel each step, and track the cat as it navigates around obstacles and marches on toward your face. The experience of the cat and its location is mediated here entirely by touch, even though the cat is clearly located beyond the range of the body, and also beyond the apparent limits of your body. Such a complex touch experience undermines the plausibility of ACT, for there is no sense in which the apparent limits of the body extend to include the mattress and the bed.

In these cases of distal experience there is no need to attend to or experience our bodies as the object of the experience in order to experience the projected qualities of the distal object. Even Martin allows that we do sometimes project our tactual experiences in just this manner, but he claims that such cases are rare, and more importantly, that they always involve an alteration of body sense such that the experience occurs at the apparent limits of the body (Martin 1992; 202).

I wish to be cautious in my use of “causal” here. It may not be correct to say that we always represent to ourselves a causal connection in such an experience. Indeed, when driving we may simply experience the road directly, without representing to ourselves the fact that it is the road that is causing our experiences in the seat. Thus it may turn out that tactual projection involves an implicit or automatic extension of experience to a distal object. Still, even if it is not an explicit representation of a causal connection, the experience of a distal object through touch seems best characterized as a projection through our total proximate experience to that which is causally connected to it. We will return briefly to these sorts of problems at the end of the paper.
In other words, in having such experiences we always project our body out through the mediating surfaces to the location where the object is experienced.

We can agree with Martin that alterations in body schema do occur. Phantom-limb patients clearly seem to experience sensations in limbs which only apparently exist, and a professional tennis player sure seems to experience her racket as a literal extension of her body. We can even agree that they occur often in our ordinary daily interactions. It seems reasonable, for instance, to think that putting on a hat or wearing a heavy coat alters our perceived sense of bodily space. However, it is incorrect to suppose from such cases that all extended tactual experiences involve a reordering of one's body sense. In the driving example, it is simply not the case that I experience my seat or the car itself as an extension of my body. Similar points can be made about cat-tracking. I still have an experience of the limits of my body, and this is an experience of my body as sitting on the seat, not as continuous with or a part of the seat, or the car frame, axle, or wheels. Outside of the points of contact with the seat, there are no good, principled candidates for the apparent limits of my body which explain my experience of the road. If my body image were to expand to the whole car, for instance, then I ought to experience a passenger as sitting inside the limits of my body. Clearly, this does not happen, and we ought to describe this case, like tracking a cat on a bed, and a kind of distal touch that violates ACT.

3.7 Examples of Distal Touch

Cat Tracking and Driving are not isolated cases, but merely good examples of distal touch.66 They are experiences of objects removed from our bodies, and recognized as such.67 We can

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66 Similar examples and criticisms have been offered by Michael Scott (1997). While Scott makes many of the same criticisms that I do of positions like those of Martin and O'Shaughnessy, his focus is more directly on the relation
classify such examples into several general categories. These examples differ widely from one another, and a uniform explanation seems required.

3.7.1 Tactual Projection

Consider the following two examples:

**Writing:** Using only a pen or pencil, you write upon two sheets of paper laid out side by side in front of you (assume your eyes are closed). You experience one paper as rough and difficult to write on; the other is very smooth and easy to write on.

**Cooking:** You are cooking two large chicken breasts in a frying pan using tongs. Using only the tongs, you are able to determine the location, size, shape and texture of the breasts. As the cooking nears completion, you use the tongs to press against the meat to determine its elasticity and firmness (indicators of the doneness of the meat).

These are examples of what I will call *tactual projection*. They involve experiences of distal objects and properties through an intervening probe. In these cases some mediating element exists between the objects we experience through touch and the actual sensory surfaces of the body. The critical question is whether such cases involve an experience of an object beyond the apparent limits of the body. Reflection on the nature of tactual experience undermines the claim that such experiences involve contact with the apparent limits of the body. The experience of texture through a pen does not at all feel like using a part of our body to feel the paper, but like

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67 These are primarily experiences of what Susan Lederman and colleagues (See Lederman and Klatzky 1997) have called "intensive" features, such as texture or material composition. That these are not principally spatial properties is not of great importance in touch, since tactual recognition and object reference is largely grounded in such features.
using a tool outside the limits of the body to probe objects some distance from the body. It is the same with the tongs, they are a tool *through which* I determine the tactile qualities of the meat; never once do I feel like an apparent part of my body is making direct contact with the surfaces of the meat or the pan. A manipulation of body schema in some cases like this is certainly possible, but this is not required. Full incorporation into our body schema would require greater motor-integration of the intervening tools, as well as consistent multimodal cues of short-term body image. Typical projected touch experiences do not involve such incorporation; altering our bodily representations is not as easy as picking up a pen.

The issue of how, and to what extent, our body-image changes is a difficult one. We might think our body-image alters in projected touch because in such cases we often seem to experience the objects directly, and do not attend to the mediating elements or sensations much, if at all. It might seem as though we were reaching right out to the objects, projecting our bodies out to the objects themselves. This assumption is not warranted, however. A better account for these experiences is the view that the mediating element is just that, a medium through which distal information about an object is transmitted to our sensory surfaces. This latter proposal is more consistent with our typical projected touch experiences. The mediating object seems to be merely a conduit of tactual information about the object on the other end. This is related to an idea discussed by Evans (1982). He argues that direct informational links are a necessary condition of perceptual reference. His idea was that a perceptual experience refers to a particular object in virtue of the informational links connecting the perceptual state to the object. As Evans correctly notes, such links are not sufficient to ground perceptual identification; however, I think he was correct that some such link is a necessary condition on perceptual reference. This insight allows us to develop a more plausible account of tactual reference.
To see this more clearly, imagine something further removed from our skin than a pencil. It is unlikely that we would experience a broomstick or a shovel as defining the limits of our bodies, though we can just as easily drag either along the ground to determine its texture and hardness, or probe the walls of a dark room to determine its shape. It is much the same with stilts, bikes, roller skates, or other extensions of our tactual abilities. That we project our experiences to distal objects does not show that we project our body-sense. It is not the case that whenever we touch an object with some mediating object, we incorporate the mediator into our body-image. It is far more likely that we experience on our sensory surfaces stimuli that give us consistent information about distal objects, information that is merely transmitted through some intermediary tool or object which is not itself the object of our experience.

3.7.2 Tactual Filling-In

Consider Martin's example of touching the rim of a wine glass. Martin claims that when touching the rim we experience five distinct points where our fingers contact the glass, and nothing in-between or alongside our fingers. But this misdescribes the experience. We experience a single object—the wine glass—and not five distinct and separate points of contact. We also experience our separate fingers, but we do not experience the glass as a whole in virtue of experiencing these separate finger sensations as such. When we experience the glass, we might not notice or feel the gaps between our fingers, but we in some sense “fill-in” the various gaps; we experience through our grip a single, solid, round object. Martin thinks we arrive at this percep solely in virtue of the experience of the five points of contact, but this is highly unlikely. It is more likely

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68 I mean to imply nothing about the nature of filling-in. Following Dennett (1992), I tend to favor a restrained account of cases of filling-in. I am here just invoking the fact that it seems, at the phenomenological level, to be an experience of filling-in.
that we experience a single glass because we receive more information about the cup than mere cutaneous inputs to the separate fingertips. Any grip or prehension is a highly complex movement, involving coordination of the fingers, hand, and wrist, and incorporating responses from each of the fingers as well as from the stretch receptors in the arm (Jones and Lederman 2006; Castiello 2005). It is not the case that the content of such tactual experiences are exhausted by awareness of the points of contact. More to the point, there is more content in our objective experiences of the glass than in our tactile experiences of the contact points alone.

Consider an even simpler case:

**Tabletop:** Fanning your fingers apart, you run your fingertips down a tabletop. You experience the unified and singular surface of the table as your hand moves.

Here you do not just feel the table at five points; you experience one solid, uniformly connected table. There may be no experience at all of the gaps between your fingers. You have a tactual experience of unity *despite* the gaps between the fingers. Tactual filling-in is similar to tactual projection; we have an experience of an object or property which we are not in direct contact with. Unlike projection, which involves a probe or other device connecting us to the distal object, filling-in involves a kind of experiential completion between the points of contact, where there are no bodily sensors. For this reason, however, it is perhaps even more clear that the experience does not involve an alteration of body-sense; in no way do I experience my hand as a large circular whole as I run it along the table. I still have the distinct feeling of fingers and their individual limits. Rather, when I run my hand across the table I am experiencing the table as unified and non-gappy, while at the same time experiencing my body as fingered and involving multiple points of contact.
3.7.3 Volume Touch

Volume touch—first discussed by pioneering psychologist David Katz in 1925—is most similar to tactual projection. Volume touch involves touching objects through thick mediating layers of cotton or other such materials. Such experiences give the impression of a volume of space through which the distal object is perceived. We are typically good at determining tactual properties and identifying objects even through thick layers of mediating material. Reflecting on the phenomenology, it seems clear that such experiences concern the distal objects we are in mediated contact with, not the bodily experience created by the medium. For example, we can easily determine that an object under a layer of cotton is a sphere.\(^{69}\) Such cases are similar to projected touch, but do not involve extension through a solid object or probe. Instead, the experience is through some soft material which adds a distinct sense of depth and space. As in projected touch, the mediating material does not become an apparent part of our body. Cotton layers do not extend the apparent limits of our bodies. It is through the cotton that we have the experience, we press our body (our hands and fingers) against the cotton and through it feel the object. At no point in such an experience does the intermediate material feel as though it is a part of your body. There is some sensation at the point of your body, a sensation caused by your contact with the material, but the genuine object of the experience is the object which lies underneath it. Your experience is of the sphere.

A case similar to volume touch involves the use of palpation. Doctors, therapists, and masseurs use palpation to sense such objects as tumors, cysts, and muscle knots which lie below

\(^{69}\) Note that in cupping a sphere in our palms we easily experience the sphere, but do not at all experience separate subjective points of contact. Here it seems clear that our experience of the sphere could not be inferred solely from the tactile sensations made by the sphere upon our palm.
the surface of the skin. A doctor using palpation can determine the size, shape, density, and location of a tumour located a considerable depth in a patient's body. Diagnoses are conducted all the time using the techniques of palpation, and they are accurate in a large range of cases. Consider a doctor using palpation to discern properties of a patient's tumor. In such a case, the doctor does not take the limit of her body to extend into the internal parts of another person's body. Throughout the palpation, the doctor's body-sense never strays out beyond the hand, but throughout the doctor would seem to have a consistent sense of her own body limits.70

We might consider another case similar to volume touch, call it indirect touch. Such a case would involve touching an object through a thin, non-spacious material, like a blanket or towel. We can touch a playful puppy hiding under a blanket, and determine its shape, size, location, and even texture. In so doing, I think that the blanket functions as a medium through which we touch the puppy. The surfaces of the blanket do not become the new apparent limits of our bodies. We experience the puppy on the other side of the blanket, not as in direct contact with the apparent limits of the body. Touching an object through winter gloves, or through some other soft material, would be another example of indirect touch. We can think of such cases as occupying a position in-between touch through thin latex gloves and those through thicker volumes.

3.8 Haptic Engagement

We have just considered several examples of distal touch. In addition to these cases, we can enrich our notion of distal touch—especially its spatial character—by a consideration of the

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70 There is little psychological research on palpation, though work on the accuracy of palpation-based diagnoses seem to support the view that it is relatively accurate, see e.g., Rimsten et al (1975).
inherent richness of typical touch experiences. We touch with our whole bodies, in an active, complex manner, using a range of exploratory actions, such as grasping, holding, shaking, tapping, squeezing, and rubbing (Jones and Lederman 2006). For this reason, typical touch experiences involve far more than cutaneous sensation. Consider touching an object too large to hold in your hand, such as a large box. Feeling the shape of the box involves actively exploring the external features of the box over a period of time. While touching any single part of the box, one is only in partial contact with the box. Yet, the haptic experience of the box is of a single solid object; one can haptically perceive the overall shape of the box. Here again is a case where ACT breaks down: our experience is not simply of the points of contact with the actual or apparent limits of the body, but of a single external object, some parts of which lie beyond the apparent limits of the body. The claim here, as with filling-in, is that one does not project one's body-image into parts of the box not currently touched or manipulated. Instead, the experience of the object is grounded at those points by information provided by other aspects of tactual sensory processing (see e.g., Millar 2008, Kappers 2007).

Such facts about touch are bound to be of great importance as technological advances are being made in haptic interfaces and remote haptic control systems. Current remote-control technologies do a poor job transmitting haptic information back to the control systems for remotely operated machines, like submarines and unmanned aircraft. They often depend on camera and visual feedback coupled with simple control mechanisms. More robust systems could be implemented that transmit intensive information directly to the hands, allowing for a more robust experience of distal object features. Object location, surface solidity and roughness, and so on could all be relatively easily transmitted from a distal machine. Such devices could also be incorporated into current technologies, like cars, for delivering large amounts of
information about road conditions or for warning signals. What is required is an account of how we do experience distal objects. We now turn to this project.

3.9 The Connection Principle

We turn now to a more complete elaboration and defense of my positive account of distal touch. We often experience objects through touch which we are not in direct contact with, and which are not in contact with the apparent limits of our bodies. Tactual reference therefore cannot be explained in terms of such contact. A plausible means of understanding tactual reference is needed. We now turn to a more robust conception of tactual reference. I begin first by suggesting a principle that can replace ACT. Following that, I’ll consider the critical question of where distal objects are represented as being. The answer to this question, grounded in the distinction between different levels of spatial representation, will offer a plausible account of the spatial character of touch. One result of this investigation is that spatial properties generally will be seen to play a relatively unimportant role in touch experience (an issue to be discussed at length in the next chapter).

We started with the observation that touch appears to be a contact sense. Initially, this was understood as the claim that touch, unlike the distal senses, cannot represent objects or properties not in direct contact with our bodies. This claim has now been rejected, yet there still seems to be something important in the claim that touch is a contact sense: touch seems to need some connection to distal objects. Following Evans, I suggest that tactual reference requires a strong informational link between an object and our sensory surfaces. We cannot have an experience of an object if that object is not connected to us in the appropriate way. One cannot
experience a sphere through touch if the sphere (or its properties) are not connected in some manner to our sensory surfaces:

**Connection Principle (CP):** Tactual reference to an object requires tactual connection with the object, either directly or through some intermediary medium which is directly connected to the object.

Anything that transmits information about distal objects, and thereby allows us to have genuine tactual experiences of these objects, counts as a *tangible medium*. This will include various objects, tools, voluminous materials, and organic substances as fingernails, epidermis, and hair. Touch is a contact sense, but that does not mean that it isn’t distal. It can represent objects located some distance from the body, but only if those objects are connected to us in the appropriate ways, through the appropriate channels. Connection to an object is necessary for tactual reference. We’ll look at the nature of these links in a moment. The informational connection is not sufficient for perceptual reference, however. We cannot secure reference through a bare causal or informational connection without an experiential component. We need not explicitly experience the connection in order to properly connect the proximal stimulations with the proper external object. Instead, the kinds of informational links that connect us through touch lend themselves to the right kind of implicit awareness (skillful sensorimotor connections, for instance). In this respect, the CP is in line with the kinds of connections Evans originally envisioned with his notion of informational links.

What kinds of connections would be appropriate then? For many touch experiences, the connection seems to be closely related to exploration and control. Consider a simple case of distal thermal touch. With your eyes closed or blindfolded, you can experience the heat coming from a candle set before you. The exploratory actions you perform relative to the candle—
perhaps moving your palm around in front of you, feeling for the heat to increase or decrease—
allow you to experience the heat as coming from an external source, located in a particular spot.
It is the way in which the experience of the heat changes relative to our movements that secures
the a distal nature of the experience; we experience the heat as located at a distance from our
bodies because our heat experiences are appropriately linked to our movements. 71

The same is true of distal touch involving tools. When we use a pencil or tongs to touch
objects, we are able to move and manipulate the devices in different ways, allowing for coherent
and stable representations of objects located away from the body. When we use such a tool, or
experience an object through a soft intermediary, it is not in some random or chaotic manner;
rather, we feel stable information through the intermediaries. We are, in a sense, able to feel
through them to the object on the other side. When we explore through touch we are able to
ground and represent certain properties as located in certain places. The same is true of the use of
tools for tactual projection, which occurs when the medium becomes, in a certain constrained
sense, transparent.

That touch makes use of a medium should not be particularly controversial. The genuine
distal senses all involve stimulations that arrive at the surface of the body through a medium. As
Austen Clark (2000; Chapter 1) notes, the appearance of space in general is mysterious. He
discusses auditory experience, and the way in which qualities appear to occur out there in the
world, even though the energy is transduced at the sensory surfaces. This too is surprising and
difficult to explain. That activations on the retina or cochlea are also projected to locations in the
external world is somewhat mysterious. Touch should be no more so. Through touch we are

71 Similar issues are discussed in Chapters 2 and 5.
sensitive to pressure waves and vibrations, as well as other similar signals, and these stimuli are capable of travel through media just like light and sound waves. It thus makes sense that our touch receptors could bring us into contact with distal objects or features, especially when there is a strong informational link between the distal object and our bodies. In fact, one might suppose that the accuracy and strength of tactual reference would largely depend on the strength of the informational channel linking our bodies to the world. It would be difficult to experience a distal object through a segmented probe, for instance, because it would carry incoherent and disordered information. Some tools, like a walking cane, can carry a lot of information about distal objects. Others, like a bottle of water, cannot. And there are likely to be differences in how various properties can be transmitted. Vibration and roughness can be most easily transmitted through intermediaries; precise shape and contour cannot be.

3.10 Where are Distal Touch Objects Located?

The Connection Principle constrains our tactual experiences. But possessing the appropriate connection is not the whole story, for there are still many questions about the spatial character of distal touch. In particular, we require an account of how the tactual represents the distal objects as located some distance from the body, given that our tactual receptors are all located on the body. In this section I will argue that tactual objects are represented as located in a special intermediate spatial frame commonly called peripersonal space.

Let’s start with the observation that we seem represent space in a number of different ways. While cognitive psychologists differ in their interpretations of the data, there does seem to be ample evidence that humans have distinct levels of frames of spatial representation (e.g., Halligan et al, 2003). On most standard accounts, there are (at least) three distinct frames of
spatial reference. First, there is *internal* or *personal space*, which is the space occupied by our own bodies. An itch on the arm or a pang of hunger located somewhere in the belly are examples of representations within one’s personal space. (Halligan *et al* 2003). The locations involved here are egocentric, relating various body parts with each other without concern for their objective locations in space. In addition to personal space, there is *extrapersonal* or *external* space. Look out onto a field of flowers involves representing objects in external space. They might be represented relative to other external objects or landmarks, but they are taken to have a stable and objective location “out there.” I think that prior views of touch have assumed, incorrectly, that these are the only frames of reference relevant to perception. The distal senses have been taken to operate in external space, representing objects and properties relative to some external frame of reference. Touch, on the other hand, has been relegated to personal space, and assumed to represent features only relative to the body. Such a view seems to justify views like CT and ACT. A strong argument might be made for the view on this basis, were it not for the existence of a third level of spatial representation. This level, typically called “peripersonal space” plays a crucial role in perception, especially touch and vision for action. Peripersonal space is the area immediately surrounding a subject's body, usually defined as the area wherein one can easily reach and actively engage. These three levels of spatial representation are distinct; they can be dissociated from one another and there exist pathologies which leave a subject without the ability to represent only one level of representation through forms of spatial neglect (Mennemeier *et al* 1992, Pegna *et al*, 2001). There is ample evidence that it is representations in peripersonal space mediate many of the tactual experiences (especially tactual reference) which I've discussed in this chapter. Tactual projection is typically a projection into peripersonal space, that the use of tactual media typically occurs in peripersonal space. In addition, it has been shown that while use
of tools projects into peripersonal space, only the proximal and distal ends of the tool are ever represented in experience (Holmes et al 2005).

It is obvious that visual experiences represent objects and features in external space. It is also obvious that touch represents objects and features in personal space. The error is thinking that these are the only options. Both touch and vision seem able to represent objects in peripersonal space. I think a careful consideration of the nature of peripersonal space allows us to explain how touch is able to represent objects as located in the space around the body. The coordinates of peripersonal space are defined, after all, by such things as how far we can step or reach in various directions, and these things, being grounded in proprioception and kinesthetic feedback, play a crucial role in genuine tactual experiences. This might offer an explanation for how tactual projection works (one projects into the space where one can reach, manipulate, and so on). Using a particular Exploratory Procedure (EP) to investigate an object one can represent various parts of elements of the object in peripersonal space (by how one's grasp needs to change to feel a certain feature, say). That my arm needs to move such and such a distance to explore the far side of a large object allows me to know some spatial facts about the object. And these spatial facts can be grounded in the features of peripersonal space instead of external space, which means we no longer need to default to body awareness to explain tactual experience. When we are haptically engaged with the things around us, these things are all located at specific locations in peripersonal space, and the features of this space are available to (indeed, partially constructed by) touch (cf. Kappers 2007; Klatzky and Lederman 2003b).

The role of peripersonal space also allows us to have a better understanding of the relation between touch and the other senses. This is because peripersonal space is multimodally influenced by the other senses, especially vision. Action-guiding vision, for instance, plays a
strong role in determining the extent of our immediately accessible environment. Mohan Matthen (2005) has highlighted the importance of “motion-guiding vision,” and the relation between motor actions and the objects of our visual experience. Matthen argues that objects close enough for us to interact with have a special phenomenal character, what he calls a “feeling of presence.” The objects that are close enough for active engagement, those with the feeling of presence, are by their natures located in peripersonal space. The coordinates and locations of objects will be subject to the structures and limits, not just of our reach, but also to the influence of motion-guiding vision. There is thus a strong interaction between touch (and closely-related actions like reaching and grasping) and motion-guiding vision. A more detailed consideration of peripersonal space will offer many insights into the structure of perceptual experience and its spatial character.

Susanna Millar (2008) had subjects sit in front of a visual-tangible map with marked landmarks for key locations such as the post office or bank. Their task was to memorize the locations of these key points, using either vision or touch, and then perform a location task on the blank map. They might be asked, for instance, to locate the bank on the map. In previous studies, it had been shown that there were marked differences in task performance between subjects who used touch and those who used vision on the task. This suggested that the two senses used different spatial frames. Millar showed that this assumption was incorrect by having each group of subjects make use of different kinds of reference cues. Subjects using vision were asked to located landmarks relative to egocentric frames (e.g., a little to the right of the body’s centerline), while subjects using touch were instructed to use external reference cues (coordinate marks on the sides of the map). What Millar discovered was that the type of reference cue was responsible for task differences between touch and vision. Subjects using vision and egocentric reference cue performed the same as touch subjects in previous studies; touch subjects using external reference
cues performed the same as vision subjects in previous studies. The difference between vision and touch then is not a difference in spatial reference frames, but a difference in the reference cues typically used (Millar 2008, Chapter 6).

The main spatial difference between touch and sight is a relative difference in the types of reference cues that each typically uses. Vision typically makes use of external reference cues, like external objects or landmarks which are used as anchors for assessing spatial relations between objects. Touch, on the other hand, typically uses body-based reference cues, such as locations relative to the midline of the torso or a small movement of the hand to the left. The different emphasis on these two types of cues is largely responsible for the experimental differences found between the senses. That is, representations of external space typically involve external reference cues, whereas personal space is typically centered on body-based reference cues. Because it makes more consistent use of external reference cues, vision seems to represent objects only in external space (and vice versa for touch and bodily space). But Millar showed that by forcing subjects to use body-based reference cues in vision (and external cues in touch) subjects no longer displayed the striking differential data. When prompted, Millar found that subjects were perfectly able to use external reference cues in tactual perception or body-based cues in vision. It turns out that both types of reference cue can be invoked depending on task demands and context. The focus on the types of reference cue is important here, undermining the idea that there are strong differences between spatial frames of representation (though I’m not fully committed to this account). Still, it reveals that touch most often attains spatial information relative to body-based cues, whereas vision does not. In the intermediate range, however, both kinds of cues can be invoked, in both vision and touch, to attain spatial information about the world. In other words, touch and vision share a common space in the external environment. This
level is what I’ve been calling the peripersonal, where both types of cues—external and body-based—are present.

Another aspect of touch that has gone largely unnoticed (at least among philosophers) is the fact that spatial information plays at best a secondary role in securing object reference and recognition in touch. Touch is continually contrasted with vision, and the focus is largely on the fact that both senses involve spatial representation (considerable focus has been on the representation of shape in both senses, for instance). It is easy to assume that touch and vision make similar use of spatial information in securing reference and recognition. This is not the case. Spatial information plays a smaller role in tactual reference than it does in vision. More important in touch are so-called intensive features—things like material composition, texture, weight, temperature, and so on (we will discuss this in far more detail in the next chapter). We secure reference to the keys in our pocket far more from these features than we do from any spatial properties. This is actually a surprising fact, but one which was discovered by careful empirical investigation (Klatzky et al, 1993, Lederman and Klatzky 1997). Restricting the availability of so-called intensive cues—discussed in the next chapter—causes our otherwise excellent haptic recognitional capacities to suffer greatly (Klatzky and Lederman 2003). This means that in a typical tactual experience we can be aware of what something is—we can identify the object—without knowing where the thing is located or its spatial characteristics.

Tactual reference, which involves the experience of objects located beyond the limits of our bodies, is typically mediated by the non-spatial features of those objects. This means that one can represent an external object through touch without representing exactly where that object is located (in external space) or its precise geometrical properties. We represent distal objects in peripersonal space, with the coordinates determined by where one has to move or reach, and
these spatial features are determined by exploratory actions. This explains how it is that we can represent some distal objects and features through touch. We do so not primarily by building up some complex spatial representation of all the object's features, but by grounding our representations in other, more easily accessible features, such as texture and material composition. The locations involved in distal touch are largely peripersonal, determined by the reach and active possibilities afforded by the immediate environment.

We can now see that one of the most important aspects of distal touch involves ease of transmission. Whereas externally-based reference cues are most important in vision, in touch it is the non-geometrical features that are most important for object reference (and recognition). And these features are precisely the kinds of features that can be most easily transmitted through tactual intermediaries. We can tell whether a surface is rough or smooth easily through a probe, because such information is easily carried through the length of the tool. It is much more difficult to use a tool to determine other qualities of objects. For instance, it is difficult to use a probe to follow the exact contours of an object, and so it is difficult to determine precise shape through a probe. Such information is not easily transmissible via an intermediary. For this reason, haptic interfaces and displays ought to focus more on the most easily transferable features, like vibration, roughness, solidity, and so on. These features are easily transmitted and can be used to carry a great deal of information about distal objects. Such facts ought to be of considerable interest to those working on haptic interfaces and developing systems of tactual attention.

3.11 Looking Ahead

We sometimes have tactual experiences which represent objects located some distance from the apparent limits of our body. We locate these objects in peripersonal space, via tangible media
that connect us to the distal objects through interactive informational links. What we are left with is a necessary condition on tactual reference: the Connection Principle. In addition, we have seen the importance of intensive features in securing tactual reference and object recognition.

Adherence to the contact thesis undermines our ability to fully-understand such phenomena as projected touch, volume touch, tactual filling-in, and indirect touch. The contact thesis both overemphasizes the role of spatial representations in touch, while making it all but impossible to give a proper account of genuine haptic experience. Martin, for instance, holds fast to the idea that spatial representations through touch can one and all be built from the spatial properties of our tactile sensations (since all such sensations are spatially located on the body). But if we sometimes represent objects through touch as located beyond the boundaries of our bodies, direct spatial representation of our bodies cannot explain all of our objective representations of space. Instead, I think we need to recognize the complex character of our representations of peripersonal space, and appreciate the active nature of tactual perception.
Chapter 4: Tangible Qualities

4.1 The Ontology of Touch

The direct objects of perception—the properties or qualities of which we are directly aware in perceptual experience, that we directly experience without requiring experience of something else—play a central role in our theorizing about perception and the senses.\(^\text{72}\) The central philosophical debate concerns the metaphysical status of these qualities: just what is the color blue? What is a sound? The objects of perception do not admit of a uniform metaphysical account. Whatever colors turn out to be, they are surely different in-kind from sounds, tastes, and smells. These perceptual objects possess novel metaphysical structures, each with unique relations between simples and complexes.

The metaphysical project of understanding perceptual objects is closely tied to the more psychological project concerning the epistemology, content, and character of perceptual experience. What we experience and come to know about the world through vision and audition may depend on what exactly colors and sounds are. It works both ways, however. What the colors and their kin are may be closely tied to how human observers represent them. For instance, what it means for some quality to be red might depend on facts about how humans represent this quality—its relations of similarity and identity—rather than purely objective descriptions of certain classes of stimuli (cf. Clark 1992, 2000; Matthen 2005). For this reason,

\(^{72}\) The direct or proper objects of perception are not always objects in the ordinary sense of word (medium-sized dry goods). Philosophical and psychological investigation into our experience of the latter, often called “object perception,” are closely-related but separate from those concerning the direct objects (i.e., qualities) of perceptual awareness.
progress can be made in both the epistemic and metaphysical questions concerning perceptual objects through investigation into the structure of our perceptual representations.

When we ask about the metaphysical status and structure of tangible qualities, we face a difficult, and rarely-investigated, question. Unlike vision, with its vivid colors, or audition with its world of sound, touch does not seem to have any single defining, proper quality. Tangible objects can be rough or smooth, heavy or light; their surfaces can be hot or cold, solid or elastic; there can be subtle differences in vibration, contour, and texture; and they seem to possess a range of exotic qualities such as slimy, slippery, gooey, sandy, wet, spherical, wooden, and metallic. The sheer variety of these qualities require a detailed philosophical account. Such an account should be capable of settling which of these qualities is simple, and which complex; which fundamental and which derived; which are directly and which are indirectly perceived. My account of tangible properties shows that there are two fundamental classes of tangible property, which, when combined in the appropriate ways, account for nearly all complex tangibles. As it turns out, the metaphysical structure of these tangibles is very different from the more familiar cases of color and sound, revealing a unique domain of perceptual objects.

Aristotle was the first to investigate the objects of perception. He described the proper objects for each sense, those qualities possessed only by single sense. He distinguished them from incidental objects of awareness or those common to many senses. The proper object of sight is color, the proper object of hearing is sound, and so on. When it came to the sense of touch, however, Aristotle remarked that the objects of touch “do not form a single genus” (De Anima bk 2, ch 11). Instead, a range of different objects are associated with touch. The many distinct and interacting transducer networks subserving these many features are still poorly understood and difficult to isolate, despite steady work on the physiology of touch. Perhaps for
this reason, philosophers since Aristotle have rarely discussed the direct objects of touch, preferring instead to devote their efforts toward other perceptual objects, especially the colors.  

In what follows, I put forward a theory of tangible qualities, one that relies upon the unique way in which humans represent tangible features. In touch the fundamental concern is the apparent diversity of distinct qualities. These qualities seem too different from each other to allow a single, unified account. My proposal is that tangible features are represented in two fundamental classes of tangible quality: *intensive features* that involve a single qualitative dimension that varies in intensity, and *intrinsic spatial features*, which consist of the intrinsic geometrical features and sizes of objects. When combined, these fundamental features allow for an account of non-fundamental, complex tangibles. These tangibles are best understood as a distribution of intensive features. We can explain these complex tangibles via multidimensional feature maps.

A note on my account of spatial features. I assume two relatively autonomous notions of spatial representation: *intrinsic* spatial features and *navigational* spatial features. The former include the intrinsic geometrical properties of material objects, such as their shapes and sizes. These features play a fundamental role in the generation of complex tangibles. The latter class include relational properties such as locations, distances, and orientations, as well as environmental layouts. These navigational properties do not seem to be tied to any particular sensory modality, but involve the complex interactions of many different senses and non-sensory

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73 There has been recent work on sounds (O’Callaghan 2007; Kulvicki 2008; O’Callaghan and Nudds 2009; Matthen 2010), smells (Batty 2009, 2010; Matthen, forthcoming), and tastes (Auvray and Spence 2008; Korsmayer 1999).
neural systems. An interesting corollary of this distinction is that, while touch represents the intrinsic spatial features of objects, these representations are not the most important qualities involved in touch, and play a relatively small role in tactual object recognition.

4.2 Tangibles

What we ostensibly experience through touch are ordinary material objects and their surfaces. This is also true of vision. My concern is not with how to characterize these objects—this is a general metaphysical question—rather, the issue is with how the senses represent these objects. We experience material objects through touch via a distinct set of phenomenal qualities. Discussions of perceptual quality face a troubling ambiguity. As Austen Clark (2000) notes, the quality of perceptual experience could refer to two very different things. Wilfrid Sellars (1963) had distinguished between ascribing a quality (like red) to an object of experience and ascribing a quality to the experience itself (Sellars used the label red* for such ascriptions). Clark, similarly distinguishes between what he labels "phenomenal" properties and "qualitative" properties. Phenomenal properties are attributed to the objects of experience, whereas qualitative properties are aspects of our own experience (through which we come to experience a phenomenal property).

In this chapter, my focus is on the phenomenal qualities described by Clark. I argue that there are two fundamental classes of tangible quality: intensive features and intrinsic spatial features, and the many complexes composed of them. That is, we typically represent material

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74 When Clark (2000; Ch. 2) argues that spatial properties are not perceptual qualities, I understand his claim to apply in the first instance to what I’m calling navigational spatial features; that is, to where objects are located rather than to spatial features of the objects themselves.

75 It might be better to speak, like Roderick Firth (1949), of ostensible material objects rather than material objects as such.
objects through touch via two classes of tangible quality. While I do not claim that these are the only classes of tangible property, they are the basic building blocks involved in nearly all tactual experiences. Complex tangible qualities, like dampness, are best understood as complexes built out of distinct sets of intensive and spatial features. While Aristotle was correct that tangibles do not form a single genus, tangibles do possess some structure and coherence. The many tangibles combine and blend in systematic ways, generating a rich set of complex tangible qualities.

The complexity of the questions we shall face is beautifully illustrated by the following passage from Helen Keller:

Every object is associated in my mind with tactual qualities which, combined in countless ways, give me a sense of power, of beauty, of incongruity: for with my hands I can feel the comic as well as the beautiful in the outward appearance of things. Remember that you, dependent on your sight, do not realize how many things are tangible. All palpable things are mobile or rigid, solid or liquid, big or small, warm or cold, and these qualities are variously modified. The coolness of a water-lily rounding into bloom is different from the coolness of an evening wind in summer, and different again from the coolness of the rain that soaks into the hearts of growing things and gives them life and body. The velvet of the rose is not that of a ripe peach or of a baby’s dimpled cheek. The hardness of the rock is to the hardness of wood what a deep man’s bass is to a woman’s voice when it is low. What I call beauty I find in certain combinations of all these qualities, and is largely derived from the flow of curved and straight lines which is over all things (Keller 2003; 11).

As Keller describes it, a tangible feature like hardness is almost never experienced alone, it joins with numerous other qualities, allowing for complex and meaningful experiences of the world around us. The nature of these combinations will be explored after we consider the individual classes of tangible quality.
4.3 Intensive Features

I will start by describing the first general class of tangible quality. In order to do this, I will make use of some terminology introduced by Mohan Matthen (2005). He first distinguishes *determinable* from *determinate* sensory features (building on the work of W. E. Johnson). A determinable such as *red* is a general class that contains many subclasses. Perceptual grasp of a determinable involves “grasping certain relations of intensification that can be used to generate their subclasses” (101). Determinates are the fully specific subclasses, and do involve any deeper relations or subclasses. Determinates differ in intensity from one another along some set of values. The determinates for red would include specific shades like *scarlet*, *blood red*, etc. We can use these terms to describe relations of exclusion between sensory features. Start with the *Feature Exclusion Principle*:

A fully determinate feature excludes other features of the same type. If FD and FD* are distinct fully determinate features of the same type, there is some range of individuals, x, such that x cannot be both FD and FD* (104).

This seems true of individual shades; a particular shade will exclude other shades—an object cannot be both *scarlet* and *sky blue* at the same time—but it will not exclude other types of features such as *round*. Matthen develops a detailed account of these ranges, but we have enough terminology to describe the intensive tangible features.

An intensive feature is a determinable class of sensory features, all of whose determinates form a linearly-ordered exclusion range. The linear ordering is important, and makes the determinates in touch unlike sounds and colors, whose determinates differ along several dimensions. An initial characterization of an intensive feature is the following:
**Intensive Feature:** A determinable class of sensory feature that linearly varies in intensity along a single qualitative dimension.

We can explain intensive features in a little more detail. An intensive feature involves a single phenomenal quality—such as heat or roughness—that varies in intensity along a single dimension. These variations involve a difference of *more* and *less*: a sheet of paper can be more or less rough than another, an mug can be more or less warm than another, and so on. Intensive determinates of the same type form an exclusion range—a sheet of paper cannot be both rough and smooth at the same time, a mug cannot be hot and cold at the same time, etc. At any particular time and location, only one intensive value can be assigned to an object. If a particular surface area is smoothed out it becomes less rough, as a surface warms it thereby becomes less cool. In other words, intensive features exist along a single continuum of intensity. While intensive features vary in intensity, the variations do not have a uniform scale. The just noticeable differences between two intensive features can become squished at the extremes. For example, a small change in temperature in the middle values might not be represented the same as a small change at the extremes. There might be a large felt difference might between a mug at 20° Celsius and one at 27°, but there may be no noticeable felt difference between one at 100° Celsius and one at 107°. This characterization of intensive features seems to capture the underlying structure of many tangible properties, including the thermal properties, roughness, vibration, pressure, weight, hardness, elasticity, and so on. These considerations lend strong support to the claim that certain tangible properties vary linearly along some single qualitative dimension. These tangible properties—along with intrinsic spatial features—provide the

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76 As Matthen (2005) is careful to point out, we must not to confuse genuine differences along exclusion ranges with artifacts that arise from arbitrary scales of representation. Despite using a conventional scale here, the “squeezing” of the range of human thermal perception at the extremes is not a feature of the Celsius scale, but reflects a real difference in the receptive fields of human thermal receptors.
fundamental elements of our tactual experience. While we are primarily concerned with externally-directed features here, I should note that nearly all body-directed touch experiences are intensive in nature.  

There is strong evidence for treating these tangible qualities as intensive in nature. Let us start with some obvious phenomenological facts about tactual experience. Close attention to our experience seems to reveal the intensive structure of many tangible qualities. Objects can feel quite cold, and as they warm up, they appear to increase in felt warmth. We can describe the locations along the qualitative dimension through matching stimuli: two stimuli that are indiscriminable to a subject are located in the same place along the qualitative dimension. Similar considerations apply to a number of other tangible qualities. Objects are felt as more or less smooth, more or less hard, more or less hot, more or less heavy, etc. The felt difference between a light and heavy object, for instance, is a difference along a single qualitative dimension. Each of these intensive features forms a determinable class that does not exclude members of other intensive classes—an object can be cold and rough at the same time, or cold and heavy, etc.). Unlike the exclusion ranges in vision, however, the intensive features do sometimes combine to form unique unitary experiences (discussed in § 1.6).

For each of these individual intensive features, there are ranges of intensity that we can be sensitive to. These ranges can be qualitatively defined by a matching paradigm (Clark 1993): two sheets of paper whose roughness cannot be tactually discriminated occupy the same value on the scale (regardless of the microstructural surface properties of the sheets). The same holds for

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77 While I have already argued that pains should not be counted as part of touch, it remains an interesting question whether pains are intensive in nature or not. On the one hand, a single pain can be more or less severe. On the other, different pains vary widely in their phenomenal character. Perhaps this merely represents a weakness in our current typologies of pain.
the distances between the values; the scales involved are defined by our experiences. We can explain the nature of these ranges by appeal to the contours of the receptive fields—the range of maximal neural activation for certain features or properties—involved in touch. These result in an ordering of similarity between disparate signals, allowing us to plot the relations that hold between experiences of certain kinds. This allows us to describe the intensive features using the framework of similarity spaces. As Matthen (2005) describes:

In such representations, each sense-feature takes its place in an \( n \)-dimensional similarity space which consists of all the features in its exclusion range. This similarity space preserves the distance measures derived from similarity judgments (110).

Similarity space thus represents the differences between two sets of features along a set of dimensions. Because intensive features are linearly-ordered along a single dimension, the similarity space for each intensive feature is very simple. The only variable element is the scale along the dimension (areas of the range where noticeable differences are compressed or expanded). We’ll consider similarity spaces in more detail in § 4.7.

The intensive features play a fundamental role in many of our most important tactual abilities. David Katz (1925/1989) was one of the first to focus on the important role of vibration and other non-spatial features in touch. He noted in a series of early experiments that vibration seemed to be the critical feature underlying many of our tactual capacities. Many years later, Susan Lederman and her colleagues demonstrated in a series of important studies that certain non-geometrical tangible features are processed at very short timescales, are available almost immediately to attention, seem to vary along a single qualitative dimension, and play a central role in haptic object recognition (Klatzky and Lederman 1993; Jones and Lederman 2006). Their empirical studies revealed the contours of intensive feature processing, most importantly
showing the relatively fast onset of both receptor activations and conscious awareness for such features. In contrast, what Lederman and colleagues refer to as geometrical features are much slower to experience. In order to determine the shape or size of an object requires the performance of exploratory movements over time. Because of their relative speed, intensive features can draw our attention in a way that geometrical features cannot (Spence and Gallace, 2007). This means that the intensive features have a much greater salience for tasks such as object recognition. We most often identify objects through touch based on their combination of intensive features (their thermal profiles as well as complexes like material composition and texture). Identifying objects through touch from shape alone is not nearly so easy. Lederman and colleagues had subjects attempt to identify a range of normal objects through touch, and they found that subjects performed the task very well. But when presented with a set of stimuli shaped like ordinary objects, but made out of the same wooden material, removing intensive cues, performance on the recognition task was severely degraded. The finding is that the shapes of ordinary objects plays a relatively minor role in tangible object recognition (Klatsky and Lederman 1993).

Additional empirical considerations lend support to the distinction between intensive and geometrical features (described in the next section). I will mention one especially good example. Studies on Braille reading conducted by Susanna Millar (2008) show that experienced Braille users don’t make much use of the spatial features of Braille letters and words to comprehend their meanings. Instead, fluent Braille readers seem sensitive to variations in felt dot density over time, as the hand moves across the raised dots on the page. This change in dot density is felt as a change in intensity, and does not seem to be represented through spatial means alone (using
shape-outlines of the dots or larger arrays with the same shapes causes expert Braille readers to lose their expert reading abilities.\textsuperscript{78} The recruitment of fast intensive features offers an explanation for the extremely fast encoding performed by fluent Braille readers. When non-experts try to read Braille, they seem to rely on spatial processing (figuring out the shape of the dots pattern). Their reading is thus much slower and less accurate than those who become sensitive to the intensive features.

4.4 Intrinsic Spatial Features

Touch represents the intrinsic spatial features of objects. Unlike intensive features, the shape of an object is not determined by a location along a single, linearly-ordered qualitative dimension. Such representations are distinct from the role touch may play in our general, multimodal navigational capacities. Through touch we can determine whether an object is a cube or a sphere, that a surface is curved or concave, that one marble is slightly larger than another, and so on. These features are not linearly-ordered, but likely involve an ordering along many distinct dimensions, such as size, number of sides, regularity of sides, etc. Any two objects can be assigned values along these many intrinsic spatial dimensions, giving a similarity vector between the intrinsic spatial features of any two objects.\textsuperscript{79} We require an account of the nature and structure of these features, and how they might be represented in touch. Because of their central importance in touch experiences, in the following I will focus on the representation of intrinsic spatial features and causation. Following this discussion, I will contrast my view with an

\textsuperscript{78} There are some spatial elements involved, since density involves a spatial component, but dot density over time is not represented as a spatial property.

\textsuperscript{79} While I restrict the discussion here to intrinsic spatial features, the similarity space we could be expanded to include variables for felt movement, location, causal interaction, or other similar tangible properties that do not vary along a single intensity gradient.
alternative view put forward by Armstrong that attempts to reduce tangible features to a single class. Finally, I will suggest how the arguments of this chapter can be used to generate an account of the quality space of touch.

While often we can account for the processing of an intensive feature by appeal to a specialized sensory channel, tactual awareness of object shape and size does not have its own sensory channel. Instead, such processing depends on sequential operations of other underlying systems combined with spatial information derived from kinesthesis and proprioception. Our ability to experience the spatial properties of objects thus partly depends on the processing of intensive features, as well as our ability to actively engage and explore the world. We are unable to experience some complex shape properties through touch without exploration. This is especially true for any large object (anything bigger than the hand, say). In vision we seem to see the complete shape of an object more or less right away; this is not the case for touch. To experience complex shape we must construct a representation of such features, step by step.\(^80\) The movements of our fingers, hands, arms, and whole body can make a difference in how this is accomplished.

One especially vexing question that could arise (as it has for vision) is how our neural system succeeds in representing 3-dimensional properties of objects when the skin itself is a relatively flat 2-dimensional layer. In vision there have been many competing theories, from computational accounts that try to determine the precise algorithm the brain uses to derive 3-D representations from 2-D inputs (Marr 1981) to more enactive and embedded views that seek an

\(^{80}\) Because the constructions are automatic and the exploratory movements linked in the appropriate ways, it seems correct to hold that we can still directly perceive many of these complex shape properties through touch, despite the involvement of exploratory action. After all, this is essentially how vision works as well. The difference, of course, is that vision performs its scanning at much shorter timescales.
explanation of visual experience in the dynamic coupling of the brain and world (Haugeland 2000, Ch. 9; Noë 2004). In touch however, purely computational models like those found in vision do not seem entirely plausible. Instead, touch appears to derives its spatial content partly from spatial information derived from our active movements in the world. That is, the spatial properties of objects are largely derived from their locations in peripersonal space (described in the last chapter). To perceive an object as a cube through touch involves exploring and manipulating that object in the distal space around us.

We can say a little more about how exploratory actions ground our experience the intrinsic spatial features. While some of the spatial content in touch seems built up, through sequential movements It seems that some of the spatial content comprising such representations is conditional in nature. What I have in mind by saying the intrinsic spatial content is conditional is that the spatial locations are partially determined by the range of intensive features we would feel if we were to perform certain exploratory movements: “If I move my hand to location L, I will feel intensive feature F,” where L is a location in peripersonal space (see previous chapter). The movements provide a means of representing coordinates surrounding the body, and the location of intensive features along these coordinates allows an awareness of the spatial characteristics of objects. The result is a distribution of intensive features in the area around the body in which we can actively engage. This is, of course, a gross simplification. The determination of coordinates in haptic space is extraordinarily complex, involving many different sensory systems. Still, the idea should be relatively clear. When I explore a metallic sphere, move my hands in certain ways around the object and determine the relative location of intensive features (like cool, and smooth) and these in turn allow me to determine that the sphere is spherical. This all occurs very quickly, of course, a few simple movements and one can have a full tangible perct of the sphere.
The spatial contents determined by our actions in peripersonal space function alongside our working memory and recognitional capacities, linking and blending the individual haptic experiences into unified representations. This linking seems largely automatic and implicit, allowing us to perceive whole objects through touch. While we cannot experience every feature of something like a chair through touch all at once (nor can we through vision, for that matter), we do seem to experience it as a single, unified object. This perception is grounded in the fact that when our exploratory engagement with the chair is coherent and unified—we can pick up a chair and move it across the room, etc). The parts of the object move together, the arrangement of the individual features stays constant relative to the object itself.

The form of conditional content I just described must be distinguished from the “virtual content,” described by Alva Noë (2004). While Noë agrees that our experience of objects through touch must be built up in a certain manner (Noë 2004, 15), his account is different from the conditional spatial content. Noë’s virtual content results from knowing how our sensations will be altered in relation to bodily movements. Virtual content is meant to challenge the notion of rich representations stored “in the head.” Instead, the content is acted out virtually as a result of the interaction between our body and the world. In other words, such content supervenes on the body-world relation rather than solely in neural representations. My view of conditional spatial content makes no such metaphysical commitments: the exploratory movements I’ve described could just be causally necessary for the build-up of rich neural representations. This allows the spatial content to be “rich” while generated through a temporally-extended, exploratory process. Similarly, Noë relates perceptual content to an implicit understanding of the

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81 Though touch does seem to involve haptic and tactile representations. These representations function along with working memory systems to build up some complex representations in the world. This would be a difference from the sensorimotor account.
structure of our sensations relative to bodily movements. The spatial content I’ve described does not relate contents to sensations, but relates specialized motor actions or sequences of exploratory movement to certain complex haptic representations. The contents are thus entirely spatial, and the relations are between tangible features and locations rather than implicit sensorimotor knowledge and sensations. So while Noë takes his virtual content to be true of perception generally, the conditional content I’ve described only occurs in certain haptic perceptions.

The distinction between intensive and spatial features seems to be a strong (structural) difference between touch and vision. This is because vision seems to be predominantly concerned with geometric features, especially in the identification of objects. Specifically, vision seems to primarily involve the processing of external reference cues in order to resolve spatial information. Objects and features in the visual world always are related to each other in external space. While touch can use many of these same external reference cues, it is primarily an intensive system, one where spatial information is not always the most important. It seems difficult to imagine that one could see a blue patch in one's visual field that had no location, or spatial dimension whatsoever. In order to see a blue patch, at least in ordinary cases, the patch has to have some location or geometrical properties. A ganzfeld might be a counter-example to this claim, but then a ganzfeld seems so striking precisely because of the lack of typical spatial cues (and, it should be noted, we quickly go blind when exposed to one; see Avant 1965). This is not the case in touch. In touch, one can have an experience of an object that doesn't have an exact spatial location or any particular shape to it. A feeling of pressure can have only a general spatial character (i.e., somewhere on my back). One sometimes has to feel around with one's hand to track down the location of the pressure or feeling. One might only have a vague sense of the proper location in such cases, but this sense does not seem to involve any properties of the
itch (they might involve other properties or aspects of the experience). We can also identify objects with our hands even if we don’t know the shape or size of location of the object. When we first touch an object, we do not experience the location or geometric properties of the object, we first experience intensive properties such as texture or temperature (Klatzky and Lederman 1993). In order to discover where an object is located or what shape it is requires a separate, slower, and less precise processing step.

4.5 Causation

Along with intensive features and intrinsic spatial features, there may be many other proper qualities involved in touch. Yet, as we’ll see in the next section, I believe that intensive and intrinsic spatial features alone offer a robust account of nearly all proper tangibles. In this section, I want to briefly motivate the idea that causal relations—despite being represented through touch—ought not be included among the proper perceptual objects of touch. (similar remarks could apply to locations, motion, similarity, and the feeling of agency).  

The question is whether causes are among the proper objects of touch. I think they are not. The primary reason is that our experience of causation seems to stem from a largely independent causal-perception system, one that takes tactual inputs, along with other information (temporal, agential, motor-directed information) and detects causal relations. So while I do think that we experience causes through touch, such relations are not themselves among the fundamental objects of our tactual experience. Our experience of causation is mediated by the other tangibles and direct awareness of our own agency (among other things). On this model, tactual experiences *feed into* a more robust system of causal awareness, one not restricted to

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82 See Bayne (2010) for discussion of the sense of agency
touch (though a proper understanding of the role of touch in causal perception and the feeling of agency is essential). I will now defend this characterization.

Alfred Michotte (Michotte and Miles 1963) was one of the pioneering investigators working on causal perception, and he put forward a thesis that humans were endowed with a natural input system for detecting and representing causal experiences. This capacity for causal awareness depends on the existence of other perceptual parameters that fall within certain ranges. In vision, for instance, two objects might be seen to causally interact if their spatial vectors and temporal interactions are consistent in the appropriate ways. We experience one billiard ball causing another to move if their movements are properly aligned—if the struck ball moves away in the direction of impact, say—and if the struck ball begins to move at (or very shortly after) the moment of impact. There is nothing essentially visual about this kind of experience; so long as the parameters were met we could experience the same causal interaction through another sensory modality. We could hear one ball rolling across the table, the crack of impact, and then two balls rolling away. The very same principles of spatial and temporal coherence would apply to this case, and equally activate our causation detector. Call this the causal detector theory. According to this model, humans are endowed with a general-purpose capacity for representing causal relations. This capacity is not located in any particular sensory modality, but serves as a higher-level mechanism for detecting and responding to causal interactions. The causal detector theory requires that there be no modality-specific causal representation. That is, causal representations are multimodal, and not specific to any single sense. Consider the motion-bounce illusion discovered discussed in chapter one: our visual experience of a bounce rather than a cross is determined by the presence of absence of an auditory click. The causal relation is thus not, properly speaking, among the direct objects of visual experience (though certainly vision represents causal relations, cf. Siegel 2009). While we experience causes through touch, it is only
in virtue of the tactual inputs feeding into our general, multimodal causal detection mechanism.

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Michotte’s view is not the only way of understanding our experience of causation. An alternative conception of causal perception explicitly invokes touch and the tactual experience of causality (discussed by Saxe and Carey 2007). According to this line of thought, our capacity for causal perception depends (somehow) upon our tactual experience of agency, characterized as a kind of self-causation. We are able to move ourselves, and thereby experience the effects of such actions in the world. By reaching out and hitting it with my hand, I am able to cause, and experience myself cause, a billiard ball to move. It is in virtue of such experiences that I develop the capacity to represent other (non-agential) objects as being involved in causal interactions. The thought is that the experience of moving and interacting directly with objects through touch is a necessary condition on causal perception. The claim seems to be a developmental claim about the necessary causal conditions for such experience, though one could perhaps read the claim in a stronger way: that without direct experience of self-caused interactions, we could never experience causes period. This would imply a close conceptual link between our actions and perception of causation. For instance, one might think that visual experiences by themselves under-determine causal interactions (as Hume may have thought, perhaps we never really see causes, only constant conjunctions).

This explanation of causal experience arises from our genuine capacity for perceiving the effects of our own actions. We are aware of our own actions and intentions in a way that brings us into direct contact with our effects on the environment. Nevertheless, the recent work on cross-modal illusions and visual perception suggest that it is unlikely that our representation of causes is restricted to touch. Recall the motion-bounce illusion. Here an auditory input alters our
visual experience and leads to a representation of a bounce (rather than a crossing). That two senses—neither of them touch—can interact in such a way to generate a causal representation should strongly suggest that our representation of causes is not in the first instance a purely tactual capacity. Similarly, Susanna Siegel (2009) has convincing argued (using some findings of Michotte) that visual experiences represent causal relations, with no mention of reduction to some purely tactual capacity. While these are not conclusive points, and the empirical evidence could of course turn out either way, there are very good reasons to think that causal awareness is not tied to any particular modality. Neither vision nor touch represents causation in modality-specific ways; rather, both seem to feed into a separate causal detection module.

4.6 Complex Tangibles

If the preceding is correct, then among the qualities represented by touch are two general classes: a range of distinct intensive features, and the intrinsic spatial features of objects. For each of the intensive features, at least, we can plot their values along the qualitative dimension through a matching paradigm like that discussed by Clark (1993). The values for intensive features can thus be ordered in a graphical representation of similarity and difference between individual values. This is typically called a quality or similarity space. Using stimulus-matching and other techniques, we can say a great deal about the experienced qualitative relations between thermal qualities, different vibration frequencies, and gradations in pressure, and so on. This is useful if we want to understand intensive features in isolation. If we want to understand most common touch experiences we need to expand this framework, and consider combination of intensive and spatial features. A typical a typical tactual experience will involve many complex interactions

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83 Whether visual experiences can represent causes, if causation is detected by a high-level causal detection module that takes only visual inputs, is an interesting question that must be passed by in the present discussion.
among tangible features. Many intensive features have strong influences on one another, and can blend in interesting ways. Perhaps the clearest example of such interactions involve the tangible qualities by which we make judgments of material composition. We are generally very good at distinguishing material composition through touch alone. A blindfolded subject presented with a range of different objects has little difficulty picking out the wooden, plastic, and metallic objects from each other (recounted in Jones and Lederman 2006). Such categorization is accomplished through salient combinations of intensive and spatial features. Objects that are cool, hard, and very smooth, for example, are felt simply as metallic (where “metallic” refers to a particular tangible quality that typically picks out metal objects). There are many similar qualities that seem represented in touch by a particular set of values among a range of intensive qualities. These include qualities such as damp, sticky, slimy, wooden, plastic, and elastic. Because they arise from the combination of lower-level features, I’ll call these qualities complex tangibles. They are unitary experiences or blends, not mere collections of individual experiences (cf. Matthen 2005; 117-8). These complex tangibles are directly experienced via particular combinations of values along a range of fundamental, determinate intensive and spatial features.

Let’s consider how we might explain a particular complex tangible: the quality by which we make judgments of metallic (henceforth, simply metallic). Rather than having its own fundamental qualitative dimension, the tangible quality metallic involves specific combinations of other determinate intensive features. We need to be careful to distinguish the felt tangible quality feeling metallic from the property being a metal. Some plastics and paints can mimic the feel of actual metal objects, and some metals can feel more like plastics. Despite this occasional divergence, our tactual system is sensitive to those properties typically associated with metal objects. Nearly all processed metal objects feel cool and smooth to the touch, are hard, and heavy for their size. Our tactual system usually does a good job identifying such objects. The critical
point here is that touch does not involve anything like a single, specialized metal-transducer. Rather, it detects other more basic intensive features that highly correlate with metals, but seems to deliver a single experience as of metal. The interesting thing is that our awareness is not to a set of qualities, but to the object feeling as of metal. The phenomenology does still contain the constituent elements—metal objects still feel cool, and hard, and so on—but in addition there seems to be a unitary element to particular combinations that represents complex features like metallic. In other words, it does not appear to be an associative complex that we assign to metal objects.

Unlike intensive features, complex tangibles such as metallic or damp do not vary along a single axis of intensity. Objects are not perceived as more or less metallic than each other along a single metallic dimension. On the other hand, our perception of metallic objects does not seem to be categorical either. It is not as though we experience all metallic objects as uniformly metallic—there are very real and salient differences between different metallic objects. Some feel more obviously metallic, while others might be difficult to differentiate from certain plastic or wooden objects. One proposal for explaining this is that touch involves an implicit, largely automatic system for classifying such features on the basis of constituent intensive values (cf. Klatzky et al 1993). A system like this would involve assigning different weights to the various features involved in the classification, and then weighting the various combinations. Certain combinations of features and values would reach a criterion or threshold value, allowing for the appropriate classification to occur. For instance, objects would feel metallic just in case they were cool enough, hard enough, and smooth enough. An object that was not cool enough, for instance, might fail to be clearly classified as metallic (it might not be clearly classified at all, or as some other material).
An alternative conception would be what Zenon Pylyshyn and Jerry Fodor (1981) have referred to as a “compiled transducer” (see also Pylyshyn 2006). On this view, the various transducers for individual intensive features might, at higher levels of functional organization, share and process their inputs and thereby function as a (kind of) functional metallic detector. This would be more like the recognition of a complex associated with metal objects. Such a system would take values from several input systems—thermal, pressure, roughness, etc.—and using its own higher-level algorithms, assign some value for material composition. This model of tangible processing would require some additional resources not found in Fodor and Pylyshyn’s original model, since the interactions involved in touch are widely-dispersed and highly dynamic, involving complex interactions between multiple systems at many levels of processing. Perhaps the tactual system as a whole, through pervasive reciprocal innervations, wide multidimensional receptive fields, and various levels of sensory integration, is sensitive to higher-order tangibles like *metallic* and *damp*. Whichever model turns out to be correct, it seems clear that we can explain an even wider range of tangible features through appeal to combinations of intensive and spatial features.

### 4.7 The Quality Space of Touch

We now have the resources to outline the quality space of touch. A quality or similarity space, recall, is an ordering of similarity relations among sensory qualities (see Clark 1993, 2000; Matthen 2005). Constructing such a space is most plausible in the case of intrinsic sensory features like colors. Points in the quality space are determined (say) by matching tasks which ask a subject to say whether two stimuli are the same or different. If two stimuli are not distinguishable (perhaps across a range of contexts), then those stimuli are in the same location in quality space. It should be clear that each of the intensive features immediately yields a quality
space, since the values along the single qualitative dimensions are determined through stimuli matching and similarity assignments. This gives us a rich space for each intensive quality, but we should, in principle, be able to say a bit more about how to construct a space for more complex tangible features.

According to Austen Clark (2000), a "quality space" is an ordering of the qualities presented by a sensory modality in which relative similarities among those qualities are represented by their relative distances in the space. According to Clark, the occupants of quality space are not stimuli, but qualities that the stimuli present. The relations among items in the quality space order the qualities experienced, not the physical excitations on the body. Since intensive and intrinsic spatial qualities are precisely these kinds of entities, we ought to be able to specify the similarity relations among higher-order tangible features. Such a specification would be quite complex, including a large number of intensive dimensions (and their complex interactions), along with the multidimensional elements of intrinsic spatial features. One thing to keep in mind is that this complex, multidimensional quality space is not itself apparent in our experience. As Clark notes, to say an appearance has a location in quality space does not imply that it is experienced as having that location. The experience need only be of a quality that happens to have a certain location in quality space (Clark 2000; 8). At present we are hardly in a position to construct a detailed specification for touch, but the general contours are clear.84

A model of the quality space of touch, constructed as we learn more about the nature of the individual transducers and their myriad interactions, will allow us to say more about the

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84 The sense of “interact” here will likely be very much like the kind of feature binding that was discussed in the first chapter. It will turn out that the many intensive tangibles, far from being isolated individual features, subserved by distinct sensory features, are closely connected and strongly interact with each other on a regular basis.
contents and phenomenal character of tactual experiences. Tactual intensity values might turn out to be among the secondary contents of touch experiences. The notion of secondary contents is introduced by Mohan Matthen (2005) to describe the actual properties in the world that cause perceptual representations, distinguished from primary contents, which describe the particular way in which those properties are represented by an organism. For instance, it is likely that a certain complex of objective properties define dampness. We can give a scientific account of what it is for an object to be damp. But the feeling of dampness, whereby we represent damp objects, involves a complex set of interacting features represented by a special feeling, dampness* (to use Sellar’s notation). This feeling provides an initial classification that allows us to decide what we ought to do next with that object (an important consideration in touch, involving as it does active exploratory movements).

4.8 Reductive Accounts

I would like to conclude this chapter by considering an alternative conception of tangible properties put forward by David Armstrong (1962), that attempts to reduce the many tangibles to a single fundamental class of feature. Doing so will highlight the advantages offered by the account I’ve put forward in the preceding pages.

Armstrong argued that (nearly) all tangible qualities are themselves, or are reducible to, spatial properties. (This even includes ordinary material objects themselves, which are reduced to a set of purely spatial features.) Armstrong goes through a standard list of tangible features, showing how the reduction goes for each of them. Hardness and softness are not obviously spatial, but Armstrong explains, “A hard object is one that does not change its shape, or break up easily (a form of change of shape), under pressure; while a soft object does change its shape
easily under such conditions” (21). Similar reductions are offered for other simple tangibles. These simples are all argued to be spatial in nature, and thus to differ from one another only in spatial qualities. This is a very different model than the one I argue for in this chapter.

Like my view, Armstrong holds that there are complex tangibles, only for him, they all involve the combination of several distinct spatial features. A rough object, for example, is one that is hard (again spatial) with an irregular surface shape. A smooth object is one that is hard with a regular surface shape. The felt property of roughness is thus a collection of distinct spatial features. This method of reduction is suggested for all of the non-thermal tangibles. For each one, Armstrong suggests we specify the various features involved and show how each of them is or can be reduced to purely spatial features.

Note a curious feature of these reductions: they seem to involve something more than mere spatial awareness. When we touch a hard surface, what we feel is that the object does not change shape, despite our pressing firmly against it. Our awareness of the object seems to involve our awareness of the pressure we apply, not merely the stable shape of the object. For Armstrong, it is the fact that the shape remains constant despite firm pressing that allows us to experience the surface as hard. This seems to be the case for many tangible properties discussed by Armstrong, such as weight and even roughness: the effort we put forth combined with the resulting lack of spatial change seems to play a crucial role in many such experiences. If this is correct, then Armstrong must offer a spatial account of felt pressure or effort (if he wishes to maintain that all tangibles are reducible to spatial features). If pressure is not a spatial property, then many tangible properties, like solidity, smoothness, and hardness would also not be entirely
spatial. They would have an additional non-spatial element—felt pressure—that was essential to the experience.85

Armstrong attempts to show that pressure can be accounted for in purely spatial terms. He claims that felt pressure is an experience of our bodies being moved and movement is spatial (or, crucially, an experience of an increased tendency in our bodies to move). He writes, “pressure perceived by touch is a matter of actual bodily displacement or change . . . so we can give an account of perceived pressure solely in terms of the perception of change of spatial properties of physical objects” (23). In other words, when we feel pressure, we have an immediate awareness of our bodies moving. Since what we experience is movement, which involves changes in spatial location, our experience of pressure is itself fully spatial. What we experience is nothing more than a change in spatial properties.

But we can feel pressure even if our bodies do not or cannot move (if we are being pressed equally from two sides, for example). In such cases we still feel pressure, and Armstrong must account for this. He holds that what we experience is an increased tendency in our bodies to move. This tendency is again defined in spatial terms (a tendency to change location). In both cases, however, we also feel that something external is causing our arm to move (or to be moved). Without this causal aspect of the experience, we wouldn’t feel the movement as pressure (simply moving your hand does not elicit an experience of pressure). The experience of pressure seems to essentially involve a direct experience of causal relations: “The concept of pressure involves the concept of causation, of one thing making another happen. But can we

85 I should not that pressure on my view is an intensive feature that linearly varies along a single dimension. Of course, I also allow that one of the causal influences on such awareness is the effort we might use when pressing against an object.
have *immediate* perception of causal relationship? If we cannot, pressure cannot be immediately perceived” (23).

Armstrong maintains that we do experience causation directly through touch. Rather than explain such experience in detail, he remarks that the fact of causal perception is “simply one of the peculiar features of tactual perception” (23). This issue settled, Armstrong now must again show that our experience involves purely spatial properties. He suggests that a direct perception of causation is always an awareness of a spatial change in our bodies or our bodies making a change in the world. For instance, when I push a ball across the table, I experience my hand moving toward the ball and then the ball moving away from my hand. These movements, again, are deemed purely spatial properties inasmuch as they are changes in locations, which are paradigm spatial features.

Armstrong’s view is an ingenious attempt to make sense of the tangibles. He strives to give an account of tangible simples, and show how complexes can be constructed out of them. However, it suffers from several major weaknesses. The first and most obvious is that it relies on a liberal, and unsupported, notion of a spatial property. Armstrong does not clearly state what it means for a property to be spatial, and ends up allowing almost anything to count as a spatial property. For example, experiences involving lack of change in shapes and tendencies to remain in the same location count as spatial in the exact same way that shapes and locations proper do. If the reduction to purely spatial properties is to mean anything at all, then the notion must be constrained in some manner. Many empirical accounts of tactual spatial perception rely upon operational definitions of spatial representations, for example defining them as representations that provide information about shape, layout, and location through the use of reference cues (see e.g., Millar 2008). Such a definition has the advantage of offering clear notions (reference cues)
that can be independently manipulated and assessed. My own view constrains spatial properties to the intrinsic sizes, shapes, and orientations of objects, defined along a set of qualitative spatial dimensions. Armstrong provides no such account. This actually leads Armstrong to worry at great length about the prospects of ever understanding spatial perception through touch, since we would like to explain spatial representation by appeal to some non-spatial properties (objects, distributions of non-spatial features, reference cues, etc.).

A further problem with Armstrong’s view is that the reduction requires that we have immediate experience of causation in touch, and that such causation reduces to spatial properties. Armstrong’s reasoning is that in experiencing one thing cause another, what we experience is a spatial change in our bodies or a spatial change in an object. While I agree with Armstrong that we can experience causation through touch, such experiences cannot be accounted for purely in terms of spatial properties. Two simple arguments show this to be the case. First, causal perception depends critically on the temporal relations involved, and these are clearly not spatial. Whether I experience my hand as the cause of a ball moving depends on the ball moving at the time that my hand comes into contact with it, but not before. So a hand motion involving the exact same spatial properties, but with different temporal structure, will elicit different causal experiences. So causal perception cannot be awareness of purely spatial properties. Consider a second example, this time involving the experience of agency. When we press our finger against the top of a table we have a certain experience of solidity and perhaps pressure. We feel ourselves as agents pressing against the table. The deformation of our fingertip is experienced as caused by our pressing. Now imagine that instead of pressing against the table top, that the table is rising up against our passive (but restrained) finger at the same force we previously applied to the table. Even though the pressure and deformation is the same, the second experience would feel unlike the first. We would feel the table causing the deformation in our fingers. This would
be a reversal of the causal relation experienced, but with no difference in spatial features. It cannot be, then, that an immediate awareness of causation is an awareness of purely spatial properties. Something additional is required, such as a causally-consistent temporal structure or a non-spatial feeling of agency (and again, I believe the best account of such capacities is a modality-independent causal detector). Without a spatial account of causal perception, Armstrong cannot maintain that pressure perception is purely spatial either, and his elegant account fails at a critical step.

In addition there is a blaring weakness with Armstrong’s view: his view completely leaves out thermal features. In addition, it has difficulty with other important tangibles like vibration. Most tactual experiences involve a thermal component, which as we’ve seen, often plays an important role in the experience of complex tangibles like material composition. In addition, vibration plays an important role in touch but seems to resist a spatial account. The difference between a slow vibration and a fast vibration does not seem to be a spatial difference (the small movements could be identical). Instead differences in vibration seem to be intensive in character, involving an experience of distinct values (frequencies) that vary in value relative to one another. Starting with David Katz, many have argued for the primacy of vibration in touch, suggesting that properties such as roughness might be mediated by vibration (as we drag our hand across a surface, for instance). If this is so, then properties like roughness and smoothness which rely upon vibration would also resist a purely spatial account. A hard surface with an irregular shape would not feel rough if it did not generation sufficient resistance to elicit vibration.

Touch represents the spatial properties of objects, but these features alone cannot explain the wide range of tangible qualities. Instead, we should think of touch as representing properties
in (at least) two fundamentally distinct ways. First, touch represents variations in intensity along a single qualitative dimension, for a range of distinct qualitative features. Second, it represents the intrinsic spatial features of objects. Putting these two fundamental classes together in the appropriate ways allows for a robust account of tangible complexes, and thus the whole range of tangible features.
Chapter 5:
Haptic Touch and Exploratory Action

5.1 Action and Perception

Haptic touch, more clearly than any of the other senses, is an inherently active form of awareness. We experience objects through haptic touch by actively engaging them. We must reach out, with our hands or some other intermediary, and directly interact with an object in order to experience it through touch. Such actions are not merely causally necessary for haptic experiences. When touch engages with external objects, and tries to determine their features, it is essentially active. It is, in this haptic mode, a repertoire of specialized exploratory procedures, some idealized for a small set of external tangible features, others more general and oriented toward object-recognition.

Philosophers have often construed touch in terms of the experiences it provides. This is an inappropriate model for haptic touch, since, unlike vision, touch must connect us, either directly or through some appropriate intermediary, with the objects of our experience. Vision by contrast is teleosensing—it requires no intermediary to connect us to distal objects—and passive momentary visual experience gives us information about external objects (though Matthen in preparation argues that this is a somewhat restricting view even of vision). Touch on the other hand is a contact sense—while we can experience distal objects through touch, it requires the use of suitable tools or intermediaries, as we saw in Chapter 3. Something must connect us to distal objects in ways that simply do not occur in vision and audition. Touch thus brings us knowledge of external objects in ways that are incommensurate with the methods of the teleosensing modalities.
This contrast between vision and haptic touch is important. Some have criticized action-involving views—like those of Alva Noë and Susan Hurley—for mistaking a causal relation for a constitutive one. Actions may be causally necessary for perception, suggest the critics, but only because they put us in a position to have certain experiences, experiences that are metaphysically separate from the actions that lead up to them (see Ned Block 2005 and Jesse Prinz 2006). Such criticism misses an essential point when it comes to haptic touch— in the contact senses interaction with external objects by means of a repertoire of exploratory actions is an essential part of how we pick up information about the external world; it is not simply a way of putting us in the way of certain tactual experiences. This is because in themselves such experiences only provide us, for the most part, with information about our own bodies (see Chapter 2). On the other hand, there are commonalities in the kinds of information that touch and vision deliver—there is object grouping and segmentation, patterns of object recognition, and determination of figure and ground. In these respects, action seems to play a similar role in haptic touch and the teleosenses.

I’ll begin this final chapter by discussing what we know about the mechanisms of exploratory action in touch. Following this background, I will argue for the view that haptic perception involves a special form of exploratory engagement with external objects. An important element of this view is our experience of our own exploratory actions. In the remainder of the chapter, contrast my view with other constitutive views of perception, and reconsider the distinction between haptic and passive touch.
5.2 The Role of Action in Haptic Touch

5.2.1 Exploratory Procedures.

To perceive through haptic touch is to have actively explored. However, the actions involved in haptic perception are constrained, forming classes of standardized movements. Haptic touch involves far more than simply reactive actions; it essentially involves exploratory, engaged, agent-directed movements. Lederman and Klatzky (1987) have called these exploratory movements “exploratory procedures” or EPs (see also Jones and Lederman 2006). There are many EPs, each of which primarily mediates a distinct set of tangible features. Some movements, for instance, are best suited for awareness of particular features. As Jones and Lederman (2006) state, “people normally chose to execute different stereotypical hand-movements when they manually explore an object to learn about a specific property” (76). When asked to compare and identify objects based on specific properties, “subjects systematically choose to apply a specific EP, depending on the attribute they were instructed to explore” (op cit, 76). They discuss six exploratory procedures (Lederman and Klatzky 1987 discuss eight): Lateral Motion, Unsupported Holding, Pressure, Enclosure, Static Contact, and Contour Following. Each procedure is used to extract a particular set of basic tangible features from a haptically-perceived object. Lateral Motion, for instance, involves a flat motion of the hand across a surface that allows for the perception of texture. Enclosure involves cupping or grasping an object in the hand in order to determine its global shape and volume. Contour Following involves moving one’s hands around the outside surface of a large object in order to determine exact shape and orientation. Jones and Lederman note that, “For each property, one EP is optimal and, in the case of fine shape, necessary, as opposed to being merely sufficient or insufficient to
perform the task” (Jones and Lederman 2006, 76). Jones and Lederman (2006) nicely summarize the differences between the various EPs:

EPs also varied in terms of their generality (sometimes called breadth of sufficiency), that is, in terms of the total number of object attributes that each EP could extract with above-chance (sufficient) performance. For example, lateral motion and pressure EPs are relatively less general because they provide only three different types of object information (i.e., texture, hardness, and thermal properties). In contrast, both enclosure and contour following EPs are more general in that they provide some information about almost all of the attributes that have been studied. Finally, the EPs differ in terms of mean duration or execution time (76).

For the experience of fine shape, a particular EP is necessary. For the others, a number of EPs could be used, with one being optimal. However, for nearly all tangible features, *some EP or other* is necessary. We may choose, in certain circumstances, between Lateral Motion or Enclosure when touching some object, but we still must adopt some active movement in order to experience the tangible properties of an object. These active movements are at least causally necessary aspects of the experience. There is some reason for regarding the relation as even stronger: the active exploration changes our sensory activations, but also combines with feelings of agency and effort to become an essential component of the overall experience.

EPs are causally necessary for the experience of certain properties in part because such movements make important changes to our sensory inputs. The systematic hand movements used in various EPs cause objects to pull and tug on our skin in ways that they simply would not without movement. These tugs generate novel activations on various cutaneous receptors, as well as activating stretch receptors in our joints and muscles. Our exploratory movements are systematic in large part to generate specific configurations of surface deformations. These deformations allow us to better experience a range of distinct features in the world. The active
movements also generate an array of kinesthetic and proprioceptive feedback from our joints and muscles, providing information about object properties like shape and weight.

These causal influences are not the only important contribution of exploratory movements. The voluntary movements involved in the various EPs also change the way various cutaneous signals are processed. Activations of the voluntary motor areas during an EP reduce (or augment) many cutaneous activations. For instance, motor actions can dampen a range of cutaneous activations, especially those involved in the processing of very sensitive features (Kaas 2004, Jones and Lederman 2006). This dampening may serve to boost the signal of the activations involved in haptic touch. In addition, it seems that the voluntary, exploratory nature of our movements is required for the experience of complex shape properties, likely due to the spatial information attained and recruitment of working memory involved in voluntary explorations. For this reason, some of the properties experienced through EPs require voluntary movement (a complex object moving against a stable hand would not generate the appropriate haptic experiences). This is crucially important in the generation of external awareness through touch; we not only have to move in certain ways, but we often have to both initiate and be aware of our own movements in order to have the appropriate kinds of haptic experiences. Despite the important role of voluntary action, there are some tangible features that do not require voluntary movement. The perception of a surface’s roughness is nearly identical in the active movement case (where we move our arms across the surface) and the passive movement case (where the surface is moved across our body). This indicates that roughness perception does not require any of the special aspects of voluntary movement (such as cutaneous dampening). Other features, such as the global shape of a complex object, do require that we initiate and move our bodies against the world.
The role of EPs in touch are used to (maximally) experience particular tangible features (or clusters of features). This is a unique role for action in touch; no analogous role for exploratory action seems to exist in vision or the other senses. There is no correspondence between particular exploratory visual actions and individual visual features (any visual action seems to influence the whole range of visual features, rather any privileged set). There are no visual actions for increasing only our awareness of visual shape or color. And certainly there are no particular visual actions that are necessary for the experience of color, or texture, or shape. While exploratory actions exist in vision—we might crane our neck or move around an object to get a better view—these movements are not precisely tied to specific visual properties. Instead, visual actions influence the entire range of visual features. There may be broader epistemic actions, not strictly visual, that are used to discover specific things about the objects of perceptual experience. For instance, we might view an object under a variety of lighting conditions to discover its true color (Matthen, in preparation). These sorts of actions do not relate particular movements with the immediate experience of colors rather than shapes; rather, action provides different points of view of visual objects, and the different perspectives are combined and integrated over time. In touch, the EP leads directly to a particular experience. The exploratory actions involved in visual experiences therefore do not serve the role played by EPs in touch. When we explore the world through touch, the movements alter and change our receptor systems, allowing us to experience particular sets of feature rather than others. When we lift an object and squeeze it to feel how hard or heavy it is, the active component is a part of the perceiving process (not merely feeding into it).
5.2.2 Temporal Extension.

We do not experience objects one feature at a time. In order to fully experience and engage with objects we must process many different features when touching objects. This is accomplished in two ways: first, many distinct EPs can be strung together to generate a robust representation of an object; second, special kinds of movement—such as a haptic glance—can be used to experience a range of the distinct tangible features. These two modes of active tactual engagement have distinct temporal aspects. Most individual EPs take some time to complete, and when we freely explore an object we often use several different EPs that together can take a significant amount of time. To experience several parts of an object or a complex shape might require that several distinct EPs be performed in sequence. One must move one’s hands over the object, linking the movements together to form a coherent tactual representation of the object. We might determine that an object is hard by tapping on it, then roll it around in our palm to feel its surface texture, then lift it up and down to feel how heavy it is. All of these movements, and their associated properties, are unified in our awareness and experience of the object (not necessarily unified into a single experience, but brought together such that one experience will influence and complement the ones before and after). Such connected representations require the use of robust tactual memory systems to coherently piece together the various features of the same object. The relations between the various kinds of action seem to play an important role in the unity and coherence of our object experiences; The actions have to be systematic, one movement following the other in the right order, in order to be connected in our tactual experience.

We often use a sequence of different movements in order to experience and engage with the world through touch. This is not always the case. We also have haptic experiences that occur
relatively fast, and are not built up over a long period of time. Susan Lederman and her colleagues (see especially Jones and Lederman 2006) have described what they call the “haptic glance.” While one EP might be best suited for a particular property, other EPs are more general, and deliver information about a range of different properties (referred to as “redundant EPs”). When such a redundant EP is performed, a cluster of tangible features are experienced all at once. This means that even a very brief haptic encounter with an ordinary object can be sufficient for object recognition. Such an informative encounter is the haptic glance, and it plays a critical role in our tactual experience of the world. This is possible because on haptic touch a range of salient features (almost all intensives) can be available immediately, including hardness, smoothness, thermal profile, and solidity. Even a small combination of these properties can be highly diagnostic of most ordinary objects, making easy to identify objects very quickly. A pencil, for instance, has a certain immediate global shape along with a light weight, a warm or neutral thermal profile, smoothness, and so on. A small iron bar shaped like a pencil would almost never be confused for a real pencil, despite having the exact same shape as a real pencil. As soon as you grasped the iron imposter you would feel that it was too heavy, too cool, too rough, and too hard to be an actual pencil. All of these features of the pencil and its imposter are available right away, so long as we perform the appropriate action.

The haptic glance is active, and requires some movement or exploration of an object, but the experience is not (very) temporally-extended. Like vision, it is nearly immediate, taking in the tangible scene in a single step (hence the use of “glance,” see Green and Oliva 2009). There are thus two ways of experiencing the range of tangible features: through performing a range of exploratory movements over an extended period of time, or by choosing a specialized movement that allows for a greater range of features to be experienced at once. There are important epistemological tradeoffs involved in these different options. If we care most about accuracy,
especially for an individual feature, we would be best to use an ideal EP relative to that feature. If instead we care most about object recognition, or time is a critical factor, then we would be better off using a redundant EP that delivered a range of features all at once. The context and the task demands can determine which of the two strategies we ought to use, though in most cases there is little harm in doing both: starting with a haptic glance and then continuing our explorations as required for greater detail as needed. We might perform a Grasp and Pull, one of the most general EPs, and then continue our explorations with Contour Following or some other more precise and focused movement.

### 5.2.3 Grouping and Segmentation

Exploratory action clearly plays an important role in the experience of individual objects though touch. The active nature of touch is not exclusive to individual objects, however. When we experience the world through touch we do not always experience individual objects one at a time, in isolation from each other. Through touch we also experience and interact with groups of objects. A more complex range of tactual actions becomes involved in the grouping and segmentation of material objects. Imagine dropping a coin into the shallow water at the edge of the beach. You reach down through the water to feel for the coin, digging your hands into the fine grains of sand while the water flows all around. This is a highly complex task, and through touch you experience a wide range of distinct features and objects. You can feel the ocean water swirling around your hands, subtly changing the inputs to your cutaneous receptors and making your exploratory movements more difficult; you feel many other sharp and smooth objects like rocks or bottle caps located in the sand; you feel the heavy, clumping sand at the bottom; and as you dig around, you find the small coin you are looking for. To successfully find the coin you need to separate the many distracting objects from the one you are looking for. You must
segment the objects of interest from the background, while determining whether the object you segment is the correct one. In other words, you must separate figure from ground. In this example, the ocean water and the sand function as the ground, while the coin and other objects are the figure. Like in vision, these terms refer to a kind of contrast. The ground is a relatively uniform and stable component, providing a strong contrast to the objects in the figure. Here, as in individual object awareness, exploratory action plays a crucial role. Unfortunately, almost no experimental work has been conducted on how figure and ground are processed in haptic touch. We can nevertheless consider the roles for such action. We might make use of more complex exploratory movements, like sweeping and scooping our hands across and through the sand, feeling for any features that might possessed by the coin. Or we might grasp large handfuls of sand and let the small grains fall through our fingers, hoping to catch the coin in our palms. Such complex movements serve to separate the object of interest from the background. Such tasks require sets of exploratory actions that go far beyond the basic EPs described by Lederman and Klatzky.

My suggestion is that we separate many tangible inputs into figure and ground through the deployment of particular exploratory actions. These specialized actions are the means by which we determine figure and ground through touch. Such actions also allow for multiple objects to be grouped or chunked into sets. We might experience a group of distinct objects as a coherent set if there are exploratory actions that can performed on all of the objects at the same time. We can use these two insights to develop an account of haptic exploration. Consider an example:

**Keys:** I am trying to find my keys in my bag, which also contains pens, small notebooks, loose change, and many other assorted objects. As I reach into my bag, I grab and pull on
various objects and surfaces, trying to separate them from each other, until I find the set of keys.

In Keys, the various pulling and separating motions help isolate individual objects, allowing them to be appropriately grouped together. If I grab hold of a single key and pull at it, the rest of the keys on the ring follow along. One of the important diagnostic properties might be the general connection and coordination between the parts of the objects: a single key is more unified and connected than many keys on a ring, while these in-turn are more connected with one another than a pile of individual keys. There are thus important structural elements of tangible objects to which we are sensitive in haptic touch, and these elements require exploratory interaction in order for us to become aware of them. My pulling motion, by assessing the levels of connection between object parts, allows me to determine that I’ve grabbed hold of the set of keys, rather than some isolated metal object like a coin. Essentially, what I’m doing is grouping a number of objects in virtue of the fact that I can act on these objects in a connected and coherent manner. Once I’ve grouped the keys together as a set, I can then move on to exploring the individual keys, feeling for the correct one. Again, my actions allow certain tangible features to be appropriately grouped with individual keys, allowing me to find a single key out of the jumble. Not only do my EPs function to assign features to the right objects, then, but they also help determine which object is the focus of attention, whether it is a part of some larger grouping of objects, and how it ought to be classified. The figure and ground can shift through such interactions. In the first instance, the set of keys is the figure and the rest of the objects in the bag (and the bag itself) serve as ground; in the second, the individual keys are the figure while the rest of the keys and the ring serve as ground.

The way that I move and tactually interact with objects in the world plays a central role in my ability to experience objects as such, so separate them from other objects and background,
and thereby to identify them. And as we’ve already seen, the most salient features for these tasks are often intensive features that are quickly processed and diagnostic of most ordinary objects. The movements we typically perform on an object—like the Grasp and Lift—are those that are maximally sensitive to intensive features like roughness and hardness (Lederman and Klatzky 1987). At each stage, a different type of action may be performed, linking and combining with others to generate a seamless experience of the object.

5.2.4 Evolution and Coupling.

The active nature of touch is not unique to humans. By considering the active nature of touch in other organisms we can better appreciate the deep connections between exploratory movement and tactual perception. For instance, the highly stylized movements that occur in human haptic perception have many analogues in the animal kingdom. Ordinary rats and mice, for instance, move their vibrissa—specialized whiskers—along very precise sweeping paths in front of them. These movements allow rats to gather coherent tangible information about their surroundings (Curtis and Kleinfeld 2009). Among the most interesting tactual creatures are the naked mole rat and the star-nosed mole. Because both of these animals live in dark environments, they have evolved sophisticated systems of touch. Both animals have enhanced tactual receptor systems, and rely upon touch as their main means of navigation, foraging, and awareness of the world. Both of these creatures use specialized movements that enable them to experience the world in particular ways. Naked mole rats often use their teeth for tactual perceptual and use hairs on their bodies to orient toward interesting stimuli (Catania and Henry 2006, 468). Subserving these sensory capacities are highly specialized and massively expanded primary somatosensory cortex (S1). Similarly, the star-nosed mole possesses a large touch organ, consisting of 22 separate sensory arms. All of these tactual appendages are sensitive, but one appendage—the 11th—is
especially sensitive, and functions like a tactual fovea (Catania and Henry 2006, 470). The creature is able to use the varying cues on its touch organ to foveate, or bring into high resolution, the tactual features of an object. This results in special forms of movement, called “tactile saccades,” which are similar to the movements made by the eyes when they explore a visual scene (op cit, 470). While different from human exploratory actions, such movements highlight the deep evolutionary connection between movement and touch (at least for mammals). Because touch receptors are located on or inside the body of an organism, it only makes sense that a number of important strategies should have evolved for appropriately bringing those sensitive surfaces into contact with the world.

Of course, this is not meant to suggest that the actions involved in human touch are not special. The human hand, for instance, is an especially sophisticated organ of touch, combining precise motor dexterity, highly sensitive cutaneous receptors, and a complex network of feedback from the tendons and joints of the hand. As Gibson argued, the human hand is best understood as the organ of touch, and as such, it serves a number of distinct roles, combining perceptual awareness with remarkable ability to manipulate and interact with object (Gibson 1983; 99ff). In addition, we are able to extend our tactual capacities through the use of tools, to extend our reach or to allow for more precise manipulation of objects. At every level then, human touch involves the close physiological and practical connection between action-involving systems and tactual receptor systems.

The neural and physiological systems involved in touch reflect the deep interconnection between the two systems. James et al. (2007) nicely summarize the known neural pathways involved in touch. They suggest that the evidence favors two primary neural streams: one for geometric properties and one for material properties (lending further support to the distinction
between intensive and spatial features discussed in the previous chapter). The relations between action-involving systems and the different streams are not uniform. Recognition of spatial properties seems to require a specific set of motor abilities, processed in areas that strongly overlaps with visual motor areas. SII, the secondary somatosensory cortex, is involved in the processing of material properties of objects, and involve specialized motor areas that seems to be essential for fast and accurate haptic recognition. These motor systems do not strongly overlap with visual areas. Nevertheless, the two streams, along with a host of other neural systems responsible for motor-actions such as grip selection and prehension, are closely tied to one another, working largely in concert to generate robust haptic experiences. The neural evidence supports the claim that there are close, strong connections between the motor areas of the brain and those responsible for the generation of haptic experience.

These reflections on the evolution of touch and the unique capacities of the human hand help to clarify an important aspect of human haptic perception. The various elements involved in motor-control and exploratory actions are highly adapted for close interaction and deep interoperation. In many cases, our ability to experience certain features in the world is inextricably linked to our ability to actively explore that object. If we want to feel how heavy an object is, or to determine its fine shape, we need to reach out and perform a certain action, and our hand and tactual systems are perfectly aligned for such purposes.

### 5.3 The Haptic Exploration Thesis

We can summarize these various roles of action in touch. an essential part of how we pick up information about the external world in haptic touch is by interacting with external objects through means of a specialized repertoire of exploratory actions. Haptic perception involves
systematic, strategic, (typically) voluntary, temporally-extended engagement with the world. When we want to experience something through touch, it is not enough to simply move our bodies randomly through the environment. We have to apply particular, specialized movements and exploratory strategies in order to elicit the appropriate awareness. Unlike teleosenses like vision, touch requires that we be actively engaged with the world in very specific ways in order to elicit the appropriate external awareness. The exploratory actions, in other words, do not serve to properly position or orient our bodies to be in the right place at the right time, to have experiences of a certain sort that we could have in a related passive state. This is because passive touch (which we will discuss shortly) does not typically inform us of the state of external objects; instead it informs us primarily about the current state of our body (cf. Chapter 2). For this reason, exploratory action in haptic touch is not simply a way of putting us in the way of certain tactual experiences. Rather, the act of exploration is part of what it is to have haptic perception of external things: to haptically perceive is to haptically explore. Let us call this the *Haptic Exploration Thesis*:

**Haptic Exploration Thesis:** Let $F$ define a set of tangible object properties. The haptic perception of an object $O$ as possessing a member (or subset) of $F$ is partly constituted by voluntary use of some exploratory action (or combination of actions) upon $O$.

This thesis involves several elements: Voluntary exploratory actions are necessary for haptic awareness of external things. Without such externalization, we would be unable to attend to external objects through touch. We would only experience the present changing state of our bodies as we moved through the environment. Secondly, we are aware of the tangible properties of external things in part by being aware of our own voluntary exploratory action important element is the set of properties involved. While there are some properties (like roughness) that do not seem to require an explicit voluntary movement (though they do require *some* movement), to
perceive the full set of tangible properties possessed by an object does require the use of some exploratory activity. Finally, the exploratory actions are not wild or random movements, but systematic procedures for eliciting the appropriate external awareness.

The Haptic Exploration Thesis defines a relation unique to touch; it posits an important relationship between exploratory action in touch and (1) externalization of awareness, (2) the ability to experience certain features, and (3) the appropriate assignment (binding) of sensory features to distinct objects (cf. § 1.6). While it might be true that all of the senses involve exploration of some kind, the role of action in the other senses—especially vision—does not anything like the role it plays in touch; there is no equivalent Visual Exploration Thesis. Visual actions are not necessary for externalization of awareness; we can passively sit on one side of the room and see the whole external world before us. Similarly, no particular actions are required in vision in order to experience a particular visual property or set of properties. If we want to be more confident of a thing’s visual properties, we might try to get a better look at an object, we may move around it, looking at it from different angles, or we might change the lighting conditions, or bring it closer to our eyes, etc. (Matthen, forthcoming). But the explorations involved in haptic touch are different, for we do not begin to experience externalized tactile properties except in the context of exploratory actions—these actions are not required just for greater certainty. Moreover, specific haptic actions are closely tied to individual properties (or specific sets of properties). If one wants to feel how heavy some object is, one has to pick it up; one can’t simply tap it or press against it with one’s elbow. Similarly, if one wants to know how rough or smooth something is, one has to press or rub one’s skin against the surface. To engage in haptic perception is to engage in a specialized set of exploratory actions. Finally, visual actions are not necessary for the proper assignment of sensory features to objects; feature binding
does not require a specialized set of exploratory actions, but as I have argued in Chapter 1, this is what is needed in the case of touch.

The Haptic Exploration Thesis suggest that haptic perception is partly constituted by voluntary exploratory actions. As we’ve seen, action serves many roles in touch, from sensory binding and feature recognition to object segmentation and recognition. These are distinct roles that arise from a number of distinct features of both tactual perception and exploratory action. Rather than claim that haptic touch just is a form of movement, the claim is that to perceive through touch is to engage in a kind of exploratory activity. This activity is required because such activity generates externalized awareness of particular sets of features that can be appropriated assigned to individual objects for the purposes of object grouping and recognition. This role for action is unlike that found in vision and audition. We can further illuminate this special relation by focusing not so much on the gross motor actions themselves—the various muscle firings and changes to sensory inputs—but by consideration of the role played by our awareness of our exploratory actions.

5.4 The Awareness of Action

Haptic touch is a form of engagement in which one’s awareness of one’s manipulations (or lack of manipulations) of some external object O form a part of one’s overall experience of O. When I explore a tabletop, my feeling it as cold and hard is partially constituted by my awareness of my own exploratory action in touching it. I feel the toughness/tenderness of a piece of meat by poking it with a fork, my awareness of manipulating the fork is a constituent part of my awareness of the softness of the meat. In order to explain the nature of this awareness, we need to step back a little and consider how it is that we come to know about our own actions in the first
place. Then we can better understand how the awareness of our exploratory activities can play such an important role in the generation of robust haptic experiences.

Haptic touch involves the stimulation of cutaneous sensory surfaces in the context of coordinated active movements. Haptic touch involves *kinesthesia*, the seemingly direct experience of our own bodily movements. Such awareness plays a critical role in haptic perception but also in our experience of ourselves as active agents in the world. We have thus far referred to kinesthesia as though it were a simple sensory system in its own right, but the term is actually shorthand for a far more complex active-exploratory system that involves proprioception, the experience of agency and control, and coordinated exploratory motor engagement with the world. Further complicating matters is the fact that kinesthesia itself is partially mediated by tactile and other sensory inputs. Feeling one’s arm brush against a wall can help determine where the arm is located and how fast it is moving. This means that kinesthesia is best understood as a component in a larger system of sensory awareness that is able to coordinate and unify its representations for a range of purposes. The objects of these representations happen to be parts of our bodies and their trajectories. In other words, kinesthesia is not *merely* the system that processes bodily movements, but is a constituent in a larger, highly-coordinated system of active exploratory movement and movement awareness, and it is this overall system that plays a role in the generation of haptic experience. The system operates in such a manner that we experience our bodily movements more or less directly, and these perception-like experiences themselves contribute to our overall awareness of external objects and their properties. While there are many ways of distinguishing perceptual states from mere

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86 Visual signals can have similar functions: seeing our arm arc through the visual field can also inform us of the arm’s location and movement.
sensation or other cognitive states, perceptual experiences typically (though perhaps not always) involve some qualitative character combined with content that is assessable for accuracy conditions. Kinesthetic experiences—generated by a large and diverse network of interacting sensory systems—passes these minimal requirements for a perceptual experience. Kinesthetic representations can be veridical and non-veridical: we can experience an arm moving even when it’s not, and fail to experience it moving when it is, etc. (and as I’ll suggest shortly, they also seem to have qualitative characteristics).

Haptic perception is dynamic: a range of interacting systems at many levels coordinate and function together to generate novel and unified experiences. These various systems involve feedback in many directions. We have considered in some detail already how gross movement and action coordinate with cutaneous touch, but an important element of haptic experiences involves our experience of the actions themselves. While we experience our actions and movements through kinesthesia, it’s not clear exactly how our awareness of our bodies in motion is mediated. Two philosophically significant options present themselves. First, kinesthesia could be a genuinely perceptual experience of our own actions and movements. Since kinesthetic awareness seems to pass the minimal threshold of accuracy conditions this would seem to be the most plausible option, and in fact is the view I support. However, a second option exists in the literature. G.E.M. Anscombe argued that proprioception, by which she meant awareness of our bodily location and orientation, was not a perceptual form of awareness, but rather a kind of automatic or implicit knowledge of our body’s position (Anscombe 1956, 1962). She claimed that we just know our current posture, with no intervening qualitative character or perceptual experience. Her argument is that there is no particular sensation associated with particular orientations of the body. While we have sensations when we are sitting in a chair, they are not aligned with our bodily orientations per se (it can feel many different ways to sit in a chair).
Instead, without requiring that we look or reflect on our feelings, we just seem to know our current position and orientation. The nature of this awareness does not seem perceptual according to Anscombe because of the lack of associated experiential qualities and the seemingly immediate nature of our awareness.

Anscombe is certainly correct that it is difficult to isolate any specific, coordinated sensations delivered by kinesthesis. As I’ve noted, our awareness of bodily position and movement is mediated by deep interactions between a range of distinct sensory systems. It therefore does often feel as though we have a direct, unmediated knowledge of our bodily position and its motion. In other words, kinesthetic awareness doesn’t really feel like anything. At least not anything particular to kinesthesia. However, just because a form of awareness does not involve a unique class of explicit sensations does not mean that it is not perceptual in nature. Some kinds of sensing might not involve sensations at all: vomeronasal activations, masked visual stimuli, reactions to fast looming objects, some forms of spatial or numeric awareness, etc. Even so, some qualitative feeling seems associated with our bodily position and motion, though it is often difficult to describe this feeling in great detail. Having an arm relaxed on your lap just feels unlike having your arm raised up and stretched above your head. This difference seems to be entirely qualitative in character. Instruction in proper bodily movements through yoga and tai chi often involve students learning to recognize and become sensitive to these feelings. In this way, students learn to keep proper alignment and orientation of their bodies. If we had direct, unmediated access to our current position and orientation, such learning would be very difficult to explain. Because kinesthetic experiences contain qualitative information about the location of the limbs, how fast they are moving, how much force is being applied to a surface, the resistance generated by a lateral movement across a textured object, and so on, we are able to attend to these features and associate them with certain orientations and movements.
If this is right, then our awareness of our actions is itself a kind of perceptual experience. This perceptual experience of our body moving blends with our overall tactual experience in order to generate a unified experience of external objects and their properties. This awareness need not be explicit. That is, we need not directly attend to our bodily movements and positions in order for there to be appropriate awareness. The awareness required is relatively low-level, and may not be clearly felt at the level of one’s overall experience. Consider a similar example from vision: shape from shading. In vision we have a low-level system that processes an object’s shape from the object’s shading in a visual scene (Todd 2004). When this happens we experience the shape without any explicit awareness of the special role played by the shading; nevertheless, we are aware of the shading and this awareness plays a crucial role in our awareness of the shape. While it just seems to us as though we are seeing the shape directly, without the mediation of shading, in reality there is an essential relation between the two. Something similar happens in haptic touch. Knowing where our arms and fingers are located when touching an object plays a critical role in our tactual awareness, but this does not require that we be aware of this role or that we focus our attention directly on our movements and bodily position as such. These considerations allow for a much more robust defense of the Haptic Exploration Thesis, showing that not only action, but our awareness of our action, is an important element of our haptic perceptions.

5.5 Contrasting Views

The Haptic Exploration Thesis posits a special relation between haptic perceptual experiences and certain classes of exploratory action. The nature of this relation is essentially constitutive; to perceive an external object and its features through touch involves active engagement with that object. While this thesis is applies specifically to touch, it is part of a much larger debate
concerning the relation between action and perception generally. One might wonder how the Haptic Exploration Thesis relates to other views that posit a constitutive relation between action and perception.

Much recent debate has centered on the relation between action and perception. For convenience, call this the Action-Perception Relation (APR). The interest in this issue is well-motivated: we act in the world on the basis of our perceptual experiences, and our successful perception causally depends on our ability to move and explore. The central debate concerns the nature of this dependence. Is it merely a weak causal dependence? Or is the relation genuinely constitutive—might perception actually be a kind of action?

Despite the recent interest, debate concerning the APR remains highly contentious, with many opposing views. One reason is certainly historical. Many traditional accounts of perception do not include much role for action (e.g., Marr 1981), while more recent action-involving theories can seem deeply counter-intuitive or theoretically suspect (Noë 2004). Theorists divide on a number of closely-related, and difficult, questions: what role, if any, do movements play in the character of perceptual experience? What do movements contribute to perceptual contents? Is the relation between perception and action uniform across the senses? Does action contribute to the unity of perceptual experience? And then, there are questions about the nature of the actions, since different views appeal to different notions of action. Do we include purely reactive actions, performed in response to incoming stimuli, and must we include exploratory actions, mutually interactive and agent-directed?

Susan Hurley (1998, 2001) suggests that the APR debate centers on two issues: whether the relation between action and perception is merely instrumental or not (whether they are merely causal means to the other), and whether the causal flow between them is in one direction
(linear) or not (dynamic) (Hurley 2001, 1-3). She takes the traditional view of the APR to be instrumental and linear. According to the traditional view, action and perception are separate peripheral systems, connected only by weak causal interactions. As she states it:

On this traditional view, the mind passively receives sensory input from its environment, structures that input in cognition, and then marries the products of cognition to action in a peculiar sort of shotgun wedding (2001, 11).

Hurley traces the theoretical foundations of this view to a classical, vertically modular view of the mind. Each perceptual system is composed of vertical modules, running more or less directly from sensory input to a central node of cognition, which is classically computational. This central node in turn directs motor action. Cognition is the mediator between these two peripheral systems, leading Hurley to dub the view “the sandwich model” of the mind. The result is that:

The perceptual system registers and constructs meaning for sensory events, while the action system formulates and executes motor commands. The two systems have no essential contact with one another, and they provide separate research areas (2001, 11).

Hurley canvasses three alternatives to the traditional view, each of which denies one or both of the starting assumptions. The first option is to deny the one-way or linear assumption. Hurley takes the ecological views of J.J. Gibson and his followers to take this route. The second alternative is to deny the instrumentalism, while keeping the linear relation. Hurley says this leads to behaviorism. She argues that both of these options are inadequate:

Ecological views reject a linear or one-way view of the causal relations between perception and action in favor of a dynamic, circular view. But they restrict action to an external and instrumental role in perception. Behaviorist views give action a constitutive role in perception, but fail to recognize the essential role of dynamic feedback from action. As a result, they substitute one kind of one-sidedness for another (2001, 22).
Hurley suggests that we reject *both* assumptions. This leads her to adopt a two-level interdependence view, arising from motor-theories of perception and control theories of action, where the relation between action and perception is both essential and dynamic:

On such a view, perception and action can be constitutively as well as instrumentally interdependent, because the contents of both perceptual experiences and intentions can be co-dependent: functions of relations within a complex dynamic system (2001, 30).

According to Hurley’s taxonomy, there are two issues on which theorists might differ: whether there is dynamic, or bidirectional, feedback between perception and action, and whether or not they are constitutively or instrumentally related. Prima facie, touch seems to support Hurley’s interdependence view. Haptic perception seems to involve active, dynamic feedback from exploratory movements, and as haptic perception is *defined* as involving kinesthetic activations the constitution relation certainly seems plausible.

Alva Noë offers a view similar to Hurley’s, which he calls the sensorimotor (or occasionally “enactive”) view (Noë 2004, Noë 2006; see also Noë and O’Regan 2001). According to this view, perception is literally a kind of action, a form of doing rather than a passive sensing. He summarizes Hurley’s view and places his own in context:

Susan Hurley (1998) has aptly called this simple view of the relation between perception and action the input-output picture: Perception is input from the world to mind, action is output from mind to work, thought is the mediating process. If the input-output picture is right, then it must be possible, at least in principle, to dissociate capacities for perception, action, and thought. The main claim of this book is that such a divorce is not possible. I doubt that it is even truly conceivable. All perception, I argue, is intrinsically active…Perception and perceptual consciousness are types of thoughtful, knowledgeable activity (2004, 3).
He later adds that “the process of perceiving, of finding out how things are, is a process of meeting the world; it is an activity of skillful exploration” (2004, 164). Perception on this account just is a kind of action; we cannot separate out the perceptual capacities from our actions in the world. The general idea of the enactive view is that perception is essentially active, that it involves the implicit, skillful knowledge of how our sensations change in response to exploratory motor movements.

According to Noë, touch represents the paradigm of perceptual experience, as it seems most clearly constituted by skilled movements and exploratory interaction with the world. Noë suggests that we ought to understand vision and the other forms of experience as being essentially “touch-like” in character. For this reason, he immediately begins his (2004) by invoking touch, and linking the nature of touch to perception generally. It is worth quoting from the opening page, where touch is invoked:

Perception is not something that happens to us, or in us. It is something that we do. Think of a blind person tap-tapping his or her way around a cluttered space, perceiving that space by touch, not all at once, but through time, by skillful probing and movement. This is, or at least ought to be, our paradigm of what perceiving is. The world makes itself available to the perceiver through physical movement and interaction . . . What we perceive is determined by what we do (or what we know how to do); it is determined by what we are ready to do. In ways I try to make precise, we enact our perceptual experience; we act it out. (Noë 2004, 1)

According to Noë “vision is touch-like. Like touch, vision is active” (2004, 73). This is right in general—both touch and vision are in a basic sense active—but vision is simply not active in some of the ways that touch is. Specifically, there is no visual analogue of the Haptic Exploration Thesis, no relation between visual exploration and externalization, individual sensory features, and sensory binding. Noë’s claims that our visual organs function much like our hands in touch,
moving and exploring the world around us. But this is only partly right; while scanning and scene-parsing occur in both vision and touch, such activities are not of the appropriate kind for grounding a constitutive view of touch.

Touch provides the model and intuitive backbone for Noë’s sensorimotor view. The focus on touch makes a great deal of sense, given the many active elements of touch experience. (and Noë is certainly right that haptic touch represents a coherent and unified form of sensory awareness⁸⁷). But the active components of haptic touch—captured by the Haptic Exploration Thesis—simply do not translate to teleosenses like vision and audition. Exploratory action in touch serves very specialized functions. It unites a range of disparate tactual signals from the body (position, movement) as well as from externally-directed receptors (glabrous skin, sensitive hairs and nails). When we explore an object, the action naturally serves to coordinate and unite these many different signals, allowing for a robust and unified perceptual experience. By stretching and pulling on the surface of the skin, and activating receptors in the muscles and joints, exploratory actions also generate novel tactual inputs that otherwise would not be present. This allows for the awareness of certain features that otherwise could not be experienced at all. These novel inputs help us experience of range of distinct properties, from surface textures to object density. Finally, exploratory actions play a critical role in object segmentation, grouping, and recognition. We recognize objects through touch by manipulating and exploring them in various ways. Our ability to navigate and determine features of the tangible world depends

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⁸⁷ His conception of tactual unity is compatible with the view defended in Chapter 1, since on the sensorimotor view it could be the skillful operation of our sensorimotor capacities that explains how features become bound in experience: those features mediated by the same sensorimotor contingencies will tend to be bound together in experience.
strongly on our ability to move in various ways, where the movements themselves are a critical part of the perceptual process.

I believe that many of these elements of the Haptic Exploration Thesis could be incorporated into Noë’s view (especially the externalization component—something we’ll consider shortly). But the central point of disagreement concerns the relation between actions and experiences. Whereas Noë claims that implicit knowledge of sensorimotor contingencies constitute our perceptual awareness across all modalities, my claim is that haptic perception involves a specialized set of exploratory movements that are part of what it means to have a haptic experience. The distinction, at least for touch, is quite narrow. The main implication of the difference is that the constitutive role of action in touch does not apply to teleosenses like vision and audition, and so no general perceptual principles follow from the Haptic Exploration Thesis.

While my view only partially overlaps with Noë’s, and only with respect to haptic touch, one worry might be that some of the stronger criticisms of Noë’s view might also apply to Haptic Exploration Thesis I’ve defended here. Both Ned Block (2005) and Jesse Prinz (2006) have argued that enactive views of perception mistake a merely causal relation for a constitutive one. This criticism hinges on Hurley’s instrumental/constitutive divide (it’s unclear whether Prinz or Block would disagree with the dynamic aspect of her account). According to these critics, action is causally necessary for perceptual experience—but it is not constitutive of it. In order to see a scene before us, we need to be able to move our eyes and head and scan around the room. Identifying an object through touch requires picking the object up and manipulating it in various ways. But, say the critics, in neither case does the action constitute the perception. The action merely feeds into the perceptual experience, which is a separate and self-contained aspect of cognition. It is no different than the claim that visual perception depends on proper lighting—
this is true, but not an interesting aspect of our visual physiology. The critics point to neural correlates of consciousness that are activated by perceptual experiences, which do not seem to include the movement of our limbs (or, presumably, the brain regions subserving such movements). Block suggests that if the perceptual centers in the brain were activated in the appropriate ways, then even in the absence of action we would still have robust perceptual experiences. In effect, the critics have replied strongly in favor of the traditional view, invoking evidence for vertical modules and defending the claim that action is separate from perception.

According to my view, these criticisms gain traction from the fact that momentary visual experiences do not seem to involve exploratory action in the way that haptic touch does. Exploration in vision simply puts us into a better position to entertain novel sensory experiences, it does not play a direct role in the awareness of individual features or in sensory binding. Here the causal/constitutive distinction really matters; action seems to serve only a causal role in visual experiences. However, this criticism misses the mark when it comes to haptic touch, since haptic touch does not involve momentary experiences of the external world. Haptic experiences are essentially extended in time and action-involving; it is required for awareness of external properties at all. So while the causal/constitutive criticism carries weight against a strong view like Noë’s, that posits a constitutive APR for all of the sensory modalities, they simply don’t apply to the Haptic Exploratory Thesis I’ve defended in the preceding.

5.6 Passive Touch

I have suggested that haptic touch is essentially active. But haptic touch is only one form of touch. Sometimes we have tactual experiences that do not involve overt exploratory actions. One of the claims defended here is that exploratory actions function to externalize our awareness. Yet
we seem capable of having perceptual touch experiences in the absence of voluntary exploratory movements. These forms of touch are often referred to as passive touch, and to fully understand the role of action in touch we need some account of such passive touch.

Passive touch, while most often directed to our bodies, can be externally-directed. Some touch experiences seem relatively accurate and robust even in the absence of self-movement. Roughness perception, for instance, does not require that we move our skin across a surface. We can also experience an insect crawling on our skin as an external object, even though the movement is generated by the insect rather than us (and even though the sensation of the insect will be located in egocentric coordinates). Such an experience is of some external object moving along and around our body. We could have such an experience even if there is no voluntary movement or exploratory action at all, so long as there is a coherent movement against our sensory surfaces. While it seems that certain voluntary motor operations play an important role in a range of haptic perceptions, not all tactual experiences involve such voluntary exploration.

We can have experiences without explicit exploratory actions. Someone touching our hand, or a light breeze blowing against our skin, can be felt as external objects or qualities despite the fact that we passively (in the sense of not initiating the movement) feel such entities. These cases do not show that exploratory movement does not play an important role, however. Recall that one of the essential elements involved in haptic touch is not simply the actually physical movement of our bodies, but our awareness of our own movements. Feeling an insect crawl along a path from one spot on the arm to another, for instance, can generate a strong experience of an external entity because when we feel such coherent sensations we are aware of the fact that we are not the ones causing such movement. This awareness of our lack of movement means that the consistent, coherent signals caused by the insect are attributed to an
external object. The externalization involved in haptic touch depends in such a case on our awareness of our own movements and exploratory interactions with the world.

So it may be that we can experience an insect on our hand as an insect only because our tactual system has been tuned, through sufficient exploratory practice, to recognize such signals from the insect as representing an external object. So even in these cases, awareness of our voluntary movement (or non-movement) plays an important role in the externalization of our touch experiences. A similar view seems to be held by A. D. Smith (2002). He argues that voluntary movement is what allows us to experience the external world:

Although no mere impact on a sensitive surface as such will give rise to perceptual consciousness, we certainly feel objects impacting on us from without. This fact needs to be recognized in any adequate perceptual theory. I shall name the phenomenon that is central here by the term that is at the heart of Fichte’s treatment of the “external world,” or “not-self”: the Anstoss. This phenomenon is that of a check or impediment to our active movement: an experienced obstacle to our animal striving, as when we push or pull against things” (Smith 2002, 153).

According to Smith, then, our voluntary actions play a central role in the very act of perception, the key element allowing for bodily sensations to reach out into the external world.

While Noë and Smith deny that there could be a passive creature that experiences external objects as such, it does seem possible that a creature could have a highly-developed surface receptor system that allowed for object experience on the basis of consistent, coordinated movements by an external source. The Venus fly trap, for instance, might be such a creature (albeit much simplified). The fly trap has three touch sensitive hairs that detect the movement of insects within its trap. In order to activate the trap, more than one hair must be touched in a coherent manner (Hodick and Seivers 1989). This prevents false activations from non-food
stimuli. While rudimentary in design, there seems no reason that consistent and coherent movements of external objects could not ground an organism’s experience as external in nature. A fly, for instance, moves in very different ways from a drop of rain or a pebble. Such differences could be utilized by the sensory systems of passive organisms. Of course, such simple organisms, especially plants, lack conscious experiences of these external objects. And one might suggest that the ability of such a creature rests in the active abilities of some other creature. Nevertheless, it seems possible that coherent, teleological movements of external entities relative to passive touch receptors could in-fact illicit externally-directed experiences. But even in such a simple system as this, there are mechanisms in place for distinguishing external movement from self-movement. The specialized hairs of the Venus flytrap function to avoid misfires when the plant sways in the breeze or slowly turns toward the sun. The takeaway for the discussion here is that, while many of the important aspects of tactual object perception—attentional resources, novel receptor activations, consistency, coherence, continuity, etc.—do not require exploratory motions that are self-generated, they do require some awareness (or underlying detection mechanism) for incorporating these movements into the overall experience. In other words, even passive touch involves an awareness of our current exploratory activities, and sometimes, awareness of the lack of voluntary movement is as important in properly classifying tactual input as awareness of such movement.

5.7 Summing Up

The relationship between action and tactual experience is complex and multifaceted. Exploratory actions generate novel inputs to our tactual system, they isolate specific tangible features allowing such features to be maximally experienced, they separate figure from ground in touch, and serve a range of functions from segmenting and grouping objects to playing an essential role
in object recognition. When it is said that touch is inherently active, any of these many relations could be invoked. What do these facts about touch reveal about the ongoing debate about the APR? For one, touch by itself does not settle many of the claims made by supporters of a strong constitutive claim about action and perception. The relations between action and touch are complex and messy, and not easily transferred to other sensory modalities. The lesson of touch is that there may be no completely general account of the role played by action in perception. The action-involving relations that occur in touch may not occur in the sense of taste for instance. The best way to move forward on the debate, I think, is to better understand the many detailed relations between action and perception in the individual modalities.
Conclusion

I began this project with the strong belief that a philosophical examination of the sense of touch would have many implications for our general understanding of perception. This belief has been borne out by the resulting thesis. The very first question about touch—whether it was a single sense or many—allowed for the development of several important issues currently at the center of our understanding of the senses. First, many problematic issues in sensory individuation were considered. Second, the more recent acceptance and consideration of multisensory interactions were brought to bear upon our examination of touch. These considerations allowed for a novel account of unisensory and multisensory relations. While focused on haptic touch, the concept of an associative relation between experiences and the predicative structure of sensory experience have implications across a wide range of issues in contemporary philosophy of perception.

Similarly, my criticisms of the functional-dissociation criterion, shared content criterion, and the multiple stimuli criterion reveal some inherent difficulties in traditional means of individuating the senses.

The duality of touch also has implications beyond a better understanding of the sense of touch. Much work in recent years has focused on better understanding the nature of bodily awareness and the role of the body in shaping our experiences. Touch is an excellent place to study because it has both a perceptual and bodily nature. Understanding how these two kinds of touch related and shift is an important part of understanding how bodily and perceptual forms of experience differ and relate to one another. The main arguments concerning the relation—the rejection of strong bodily dependence—suggest that that, while importantly different from the
other senses in its dual nature, touch is much like the other senses in not requiring direct awareness of our bodies in order to elicit externalized experiences of objects and their properties.

The notion of externalization comes up throughout the thesis, and the distinction made between teleosenses, contact senses, and connection senses allows for a more precise description of such issues as perceptual reference and the demonstrative content of perceptual experiences. While all of the senses can represent things in the world, the mechanisms underlying these representations differ from sense to sense. The way in which vision brings awareness of distal objects is not the same as the way touch does. A focus on vision or audition alone would not reveal the distinct nature of such representations in the other senses.

The fact that we can experience distal objects through touch is surprising. Part of the surprise comes from difficulty understanding how touch gains spatial content—how do we experience an object located away from our bodies when we have no way of literally touching such distal points? The idea of the connection principle allow us to understand how this is possible, but it also generates a novel account of the spatial character of distal touch, but focusing on peripersonal space, the intermediate level of space whose coordinates are defined relative to our exploratory actions. A better understanding of this level of spatial awareness has a range of important implications in our understanding of such diverse issues as motion-guiding vision, tool use, exploratory movements and navigation, and manipulations of spatial contents.

In addition to spatial contents, the thesis also developed a novel account of tangible features. While much work has been done understanding the quality space of vision—especially the colors—very little work has been done on the quality space of the other senses. By focusing on touch, new relations between basic sensory features have been discovered. Touch alone seems to possess intensive features that linearly vary along a single qualitative dimension. In addition, it
is an important finding that intrinsic geometrical features in touch, while important, have a relatively minor role in tasks like object segmentation and recognition. In addition, a framework has been developed that could explain many complex forms of awareness, from the experience of causation to complex tangibles like the feeling of something wooden or plastic. These developments have applications in many areas of perceptual understanding.

Finally, much recent work in the philosophy of perception has focused on the role of action in perceptual experiences. Many have argued that perception and action are importantly connected. Many others have strongly argued against such an identification. In this thesis, I have put forward a very precise, empirically-informed notion of the role of action in haptic touch: the haptic exploration thesis. This thesis suggests that action plays a special role in touch, a role not found in any of the other senses. This suggests that we ought to be careful generalizing an account of action and perception from any single sensory modality.

Great progress has been made in our understanding of perception by focusing on vision and visual experiences. More recently, work in audition and the other senses has furthered our understanding of many issues in perception. Many current topics of interest explicitly involve senses other than vision: from work on multisensory interactions, to the examination of bodily awareness and the representation of space. This thesis, while focused on the sense of touch, is part of this more inclusive movement, and provides many novel contributions to our general understanding of the individual senses and their multimodal interactions.
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Consciousness: Binding, Integration, Dissociation.


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