

Kant on impenetrability, touch, and the causal content of perception

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ABSTRACT: It is well known that Kant claims that causal judgments, including judgments about forces, must have an a priori basis. It is less well known that Kant claims that we can perceive the repulsive force of bodies (their impenetrability) through the sense of touch. Together, these claims present an interpretive puzzle, since they appear to commit Kant to both affirming and denying that we can have perceptions of force. My first aim is to show that both sides of the puzzle have deep roots in Kant's philosophy. My second aim is to present three potential solutions to the puzzle, and show that each faces problems.

Hume famously argues for the negative thesis that we have no genuine impression of causation, power, or force. Our idea of causation, he claims, comes merely from expectations based on constant conjunctions. As most readers understand him, Kant agrees with Hume that nothing causal can be genuinely perceived,¹ albeit while providing a different positive account of causal representations.

In this paper, I present a puzzle for the received reading of Kant. In outline, the puzzle is that Kant appears to both affirm and deny that we can perceive force in external things. This puzzle runs quite deep in Kant's philosophy, but its core lies in the juxtaposition of two passages. The first passage comes from *Prolegomena*, where Kant says:

our concepts of substance, of force, of action, of reality, etc., are wholly independent of experience, [and] likewise contain no sensory appearance whatsoever, and so in fact seem to refer to things in themselves ... [Moreover, t]hey contain in themselves a necessity of determination which experience never equals. (*Proleg.* 4:315, see also A188/B234)²

Kant understands perception in terms of sensory appearances (e.g., A115: '*Sense* represents the appearances empirically in *perception*'). Therefore, if the concept of force is 'wholly independent of experience', and has 'no sensory appearance whatsoever', then it would seem that we could not, strictly speaking, ever perceive force. At most, we could perceive some

results of force.³ So, on the natural reading of this passage, Kant appears to be accepting the negative Humean thesis.

The second passage comes from the *Metaphysical Foundations of Natural Science* (hereafter: *MFNS*). One of Kant's central concerns there is impenetrability [*Undurchdringlichkeit*], understood as a force or power: 'Impenetrability, as the fundamental property of matter, whereby it first manifests itself to our outer senses, as something real in space, is nothing but the expansive power [*Ausdehnungsvermögen*] of matter (Proposition 2)' (4:508, where Proposition 2 introduces expansive force [*Ausdehnungskraft*] (4:499)).⁴ The crucial passage for the puzzle appears in Kant's explanation of why repulsive or expansive forces, but not attractive forces, are 'immediately given with the concept of a matter':

the first application of our concepts of quantity to matter... is grounded only on that property whereby it fills a space – which, by means of the sense of feeling, provides us with the quantity and figure of something extended, and thus with the concept of a determinate object in space, which forms the basis of everything else one can say about this thing... this substance discloses its existence to us in no other way than through that sense whereby we perceive its impenetrability, namely, feeling [*das Gefühl*], and thus only in relation to contact (*MFNS* 4:510)

On the natural reading of this passage, Kant is stating that we perceive the impenetrability of matter via the sense of touch. Yet impenetrability is a force, so this statement is inconsistent with the negative Humean thesis. In addition, Kant seems to say that the feeling of impenetrability grounds the application of *all quantitative concepts* to matter, forming the basis 'of everything else one can say' about material things. The latter would seem to include any results of force. If so, then he appears to hold both that we can perceive a certain force directly (not merely via its results or effects), as well as that we perceive that force *prior* to perceiving any of its results.

Kant therefore appears to both affirm and deny that we can perceive force. I call this the 'Perceived Force Puzzle'. This puzzle has not been recognized by Kant's readers because they have overlooked the doctrine described in the second passage.⁵ For instance, Eric Watkins writes:

Though Kant reinterprets Newtonian attractive and repulsive forces in terms of his own metaphysics, he follows Newton (and other empiricists) in agreeing that the notion of

activity... is not something that we can directly observe (in intuition alone). Just as one does not literally see ‘the causality of the cause’ or one billiard ball imparting motion to another, one does not see the exercise of attractive and repulsive forces... Since one can see nothing beyond the effects of these forces, there is no empirical content to physical forces per se (as opposed to their effects, which contain all such content)⁶

Watkins may be correct that Kant denies that we can *see* forces. Yet sight is not our only sense, and Kant says that we can *feel* at least one force. Therefore, if the natural reading of the *MFNS* passage is correct, then Kant does think that some forces can be directly observed.

I have two aims in what follows. The first is to show that Perceived Force Puzzle has deep roots in Kant’s philosophy (§1 and §2). The second is to consider how the puzzle might be solved (§3). As the reader has probably guessed, a solution would involve distinguishing two senses of ‘we can perceive impenetrability’, such that Kant can consistently deny the claim in one sense and affirm it in another. The challenge is finding a textually and philosophically plausible way of making that distinction. I consider three candidate solutions, two of which have precedents in the literature. Each candidate faces problems, however, which further illustrate the difficulty of the puzzle.

A solution to the Perceived Force Puzzle would be of interest for three additional reasons. First, as the above *MFNS* passage shows (and as I further discuss below), Kant claims that perception of forces is the basis for our experience of substance in space. Understanding the puzzle therefore promises to shed light on how Kant thinks we achieve empirical cognition of substance. If the puzzle cannot be solved, however, then a central part of Kant’s epistemology becomes problematic.

Second, the Perceived Force Puzzle resembles the tension between Kant's claim that our intuitions result from objects affecting us and his limitation of the categories (in particular: causation) to the realm of intuition. A solution to the puzzle, then, might help us determine whether Kant can consistently hold his doctrine of affection, and help us understand his general views on the limitations of the categories.⁷

Third, many philosophers today accept the negative Humean thesis that, strictly speaking, causation and forces cannot be perceived.⁸ Yet we often describe the content of haptic experience in causal terms. As I lean in my chair, for instance, the sensation in my back seems to tell me that something *resists* my going further back.⁹ A solution to the Perceived Force Puzzle might provide useful historical perspective on this issue.

Two notes about terminology. First, the puzzle is formulated in terms of ‘perception’ (*Wahrnehmung*). I do this because Kant uses that term in the passage from *MFNS*. Kant typically takes perception to involve sensory representation of objects, and never identifies it with more intellectual representations like cognition.¹⁰ It is therefore an empirical awareness, involving empirical intuition (i.e., singular, immediate representations of objects: A19/B33, A320/B377).

Second, when I talk of the content of perception below, I intend this in a broadly internalist sense. For example, red being part of the content of a perception means that the perception presents something as red, not merely that the perceived object is in fact red. Someone colorblind, then, could not have a perception with redness as part of its content.

1. The roots of Kant’s denial that force is empirical

This section traces Kant’s reasons for claiming that the concept of force ‘contain[s] no sensory appearance whatsoever’. Unlike some other claims Kant makes in the *Prolegomena*,¹¹ it is hard to deny that this one expresses one of his considered views. Watkins and others presumably infer that Kant must deny we can perceive force on the basis of two clear commitments, namely:

1. Perception alone cannot teach us about necessities.
2. Force is a sort of necessity.

Given these commitments, it would seem that Kant must deny that we can perceive force. I elaborate on 1 and 2 in turn.

1.1. Kant’s commitment to denying perception can teach us about necessities

Commitment 1 resembles a central epistemological principle of Kant’s mature philosophy: ‘[e]xperience teaches us... that something is constituted thus and so, but not that it could not be otherwise... [I]f a proposition is thought along with its necessity, it is an a priori judgment’ (B3).¹² The exact meaning of the principle is not clear. For one, Kant must mean ‘experience’ here in a thin sense, since he elsewhere argues that experience in fact presupposes judgments of necessity.¹³ For another, Kant puts the principle in frustratingly metaphorical terms, as what experience ‘teaches’ (*lehrt*). Regardless, it is clear enough how

Kant uses this principle in his critical philosophy: any claim to knowledge of non-analytic necessity calls for a critical investigation. Mere appeals to perception will not do.¹⁴

This principle can allow that the things we perceive in fact *are* necessary in some way. After all, Kant holds that outer things both involve necessarily persisting substance and stand in necessary causal relations (see A189/B232, A197/B242). By the principle, though, perceptual experience alone could not teach us about these necessary features. If an object had some property, say, that *consisted* of necessary relations, then Kant's principle would seem to imply that, strictly speaking, we could not perceive that property as such.

1.2. Kant's commitment to taking force to be a sort of necessity

Commitment 2 is that force is a sort of necessity. This commitment stems from Kant's views that the concept of force is a causal notion and that causal relations are necessary. The former view is stated in various places:

Hume started mainly from a single but important concept in metaphysics, namely, that of the connection of cause and effect (and of course also its derivative concepts [*Folgebegriffe*], of force and action, etc.) (*Proleg.* 4:257)¹⁵

force itself is again nothing other than a category (or the predicable [*Prädicabile*] thereof), namely that of causality ('On a discovery' 8:223)¹⁶

Repulsive force is that by which a matter can be the cause of others removing themselves from it (or, what is the same, by which it resists the approach of others to it). (*MFNS* 4:498, see also 4:496)¹⁷

It is not obvious what Kant thinks the exact relationship is between forces and causal relations – force itself is not a relation, but something more like a capacity for certain relations.¹⁸ Either way, it seems that in order to perceive a force, one would need to perceive something like a causal relation.

Kant is just as explicit that causation concerns necessity, in particular, that causes necessitate their effects in accordance with laws. He takes this to be analytic:

the very concept of a cause so obviously contains the concept of a necessity of connection with an effect and a strict universality of rule that it would be entirely lost if one sought, as Hume did, to derive it from a frequent association (B5)

every effective cause must have a character, i.e., a law of its causality, without which it would not be a cause at all (A539/B567)

[reason thinks] that something could be so constituted that, if it is posited, something else necessarily must thereby be posited as well; for that is what the concept of cause says (*Proleg.* 4:257)

Not surprisingly, then, in *MFNS* Kant states that:

[For bodies to be immediately attracted] must be just as thinkable as an immediate repulsion of one another, that is, to flee from one another in accordance with an invariable law, without the force of attraction having any part therein (*MFNS* 4:514)

Presumably, the invariability of a law is its necessity. Perceiving repulsive force would therefore seem to require not just perceiving one body moving away from another, but perceiving one body being *repelled* from the other *in accordance with a necessary law*. Given Commitment 1, though, that would imply that genuine perception of force is impossible.

2. The roots of Kant's claim that we can feel impenetrability

I have claimed that, on its natural reading, the crucial passage from *MFNS* 4:510 states that through touch we can perceive impenetrability, that is, perceive the repulsive force whereby matter fills space. Like much of Kant's writing, however, more than one reading of that passage is possible, and Kant admits he wrote the *MFNS* rather quickly.¹⁹ However, there are further reasons for taking Kant to hold we can indeed perceive force.

2.1. The perception of force through Kant's career

Consider a passage from 2.4.1 of Locke's *Essay*:

The Idea of Solidity we receive by our Touch; and it arises from the resistance which we find in Body... Whether we move, or rest...we always feel something under us, that supports us, and hinders our farther sinking downwards; and the Bodies which we daily handle, make us perceive, that whilst they remain between them, they do by an insurmountable *Force*; hinder the approach of the parts of our Hands that press them... This of all other, seems the Idea most intimately connected with, and essential to Body.²⁰

Whether or not Kant was directly influenced by Locke on this point, I contend that Kant affirms a broadly Lockean view about touch, impenetrability, and bodies throughout his career.²¹

Before turning to Kant's texts, it is important to note that a broadly Lockean view is neutral about the ultimate metaphysics of force. For example, we might perceive physical force through touch even though physical forces ultimately reduce to the intrinsic properties of substances. That is, a Lockean epistemological view is compatible with a Leibnizian metaphysical view, as Leibniz himself appreciated (see §3.3 below). This neutrality would explain why Kant never applies his views about perceived force in the debate between pre-established harmony and influx views of causation.

As various commentators have emphasized,²² Kant was concerned with physical forces throughout his career. In the Preface to his first publication (the 1749 'Thoughts on the True Estimation of Living Forces'), Kant offers a strikingly Lockean proposal for how Leibniz came to think about physical forces:

Herr von Leibniz did not first catch sight of living forces in those instances in which he first presented them to the world. The inception of an opinion is commonly far simpler... One has certain very common experiences by which we perceive [*wahrnehmen*] that an actual motion, a blow or push, for example, always carries with it more power than a dead pressure, even if the latter is equally strong. This observation was perhaps the seed of an idea that could not remain unfruitful in the hands of Herr von Leibniz (*Thoughts* 1:14)

Kant does not explicitly mention touch here, but it is hard to read his talk of perceiving blows, pushes, and dead pressures in any other way. Thus, the very first epistemological claim about force Kant makes in his published work concerns touch. Kant appears to be saying that Leibniz's insights concerning the nature of force stemmed from felt encounters with the repulsive force of matter.

Kant's next published Lockean claim comes in the 1756 *Physical Monadology*, where he states that, 'in moving one body closer and closer to another, we say that they are touching each other when the force of impenetrability [*vis impenetrabilitatis*], that is to say, of repulsion, is felt [*sentitur*]' (*Physical Monadology* 1:483). Then, in the 1764 *Inquiry Concerning the Distinctiveness of Natural Theology and Morals*, he writes:

I cognise that a space is occupied by something if there is something there which offers resistance to a moving body... But this resistance is impenetrability. Accordingly, bodies occupy space by means of impenetrability. But *impenetrability is a force*, for it expresses a resistance... I realise that whenever I judge that I am touching [*berühre*] a body I do so by reference to the resistance which the impenetrability of that body offers. For I find that *this concept originates ultimately from the sense of touch*. The judgment of the eye only produces the surmise that one body will touch another; it is only when one notices the resistance offered by impenetrability that the surmise is converted into certain knowledge. (*Inquiry* 2:287-88, my emphases)²³

Kant claims here that bodies occupy space by the force of impenetrability, and that we gain our concept of this force through the sense of touch.

Kant says something similar in the 1766 *Dreams of a Spirit Seer*:

All matter offers a resistance in the space which it occupies; it is, for that reason, called impenetrable. That this occurs is something which experience teaches [*lehrt*] us; and it is by abstraction from this experience that the general concept of matter is generated within us... [L]ike everything else which operates in opposition to an activity, this resistance is a true force... Now,... the human understanding has reached its limit here. It is experience alone which enables us to perceive that those things which exist in the world... possess such a force; but experience does not ever enable us to understand the possibility of such a force. (*Dreams* 2:322)

Kant does not explicitly refer to touch here, but touch is the most obvious way that experience could teach us that matter occupies space by the force of impenetrability. Note that Kant talks of what 'experience teaches us', the same language he uses for his mature epistemological principle about the apriority of necessity. Kant's final claim (that experience does not enable us to understand the possibility of such a force) needs to be read with care,

but it presumably means that we do not have insight into the metaphysical grounds of such force (a claim Kant maintains in his mature work²⁴).

Kant says little about forces in the 1770 *Inaugural Dissertation*, and does not dwell on them in the *Critique*. Nonetheless, the view may be hinted at in the Amphiboly chapter, where he says:

We know [*kennen*] substance in space only through forces that are efficacious in it, whether in drawing others to it (attraction) or in preventing penetration of it (repulsion and impenetrability); we are not acquainted [*kennen*] with other properties constituting the concept of the substance that appears in space and which we call matter (A265/B321, see also A204/B249).

Kant does not tell us here *how* we are acquainted with these forces, and he does not explicitly claim that we can perceive attractive force. The exact meaning of ‘*kennen*’ here is not clear. Nonetheless, Kant says that we *kennen* attraction, repulsion, and impenetrability more immediately than we do other properties, and he again describes these as forces. It is natural to assume that Kant is primarily concerned with perception here. Elsewhere in the *Critique*, Kant states that impenetrability is an empirical concept (A20/B35, A173/B215), and claims that ‘impenetrable lifeless extension’ is the minimum we must take from experience ‘to give ourselves an object’ (A848/B876). So Kant gives impenetrability a foundational but empirical role in our experience of outer objects. Though there are non-Lockean ways of making sense of such a view (discussed below),²⁵ a Lockean view is the easiest way to make sense of such claims.

Finally, Kant continues discussing attractive and repulsive forces as the proper topic of physics in his final project, the *Opus Postumum* (21:307). Though Kant does not directly discuss touch, he does define perception in terms of interaction with forces: ‘Perception (empirical representation with consciousness) is receptivity for the moving forces of matter’ (22:465). The context implies that this is not meant to merely be an explanation of the functioning of perception, but to describe the distinctive *content* of perception in contrast with that of the understanding.

Taking these passages at face-value, Kant therefore accepts a broadly Lockean view about force throughout his philosophical career. That is, he claims that we can perceive forces, with special attention to the force of impenetrability being perceived through touch, and that force is central to our grasp of matter. Even though Kant’s views and terminology

are not perfectly consistent across his career, there are therefore textual reasons for thinking that the crucial passage from *MFNS* reflects more than a passing thought.

2.2. Kant on the immediacy of touch

Of the passages quoted in §2.1, only the one from the *Inquiry* made explicit reference to the sense of touch. We should therefore consider Kant's most extensive published discussion of touch, where he writes:

The sense of touch [*Betastung*]²⁶ lies in the fingertips... [T]hrough touching the surface of a solid body one can inquire after its shape... This sense is also *the only one of immediate external perception*; and for this very reason it is also the most important and most reliably instructive, but nevertheless it is the coarsest, because the matter whose surface is to inform us about the shape of the object through touching must be solid... Without this sense organ we would be unable to form any concept at all of a bodily shape, and so the two other senses of the first class must originally be referred to its perception in order to provide cognition of experience. (*Anthropology* 7:154-55, my emphases)²⁷

In claiming that touch is the sole sense of ‘immediate external perception’, Kant gives the other objective senses, sight and hearing, only a mediate status.²⁸ Though he does not say that touch acquaints us with forces here, he does echo the claim from *MFNS* that touch is crucial for us to think of physical objects in quantitative terms (including shape, which Kant defines as the interaction of attractive and repulsive forces²⁹).

2.3. Matter reduced to force

We have seen textual reasons for thinking that Kant holds we can perceive force through touch. Next, I want to show how Kant’s views on the nature of matter yield principled reasons for holding that, in all strictness, we do perceive physical forces.

In his mature thought, Kant holds that *all there is to* physical matter is force. The above A265/B321 passage states that we know material substance only through knowing forces. In *MFNS*, Kant goes further, stating: ‘The concept of matter is reduced to nothing but moving forces’ (4:524).³⁰ Kant is explicit that the relevant concept of matter is ‘intrinsically empirical’ (*MFNS* 4:472).

To be sure, matter might be reduced to forces without our perceiving forces, if we were in only indirect perceptual contact with material things. But Kant insists that we are *immediately* conscious of material objects. This is perhaps the main point of the Refutation of Idealism, where Kant also suggests that the persistent intuition of impenetrability grounds the application of the concept of substance (B278, see also A368-71, B276ff.).³¹ So Kant has good reasons to say that we can perceive force (not merely its effects), since he thinks we are immediately aware of physical objects, and that physical objects are ultimately made up of nothing but forces. Hence, he claims that ‘[w]hen we speak of appearances, we will see that we are acquainted with mere powers... All basic powers must be given through experience’ (*Mrongovius* 29:772).

A contrast with Hume may be helpful. Hume grants that a feeling of solidity enters into the vulgar idea of force, but denies it any serious philosophical role (*Enquiry*, §7). Hume lacks Kant's grounds for taking tactile sensations to teach us about force: he does not think solidity is central to material things (see *Treatise* 1.4.4), he has little interest in giving a philosophical basis to Newtonian physics (see *Treatise* 1.2.5), and he never privileges the sense of touch as Kant does (see *Treatise* 1.2.3).

Kant's suggestion that we can immediately perceive the force of impenetrability therefore has deep roots. Yet since his claim that the concept of force is ‘wholly independent of experience’ also has deep roots, the Perceived Forces Puzzle cannot be easily dismissed.

3. Candidate Solutions to the Perceived Force Puzzle

Perhaps the mature Kant is simply inconsistent, due to lingering pre-critical views.³² For the sake of charity, however, we should try to find a philosophically charitable and textually plausible solution to the Perceived Force Puzzle.³³ In this section, I consider what I take to be the three most promising approaches to the puzzle. Two of these have precedents in the secondary literature, while one is novel. Each faces problems, however. These are not the only possible solutions, but the problems they face would, I suspect, be faced by any attempted solution.

3.1. First candidate solution

Say that one held that, for Kant as for Hume, there is no deep sense in which we perceive forces, so that the ‘ultimate’ content of all perceptions is non-causal. In that case,

one might try to solve the puzzle by claiming that Kant's 'impenetrability' ('*Undurchdringlichkeit*') is ambiguous between a *force* (which we cannot really perceive) and some non-causal *correlate* or *consequence* of that force (which we can really perceive).

There may be some textual support for such a line. Kant sometimes describes impenetrability a *result* of force, e.g.: '[m]atter is impenetrable, through its original expansive force... But this is only a consequence of the repulsive forces of each point in a space filled with matter' (*MFNS* 4:503). Perhaps this passage shows that Kant sometimes uses 'impenetrability' to describe a mere result of force.

That said, this textual support is inconclusive at best. Kant holds that forces can be consequences of other forces (e.g., *MFNS* 4:534), so nothing so far suggests that he uses 'impenetrability' to describe anything other than forces. In passages like 4:503, he may be using the term for some derivative force. Nowhere does Kant talk of impenetrability in terms that are *inconsistent* with its being a force and, as we saw above, he explicitly calls it a force on multiple occasions.

In addition, this first candidate solution runs directly into the issues described in §2.3. Kant has systematic reasons for holding that we immediately perceive matter, and he reduces matter to forces. So any limitation of our perceptions to mere effects of those forces will be in tension with some of Kant's core commitments.

Nonetheless, since every approach to the Perceived Forces Puzzle may face problems, it is worth considering this first approach in more detail. A key question is: *what* is the perceived correlate or consequence of force? One answer would be that it is a mere sensation or an effect on our own bodies. A second answer, suggested in the earlier quote by Watkins, is that what is perceived are certain motions. A third answer, which Michael Friedman appears to endorse, is that we perceive is the mere filling of space. Any of these answers would seem to allow Kant to accept the negative Humean thesis after all.³⁴ Yet each answers faces non-trivial problems.

The first answer has some precedent in Hume, who distinguishes the feeling of solidity from solidity itself (*Treatise* 1.4.4). Yet Kant cannot think that touch is merely the perception of a bodily feeling, for he counts touch as one of the three properly external senses (see *Anthropology* 7:154):

if the sensation becomes so strong that the consciousness of the movement of the organ becomes stronger than the consciousness of the relation to an external object, then external representations are changed into internal ones. – To notice smoothness or roughness in what

can be touched is something entirely different from inquiring about the figure of the external body through touching (*Anth.* 7:156, see also 7:154-5).

While Kant talks about perceiving impenetrability in external bodies, he never talks about the subjective senses (smell and taste) in such terms. This is presumably because smell and taste present us only with ‘movement[s] of the organ’. Touch is supposed to be different. So if the perception of impenetrability is really just a consequence or correlate of force, that consequence or correlate cannot be merely something internal to us.

Watkins’ suggestion that what we perceive is motions does better on that front. It also has some textual support. In the Preface to *MFNS*, Kant states that ‘[t]he basic determination of something that is to be an object of the outer senses had to be motion, because only thereby can these senses be affected’ (*MFNS* 4:477). Perhaps Kant is saying here that motion is basic in our experiences of outer objects. In the Second Analogy, he states:

Now how in general anything can be altered... of these we have a priori not the least concept. For this acquaintance with actual forces is required, which can only be given empirically, e.g., acquaintance with moving forces, or, *what comes to the same thing*, with certain successive appearances (as motions) which indicate such forces. (A206-7/B252, my emphasis, cf. *OP* 21:387)

Here, Kant seems to say that our empirical acquaintance with moving forces is really just acquaintance with motions, so that, strictly speaking, all we perceive are motions that, in turn, merely indicate the presence of forces.

Nonetheless, there are problems with attributing this view to Kant. First, one can obviously feel resistance in stationary external things. Recall Locke’s example of feeling a solid object between our hands (and see again *Thoughts* 1:14). Surely, this is a case of feeling impenetrability, but there is no actual movement. In the Second Analogy, moreover, Kant’s example of the moving ship involves perceptible movement, but his example of a stove causing a room to warm (A202/B247-8) does not. While, physically speaking, heat rests on moving forces (see *MFNS* 4:522), our awareness of causal forces in such cases is not based on the perception of motion as such. So the above passages are probably best read either as giving a *physical* explanation of the operation of the sense organs or as saying only that, in *some* cases we have acquaintance with moving forces via a perception of motions. That

would explain the ‘e.g.’ in the A206-7/B252 passage. If so, then Watkins’ suggestion has limited support. It also conflicts with the claims described in §2.3.³⁵

The third view about what we perceive comes from Friedman. Friedman thinks Kant identifies impenetrability (in at least one sense) and the filling of space, where space-filling is the result of force.³⁶ To be clear, Friedman never directly considers Kant’s claim that impenetrability is a power, and so does not offer this possibility as a solution to the Perceived Forces Puzzle. Even so, a significant advantage of this approach would be that it would explain Kant’s emphasis on *shape* in the passage concerning touch from the *Anthropology*, since shape just is the way that objects fill space.³⁷

One worry for this approach is textual. Kant never explicitly identifies impenetrability and space-filling. Impenetrability is indeed closely *related to* the filling of space, and Kant talks about the filling of space in terms of motion being prevented within that space (*MFNS* 4:496). But all that is compatible with impenetrability being a force. More importantly, Kant’s notion of *filling* a space is causal – to fill a space is to ‘resist others that are striving to penetrate within’ (4:497). So this proposal does not offer a non-causal result of force we could unproblematically perceive.

Since the three most obvious specifications of the first candidate solution each face non-trivial problems, it is worth considering other potential solutions.

3.2. *Second candidate solution*

An alternative potential solution to the Perceived Forces Puzzle would be to ‘pre-pack’ the content of perception.³⁸ That is, one could restrict Kant’s principle about experience being unable to teach us necessities to *pre-perceptual* sensation, and thereby allow for robustly causal content in our perceptions. After all, Kant does claim that there is more mental activity involved in our perceptions than we may realize. For example:

The objective unity of all (empirical) consciousness in one consciousness (of original apperception) is thus the necessary condition even of all possible perception (A123)

by the synthesis of apprehension I understand the composition of the manifold in an empirical intuition through which perception, i.e., empirical consciousness of it (as appearance), becomes possible (B160)

all synthesis, through which even perception itself becomes possible, stands under the categories (B161)

Perhaps, then, Kant can allow for the perception of force so long as an a priori synthesis is the source of its causal content.

Unfortunately, the textual basis for this approach is limited. Unlike space, time, and the quantitative and qualitative categories, Kant denies that the category of cause is constitutive of perceptions (see A187/B221ff.). This seems to imply that perceptions are not ‘pre-packed’ with a priori causal content the way they are with spatiotemporal content. Hence, Kant claims that ‘no necessity of [objects’] connection is or can become evident in the perceptions themselves’ (B219).

In addition, such an approach would radically restrict the scope of Kant's crucial epistemological principle. If his claim that experience cannot teach us necessities means merely that no necessary facts can be learned from pre-perceptual sensation, then his principle allows for learning necessary facts from normal perception. Yet Kant thinks his principle shows that accumulating perceptions inductively can get us only to ‘comparative universality’, not the true necessity and universality.³⁹ Limiting the scope of that key principle would threaten the basic motivations for his entire critical project.

3.3. *Third candidate solution*

A third candidate solution to the puzzle might steer a middle path between the first two. The first candidate gave no ultimate causal content to the perception of impenetrability, while the second aimed to allow such content. I think we can make sense of a view according to which perception shows us *some* genuine aspects of forces without showing us their full nature. Leibniz may have flirted with such a view in his commentary on Locke's *Essay* (a commentary Kant was familiar with). In response to Locke, Leibniz says:

It is true that we find resistance in the sense of touch, when there is difficulty in getting another body to give way to our own... [but] the senses unaided by reasoning do not suffice to establish that perfect impenetrability which I hold obtains in the natural realm... [S]olidity, in so far as there is a distinct notion of it, is fundamentally conceived through pure reason, though the senses provide a basis for reasoning to prove that solidity occurs in nature. (*New Essays*, 124)⁴⁰

Leibniz's seems to hold that the senses tell us *enough* about force for us to say that it exists, but do not tell us the whole story. In Leibniz's case, this is partly because, in the *New Essays*, he agrees with Locke that matter is absolutely impenetrable, and he presumably holds that such absoluteness cannot be presented to us by sensation alone. Kant denies that matter is absolutely impenetrable (*MFNS* 4:501-02), so we cannot directly map his reasoning onto Leibniz's. Even so, Kant might share the view that perception can give us a 'basis for reasoning to prove' that forces (as conceived a priori) occur. To see if the approach can work, we should winnow down the content that the perception could have for Kant, and then see whether any content would be left to the experience of touch.

It will be useful to focus on a concrete example: Locke's case of feeling yourself being supported by the ground. Kant presumably thinks that, in such a situation, the ground resists your sinking downwards 'in accordance with an invariable [i.e. necessary] law' (see *MFNS* 4:514). Note that this case does not involve actual movement, and need not involve any effort of the will. These features bring it in line with the crucial *MFNS* passage, where Kant mentions neither actual movement nor effort of the will. The case therefore lets us focus on the content of the feeling of impenetrability alone.

For Kant, the empirical content of any objective perception would come from intuitions (see A19/B33, A68/B93). Intuitions, for Kant, always have singular content (see A19/B33, 'Progress' 20:274, *Logic* 9:91). That is why we cannot learn general laws from isolated perceptions (though see 4:468, A646/B674ff.). Locke's description supports that: while sitting or lying down, we feel something under us that 'supports us, and hinders our farther sinking downwards'. Nothing about that experience alone would tell us that *other* bodies or surfaces would hinder our farther sinking downwards, or that these surfaces would hinder our sinking were we to shift positions. All such general knowledge seems to come either from instinct, from induction, or from something a priori.

Beyond the singularity of intuition, though, Kant has reasons for holding that even *accumulated* experiences of impenetrability alone could not teach us anything precise about movement. This includes the laws governing moving forces, for Kant thinks the causal laws governing the interactions of bodies' physical forces concern *motion* (see *MFNS* 4:514). To fully grasp those laws, then, we would have to have a determinate grasp of the relevant motions. Yet Kant holds that a determinate representation of motion requires reference to absolute space:

Absolute space is therefore necessary, not as a concept of an actual object, but rather as an idea, which is to serve as a rule for considering all motion therein merely as relative; and all motion and rest must be reduced to absolute space, if the appearance thereof is to be transformed into a determinate concept of experience (*MFNS* 4:560)

Kant holds, though, that absolute space ‘cannot be an object of experience... and yet it is a necessary concept of reason’ (*MFNS* 4:559) that arises from thinking of one’s own space as contained in increasingly greater spaces.⁴¹ However, the sense of touch cannot (accurately) represent spaces beyond one’s own location (see *Dreams* 2:324). In contrast to touch, Kant calls the sense of sight the ‘noblest’ sense precisely because it has ‘the widest sphere of perception in space’ (*Anthropology* 7:156). In order for us to learn the laws governing the interactions of physical substances, then, we would have to make reference to absolute space, but touch alone cannot provide such a reference.⁴² It follows, then, that touch alone cannot teach us the laws of the force of impenetrability, nor can it teach us about particular determinate motions.

Given all that, what is left in the sensation of impenetrability that could provide the basis for the full-blooded concept of force? As Locke's examples illustrate, actual motion need not be part of the content. Kant himself gives us little guidance. One hint is Kant’s choice of the terms ‘impenetrability’ (*Undurchdringlichkeit*) and ‘resistance’ (*Widerstand*). Both of these sound modally-rich. To say that a body resists the movement of another is, plausibly, to say that the latter *cannot easily* move in a certain direction, or is *making it harder* for the latter to move in some direction. I propose, then, that Kant might think the content of the feeling of impenetrability is modally rich but singular, involving a relation of possible motion concerning us and something external.⁴³ The modal richness therefore involves a reference to non-actual and less-than-fully-determinate motion. The content of feeling of pressure from the floor might be glossed as ‘this external body is not easily letting you go downwards’.

There is textual support for this interpretive line. After stating that we do not perceive attraction as immediately as repulsion (4:509), Kant considers what it would be like if we could sense attractive force as immediately as repulsive force:

Attraction, even if we sensed it equally well, would still never disclose to us a matter of determinate volume and figure, but only *the striving of our organ to approach a point outside us* (the center of the attracting body). For the attractive force of all parts of the earth can affect

us no more, and in no other way, than as if it were wholly united in the earth's center, and this alone influenced our sense... But we thereby obtain no determinate concept of any object in space... The mere direction of attraction would be perceivable, *as in the case of weight*: the attracting point would be unknown, and I do not even see how it could be ascertained through inferences, without perception of matter insofar as it fills space. (4:509-10, my emphases)⁴⁴

If we sensed attraction, Kant holds, what we would sense would be 'the striving of our organ to approach a point outside us'. This involves the causal/modal notion of striving [*Bestrebung*]⁴⁵ and a direction. Moreover, the striving is not a mere sensation, but a relation between us and something external. The perception, however, would be limited in its determinate content. Kant emphasizes that we would be unaware of how the forces were distributed in the external object. Note also that Kant's description is in firmly singular terms. Yet all of this is meant to describe what we would sense if we sensed attraction as well as we sense repulsion or impenetrability, so we can ascribe the same sort of content (with the direction of striving reversed) to our perception of impenetrability.

Unfortunately, this interpretive suggestion seems to go against Kant's crucial epistemological principle. Wouldn't being able to perceive modally-rich singular relations imply that we can in fact perceive necessities? There are, I think, two ways this suggestion might be spelled out so as to avoid conflict with Kant's principle.

First, note that Kant never explicitly contemplates the idea of entirely singular necessities.⁴⁶ He states that necessity and universality 'belong together inseparably' (B4) and always pairs universality and necessity as criteria of the a priori.⁴⁷ We could look at this either as philosophical myopia, or, more charitably, as showing that Kant uses 'necessity' (*Notwendigkeit*) to refer to a narrower notion than we do today. In the latter case, his principle that experience cannot teach us 'necessities' would allow for experiences with necessary content in *our* wider sense. With the right qualifications, then, we gloss the content of a perception as 'given just the current masses, motions, and locations of your body and the floor, it is impossible for your body to go downwards now'.⁴⁸

A second way to spell out the modally-rich content starts with the way that Kant connects impenetrability to the category of reality. In the *Critique*, Kant's principle concerning reality is (in the B edition): 'In all appearances the real, which is an object of the sensation, has an intensive magnitude, i.e., a degree' (B207), and (as Daniel Warren has argued⁴⁹) this principle underlies Kant's discussion of physical forces in *MFNS*. Given that, one might think that *all there is* to force are certain gradable modal connections. If so, then, it

would be natural to tie degrees of physical force to degrees of modal strength. Since Kant does not think there is absolute impenetrability, he does not think we can experience impenetrable force of an infinite degree (i.e., necessity). In perceiving impenetrability, though, we could perceive modal connections that are stronger than mere actuality but weaker than necessity. Say, for instance, that there was some modal scale from -1 to 1, with -1 being impossibility, 1 being necessity, and 0 being mere actuality.⁵⁰ The content of the sensation of the floor then might be understood as giving a -.3 modal value to your body going downwards.⁵¹

On either understanding of the content of the feeling of impenetrability, feeling would teach us almost nothing about universal laws, and so not present all aspects of force to us. That fact that the floor *now* is keeping me from going downwards does not by itself tell me anything about what other floors will do, what this floor does at other times, or what sort of general law is involved. At the same time, though, this modally-rich content could *point* in the direction of causal interactions in accord with necessary laws. It at least clues us in to something modal being at work. This modally-rich content, I propose, could make it reasonable for Kant to describe the experience as a perception of force.⁵² Just as importantly, it would also allow Kant to hold that our perception of bodies is immediate in a very strong sense.

3.3. *Three remaining problems*

Though the third candidate solution has significant virtues, it faces at least three non-trivial problems.

The first problem is that the third candidate might still attribute too much content to intuition. As described above, the intuition of impenetrability involves something like propositional content. Yet one might think that such content belongs only to judgments for Kant, and Kant is clear that intuitions are not judgments (e.g., A293/B249). What the representational content of an intuition is for Kant is an extremely difficult question, though, so it is hard to say how serious this problem is.⁵³

The second problem concerns Kant's claims about the modal categories in the *Analytic of Principles*. He writes: 'The categories of modality have this peculiarity: as a determination of the object they... express only the relation [of the object] to the faculty of cognition' (A219/B266, see also *Jäsche Logic* 9:108-09). The principle governing the category of necessity is: 'That whose connection with the actual is determined in accordance

with general conditions of experience is (exists) necessarily' (A218/B266). Yet, on the proposed solution, the content of tactile perception would concern merely the relation between one's body and another physical thing, not the faculty of cognition.⁵⁴ That said, Kant himself does not restrict his modal claims to experience in the way the *Analytic of Principles* would make us expect. For instance, he allows for a coherent belief in a necessary being (God) who is not obviously 'determined in accordance with general conditions of experience'.⁵⁵ Finding a coherent view in all this is no easy matter.

The third problem is that the proposed solution bypasses Kant's own explicit account of how causal concepts are applied to the empirical world. In the *Schematism*, Kant claims that 'pure concepts of the understanding [including causation]... in comparison with empirical (indeed in general sensible) intuitions, are entirely unhomogeneous, and can never be encountered in any intuition' (A136/B176).⁵⁶ Kant himself thinks that, despite this heterogeneity, it is possible to apply the concept of cause via its schema, which is regular succession (see A144/B183). None of that, however, makes reference to touch or to modally-rich singular perceptions. In addition, touch is only able to show us limited regularities in nature (given its short range). If Kant did think that we have perceptions of modally-rich singular relations in the way I have described, we would at least expect him to lay the groundwork for this. Yet he does not.

To review: I have argued that for the existence of an interpretive puzzle, and offered what I take to be the three most promising solutions to it. Every candidate solution faces serious obstacles, however. Perhaps with further development, one of them might be able to overcome these obstacles. If not, then the Perceived Forces Puzzle remains. Because of the connections, described above, between the perception of force and empirical cognition of substance, this puzzle has troubling ramifications for Kant's entire theory of experience.⁵⁷

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¹ Kantian perceptions (*Wahrnehmungen*) should not be identified with Humean impressions. However, since Kant holds that sensation is necessary for perception and sensations play a similar role in Kant's system to the one impressions play in Hume's, it is plausible that Kant and Hume share a subject matter.

² As is standard, references to the *Critique* will use page numbers to the first (A) and second (B) editions.

² As is standard, references to the *Critique* will use page numbers to the first (A) and second (B) editions.

References to Kant's other works use an abbreviated title with the volume and page number of the Academy edition.

³ E.g., 'we cognize the existence of a magnetic matter penetrating all bodies from the perception of attracted iron filings' (A226/B273).

⁴ Kant talks of force and power interchangeably in *MFNS* (e.g., 4:496-7, 4:534). He identifies impenetrability with repulsive force at 4:512, with a moving force at 4:551, and with expansive force at 4:552. He talks of the 'force of impenetrability' at 4:513 and 4:513, and gives impenetrability the explanatory role of a force in various places (e.g., 4:502, 4:511, 4:514, 4:533). For my purposes here, impenetrability could either be identified with fundamental repulsive force (as in Langton 1998: 171) or instead be understood as a non-fundamental force that results from some other force or forces (as in Schoenfeld 2000: 171-72 and Warren 2001a: 55, Warren 2001b: 97 (but cf. Warren 2001a: 68 and Warren 2001b: 100)). I return to this issue in §3.

⁵ Broadly similar puzzles have been considered concerning both matter and motion (see Friedman 2001 and Pollock 2006). The fact that causation is a dynamical category, whereas matter and motion relate to mathematical categories, however, makes the present puzzle more difficult. We would expect perception to have only mathematical categorical content (see A160/B199).

⁶ Watkins 2005: 271 (see also Watkins 2002). Michael Friedman discusses this passage (Friedman 2013: 175-80) but does not notice the puzzle (for more, see below). In earlier work, Friedman largely passed over Kant's claims about the immediate sensation of impenetrability (Friedman 1992 and Friedman 2004, though see Friedman 2001: 65). Rae Langton discusses Kant's views of impenetrability in *MFNS*, but explicitly sets aside issues of touch (see Langton 1998: 144). Daniel Warren states that '[r]elative impenetrability is precisely the kind of property that can, at least in principle, be presented to us through the sensation-component of empirical intuition' (Warren 2001b: 99) and mentions the exertion of force on one's hands (Warren 2001a: 67, cf. Warren 2001b: 98). However, Warren also seems to miss the crucial passage, saying 'inner properties like impenetrability or gravitational mass are known only through the effects they have on the state of motion of outer bodies' (Warren 2001a: 50). Besides Friedman, the only recent commentators who explicitly note the crucial claim about touch are Dina Emundts (Emundts 2008: 131) and Konstantin Pollok (Pollok 2001: 279-80), though neither directly considers the Perceived Forces Puzzle.

⁷ The similarity between these issues is discussed in Adickes 1929 (see also Kitcher 1999).

⁸ Some philosophers of mind hold that we visually represent causation (e.g., Beebe 2003, Siegel 2008). Such representational claims do not imply that any causal properties are actually instantiated. For reasons discussed in §2, I take Kant's claim in the *MFNS* passage to be stronger than this sort of merely representational claim.

⁹ For arguments that we should accept such causal descriptions and reject the Humean thesis, see Fales 1990: Chapter 1 and Mumford and Anjum 2011: 195-213.

¹⁰ Sometimes it sounds like any representation accompanied with sensation counts as perception (A115, B147, B207, *Proleg.* 4:300, *Metaphysics Vigilantius* 29:999, *Metaphysics Mrongrovius* 29:794), but elsewhere Kant implies that perception is more objective than empirical intuition (B162). In a Humean moment, Kant uses the Latin '*Perceptio*' to denote any representation with consciousness at A319-20/B376, but he does not talk of *Wahrnehmungen* there (though cf. *Jäsche Logic* 9:64). Kant identifies *Wahrnehmung* and empirical intuition in the *Anthropology* (7:135 and 7:153) and the *Prolegomena* (4:283). In unpublished work, Clinton Tolley shows

that for Kant and several of his predecessors, *Wahrnehmungen* involves the conscious apprehension of the given without addition of intellectual content (Tolley, Manuscript).

¹¹ See, e.g., Guyer 1987: 91ff. and Longuenesse 1998: 167 on the distinction between judgments of perception and judgments of experience (*Prolegomena* 4:298).

¹² Versions of this principle appear in all Kant's major works from 1770 on. See *Dissertation* 2:404, *Critique of Pure Reason* A1, *Prolegomena* 4:268, *Groundwork* 4:389, *Metaphysical Foundations of Natural Science* 4:468, *Critique of Practical Judgment* 5:12, *Critique of the Power of Judgment* 5:182, *Metaphysics of Morals* 6:215, *Opus Postumum* 21:402. Kant is less explicit about the principle in the *Religion* (though see 6:3), but that may be to sidestep the question of whether necessary truths can be learned through perception-like revelation (see 6:9).

¹³ See, e.g., B234. On the thin sense of 'experience': 'In the strictest sense, there are no experiences, only perceptions, which, taken together, constitute experience. Here we use the expression simply in its usual meaning of perceptions' (*Physical Geography* 9:157).

¹⁴ Most contemporary philosophers accept something close to this principle. See, e.g., Goswick 2010: 441-42 (but cf. Elder 1992).

¹⁵ A derivative concept has all its non-logical content from the concept from which it is derived (see, e.g., *Jäsche Logic* 9:52, 9:85, but cf. 9:96). For example, the rightness of angles is a derivative concept of that of a triangle (*Dohna-Wundlacken Logic* 24:727).

¹⁶ On predicable concepts, see A81-82/B107-08.

¹⁷ Power (*Vermögen*) is likewise causal: 'Among the different kinds of unity according to concepts of the understanding belongs the causality of a substance, which is called "power"' (A648/B676, see also *Metaphysics* L2 28:564).

¹⁸ For a helpful discussion, see Langton 1998: 38ff. Watkins argues that, for Kant, the forces themselves are causes, not the substances that have them (Watkins 2005: 269).

¹⁹ See *MFNS* 4:478, and the discussion in Friedman 2004: xxviii.

²⁰ Despite calling solidity a force, Locke does not explicitly discuss solidity in his chapter on active and passive powers (*Essay* 2.21). This may be because Locke thinks active powers are what allow a substance to *initiate* a causal chain, and passive powers are mere capacities for change. Solidity fits neither of those descriptions. Newton also grants that impenetrability is encountered in touch: 'That all bodies are impenetrable [*impenetrabilia*], we gather not from reason, but from sensation. We find those bodies that we handle to be impenetrable, and hence we conclude that impenetrability is a property of all bodies' (Rule 3 for causal reasoning, at Newton 1726/1999: 795).

²¹ Kant disagrees with Locke about the nature of solidity. Against Locke and others, Kant argues in *MFNS* that matter is only 'relatively impenetrable' (*MFNS* 4:502), so that compression can be understood without assuming a vacuum or the imperceptible escape of fine matter. See Warren 2001a: Ch. 3 for one account of Kant's reasons for rejecting absolute impenetrability (as well as Langton 1998: 166).

²² E.g., Friedman 1992, Schoenfeld 2000, Watkins 2005.

²³ Friedman denies that Kant took touch to play an *essential* role in the formation of the concept of impenetrability (Friedman 2013: 131ff.), though he does not discuss this passage from the *Inquiry*. Friedman's claim may be right as far as the critical period is concerned, however.

²⁴ See *MFNS* 4:513, 4:524, 4:534. Also relevant is the May 12, 1789 letter to Reinhold (11:37) and *Opus Postumum* 21:474. Langton and Warren claim that knowing the possibility of forces in this sense would require knowing things in themselves (Langton 1998: 173, Warren 2001a: 90, Warren 2001b: 107-110, but cf. Watkins 2002).

²⁵ Michael Friedman suggests that, in claiming the concept of impenetrability is empirical, the mature Kant is just asserting that the ‘the concept of a specific force or cause can only obtain objective reality empirically’ (Friedman 2013: 119). Kant does hold that latter view, but he holds it for both empirical and pure concepts (see A239/B298). So if that were all Kant meant in saying that the concept of impenetrability is empirical, we would expect him to say that the concept of causation was empirical too. Yet Kant never makes that claim, so Friedman’s suggestion is implausible.

²⁶ Kant predominately uses ‘*Berührung*’ for touch, sometimes ‘*tactus*’, and sometimes (as in the key *MFNS* passage), ‘*Gefühl*’. The context of this passage (the listing of five senses) suggests that these are meant to be synonymous.

²⁷ Though Kant emphasizes the limitations of touch, he gives it a privileged status in his lectures. E.g., ‘Sight and touch are completely objective representations. But touch is the fundamental one of the objective representations, for through touch I can perceive shapes when I can touch them from all sides, it is thus the interpretive art of shapes’ (*Metaphysics LI* 28:232, see also *Metaphysics Mrongovius* 29:882-83). Kant’s view is probably influenced by Berkeley, Condillac, and Rousseau – for useful discussions, see Kitcher 1990: Ch. 2 and Svare 2006: 64-9. On the limitation of the sense of touch, see also *Judgment* 5:323.

²⁸ This claim is *prima facie* inconsistent with Kant’s apparent view that all empirical intuition represents objects immediately. I think we can avoid inconsistency by understanding ‘immediate’ (*unmittelbar*) here either in terms of spatial proximity of the physical sense organ or in terms its representing a fundamental property of its object (e.g., since sight presents only non-fundamental properties of matter, it has a mediate status).

²⁹ See *MFNS* 4:510-12, reiterating a Leibnizian view found already in *Thoughts* 1:17. On shape and volume being quantitative, see A163/B204 and A173/B215.

³⁰ See also R3928 and *OP* 21:373. At times, Kant speaks of matter as a substance that *has* forces. Pollok argues that this is a mere relic of his pre-critical views (Pollok 2001: 281-82).

³¹ For one relevant discussion, see Chapters 1 and 2 of Hanna 2006.

³² For one discussion of inconsistency in the *MFNS*, see Rand 2012.

³³ By contrast, it would be implausible to solve the puzzle by attributing a contemporary tracking theory of perception to Kant. For a relevant historical discussion, see Wilson 1990.

³⁴ One could also try to marshal support for this line by considering Kant’s remark that ‘[i]t therefore seems as if every immediate action of one matter on the other could never be anything but pressure or impact, the only two influences [*Einflüsse*] we can sense immediately’ (4:510). Yet since neither impenetrability nor force is an influence for Kant, this sentence alone is neutral on whether we also immediately perceive impenetrability.

³⁵ A referee for *EJP* suggests a revision of Watkins’ view, according to which motions themselves *are* forces. In support of this suggestion, the referee points out that Kant allows for motion that does not involve an alternation of place at *MFNS* 4:482-83. The idea, I take it, would be that some forces are not fundamentally causal/modal, and so could be unproblematically perceived. Some approach along these lines may be ultimately defensible. However, as the passages quoted in §1.2 show, Kant explicitly claims that all forces are causal, and his

examples of motions that do not involve alterations of place at *MFNS* 4:482-83 are rotations and vibrations (neither of which sound like forces). Finally, Kant's claim at A206-07/B252 that motions indicate (*anzeigen*) forces suggests that motions are not themselves forces, since Kant never talks of a thing indicating itself.

³⁶ 'Kant's key move is to conceive impenetrability or the filling of space as the manifestation of a repulsive central force' (Friedman, 1992: 9; likewise Friedman 2013: 31, 105). At the same time, Friedman occasionally talks of the 'force of impenetrability' (e.g., Friedman 1992: 23, Friedman 2004: xix, Friedman 2013: 174).

³⁷ See Friedman 2013: 227ff.

³⁸ See, e.g., Kitcher 1999.

³⁹ See his remarks on chemistry in the preface to *MFNS*, and his remarks about the limitations of a Lockean empirical deduction of the categories (A85-87/B117-19).

⁴⁰ See also §108-10 of Christian Wolff's *Psychologia Rationalis*.

⁴¹ See Friedman 2004 and Friedman 2013. Presumably, this is why Friedman claims that if 'the solar system... as this system of bodies is described by Newtonian physics... were not given to us in perception, then we would have no basis whatsoever for extracting the fundamental forces of attraction and repulsion "from data of experience"' (Friedman 2001: 59-60). See also *OP* 21:475.

⁴² In the first chapter of *MFNS*, Kant states that fully understanding moving forces requires that 'the principles of their composition in general have been previously laid down, purely mathematically, as basis' (*MFNS* 4:487). Yet representing the addition (composition) of one motion to another requires references to *two* spatial frames (*MFNS* 4:490), which is presumably beyond the capacity of the sense of touch. Nor would it seem that touch could teach us the equality of action and reaction in the communication of motion (*MFNS* 4:544).

⁴³ See also his comments on a letter from 1792: 'in experience, all one determines are the forces that act at or from a [given] place (forces that fill a space only to a certain degree), or [one determines] the distance from the center of one force to that of another force' (11:363, editor's interpolations).

⁴⁴ Kant's point here concerns the difference between surface forces (like repulsion) and penetrating forces (like attraction). See Friedman 2013: 172-74.

⁴⁵ See *True Thoughts* 1:141 (which ties *Bestrebung* to force), *MFNS* 4:539, 4:561, *Anthropology* 7:264.

⁴⁶ A possible exception is his conception of God (see A559/B587ff.), though even that hinges on general principles of reason.

⁴⁷ See the pages cited in note 12. Others have noted this connection before, e.g., Allison 2004: 247.

⁴⁸ For one discussion of causal perceptions with singular content, see Armstrong 1997: Ch. 14.

⁴⁹ In Warren 2001a (see *MFNS* 4:476). Warren does not tie the issue of degree to these modal issues or to the content of touch.

⁵⁰ If modality was understood in terms of the space of possible worlds, then we could cash this out in terms of how far out in that space one would have to go. Kant, however, shows no temptation to understand modality in such terms.

⁵¹ In a related vein, Johann Tetens suggests that some cause-effect connections are contingent: 'The connection between a cause and its effect is thus contingent when the entire positive ground can exist and remain as it is along with all remaining positive requirements when the effect is caused, and a new obstacle can nonetheless intercede that holds up its achievement or causality' (translation from Watkins 2009: 387). Mumford and Anjum defend this same view in a contemporary context (Mumford and Anjum 2011: Chapter 3). So long as contingent

causal connections are still modally rich (as Mumford and Anjum suggest at viii), this could fit with the present proposal. See also Fales 1990: 19 and Marshall 2015.

⁵² For an empirical study that supports something like this view, see Wolff, Ritter, and Holmes 2014.

⁵³ McLear 2016 provides one in-depth discussion. For a relevant view about the singular content of intuition, see Smit 2000.

⁵⁴ On the other hand, if we take seriously Kant's claims about the necessity of touch for the application of quantitative concepts, then perhaps touch would count as a full-blown general condition for experience and faculty of cognition.

⁵⁵ For a helpful discussion of Kant's complex modal metaphysics, see Stang 2016.

⁵⁶ This alone is a *prima facie* problem for both the second and third candidate solutions. If we could perceive force, then some intuitions would seem to be homogeneous with the category of causation. Significantly, Kant claims that touch is the least noble of the three objective senses, where nobility is a matter of distance from pure representations (*Anth.* 7:156).

⁵⁷ For helpful feedback on earlier drafts, I'm grateful to Ralf Bader, Mary Domski, Dai Heide, Samantha Matherne, Jennifer McKittrick, Colin McLear, Melissa Merritt, John Morrison, Elliot Paul, Mike Raven, Markus Schrenk, and audiences at Columbia, Monash, Sydney, Oklahoma, Washington, New Mexico, Urbana-Champaign, Nebraska, and Simon Fraser.