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Hunger, homeostasis, and desire

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Hunger is a psychological state that serves physiological energy homeostasis. I argue that it is a *pure underived desire to eat* and examine its role in homeostasis. After scene-setting explanations of homeostasis and desire, I argue that hunger is a close phenomenological match with underived desire. Then, I show why desire is an apt instrument for energy homeostasis. Finally, I argue that energy homeostasis is a multi-factorial future-regarding behavioural strategy. Hunger is a special purpose sensory state that serves only to implement the strategy. Thus, it is a *sensory desire*. I conclude by reflecting on the credibility of this desire.

KEYWORDS
appetite, bodily urge, desire, empiricism, homeostasis, hunger, interoception

1 | INTRODUCTION: VOLUNTARY HOMEOSTASIS

The great French physiologist, Claude Bernard, observed that living organisms maintain their bodies in a steady state in the face of changing external conditions and internal decay. The Harvard medical scientist, Walter Cannon, labelled this "homeostasis".[1] In this article, I examine a *psychological* instrument for bodily homeostasis—*hunger*.[2] After an introduction to the mind's role in physiological energy homeostasis (Section 1), my investigation falls into two parts. First,

[1]*Homeostasis* is increasingly replaced or supplemented in the literature by a more dynamic kind of self-regulation known as *allostasis*, in which the homeostatic steady state is itself the target of regulatory adjustment (see Sterling, 2012). I will stick with homeostasis here, both because the issues I am concerned with are mostly not affected and because the literature on hunger makes little if any use of the more general concept.

[2]Some have talked about *psychological* homeostasis—for example, the increase of volitional attention to compensate for distractions (Fletcher, 1942). This is *not* my topic. I am concerned with a psychological mechanism that helps maintain a physiological steady state.

I will sketch the nature of desire and argue, on the basis of its phenomenology, that hunger is a *pure underived desire to eat* (Sections 2 and 3). Then (Sections 4 and 5), I will bolster the phenomenological argument by explaining why desire is functionally requisite to the role that hunger plays in homeostasis. I conclude (Section 6) by briefly arguing that hunger is a sensory state—a sensory desire—and remark on what this says about its credibility.

For the purposes of this article, homeostasis will be understood as the hierarchically organized maintenance of some bodily variable at a set value. Some cast the net more widely, but my concern here is with the kind of regulation that we find where a variable is subject to environmentally induced fluctuation and natural decay and is brought back to a set value when it departs from it.

Take thermoregulation, which maintains the body at a set temperature. Animals sweat when they are too hot, and this cools them to the setpoint; they shiver when they are too cold, and this warms them up. These behaviours are triggered by *feedback loops*: The system generates an "error signal" when it senses a departure from a pre-set temperature value, and this initiates action to restore the set value. This kind of regulation by means of autonomic[3] feedback loops is generally considered the ground level—the "normal", so to speak—of homeostatic control.[4]

Higher control centres intervene in these autonomic processes "from above", monitoring, adjusting, and supplementing feedback loops as needed. Such interventions may allostatically raise or lower the set level for a particular variable (see fn. 1). Or they may augment or supplement actions like sweating and shivering. Most importantly for present purposes, they may anticipate outside influences and *prevent* or *minimize* a change from the set value by means of what is known as "feed-forward" regulation: action that is oriented to the goal of maintaining the set-point *before* an error signal has been generated.

Here is an example of feed-forward intervention. When the air is cold, an animal may curl up to minimize heat loss. This is not initiated by a feedback loop; the drop in body-temperature has not yet occurred. Curling up is, at least initially, anticipatory or future-regarding. Since the outside air is cold, the body *would* become too cold unless something is done. The system seeks proactively to prevent this. It may do this in a variety of circumstances. Animals do not curl up just when it is cold; they also do so when they go to sleep, in order to compensate for a lower metabolic rate in sleep. Thus, feed-forward regulation may, generally speaking, be multifactorially initiated and controlled.

One other point about curling up, independent of its being feed-forward. Unlike shivering, this action is not autonomic; it is instinctive, but still under the organism's executive control—an animal could choose to find a warm shelter or to brave the cold instead of curling up to keep warm.[5]

Feedforward regulation can also be mediated by learned or intelligent responses. As George Billman writes:

> The higher centers can "intervene", making the adjustments as required to support the autonomic ... processes. This control can occur either at the conscious or unconscious level. An example of a conscious intervention would be the initiation

[3]I use the term "autonomic" to denote a process that is autonomous (i.e., self-initiated) and automatic (i.e., self-regulated).

[4]Goodman (1980) and Billman (2020) have influential reviews of homeostasis.

[5]Colin Klein (2015) writes: "[T]here are homeostatic processes that require us to do something to bring our bodies back in line". He calls this "behavioural homeostasis" (p. 13).

> of behaviors to cope with changing room temperature—adding or removing clothing, opening or closing windows, seeking shade or sun, etc. (Billman, 2020, p. 8)

This nicely illustrates how mental faculties—conscious choice, executively controlled bodily movement, and learning—can intervene to support and supplement autonomic homeostasis. This is the backdrop for the treatment of hunger in this article—the body's recruitment of the mind in support of feed-forward homeostatic regulation.

Coming now to my main topic: Hunger and its opposite, satiation, are components of *energy homeostasis*. In the short term (day-to-day), the body maintains its stored energy levels by balancing energy utilization with food intake. Draws on stored energy activate hunger; adequate replenishment activates satiation. In the longer term (say month-by-month), this system seeks to maintain the body at a set quantity of adipose tissue, in which energy is stored. The long-term target for adipose tissue-mass varies from individual to individual and circumstance to circumstance. When total fat falls below the set quantity, hunger is stimulated over and above that needed for energy replacement.[6]

Now, energy homeostasis is different from thermoregulation in a crucial way. For the acts that it initiates through feedback loops at the ground level—eating (through hunger), ceasing to eat (through satiation), and refraining (through lack of hunger)—are voluntary, not autonomic. Since the system cannot feed or stop autonomically, it does its work by sending hormonal signals to the hypothalamus and brain, which cause them to generate *motivations* to eat, stop, or refrain as appropriate. Thus, conscious motivations and the executive mind are involved at the ground level of energy homeostasis. As Richard Nisbett (1972) once nicely put it, "adipose tissue mass is defended by the central nervous system" (p. 435). (His attribution to the CNS is confirmed and elaborated by Schwartz, Woods, Porte, Seeley & Baskin 2000, Morton, Cummings, Baskin, Barsh & Schwartz 2006, and Farr, Li & Montzoros 2016).

Eating, stopping, and refraining are prompted by two interacting sensory systems. *What* an animal should eat is regulated by a family of reactions that includes pleasure and disgust; *when* and *how much* it should eat is governed by an interoceptive faculty that I will call "appetite",[7] which generates hunger, satiation, and related feelings.[8] Both systems are dynamic; that is, both react indexically to the current situation—*that* stuff smells delicious (*now*); *I* am hungry (*now*). Both operate through the medium of choice—I choose to eat this stuff because I am hungry and it appears appetizing, but I could have eaten something else or nothing at all. So, to reiterate, the conscious mind is not just an occasional as-needed intervenor in energy homeostasis. Guided by appetite and the hedonic sense of taste, it is the main actor.

Though they work together, the hedonic sense and appetite have different contents and functions. Pleasure and disgust are outwardly directed; they are felt evaluations of the things we consider eating. Because of this, they ride on the back of factual perception: Something seems inviting to eat because it smells savoury or looks creamy; it seems repulsive because it

[6]The system is less effective, when it comes to correcting adipose tissue *above* the set quantity, perhaps because the need to correct surpluses of stored energy is less pressing. Though there is some tendency to get less hungry in this circumstance, the set point simply tends to drift higher.

[7]The term "appetite" has two meanings. It can denote an occurrent state: "After my walk, I had a good appetite". Ombrato and Phillips (2021) use it in this way to denote a pleasant state of wanting to eat. The term is also used to refer to a bodily system that regulates eating through motivational states such as hunger. I use it primarily in the latter sense.

[8]The difference between "liking" (hedonic affect) and "wanting" (appetite) is discussed in Berridge et al. (2010). Of course, the two influence each other: when foods promise pleasure one tends to eat more; when one is hungry, one finds food more pleasant.

smells sulphurous or looks slimy. Appetite, by contrast, is interoceptive: It looks inward to the subject's own body and produces various degrees of hunger and satiation, which are free-standing motivational states that are not grounded in perceived features of external things.

There are other motivational states of this sort: action-initiators generated by homeostatic systems. I call them *bodily urges*. Thirst, sleepiness, fatigue, and excretory impulses are other examples, produced by other interoceptive faculties. This article is about hunger and its role in homeostasis. Much of what I say applies mutatis mutandis to the other bodily urges.

2 | WHAT IS DESIRE?

My thesis in this article is that hunger is the underived desire to eat generated by appetite to serve energy homeostasis (or, as I will explain, a hormonal match with such a desire). Further, it is a *pure* desire in the sense that it is not conjoined with some other kind of mental state on which its function relies. Thus, it is not a co-instantiation of two mental kinds in the way that one and the same feeling might be held to be both an itching *sensation*, which indicates a part of the body, and also a *desire* to scratch the part of the body thus indicated. And it is also not a separate component of a compound state—it is not, for example, a sensation of gastric unease coupled with a desire to eat to ease it. It is, in this sense, a *pure* desire.

This is how I will proceed. In this section, I will clarify the nature of desire by recounting two "definitions" of desire found (implicitly or explicitly) in philosophical discussions, and in Section 3, I will use these definitions to argue in support of the theses stated above. Then, in Sections 4 and 5, I will attempt to explain why *desire* as characterized here is a good instrument for homeostatic energy regulation.

Here, then, are two characteristics of desire. Both concern its effects, and both are treated as definitions by researchers in different sub-fields. I will treat both as essential characteristics and utilize both in my effort to understand hunger. (I assume that they overlap greatly in extension but will not worry about their exact equivalence.) Both play a role in the arguments that follow.

Desire as mediator of choice. My desire to eat causally contributes to my eating. How? Not simply by mechanistic or chemical action on my body. Rather, it causes me to eat by being a *defeasible reason* to do so. Thus, hunger satisfies the following definition of desire:

> *Definition 1* A *desire* for outcome O is a psychological state P that represents O in such a manner[9] as to give the subject *by P's occurrence alone* a defeasible reason to act so as bring about O.[10]

Now, this way of understanding desire has a significant flaw. Most non-human animals are incapable of reasoning. Yet they have desires. More generally, the reason-based approach to understanding desire has been accused of over-intellectualization. To accommodate this sort of

[9]One way to understand the manner of representation here is as a Fregean "force". The outcome O can be thought of as the content of an assertion, the content of a fantasy, and so forth, and importantly for us as the content of a desire. When a subject S represents O with the force of a desire, S has a defeasible reason to act so as to bring O about. Karl Schafer (2013) offers an account of this kind, but he says that the force of desire is "imperatival". For reasons I will explain later, I think this is too broad. Occurrent felt desires are, in my opinion, *sui generis* motivators. You cannot understand their force by appealing to some other context.

[10]The appeal to reason is central to treatments of desire by Stephen Schiffer (1976), Wayne Davis (1984), Dennis Stampe (1987), Michael Smith (1987), and others.

concern, we need to generalize the notion. The following formulation acknowledges the representational component of desire and is a good starting point for such a generalization:

> A *desire* for outcome O is a psychological *state* P that represents O in such a way as to motivate the subject *by P's occurrence alone* to act so as to bring about O.

For my purposes here, I will let this issue stay in the background. But I will assume (without further argument) that the "reasons" of Definition 1 are the human homologues of animal motivations. Accordingly, I will take it that when we find animal desires that are structurally similar to human reasons to the extent that it is possible to distinguish direct and indirect motivation, then we have evidence that the human homologues of these desires have the corresponding structure.

Desire as a learning cue. To explain the role of learned behaviour in voluntary homeostasis, it is useful to supplement the above with a functional characterization. The following, which comes into play in Sections 4 and 5 below, is adapted from Tim Schroeder's (2004, p. 70, 2006) by now near-canonical account of the connection between desire and instrumental learning:

> *Definition 2* An *underived desire* for outcome O is an occurrent psychological state P that *rewards* an action A if it leads to O in circumstances C, with the consequence that the subject *learns* to do A when it is in state P in circumstances C.

This way of understanding desire explains how hunger helps us *learn* homeostatic interventions (as outlined in Section 1 above).

3 | THE PHENOMENOLOGY OF HUNGER

In this section, I will begin with an overview of how hunger fits into the landscape of practical reasoning. This gives a preliminary justification for the claim that it is a desire under the definitions of the previous section. Then, I will lay out four phenomenological characteristics of hunger that reinforce this conclusion, and show, moreover, that it is *underived* and *pure*—a desire that is neither derived from some more general desire, nor by its nature conjoined with some other kind of mental state that it depends on to do its homeostatic work.

Hunger answers to Stephen Schiffer's (1976, p. 198) description of a "reason-providing desire"—an underived occurrent desire from which derived desires follow. Such a desire can serve as the *only* reason for eating. Substituting hunger for Schiffer's examples:

> At this moment, I am not in the least hungry, but if I were, I would (with no other change in me) have a *good and sufficient* reason for eating.

There are three points to notice here. First, the change of state from *hungry(−)/reason-to-eat(−)* to *hungry(+)/reason-to-eat(+)* shows that hunger is an occurrent reason. That is, I acquire a reason to eat when I become hungry. Second, *good-reason* shows that hunger satisfies the Mediator of Choice definition of desire above. Third, *sufficient-reason* implies that hunger is an underived desire—it is not *reason-following*, but *reason-providing*, to use Schiffer's terminology.[11]

[11]The way I look at it, hunger is underived because *the subject* has no *reason* for hunger; it is not a state brought about by reasoning. Now, Schroeder (2004) worries about a different problem—the body's generation of occurrent desires. He

Elaborating this observation, imagine that it is 1 o'clock in the afternoon, and I have only had a cup of coffee since waking up at 7 AM. I am hungry. Consider three common scenarios that could follow.

> *Normal*: I am aware of being hungry. This gives me a reason to eat, and I do.
> *Inattention*: I am at that moment completely caught up reading a difficult but attention-commanding paper. Consequently, I am inattentively unaware of being hungry. My hunger, though real, is causally inert, and I do not eat.
> *Conflict*: I am aware of being hungry, but I also know that I am due at a PhD oral examination and cannot spare the time to eat. So, though I want to eat, I recognize a compelling reason to put it off, and I do not eat.

Given reasonable assumptions, the "Normal" scenario demonstrates a causal relationship between hunger and eating. But by itself, this scenario is compatible with hungry-eating being (a) quasi-compulsive, like addictive behaviour[12]; (b) habitual, like snacking while watching TV; or (c) automatic-but-resistible, like falling asleep at the end of the day. The "Inattention" scenario, however, argues against these alternatives. It shows the pertinence of a metacognitive attitude: Without awareness, hunger would not cause eating in the Normal case. This argues against the alternative accounts, (a) to (c) above, for in these cases metacognitive awareness does not play a role: the addict, the TV-snacker, and the sleepyhead can all act/behave without attending to their action-inducing condition. As well, The "Conflict" scenario shows how competing reasons (or motivations) interact with hunger and can normally prevail without undue effort. Cumulatively, these scenarios suggest that in normal cases at least, and in the absence of eating disorders, hunger answers to the Mediator of Choice definition—the first conception offered in the previous section.

Hunger also answers to the *learning cue* characterization of desire. Suppose I am hungry in a strange city, go down an obscure street by chance and find something delicious to eat. Intuitively, this would result in my reaping a psychological reward, with the result that I am more likely to go down this street when I am hungry in that city. If so, hunger would be an underived desire by Definition 2—its satisfaction would be a reward and thus a learning cue.

Schroeder (2004, pp. 151–152) disagrees. He claims that hunger is a "fleeting desire" derived from the standing desire to maintain homeostasis in situations where eating is needed to maintain the energy set-point. He attributes this standing desire to a subpersonal organ, the hypothalamus, justifying this by pleading the rightness of attributing representational states to sub-personal systems. Now, the satisfaction of derived desires is not rewarded; so, this implies that hunger's satisfaction is not rewarded; only the satisfaction of the underived desire

suggests that hunger is a desire derived from the more general desire, which he attributes to the hypothalamus, to maintain stored energy at a fixed level. (Note, though, that this is not a reasoned derivation by the subject.) Staying more or less in Schroeder's explanatory framework, Butlin (2017) disagrees with his conclusion. He argues, on the basis of experimental work by Dickinson and Dawson (1988), that hunger is not a desire of any sort, derived or underived, because it plays a more indirect role than desires. (It changes the organism's reward structure, he says.) My disagreement with these authors comes down to what a derived desire is: I think it is derived by reason from a more general desire. They think that it is an application of condition to a more general disposition, however this is effected.

[12]Holton and Berridge (2013, 2016) say that addicts "want—indeed crave—their drugs" (2016) but do not *like* them. And they say that addicts may "see nothing good in their drug whatsoever" (Ibid.). On some accounts, this implies that the addict cannot cite her "wanting" a drug as a *reason* for taking it—reasons represent their goals as good (Tenenbaum, 2007). Thus, these "wants" fall short of prototypical desires as I have characterized them; they fail the Mediator of Choice characterization.

from which it comes. So, Schroeder would have to say that when a hungry organism eats, it is the *return to homeostatic equilibrium* that is rewarded, *not* the act of eating. This is an unintuitive result. Even for rats, and clearly for humans, food and sweets are rewards—the learning cue is *not* the restoration of blood sugar levels that follows eating after a time lag. And this indicates that hunger is the primary desire—the fact that it is "fleeting" does not tell against this.

These considerations constitute a preliminary basis for saying that hunger is an underived desire. In the remainder of this section, I want to reinforce, clarify, and extend this conclusion by offering four propositions about the phenomenology of hunger. These reinforce the thesis that hunger is a simple underived desire to eat.

3.1 | Motivational immediacy

Hunger rationalizes food-eating in virtue of its very occurrence. Nothing is needed to supplement it.

Motivational immediacy seems to hold in animals. For when my dog is hungry and is not diverted by other needs and desires, he eats the food that is put in his bowl. He does not know, and does not need to know, that this action will restore his body's energy expenditure balance, or that it is good for him, or that eating will result in his feeling less hungry. (Compare the *Normal* condition, above.) However, he will not eat if he is distracted by other things (*Inattention*), or if he is trained not to eat until given the word (*Conflict*). As indicated, his motivational structure parallels the three conditions of human desire-based reasoning mentioned earlier. Thus, the motivational force of hunger comports with the first characterization of desire in Section 2 above; it works without supplementation, though it requires awareness and is defeasible. This strongly suggests that the rational structure of human hunger-motivation is homologous with the primitive body-generated desires of animals.

Motivational immediacy blocks a number of attempted analyses of hunger. Take Dennis Stampe's (1988) analysis of *needs*—his example is thirst, but I will take it that he intends to apply it to hunger as well. Stampe treats hunger and thirst as mental representations of bodily needs that cause the subject to rectify the need by eating or drinking. This looping structure is insightful, but Stampe's elaboration is vitiated by three crucial errors inherited from traditional treatments. To begin with, its central assumption is a mistake: We saw in Section 1 that homeostatic urges like thirst and hunger are not always driven by needs; they can be feed-forward or anticipatory. Secondly, Stampe says (ibid. pp. 149–150) that the mental representation in question is a *sensation*, a conscious awareness of need.[13] As I will argue, hunger is not a sensation. Most relevantly to the present context, Stampe's thesis violates Motivational Immediacy. We need a desire to transition from a fact-indicating sensation to a motivation to eat. But the connection between hunger and eating is unmediated.

Next, consider the idea that hunger is a motivational state, but one that acts a bit differently from desire. An example is Colin Klein's (2015) proposal that hunger is an "imperative",—"what the body commands", as he puts it. In Klein's strict reading of imperatives, they are not by themselves reasons for the agent to comply.[14] They yield a reason only if the person

[13]The assumption of fact-indicating perception of need vitiates Stampe's (1987) theory of the "authority of desire".

[14]Many authors understand imperatives merely as non-indicative motivating states. (See e.g., Matthen, 2005, p. 240; Schafer, 2013.) Desires are imperatives in this more accommodating sense, but this does not account for the (defeasible) sufficiency of occurrent desire.

commanded recognizes the "authority" of the entity that issues the command. Accordingly, Klein argues that there is a sense in which we recognize the body's authority to issue this command, and that this stands behind hunger.[15] But if hunger has motivational immediacy, it does not require this (or any other) additional premise. A structurally similar criticism can be made of the idea that hunger is an emotion. I will return to this later.

Some philosophers claim that hunger is an unpleasant condition that we eat to ameliorate. Right off the top, this is untenable: As Ombrato and Phillips (2021) point out, hunger can be pleasant, as when you anticipate a holiday feast. But putting this aside, it would be a reason to eat even if eating did not make it go away. Imagine an organism that was hungry all the time and ate constantly in much the way that it breathes constantly. Eating would not make it less hungry, yet hunger is what motivates it to eat. Or imagine somebody who had an eating disorder and knew that they would never stop being hungry no matter what or how much they ate. There is no reason to deny that this person is motivated by hunger in exactly the same way as others are.[16]

What about a dual aspect theory of hunger—a desire that is also a sensation? Is hunger like an itch—a sensation that is at the same time a desire. Or could it be an Armstrong-style compound-state: awareness of a homeostatic eating-occasion *together with* a desire to eat?[17] My response to these suggestions is two-fold. First, that since any other kind of mental state fails Motivational Immediacy, it would be the desire that is doing the work in any such combination. More importantly, though, there is simply no sensation that is a constitutive part of hunger—argument yet to come. So, even if itches and pains work like this, a dual-aspect theory of hunger fails. Whether or not there is an accompanying sensation, it is not what hunger is.

3.2 | Psychological self-containment

To *feel* hungry is the same as to *be* hungry.[18]

Hunger is the feeling generated by the interoceptive faculty of appetite to motivate eating for the maintenance of energy homeostasis. To have this feeling is to be hungry; nothing more is required.[19] This shows that hunger is not a physiological state. It is not, for example, the state of needing nutrition, or (as Tolman apparently operationalized it) "time since last feeding".[20]

[15]Klein (2015) sums his position up in this way: "The body issues imperatives. These motivate us by giving us a reason to act. They do so because we accept the body as an authority, and authoritative commands give us reasons for action" (p. 76).

[16]Here, I follow Stampe (1987).

[17]To be clear, this is imported from Armstrong's theory of *pain*. His theory of hunger is that it is "primarily the desire to eat" regularly accompanied by "hunger-pangs" (1962, p. 114). Substitute "in certain circumstances" for "regularly", and this accords very well with my view.

[18]Armstrong (1962) makes this a defining characteristic of "intransitive sensations:" "a pain *is* a sensation of pain, and itch *is* a sensation of itching" (ibid, 1). And hunger is, for him, an intransitive feeling.

[19]One slightly technical aside about self-containment. Hunger is "immune to error through misidentification;" that is, one cannot be wrong about the feeling of hunger by being wrong about *who* is hungry. Some have argued that proprioception *is* prone to error in this way. If one were hooked up to somebody else's musculoskeletal sensations, it could feel as if one's own knee were flexing when in fact it is this other person's knee that is flexing. This is because proprioception is located relative to the body, and in this kind of case, one is mistaken about *which* body is involved. But hunger is attributed to the self. One cannot by wrong about who this is. Even if my feeling of hunger came from somebody else's body, it would still be me that is hungry.

[20]See Hasok Chang (2021) for this attribution to Tolman. Tolman was no behaviourist, of course; Chang emphasizes that he "did not deny that hunger was a subjective feeling".

But there are complications in this statement that I will now explain.

Feeling hungry is not the same as metacognitively being aware of feeling hungry. One can be inattentively unaware of hunger. One can also misidentify some other feeling for hunger. It sometimes happens, for instance, that one is bored, and as a result the desire to eat spontaneously pops up. But here, what one feels is not hunger. Hunger is not just any desire to eat.

Could one say that hunger is the desire to eat *generated by appetite*? This is better, but it does not exactly conform to clinical practice. Appetite generates hunger and satiety by sending characteristic hormones to the brain—to over-simplify, ghrelin for hunger and leptin for satiety.[21] Clinicians count the urges brought about by the medical administration of these hormones as hunger and satiety,[22] Hunger, and the secretion of ghrelin, is also an undesirable side-effect of certain drugs used to treat diabetes and of some anti-psychotic drugs (Maayan & Correll, 2010) even though the faculty of appetite is once again not involved.[23] So, appetite is not as such the key factor; rather, appetite's hormonal signature is.

Summarizing: Hunger is the feeling of wanting to eat food autonomically generated by hormonal action that matches that of appetite. One can misidentify this feeling, or fail to be aware of it; nevertheless, it is hunger. If one has this feeling, then one is hungry.

3.3 | Attribution to the self

I am hungry, not my body.

It is not an accident of language that bodily urges are attributed to the self, not to the body or one of its parts. Desires are generally attributed to the self because they motivate actions performed by the self—it is *my* desire because it represents and directly motivates what *I* will do. By contrast, sensations are attributed to a part of the body. They are, to use David Armstrong's (1962) term, *transitive*: When you feel a sensation in a part of your body, you feel that part of the body. Hunger does not identify any part of the body or even the whole of it. It represents an action of the undivided self.[24]

Now, bodily urges are often associated with localized sensations—hunger with pangs in the stomach, thirst with a dry mouth; fatigue with aching muscles, sleepiness with eyes that want to shut, and so on. And so, it is tempting to make these sensations a constitutive part of the urges. Hunger is felt in the stomach, some would like to say. This is a mistake. The localized sensations are not the *same* as the bodily urges they accompany. Stomach pangs are associated with, but different from, hunger.[25] Attribution to the Self, however, implies that hunger is not a bodily sensation, for these are attributed to parts of the body.

[21]Ghrelin was identified and named by Kojima et al. (1999). Its effects on hunger are reviewed by Neary et al. (2004), Kojima and Kangawa (2005), and Klok et al. (2006). For informed speculation that there are other regulatory hormones in play, see Lund et al. (2020).

[22]Ozempic is a drug used to induce satiety by matching appetite's hormonal action both when the body's set point is above what an individual desires and when it is slow to react to over-feeding. There is currently a heated debate about whether it should be considered a treatment for a dangerous illness (i.e., obesity) by overriding an overly high homeostatic setpoint, or a vanity drug that disregards Nature's setpoint. For two relatively measured but somewhat opposed viewpoints, see Garcia-Navarro (2023) and Tolentino (2023). Neither side of the debate disputes the authenticity of the satiety produced in this way.

[23]Tagging hormones in this way is a placeholder: it is entirely possible that in the future, hunger will be identified with some other signature. The important point here is that phenomenal matching is not sufficient.

[24]This is another reason to resist Schroeder's idea that hunger is derived from a desire attributed to the hypothalamus.

[25]See Fulkerson (2023) for a parallel argument based on double dissociation that thirst is not the same as a dry mouth.

The primary indication of this is that hunger belongs to a family of motivational states produced by appetite, not all of which are associated with any sensation. Urgent hunger is indeed associated with stomach pangs. But you can be hungry without being urgently so—think of your experience at scheduled mealtimes. These circadian desires are not typically accompanied by any sensation in the stomach. The same can be said of satiety: You can have eaten so much that the very idea of eating any more is repellent. Like urgent hunger, this is accompanied by localized sensations: stomach distension, bloat, and the hint of a gag-reflex. But there is also the feeling of hunger barely satisfied: After a quick sandwich, you might lose the desire to eat, but not feel any of the unpleasant sensations of repletion. These four states—urgent and non-urgent hunger, moderate and extreme satiation—belong to a family. The common element is that they are motivational states relative to eating generated by appetite. Only the extreme ones are accompanied by distinctive bodily sensations. These accompanying sensations are explained by associated events in the body, for example, the digestive system's insistent preparations for eating cause audible signs and sometimes even discomfort; when you are over-full, the pressure of ingested food causes bloat. But you do not typically recognize a state of hunger by the accompanying pangs. Rather, you recognize the pain in your stomach as a pang of *hunger* because, by a fairly complex process, you identify it as the concomitant of a desire to eat.[26]

This is why an Armstrong-style compound state definition of hunger would be mistaken: Even when it is associated with stomach grumblings, and so forth, hunger is not that sensation, in whole or in part. It is just the desire.

3.4 | Behavioural focus

Experiences like hunger fall into a broader class of non-localized, whole-self attributed motivational states. This broader class includes *moods* and *emotions*. *You* feel sad or affectionate or anxious, not any part of you. And you know this, or are capable of knowing it, in a special "first-person" way to which others lack access. But the emotions focus on more abstract goals than hunger and the other bodily urges do. They are evaluations or action tendencies which, to a much greater extent, leave it open how to act in response. For example, sadness tells you that you have experienced personal loss. You can respond to loss in different ways: You can spend time mourning; you can seek solitude; you can drown oneself in work. Hunger, by contrast, directly motivates eating without any evaluation of the situation that makes eating desirable.[27] This is how it is different from moods and emotions.

I will conclude this section by mentioning an argument advanced by Klein (2007, 2015) building on an observation of Richard Hall (2008). These philosophers insist, rightly, that desires (and also beliefs) are attributed to the self, not to a sensory system or bodily part. But they think that *hunger* is *not* attributed to the self, but rather to a sub-personal perceptual system. Klein elaborates this as follows:

[26]The predictive inference model proposed by Barrett and Simmons (2015) seems to offer a good account of how certain stomach pains are associated with hunger. However, I do *not* believe that hunger itself is identified by predictive inference but discussing this is best left to another occasion.

[27]Ron Mallon drew my attention to Thomas Nagel's (1969) view of hunger: "Hunger ... is an attitude toward edible portions of the external world, a desire to relate to them in rather special ways" (Ibid. p. 7). Though this is equivalent to my formulation, I would put it the other way around: it is an attitude toward ingestion, namely that certain rather special objects should be its targets.

> [S]ensations ... are felt as things that happen to us ... Hunger, thirst, and the other homeostatic sensations also come in that same unbidden way and are similarly beyond our control (that is why they are frequently annoying and inconvenient). Sensations are part of the more basic, peripheral milieu to which more central propositional attitudes must respond (Klein, 2015, p. 128)

The suggestion is that since hunger is not attributable to the self because it comes to us "unbidden". Hall (2008, p. 532) supports the same conclusion by citing Gareth Evans's (1982, p. 124) assertion that belief should be defined in terms of judgement. Belief and desire are always the product of reasoning. This is how the bodily urges fall short, Klein says.

Now, it is, of course, correct to say that perceptual experience and hunger are largely beyond our control; they are not the products of judgement. Nevertheless, we use these mental states to *ground* judgement. As I said earlier, hunger is a reason-providing desire—a reason in virtue of desire, not a desire in virtue of reason. And this implies that hunger is an element of practical reasoning: "I am hungry, so (other things being equal) I should eat". It may seem odd to say that the secretion of a hormone can put one in a reason-supporting motivational state, but this is just the oddity that we started with—the body recruits the mind for the maintenance of homeostasis. Bodily urges are integral parts of the web of reasoning—since they are supported by interoceptive experience, not by reason, they reside at the outer boundaries of this web. But they belong to it all the same.

4 | HUNGER, FORAGING, AND DESIRE

I have been arguing that the feeling of hunger is a desire. I want now to ask what why *desire*—the kind of psychological state that mediates choice and learning as sketched in Section 2—is better suited to serve energy homeostasis than some other kind of psychological or, for that matter, physiological mechanism—a behavioural reflex, or automatism, or factually informative sensory state, or just an autonomic absorption of nutrients from an animal's surroundings, in a manner akin to breathing. What, in short, are the specific functions of desire in energy homeostasis?

My answer to this question comes in two parts. In this section, I will show how desire functions relative to what some evolutionary biologists call *tactics*[28]—choice-mediated behaviours, many learned, that vary among individuals of the same species in similar circumstances. Specific feeding behaviour—where an animal forages, what it prefers to eat—is controlled by choice; desire is a precondition of choice. Still, why should feeding be controlled by *occurrent* desires like hunger? Why not provide organisms with factual representations of their circumstances that they can then employ to adjudicate choice through *standing* desires like the will to live and flourish? I will attempt to answer this question in the following section. There, I will discuss how desire relates to *strategy*—genetically determined behavioural patterns that guide an animal's choice of tactics.

Motile animals forage for food and employ muscular organs to ingest it. The nutrition they require is not available to them in the air and soil adjacent to their bodies; they must identify food at a distance, travel to it, collect or capture it, and ingest it. These acts are voluntary; they are chosen by the animal. In many cases, they are also learned.

[28]For one application of the term, and the contrast with *strategies*, see Gross (1996).

Let us consider choice first. Why should food-gathering and ingestion be a matter of choice, rather than a reflex or automatism? To shed light on this question, let us consider the contrast between *motile* and *sessile* organisms—animals, such as humans, that can travel under their own power, as against plants and animals such as corals, barnacles, and sponges that cannot travel to food.

Sessile organisms perforce satisfy their needs by opening themselves up to what is available in the place where they are. *Motile* animals, by contrast, seek out and exploit *distant* resources by actions that involve whole-body movement. This gives them access to many resources unavailable to sessile organisms. But the actions by which they exploit these resources cannot be performed simultaneously—foraging, defence, play, rest, and so forth, are performed a few at a time, and so they must be prioritized and chosen. Sessile organisms have no occasion to choose between eating and sleeping, or between satisfying thirst and hiding from a predator. For motile organism, by contrast, while a few of their needs are met by automatisms and reflexes—breathing, metabolization, sleep—most are not. These organisms are faced with *action prioritization* and choice. Thus, some of their homeostatic systems have to compete for choice. Each has a call on action, but the whole organism is given the role of prioritizing these calls. These systems create desires that vie against one another for executive choice. Desire is the precondition of choice.[29]

A second and related point is that desire is, as we saw earlier, an instrument of reinforcement learning. An animal desires to eat, but food is not available in its immediate surroundings. So, it must forage, and we know that animals learn to do this in novel ways that suit their environments—for instance, an animal might inhabit a different part of its terrain because it has found food there or arrive at a particular location at a fixed time because that is when it has learned food will be available. Learned foraging tactics are enabled by desire. Desire brings plasticity to voluntary homeostasis.

Here is the upshot. In higher animals, activities like sleeping and eating that entail whole-organism movement demand choice. Moreover, desire enables experiential learning. In these ways, motility is served and enabled by hunger and the other bodily urges.

5 | INNATE BEHAVIOURAL STRATEGIES IN VOLUNTARY HOMEOSTASIS

The argument of the foregoing section purports to show that among action-initiating psychological mechanisms, an occurrent desire is the most apt for the regulation of eating. But now we must face a trickier question. What is the utility of generating such occurrent desires directly? Why not issue a factual representation of the state of the body, which together with some standing desire (such as a desire to be healthy) would generate the requisite occurrent desire? Why is it functionally less effective to have a two-step process between need and behaviour instead of the one-step desire that the phenomenology indicates?

[29]The argument of this paragraph is a simple (and also less general) version of that in David Spurrett (2021), who writes "Preferences enable efficient action selection", and asks when it is advantageous to have preferences. The choices I am concerned with are more basic than his—eating versus sleeping as opposed to a bird's nesting an egg laid by itself vs one laid by a cuckoo. I contend that choice with respect to the more basic functions is mandatory, not merely more efficient.

The crucial point to consider in evaluating this option is that as eating-disorder clinicians are increasingly aware—and contrary to what many philosophers continue to assume—hunger is not simply a reaction to a stored energy shortfall. The homeostatic regulation of eating is not purely feedback; it involves feedforward, or anticipatory, impulses.

Consider a very simple point. Action is needed when the body falls short of stored energy. However, there is a lag between fat-replenishment and intake of food through the mouth—the food you eat has to be digested and metabolized before stored energy levels can rise. If you ate until your body had stored enough energy, you would be eating for hours and thus overshoot the mark. So, even if hunger was always initiated by stored energy shortfalls—which, of course, it is not—*satiation* is triggered in part by a pre-digestive process (presumably modulated by the hormone, leptin) that monitors *eating* (not energy).[30] Appetite seeks proactively to establish a set level of adipose tissue. To do this, it implements an innate behavioural *strategy* for optimal feeding.

Here are some signs of a comprehensive strategy of energy management. We get hungry in response to circadian rhythms, that is, at specific times of the day. We get hungry (and remain so longer than otherwise) when we are presented with food that smells or tastes delicious (hedonic hunger), or when the occasion promises social enjoyment and fulfilment, or is otherwise associated with eating. Hunger is even evoked when we *believe* (truly or falsely) that we have eaten less than usual at the previous meal (Brunstrom et al., 2011). All of these circumstances occasion the secretion of ghrelin: All produce hormonally genuine hunger. Hunger is feedforward and multifactorial, then; it is not just a feedback response to a single homeostatic error signal.

Now, some have hinted that cues such as the ones just mentioned are non-functional, or even that they prompt something other than hunger. Thus, Stanley Schachter (1968) expresses some sympathy with the view (which he attributes to Hilde Bruch, 1961) that, "the obese literally do not know when they are physiologically hungry" because they rely on "extrinsic" cues more than people who weigh less. For example, Goldman et al. (1968) found that lesser-weight flight crew on westbound trans-Atlantic flights would want to eat upon arrival since they had not eaten for many hours, while their heavier colleagues would not, because the local time (say 3 PM when they landed) was wrong for eating (and so the external cue was missing). Similarly, they found that when obese people are offered a tasty snack, they would eat even if they just eaten a good meal, while normal people would not—"over-weight" individuals experience hedonic hunger more readily than their slimmer counterparts. Schachter argues from data like this that overweight people have a problem distinguishing hunger from association-engendered eating cues.

Schachter's findings have been probed extensively in the more than half century that has passed since publication, and they have been found wanting, mostly from the point of view of how well they explain obesity.[31] Obesity is not my concern here; I want to argue that even if you grant the data, his conclusion is an overreach. For a more neutral way to summarize the findings is to say simply that people who rely more on physiological eating-cues tend to weigh less than people who rely on a mix of cues, including external cues. Looked at in this way, it is easy to concoct an evolutionary scenario in which appetite comes to rely on both physiological and external cues. Consider two inbuilt eating strategies competing against one another for evolutionary selection. One is more *reactive*: Eat when and only when the body needs energy. The other is *proactive*: Eat so as to maintain an optimal level of stored energy. The proactive strategy

[30]For an overview of these complexities, see Zimmerman and Knight (2020) and more broadly, Yeomans (2020).

[31]Current thinking about obesity is more in line with Nisbett's (1972) idea that the body regulates quantity of adipose tissue.

would be sensitive to both physiological and external circumstances—eat enough to match expended energy (do *not* eat until stored energy is restored); eat at regular intervals to minimize energy fluctuation; eat energy-rich food (guided by the hedonic sense) when it is available (for who knows when it will be available again?); eat in social situations (for this is part of reciprocal donations of food); and so on.

Schachter's observations suggest that in affluent societies, where tasty food is readily available, people who follow the proactive strategy tend to weigh more, perhaps to the point of unhealthy obesity in some cases.[32] But it is easy to imagine that back when hominins were hunter-gatherers, or even in contemporary conditions of scarcity, the very same strategy was actually advantageous. When food is hard to come by, or where a great deal of energy has to be expended to find it, the variation of weight within populations is smaller. In such environments, greater weight is a sign of success, and unhealthy obesity is rare. However, an eating strategy that works well in conditions of scarcity can lead to wide variations of weight in times of plenty. But the reverse is true as well. A strategy that relies almost exclusively on physiological cues would reduce variation in times of plenty but lead to the excessive occurrence of emaciation when food is relatively hard to find. The fact that most people follow both physiological and external eating-cues strongly suggests that a proactive strategy was selected over a purely physiological one.

With the above considerations in mind, let me suggest that appetite follows a complex strategy that has the function of proactively maintaining a healthy level of stored energy within the body over time. Eating when, and only when, you are depleted is not a good way of achieving this. Accordingly, the body's strategy takes a number of different factors into consideration, some for homeostatic feedback, others "extrinsic" for feedforward regulation. The strategy varies from person to person, though it is not clear whether this is due to personal, environmental, or genetic factors. Generally speaking, though, hunger is multi-factorial, because the maintenance of stored energy requires attention to many different variables. An innate strategy of this kind has its pitfalls. We know that these strategies are complex and not perfectly adapted to modern affluence, and that they can easily break down. Eating disorders arise from shortcomings in their realization—from feeling hungry or full at the wrong times relative to an optimal strategy.

Now, let us return to the question with we started this section. Why does the body regulate eating through desire? Why does it not present the subject with a representation of the fact that makes it desirable to eat, along with an affective component that tags that situation as one that demands remediation? The first part of the answer is that since hunger is multi-factorial, there is no one factual circumstance in which eating is called for. And this is not merely because there is a single multi-realizable trigger for hunger[33]—there is genuinely no single descriptor for all of the eating-appropriate circumstances dictated by a proactive strategy. Rather, you feel hungry when the strategy dictates that it is a good time to eat. Note how this way of putting it echoes the behavioural focus of the urge itself.

The second part of the answer follows quite closely on this. Appetitive sensing is dedicated to a particular regulatory system. It is not a free-standing perceptual mechanism that determines a fact and allows the agent to act on it in accordance with standing desires. It is rather a system that serves appetite and has the sole purpose of determining the appropriateness and

[32]Schachter: "A person whose eating behavior is under external control will stroll by a pastry shop, find the food in the window irresistible, and, even if he has recently eaten, go in and buy something" (1968, p. 753). Lund et al. (2020) observe that variant eating strategies result in less variation in conditions of food scarcity than in "obesogenic" conditions.

[33]Klein (2015): "Hunger can be caused by a drop in a variety of nutrient levels" (p. 18). True, but by other circumstances too.

urgency of either eating or refraining.[34] General purpose sensory states have a factual representational format because this enables them to serve diverse functions in different situations. A special purpose sensory state like hunger has one use only—to motivate eating when the homeostatic system that it is attached to requires it. Because of this, the output of appetite is hormonal and acts on the hypothalamus to produce occurrent motivation.

It is worth remarking here that visceral interoception is generally special purpose and motivationally loaded, while exteroception is mostly general purpose and factual. It is tempting to analogize interoception and exteroception by saying that the first is perception of conditions inside the body as the second is a perception of conditions outside. But this neglects the fact that exteroception is available for actions of many bodily and mental systems for many purposes—my perceptual knowledge of the layout of my living room is used for navigation, interior decoration, report, planning, and memory to mention just the most obvious. Interoception, however, is generally the product of sensory systems that are functionally tied to a specific action nexus—hunger is tied to energy-homeostasis in our example. While we cannot hope to do justice to the topic here, this is the ultimate reason why visceral interoception is generally tied very closely to motivation.

In general, bodily urges are linked to triggering conditions in feedforward homeostatic strategies. Hunger, we have discussed. Thirst is somewhat similar, though it is designed less for optimal patterns and more to respond to a variety of conditions, all of which call for the intake of water.[35] Thirst is sensitive to several physiological conditions: a fall in the amount of fluid outside the body's cells, an increase of osmolyte concentration in this fluid, a decrease in the volume of blood in the body, and eating (which triggers "prandial" thirst, which encourages drinking to lubricate chewing and swallowing). And like hunger, it is sensitive to external cues: circadian rhythms, stress, and sociability. These are distinct conditions, sensed by distinct though overlapping sensory pathways; what they have in common is that each provokes the urge to drink water. Some philosophers are tempted to treat such urges as representing a disjunction of factual conditions. But as I said above, they are the outputs of a sensory system dedicated to the implementation of a behavioural strategy. A general-purpose sensory system is attuned to facts that can be used in conjunction with a variety of desires. Appetite has only one function: to determine when it is right to eat.

6 | CONCLUSION: EMPIRICISM, DOGMATISM, AND BODILY URGES

In my account, the bodily urges are special purpose sensory states that serve a regulatory system. Despite some disanalogies, they originate in ways that resemble factual perception. Appetite mediates the body's response to a certain set of circumstances as they arise. To do this, it uses dedicated receptors, processes the output of these receptors, and signals the results to the brain. It is tempting, therefore, to compare what I have said about the urges to some key tenets of perceptual epistemology. For just as factual perception stands to the justification of belief, so, one might think, motivational perception stands to the justification of action and choice.

[34]Compare Klein (2015): "Homeostatic sensations may be thought of as a bit like fire alarms. The primary purpose of a fire alarm is to get people to evacuate" (p. 19). This is just the view I reject, but it does bring out the behavioural focus of these sensations.

[35]See Matthew Fulkerson (2023) for an illuminating discussion.

To illustrate the analogy, consider the position that James Pryor calls "dogmatism".

> The dogmatist about perceptual justification says that when it perceptually seems to you as if *p* is the case, you have a kind of justification for believing *p* that does not presuppose or rest on your justification for anything else ... No further awareness or reflection or background beliefs are required. Of course, other beliefs you have might defeat or undermine this justification. But no other beliefs are required for it to be in place. (Pryor, 2000, p. 519)

To sum this up: (Factual) perceptual appearance is inherently credible, at least until it is credibly contradicted. It gives unmediated but prima facie reason for its own acceptance. This parallels the claim that I made about the bodily urges in Section 2 above: They give unmediated but prima facie reason for the action they urge.

Why does perceptual appearance have this kind of epistemic weight? Pryor does not say: He simply asserts it, or rather offers it as a route to a "modest" anti-scepticism, in which we can "justifiably believe and know such things as that there is a hand, without contradicting obvious facts about perception" (Ibid., p. 517). Perhaps, this is the right approach. Dogmatism cannot be justified, at least not in a way that would satisfy a sceptic. So, there is no point in saying why perceptual appearance is credible. Nevertheless, we can talk around it and say why it is an appealing position.

There are two ways to do this, and once again, they parallel what has been said above. The first is phenomenological. Perceptual experience commands epistemic acceptance by the way it feels. The facts and objects that we encounter through factual perception bear the "feeling of presence". In short, perception simply *seems* credible; that is the role it plays in naïve "folk" epistemology. This compares with what I said about the bodily urges in Section 3. A hungry person is presented with unmediated but defeasible reason to eat. As with factual perception, this is a brute fact: This is the role that hunger plays in our choices. We know it is unmediated because we do not go through any other channel to justify hungry eating; we know that it is merely a prima facie reason because we can conceive of reasons to justifiably resist the demands of hunger.

Functional biology, or "etiology" as it is sometimes called, can also be used to support dogmatism, or at least to bolster its phenomenologically based claims to credibility. Briefly and crudely, the claim would be that perception evolved because trusting it led to reproductive advantages. And so, trust and acceptance were selected as features of the phenomenology of perception. Again, this parallels the argument of Sections 4 and 5.

Pryor's dogmatism attempts to "diagnose and defuse" scepticism by counterposing the latter with reasonable assumptions about perception. The position I have taken targets a different kind of scepticism. Hume and others posit an absolute divide between "is" and "ought", a gap that makes it impossible to refute "the permissibility of preferring the scratching of my finger to preventing the destruction of the world". Hume's conclusion is that ultimately no preference can be challenged or justified. We can "diagnose and defuse" this kind of nihilism by appealing to the etiology of primitive motivational states (cf., Shaw, 2021). The bodily urges are reasons for actions. When one is hungry, one has a reason to eat that cannot be defeated by groundless contradictory impulses. When one is hungry (but not itchy), it is prima facie irrational to prefer the scratching of one's finger to eating.

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