2023

Artificial Systems as Disposition Bearers

Lauren Ashwell
Bates College, lashwell@bates.edu

Recommended Citation
Ashwell, Lauren. "Artificial Systems as Disposition Bearers." Artificial Dispositions, Bloomsbury Publishing Plc, 2023, pp. 83–96.

Artificial Dispositions

Investigating Ethical and Metaphysical Issues

Edited by
William A. Bauer and Anna Marmodoro

BLOOMSBURY ACADEMIC
LONDON • NEW YORK • OXFORD • NEW DELHI • SYDNEY

BLOOMSBURY ACADEMIC
Bloomsbury Publishing Plc
50 Bedford Square, London, WC1B 3DP, UK
1385 Broadway, New York, NY 10018, USA
29 Earlsfort Terrace, Dublin 2, Ireland

BLOOMSBURY, BLOOMSBURY ACADEMIC and the Diana logo are trademarks of Bloomsbury Publishing Plc

First published in Great Britain 2024

Cover image:
LisaStepanek / Stockimo / Alamy Stock Photo

A catalogue record for this book is available from the British Library.

A catalog record for this book is available from the Library of Congress.

ISBN: HB: 978-1-3503-3611-7
ePDF: 978-1-3503-3612-4
eBook: 978-1-3503-3613-1

Typeset by RefineCatch Limited, Bungay, Suffolk

To find out more about our authors and books visit www.bloomsbury.com and sign up for our newsletters.

Contents

4

Artificial Systems as Disposition Bearers

Lauren Ashwell

1. Introduction

Familiar objects that we think of as "natural"—people, other animals, most plants—seem already to be presented as individual objects prior to us thinking of them as having dispositional properties. It can therefore seem to be fairly clear what thing is the bearer of a particular disposition when we come to attributing dispositional properties.[1] When we shift our attention to artificial objects—particularly less familiar ones, or ones that are connected functionally but not through visible physical attachments—it can be more difficult to work out exactly which thing has a particular disposition and even which dispositions are to be attributed at all. Whether one thinks of something artificial as a single object or as part of a system can seem to impact what dispositions it can have. As I will argue in this essay, how one carves up systems into disposition bearers impacts issues such as whether dispositions in artificial systems can be extrinsic to their bearers, and whether and how dispositional properties of the same bearer can conflict.

The questions that I discuss have some bearing on questions of dispositional attribution beyond artificial systems; some natural systems will also raise similar questions of dispositional attribution. Many artificial systems, however, provide interesting examples of the conceptual possibilities of different ways of carving up matter into things that can bear dispositional properties, and such possibilities are often clearer than in systems that are assumed to be natural. This is particularly clear in examples where a locus of control or information is remotely connected to the rest of the system, such as with parts of navigation systems for self-driving cars or wifi-equipped household appliances.

How to think about what a system is, and what determines the boundaries of a particular system will impact the system's dispositional profile. So I will begin

in the following section with a discussion of what it is to constitute a system. As we are thinking about artificial systems, I will focus on work from engineering disciplines, as well as work in the related interdisciplinary field of Systems Theory. Here I will also touch on the concept of artificiality, although I think the question of when entities are natural or artificial is messy and difficult, and possibly without a single answer. After that, using some examples that fit the rough overall idea of an artificial system, in Section 3 I will discuss how what we take to be the disposition bearer impacts general questions about dispositional properties, including whether there are extrinsic dispositional properties, and whether and how dispositions had by some disposition bearer can conflict. I will argue that dispositions had by artificial systems can in some cases conflict, so that systems do not necessarily have a singular dispositional profile.

2. What is an Artificial System?

There are some very different referents of the word "system," and it isn't clear at first that they have much in common. There are educational systems, belief systems, electrical systems, circulatory systems, and management systems. There is systemic racism, systemic economic inequality, and diseases can be systemic rather than affecting a localized part. When it is pointed out that a problem is a problem with a system, this usually aims to correct the idea that it stems from features considered individually; the problem at your workplace might be that there is no system for how restocking occurs or who is responsible for making sure the printers work, rather than that so-and-so is lazy. Similarly, thinking of racism as an individualized issue obscures how important racial injustices are caused in part by regularities that operate above the individual level.

So thinking of something as a system is not just thinking of it as a collection of autonomous parts, but as parts in relationships. This overall idea of what a system is fits with definitions explored in the field of Systems Theory. Ludwig von Bertalanffy, who coined the term "General System Theory" in the 1940s, defines a system as "a set of elements standing in inter-relations" (Bertalanffy 1968). In reviewing different uses of the term "system," Dov Dori and Hillary Sillitto (2017) note that in the INCOSE Systems Engineering Handbook, a system is defined as "an integrated set of elements, subsystems and assemblies that accomplish a defined objective. These elements include products (hardware, software, firmware), processes, people, information, techniques, facilities, services, and other support elements."[2] Dori and Sillitto themselves attempt to give a more

general definition of what a system is, and settle on the idea that a system is "A group of parts combined in a way that creates one or more emergent properties or capabilities not possessed by the separate parts" (Dori and Sillitto 2017: 215).[3]

The conception of "emergence" here is not particularly metaphysically robust, although it is compatible with Strong Emergence as defined by Jessica Wilson (2021).[4] First, the Systems Theorists who use this definition do not take it to be up for debate whether there *are* systems, while the existence of Strong Emergence is controversial. Although this does not provide a conclusive reason to think that the conception of emergence in play here is thinner than the conception of emergence in metaphysics—of course theorists may be wrong about the existence of the type of thing that they study—it does suggest that they are using a weaker sense of "emergence" than is debated in contemporary Metaphysics. Second, Dori and Sillitto also give more detail about their conception of "emergence" when they state that one of the key characteristics of systems is that "Systems exhibit emergence—the property, function, or phenomenon that can be attributed only to the system as a whole and not to any of its components acting alone" (2017: 211). Wilson, on the other hand, discusses both Strong and Weak Emergence of features of composite wholes as a comparison between the powers had by that whole and the powers had by the organized collection of parts on which the whole cotemporally materially depends, and not a comparison between the powers of the whole and the powers of *individual* proper parts. Finally, Wilson also considers whether Strong Emergence is a feature of complex systems in general, and argues that it is not.[5]

The INCOSE Systems Engineering definition is clearly intended only to apply to the kinds of systems that are engineered or designed; Dori and Sillitto call these "human-made" or "artificial," interchangeably. However, it is not obvious that "human-made" and "artificial" are synonyms. After all, human beings are themselves, in some sense, human-made and yet not thereby artificial.[6] Human beings themselves are also created through intentional action, and, sometimes, are *intended* products of that action. Thus, production by intentional human action is not sufficient for artificiality.

Work on the concept of artifacts also tries to capture this idea of being intentionally human-made. Lynne Rudder Baker (2004) defines an artifact as an object intentionally made to serve a given purpose, where this purpose defines the nature of the artifact in question. While this may at first seem to have the same problem with intentionality noted before—human beings may be intentionally produced in order to serve a given purpose, such as living out the dreams of their parents—Baker would likely say that this "design element" that is

involved causally in the creation of the child is (thankfully) not essential to the child; the child is the person that they are independent of the intentions of their parents. Even though these intentions can causally affect the child's development, they count as being a person without their parent's intentions being part of what makes them a person. This is not the case for artifacts. A can-opener is intentionally made for opening cans, and this intended function is part of what it is *to be* a can opener. Even if, sometimes, can-openers might be broken and unable to fulfil their function, they still *have* this function.[7]

We noted earlier that being created intentionally for a specific purpose is not sufficient for artificiality; we can also see that being created intentionally for a specified purpose is not necessary for artificiality. Something may be artificial yet not itself intended; consider a new kind of polymer created by accident in the lab.[8] If the polymer is useful for some purpose, it may go on to be produced intentionally, but it need not originally be so. If it is produced intentionally in the future, its use will be shaped by the nature of the polymer, but the polymer's nature will not be determined by the intended function for which it is produced. The polymer, however, is not an artifact, so not a counterexample to Baker's analysis. This example shows that while *being an artifact* and *being artificial* are overlapping, not all artificial things are artifacts.

Something may be artificial because it contains material parts that are counted as artificial, or be artificial yet made entirely from naturally occurring material parts, with the construction or arrangement of those parts determining its artificiality. Artificial reefs may be made from old tires or other manufactured items, but they can also be made from rocks placed in the ocean. Anything that is artificial is, of course, derived in some way, at some point, from naturally occurring materials, but objects and systems can be artificial without being constructed out of material parts that are also considered to be artificial.

As a working understanding of the kinds of artificial systems I will focus on, we can combine Baker's notion of *artifact* with the concept of a system from the systems engineering literature, and consider artificial systems that are *an integrated set of elements, subsystems and assemblies that is intentionally made to serve a given purpose, where this purpose defines the nature of the system in question.*[9] As the purpose of the system defines its nature, and what makes something a system involves having a capability that is not had by any of its proper parts alone, the purpose of these engineered systems is to have and, when appropriate, manifest this system-defining dispositional capability.

The general concept of an artificial system, I think, goes beyond this definition, however. It is not obvious that all artificial systems are intentionally made to

serve a particular purpose, so this understanding only picks out engineered systems. Phantom traffic jams, where individual car-following practices combine to form a jam of stop-start traffic, involve system-level behavior that arises out of intentional actions without resulting from action that intentionally aims at creating that system; "The formation of a phantom traffic jam is an "emergent property" of a system composed with a coupled chain of cars with drivers." (Horn and Wang 2018: 2955). These kinds of systems arise unintentionally, but not naturally, through complex interactions of artificial objects, and so should count as artificial systems although they are not artifactual.

Thinking of something as a system is different from thinking of it as an object, though an object may be viewed as a system of interrelated parts serving a given purpose. In considering a system *as a system*, parts are in view as separate parts, but also as parts that are related to each other in the functioning of the whole. A residence's heating system may contain as parts an electric, gas, or oil boiler, radiators, pipes connecting these, various valves, and a thermostat with connecting wires. To look at this as a system, though, is to see the parts as integrated in such a way that they serve the function of the system as a whole. The pipes connect the boiler to the radiator in order to circulate heat to parts of the residence. Although the parts are integrated into the service of a larger function of the whole system, the parts may inhibit or alter the functioning of another part. Valves in the heating system may prevent or slow hot water flow to a particular radiator, and a thermostat may switch off the boiler once it registers sufficient heat.

Once we consider something as a system that is made up of parts, it can be difficult to see which thing is the bearer of particular dispositional properties. The system as a whole, as well as some of its proper parts, may seem to be plausible candidates to attribute a given disposition to. Dispositional properties might appear to be properties only of proper parts of the system, when they are properties of the whole, or vice versa. Particularly when systems are spatially discontinuous, or spread out over large areas, as is the case in some artificial systems, it can be unclear what entity has particular dispositional properties.[10] There are also challenges in attributing dispositional properties in cases where systems have multiple competing and conflicting functions.

3. Dispositions, Intrinsicality, and Systems

More often that one might expect, it can be difficult to definitely say what dispositional properties an object has. As dispositions are conceptually related to

counterfactuals, it is often easy to think that the dispositions something has are very closely related to what it would in fact do in particular counterfactual situations; that is, if an object has a disposition to manifest behavior M in conditions S, it must be true that it would M if it were in S. Yet it is also widely thought that there can be dispositional interference: an object can be disposed to M in S, even though it would fail to do so because of some interference.[11] What can count as potential dispositional interference—vs. what simply means the disposition was never there in the first place—is more disputed, with some drawing the line at the intrinsic/extrinsic boundary (see, for example, Choi 2005) and others arguing that intrinsic features can constitute dispositional interferences (Ashwell 2010; Clarke 2008).

One of the key assumptions in arguing against this simple counterfactual analysis is the idea that dispositions are intrinsic properties.[12] If a given disposition to M in S is intrinsic to its bearer, then the fact that an external factor *would* stop the object from M-ing *were* it to be in stimulus conditions S does not make the dispositional ascription false.[13] A poison, for example, has the disposition to harm those who ingest it, even if someone is standing by ready to provide a quick-working antidote before the poison can harm the person who ingests it (Bird 1998).

Yet it is not universally held that dispositional properties are intrinsic to their bearers.[14] A mass's weight, thought of as the disposition to exert a force on the ground, depends on the gravitational field the mass finds itself in—something extrinsic to the mass. The mass would weigh less on the moon than the earth, so you can change the weight of the mass without changing the mass intrinsically, showing that mass depends on extrinsic factors.[15] Many characteristics named by seemingly dispositional locutions—like vulnerability or visibility—seem to depend on external environmental factors. Are there threats in the vicinity? If not, then perhaps the object isn't vulnerable. Is the air clear or foggy? Sometimes a mountain on the horizon is visible and sometimes not, depending on the weather.

If you are tempted to resist the idea of extrinsic dispositions, you might deny that the defender of extrinsic dispositions is correct about what exactly is the bearer of the dispositional property in question. Although it is the mountain that we colloquially call "visible," one might argue that the mountain itself doesn't have the disposition of being visible on a clear day. Instead, visibility is a property of the mountain plus the space between the viewer and the mountain.[16] Thinking of dispositions as ascribable to systems rather than just to objects makes this move more compelling.

To the defender of extrinsic dispositions, this is going to seem like *ad hoc* dogmatism. It strains intuitive ways of attributing familiar, everyday properties, like weight, to hold that what you think of as *your weight* is in fact a property had, not by you, but by a system consisting of you together with the gravitational field you find yourself in.[17] Yet when we consider artificial systems, there isn't the same intuitive pull towards attributing extrinsic dispositions to the parts of that system rather than to the system as a whole, and the choice can feel more open.

One of the kinds of cases where I think it can be difficult to see how to attribute a particular disposition is where a system is spatially discontinuous or distributed over a large area. For example, remote control of systems is becoming increasingly common, and it is unclear whether some of the control points are extrinsic or intrinsic to the system in question. In some electrical grids, power consumers may sign agreements with their power supplier that allows the supplier to remotely adjust their thermostat so that the power supplier can manage the overall load of the grid at times of peak electrical use, such as when there is a heat wave.[18] Each year, there are fewer and fewer choices of household appliances without an app for remote monitoring and interaction. These points of remote control are not part of the objects they control, at least as we would normally conceive of these objects. The app on one's phone is not part of the washing machine, or the television, or the oven, and the grid supplier's mechanism for disabling or adjusting a thermostat is not part of the thermostat itself.

We can think of the control points as a locus of inputs from outside the system; just as your pressing of buttons on the appliance or the thermostat is input from outside of the appliance or thermostat, so is the input from the app or the electricity supplier's adjustment of your connected thermostat. After all, they seem to do functionally the same thing as manual input instructions; they turn the appliance off or on, and they set a temperature for the thermostat to maintain through its role in the heating system of the house. Your pressing of a button to turn on your washing machine or turn up the thermostat is input from outside of the system, and this input is something that system is prepared, dispositionally, to respond to.

This way of carving things up will impact what system we are considering, and so which dispositional properties we attribute to the system. When we think of the electricity supplier's control of the thermostat as an external override input to the system as a whole, it can appear to be like an external dispositional interference for the system's capability to call for heating or cooling in your house. On this way of thinking, the system has the disposition to maintain whatever temperature you have set it at and to switch on and off the heating or

cooling systems of your house to do so. If it is set to 75° in cooling mode, then it is disposed to call for cooling if the thermostat, as part of the system, measures more than 75° in the local environment. It has this dispositional property even when it is not manifesting it (because the room is cool enough). When the external override is activated by the supplier during a heat wave, it prevents this dispositional property from manifesting by temporarily removing the disposition. It may even be that the thermostat registers a temperature high enough to require calling for the cooling system to be turned on at the very same time as the electricity supplier remotely disables it. Thus it is true at the time just before 75° is exceeded that the system is disposed to call for cooling when the room reaches more than 75°, but the associated conditional "if the room reaches more than 75°, the cooling system would switch on" is false.[19]

Even if we think that the input from the supplier is an external input from outside the system, the system responds in virtue of having another power to disable or alter the thermostat's behavior in response to those inputs. The system thus has at least two distinct dispositional powers; one to heat and cool, and another to shut down or adjust demand when the supplier interrupts normal operation, and these two dispositional properties sometimes conflict, one preventing the other from manifesting in its ordinary stimulus conditions.[20]

Yet this is not the only way to think about the case. Instead of attributing a disposition to the connected system to heat and cool in response to the temperature measured by the thermostat, and another to disable that ability, we might also think of the system as a whole as having a more integrated dispositional profile. On this conception, the stimulus conditions for calling for heating or cooling is not solely constituted by the local conditions of the thermostat, but are also partially constituted by whether there is the absence of a disabling command from the supplier.

Which option should be preferred by the Systems Theorist? Recall our working definition of a system as an integrated set of elements, subsystems, and assemblies that is intentionally made to serve a given purpose, where this purpose defines the nature of the system in. One of the purposes of this system is the purpose for which it is installed: to control heating and cooling for the resident. But another purpose is to allow for the stabilization of the power grid by the supplier. These two purposes are at times at cross purposes, as some consumers found during recent heat waves in Texas.[21] So, if the purposes of a system determine its dispositional capabilities, then we have reason to accept that some engineered systems qua system might have dispositional properties that sometimes conflict. These conflict in the sense that at times the manifestation of one disposition is

prevented or altered by the operation of another dispositional power.[22] Yet the mention of "integration" in our definition of an artificial system, and the implication in that definition that systems have a single purpose makes it seems as if we should prefer the view on which we do not have conflicting dispositions, but a single integrated dispositional profile. After all, the manufacturers of the connectable thermostat gave it the ability to be remotely disabled as well as to call for heating or cooling.

However, one of the interesting things about this kind of case is that the designers of the system are not only the electricity supplier or the manufacturer of the thermostat, and their intentions are not the only ones that matter in determining the nature of the system. The system is also partially put together by the resident—or at least, by someone that they hire to do this work. Artificial systems can have multiple designers, with multiple purposes, and these purposes may not always align.

So we can revise our working definition of an artificial system to be *an integrated set of elements, subsystems and assemblies that is intentionally made to serve a given purpose or purposes, where these purposes define the nature of the system.* And we can hold that the integration mentioned here does not require a singular dispositional profile, but rather that there is a way in which the parts are connected and in relationship with each other in their operation.

Earlier I suggested that someone who thinks that all dispositions are intrinsic might take a putative example of an extrinsic disposition and attribute it to a larger system as an intrinsic property of that system. However, if one fully takes on board the view that artifactual systems have dispositional properties in virtue of the purposes for which they are designed, then perhaps there is still a case to be made for at least some extrinsic dispositional properties. Systems are generally made up of subsystems, which are themselves proper parts of the system. *Qua* subsystems of the larger whole, their nature is defined by their relationship to that larger system, and so it is plausible that they have their capacities and powers extrinsically if engineered subsystems and parts get their purposes derivatively from the larger whole of which they are a part. The thermostat doesn't intrinsically have a disposition to call for heating and cooling; it has a disposition to output an electrical signal which is a call for heating or cooling only when it is properly connected to the rest of the heating and cooling system.

There is a lot more that could be said about engineered artifactual systems, and much conceptual work that is well suited to metaphysicians which could be in conversation with work from Systems Engineering. I hope to have given at least a rough a sketch of some of the ways in which metaphysicians might think

about artifactual systems—particularly ones that have conflicting purposes—as disposition bearers.[23]

Notes

1 There are certainly examples of natural entities, however, that are less object-like and more like a complex system.

2 The INCOSE Systems Engineering Handbook, 4th Edition (INCOSE 2014a) quoted in Dori and Sillitto (2017: 210).

3 When it is very important to avoid failure, systems should be designed with redundancies so that the system's purpose can be achieved multiple different ways, so one might wonder whether there are some systems where the main purpose of the system is not realized in a dispositional property had by the system alone, and not by any of its parts. This kind of case, however, may just require a more fine-grained understanding of the dispositions involved; while the back-up subsystem is designed for the same outcome as the primary subsystem will achieve when it operating properly, as a back-up it will achieve this in response to distinct input conditions. Arguing for the distinctness here does require that we think of the identity conditions of dispositions as being in part determined by their stimulus conditions, which is not uncontroversial (See Vetter 2014, 2015).

4 Where we have Strong Emergence, as defined by Wilson, then the entity that exhibits Strong Emergence has a fundamentally novel disposition that is not had by the material composite on which the entity cotemporally depends. Weak Emergence is when the entity has fewer dispositions than its constituting material composite.

5 See Wilson 2021, Chapter 5.

6 Here I don't mean to claim that human beings are definitively not artificial, or not sometimes partially so; only that *if* humans are ever artificial, is it not because we are (sometimes intentionally) created by other humans.

7 There may also seem to be examples of things that are natural that are created for an intended purpose where that purpose determines the nature of the thing. A horticulturist might intentionally pollinate particular flowers in order to produce fruit for the purpose of growing more plants, so the fruit is intended to have that function. Here I think the right thing for Baker to say is that the intention doesn't play an essential role in making the fruit the thing it is, even if the intended function *lines up* with producing something with that function.

8 I'm also not sure that being intentionally created *by humans* is necessary for artificiality for another reason: it isn't obvious to me that complex constructed objects like beaver dams are not artificial, just because they are made by beavers and not humans. But I will set this aside.

9 In addition to modifying the definition by adding a clause inspired by Baker's work, I have also changed the phrasing from "an integrated set of elements, subsystems and assemblies that *are* intentionally made to serve a given purpose" to "an integrated set of elements subsystems and assemblies that *is* intentionally made to serve a given purpose" so that the definition can cover cases where some of the elements that make up the larger system are not engineered themselves.

10 The question of what object or system has a particular dispositional property can seem to be relevant to the attribution of responsibility in cases where such properties cause harm. Such questions of responsibility attribution, and how closely tied they are to dispositional attribution, is beyond the scope of this essay.

11 See (Johnston 1992: 231–3), (Martin 1994: 2–4), and (Bird 1998: 228) for some counterexamples to the claim that dispositional ascriptions entail their associated counterfactuals.

12 The conception of intrinsicality usually appealed to here involves the idea of duplication: does a duplicate of the object always retain the property in question, regardless of its environment? If so, then the property is intrinsic. The environmental possibilities considered usually involve holding the laws of nature fixed, so any dependency on natural laws doesn't thereby make the disposition extrinsic. See Lewis 1997.

13 Even though linguistic specifications of dispositions involve features of the object's extrinsic environment, the fact that dispositions are often relationally specified does not make them extrinsic.

14 See McKitrick 2003.

15 See Bauer 2011 for an argument that mass is also an extrinsic disposition.

16 See Giannotti, this volume, for a move of this kind. The defender of the possibility of extrinsic dispositions can likely say that there is *both* an extrinsic and intrinsic disposition here, attributed to distinct things, so this does not necessarily count against there being extrinsic dispositions. Giannotti does not argue in his chapter that all artificial dispositions are intrinsic, but simply that extrinsicality is not a defining features of these dispositions when compared with so-called natural dispositions or powers, so this response from the defender of extrinsic dispositions is compatible with Giannotti's argument.

17 At least in English, visibility would not normally be attributed to such as system. It is possible that in other languages this is not such a strain, which would make this a weaker reason for denying the move.

18 "One Houston family told a local news affiliate [KHOU: Houston, Texas] that their smart thermostat was turned up to 78° with seemingly no notice other than a text sent after the fact. When they enrolled in a program called "Smart Savers Texas"—entering them in a sweepstakes to win up to $5,000 off their energy bills for the next year—these users didn't realize that this also gave the power company

permission to adjust their thermostat during high demand periods, like heat waves" (Morrison 2021).

19 This is designed to be like a standard finking case (see Martin 1994 and Lewis 1997). Finks provide counterexamples to the simple counterfactual analysis of dispositions: although the connected thermostat has the disposition to switch on the air conditioning when the temperature is higher than its set-point, the counterfactual "if the temperature were above the set-point, then the thermostat would switch on the air conditioning" is false. Much of the motivation for standard examples of finks rests on the assumption that dispositions are intrinsic; if dispositions are not necessarily shared between intrinsic duplicates, then perhaps any supposed finking condition is part of the ground for whether an object has a particular disposition. This does not mean that the existence of some extrinsic dispositions means that there are no finks or masks; however, it does mean that a central argument for the existence of this kind of dispositional interference is nullified if dispositions are not all intrinsic.

20 See Ashwell 2017 for an argument that understanding desires as dispositional requires accepting similar dispositional conflict.

21 See Morrison 2021.

22 Such conflict would not usually involve necessary masking of one dispositional power by another. In such engineered systems, reliability of operation is not 100% reliable. See Vetter and Busse 2022 for discussion of problems that necessary perfect masking has for modal dispositionalists, such as the view developed and defended in (Vetter 2015).

23 Thank you to the editors of this volume and to an anonymous referee for helpful comments.

References

Ashwell, L. (2010), "Superficial Dispositionalism," *Australasian Journal of Philosophy*, 88 (4): 635–53.

Ashwell, L. (2017), "Conflicts of Desire: Dispositions and the Metaphysics of Mind," in J. Jacobs (ed.), *Causal Powers*, 167–76, Oxford: Oxford University Press.

Baker, L. R. (2004), "The Ontology of Artifacts," *Philosophical Explorations*, 7: 99–112.

Bauer, W. A. (2011). "An Argument for the Extrinsic Grounding of Mass," *Erkenntnis*, 74 (1): 81–99.

Bertalanffy, L. V. (1968), *General System Theory: Foundations, Development, Applications*, New York: G. Braziller.

Bird, A. (1998), "Dispositions and Antidotes," *The Philosophical Quarterly*, 48 (191): 227–34.

Choi, S. (2005), "Do Categorical Ascriptions Entail Counterfactual Conditionals?" *The Philosophical Quarterly*, 55 (220): 495–503.

Clarke, R. (2008), "Intrinsic Finks," *The Philosophical Quarterly*, 58 (232): 512–18.

Dori, D. and H. Sillitto (2017), "What Is a System? An Ontological Framework," *Systems Engineering*, 20 (1): 207–19.

Giannotti, J. (2023), "Is There a Metaphysically Robust Distinction between Natural and Artificial Dispositions?" in W. A. Bauer and A. Marmodoro (eds.), *Artificial Dispositions: Investigating Ethical and Metaphysical Issues*, 35–13, London: Bloomsbury Academic.

Horn, B. K. P. and L. Wang (2018), "Wave Equation of Suppressed Traffic Flow Instabilities," *IEEE Transactions on Intelligent Transportation Systems*, 19 (9): 2955–64.

Johnston, M. (1992), "How to Speak of the Colors," *Philosophical Studies*, 68 (3): 221–63.

Lewis, D. (1997), "Finkish Dispositions," *The Philosophical Quarterly*, 47 (187): 143–58.

Martin, C. B. (1994), "Dispositions and Conditionals," *The Philosophical Quarterly*, 44 (174): 1–8.

McKitrick, J. (2003), "A Case for Extrinsic Dispositions," *Australasian Journal of Philosophy*, 81 (2): 155–74.

Morrison, S. (2021), "How Your Power Company Can Remotely Control Your Smart Thermostat," June 21. Available online: https://www.vox.com/recode/22543678/smart-thermostat-air-conditioner-texas-heatwave (accessed June 30, 2022).

Vetter, B. (2014), "Dispositions without Conditionals," *Mind*, 123 (489): 129–56.

Vetter, B. (2015), *Potentiality: From Dispositions to Modality*, Oxford: Oxford University Press.

Vetter, B. and R. Busse (2022), "Modal Dispositionalism and Necessary Perfect Masks," *Analysis*, 82 (1): 84–94.

Wilson, J. (2021), *Metaphysical Emergence*, Oxford: Oxford University Press.