



Target Article

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Abstract

Ownership is universal and ubiquitous in human societies, yet the psychology underpinning ownership intuitions is generally not described in a coherent and computationally tractable manner. Ownership intuitions are commonly assumed to derive from culturally transmitted social norms, or from a mentally represented implicit theory. While the social norms account is entirely *ad hoc*, the mental theory requires prior assumptions about possession and ownership that must be explained. Here I propose such an explanation, arguing that the intuitions result from the interaction of two cognitive systems. One of these handles competitive interactions for the possession of resources observed in many species including humans. The other handles mutually beneficial cooperation between agents, as observed in communal sharing, collective action and trade. Together, these systems attend to specific cues in the environment, and produce definite intuitions such as “this is hers,” “that is not mine.” This computational model provides an explanation for ownership intuitions, not just in straightforward cases of property, but also in disputed ownership (squatters, indigenous rights), historical changes (abolition of slavery), as well as apparently marginal cases, such as the questions, whether people own their seats on the bus, or their places in a queue, and how people understand “cultural appropriation” and slavery. In contrast to some previous theories, the model is empirically testable and free of *ad hoc* stipulations.

1. Introduction**1.1. The problem**

Ownership is universal and ubiquitous in human societies. Surprisingly, there are very few attempts to provide a computational model of the underlying psychology. Here I propose a model based on the available psychological and anthropological evidence, and grounded in an evolutionary perspective. In this model, our common intuitions about ownership result from computational connections between two independent cognitive systems, specialized in the competitive acquisition of resources and in cooperation between non-kin, respectively, but ownership intuitions do not require a specific cognitive system geared to describing and explaining ownership as such.

1.2. The scope of the model: Intuitions

Ownership intuitions are mental representations such as “Agent A owns thing t.” If I recall that A bought t from B, I will probably (in the absence of any other information about the situation) draw the inference that, “A owns t.” If I recall that “A put t in her pocket when B wasn’t looking,” I would probably infer that “A does not own t.” Such representations are not deliberate, we do not need to engage in explicit reasoning to achieve them, and we generally are unaware of the underlying cognitive processes. Ownership intuitions in this sense are distinct from explicit principles, representations such as “you do not own stuff that you stole from others,” “if it is yours, people cannot stop you using it,” and so forth.

2. Properties of ownership intuitions and possible origins**2.1. Salient features of ownership intuitions that should be explained****2.1.1. Why stable intuitions with vague explicit concepts?**

Ownership intuitions, for example, “this car belongs to Melanie,” “that used to be my house,” seem stable across individuals, who generally have the same intuitions if they have access to the same information. In disputes, people rarely consider that they may disagree on principles of ownership – they argue for their case by mentioning particular facts that should trigger what they see as the correct intuition, which they expect an interlocutor to share if he/she also knows those facts.

In contrast, people's general statements about what ownership is and how it is established are often idiosyncratic and incoherent (Noles, Keil, Bloom, & Gelman, 2012). People may for instance state that ownership is necessarily about things, having forgotten that it applies to ideas as well, or judge that people cannot be property before being reminded of the history of slavery.

This of course is not special to ownership. One can observe a similar discrepancy between fairly stable intuitions and vague or inconsistent explicit understandings of morality or causality (Haidt, 2001; Quillien, 2020), as the explicit concepts do not generate the intuitions, but rather constitutes an attempt to explicate, justify, or systematize them (Mercier & Sperber, 2009; Sperber, 1997).

2.1.2. Why is there an intuition of legitimate possession?

A crucial feature of ownership intuitions is that in some situations they diverge from representations of possession. For young children, what is taken by force for instance is not "really" owned (Blake & Harris, 2009), because "ownership does not reduce to psychological, proximity, or outward perceptual cues" (Brandone & Gelman, 2009, p. 1732). This might be specific to humans, as suggested by the title of a comparative study, "children, but not great apes, respect ownership" (Kanngiesser, Rossano, Frickel, Tomm, & Tomasello, 2019a). The distinction is clear to very young children, even on the basis of mere verbal cues, for example, "this one is yours" (Eisenberg-Berg, Haake, & Bartlett, 1981; see also Ross, 1996). Given these cues, a child avoids appropriating a partner's resources even when the partner cannot defend them (Kanngiesser et al., 2019a). Even though young children see a territory and its contents as belonging to the occupiers (Verkuyten, Sierksma, & Thijs, 2015b) or to the first-arrived (Verkuyten et al., 2015b), they do not think you own an object that the wind blew into your territory (Goulding & Friedman, 2018).

2.1.3. Why a prior possession heuristic?

In adjudicating between ownership claims, people generally consider the order in which the disputing parties gained access to the thing. Children spontaneously employ that principle in disputes ("I had it first!") (Blake & Harris, 2011; Friedman & Neary, 2008). The heuristic is found in very diverse cultures.¹ As Friedman and colleagues have demonstrated, a first possessor heuristic emerges early in cognitive development, and is more sophisticated than a mere record of the order in which people access the thing (Friedman & Neary, 2008; Friedman & Ross, 2011; Friedman, Neary, Defeyter, & Malcolm, 2011). Children's and adults' intuitions take into account the nature of the connections between agent and thing (Gelman, Manczak, Was, & Noles, 2016).

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2.1.4. Why is labor relevant to ownership?

People generally assume that labor is relevant to ownership claims, an intuition developed in Locke's theory of property (Locke, 1988[1689]). Holding a piece of putty may provide you with a claim to ownership (from apparent first possession), but molding it into a particular shape seems to strengthen that claim (Davoodi, Nelson, & Blake, 2020; Hook, 1993). Children readily use the labor heuristic, sometimes against cues of prior possession (Kanngiesser, Gjersoe, & Hood, 2010; Kanngiesser, Rossano, Zeidler, Haun, & Tomasello, 2019b; see also Rochat et al., 2014). There are nuances in the use of the heuristic, however, as people require the creative work to be intentional, and also (surprisingly) to be successful (Levene, Starman, & Friedman, 2015).

2.1.5. Why and how do contextual cues affect intuitions?

In many situations, subtle changes in the context of interaction are crucial to ownership intuitions. Consider, for example, the difference between these three scenarios:

- [1] A tells B a joke that B repeats to C.
- [2] A tells B a joke, on their way to a party that they will attend together. A confides that she is looking forward to dazzling the party with her wit. Once they arrive at the party, B tells everyone the joke.
- [3] A is a professional comedian. She tells fellow-comedian B a new joke she's planning to use in her act. B uses that joke in his show.

These different scenarios seem to trigger very different intuitions, as to whether some violation of ownership occurred. We could be tempted to explain these differences by invoking principles like "you should not spoil other people's success at a party," or "jokes are property for comedians," but these simply state what we are supposed to explain.

2.1.6. How are intuitions readily applied to novel domains?

In prehistoric conditions, groups certainly claimed and defended territories as do all known human communities, and individuals probably owned tools and ornaments (Hoyt, 1968). But humans can also own ideas, processes, stories, genetic material, access to particular places, a right to buy or sell something in the future at a particular price, etc. The scope of ownership is effortlessly extended to new domains of reality. For instance, we do not generally think that the place where we stand on a sidewalk is our property, but panhandlers readily construe that space as something they own and will defend (Leeson, Hardy, & Suarez, 2022; Scott, 2003).

2.1.7. Ownership intuitions apply far beyond typical "property"

Ownership intuitions occur in many contexts of social interaction, beyond the typical domain of property:

Seats on the train or in a theater. If one leaves a train seat to use the restrooms, it is accepted (in most countries) that it would be improper to take "their" seat.

Places in a queue. People treat their place in a queue very much as something that is associated with one particular agent, can be stolen and must be guarded (Fagundes, 2017; Mann, 1969). *Slaves and spouses.* Slavery occurs in multiple societies, and proprietary attitudes toward wives as a good are widespread in many cultures (Wilson & Daly, 1992).

Cultural appropriation. When people adopt hairstyles, fashion, accents, cuisine, gestures, etc., previously typical of other groups, they are said “appropriate” something that is not theirs (Young & Brunk, 2012).

One may be tempted to consider such situations as outside the scope of an ownership theory, as a matter of etiquette for instance in the case of seats and places in a queue, or of political rivalry in the case of cultural appropriation. But that would be arbitrary. If people buy or sell a place in a queue, does it mean that they are conceptually confused about property? We should consider all ownership intuitions as relevant and in need of a general explanation.

2.2. Origins of intuitions: Social norms or mental theories?

One may want to explain ownership intuitions, either as the result of shared social norms acquired by individuals through cultural transmission, or as the expression of common mental theories of ownership.

2.2.1. Social norms

The idea that ownership intuitions are influenced by locally accepted norms is in a sense self-evident, as the domain of what can be owned varies from place to place. But can we describe people’s intuitions as a matter of “absorbing” arbitrary local cultural norms? That seems implausible, for two reasons. First, ownership intuitions cannot be the results of purely *conventional* norms, as that would entail that the rules are arbitrary (Lewis, 1969; Smead & Forber, 2020). But it is clear that recurrent principles (described above, sect. 2.1.) underpin people’s intuitions. Second, children’s sophisticated intuitions emerge long before they know about, for example, local property rights. Also, their intuitions sometimes conflict with local social and legal norms, as when they judge that people who invest some work in a material can claim ownership against prior possessions (Kanngiesser et al., 2010; Rochat et al., 2014; see also Shaw, Li, & Olson, 2012) for property in ideas. Also, in many domains, people faced with novel objects or situations (e.g., software, futures contracts) seem to develop appropriate ownership intuitions in the absence of previous norms (Kimbrough, Smith, & Wilson, 2008).

Crucially, the notion of intuitions based on shared norms runs the risk of *ad hoc* stipulation. The example of jokes, from the previous section, is a case in point. One may argue that there is a social norm that you should not steal other people’s thunder at parties – but then we will have to postulate the existence of a specific norm for every case in which people have particular intuitions, which makes the explanation entirely *ad hoc*.

2.2.2. Ownership intuitions derived from an implicit theory

Psychological accounts assume that specific psychological mechanisms underpin our spontaneous ownership intuitions (Furby, 1991; Litwinski, 1942; Pierce, Kostova, & Dirks, 2003, p. 84). This assumption informs most cognitive developmental research on children’s behavior regarding property and allocations, but it is rarely discussed and defended on explicit theoretical grounds.

An exception is the “naïve theory” account put forward by Nancekivell, Friedman, and Gelman (2019). In analogy with domains such as intuitive psychology (Leslie, Friedman, & German, 2004), natural language acquisition (Pinker & Bloom, 1990), or other “core domains” of human competence (Spelke & Kinzler, 2007), this account proposes that ownership too

could be described as the focus of a domain-specific, largely implicit, mentally represented theory that posits relations between agents and things and governs children’s and adults’ intuitions as regards possession, transfers, ownership disputes, etc. (Nancekivell et al., 2019).

Here I try to expand on that proposal. In particular, my goal is to describe the evolutionary and cognitive context that could explain why the stipulated mental theory is the way it is. For instance, why is there a first possession heuristic? Why does invested work matter? Why would possible benefits be relevant to ownership intuitions? I will argue that we can preserve the central points of the “naïve theory” model, namely that intuitions are principled, and do not reduce to the acquisition of external norms. But I will also argue that ownership intuitions may not require a specialized, dedicated set of principles. They may result from the interaction of cognitive systems that are not about ownership as such.

2.3. Outline of systems: Ultimate and proximate considerations

The central hypothesis here is that ownership intuitions result from the interaction of two sets of cognitive systems, to do with competitive acquisition (competition for resources) on the one hand, and cooperation (sharing, exchange, trade, collective action, etc.) on the other.

Following a “reverse engineering” strategy common in evolutionary biology (Pietraszewski & Wertz, 2011; Tooby & Cosmides, 2005), we should describe these two systems by answering both ultimate questions (What are the fitness-relevant challenges? What possible solutions?) and proximate questions (How do cognitive systems actually produce representations that support these fitness goals?), as summarized in Table 1.

The following sections (3 and 4) summarize those aspects of competitive acquisition and cooperation psychology that are both (a) well described in the literature and fairly uncontroversial, as well as (b) relevant to explaining ownership intuitions.

3. Ultimate aspects [I]: Competitive acquisition

Organisms extract fitness increments from various properties of their environments, for example, air, sunshine, food, shelter, mates, etc. Some of these fitness sources are localized in particular objects. Some are rivalrous goods with zero-sum enjoyment, such as shelter or food. Among the rivalrous sources of fitness, some constitute excludable goods such that one organism can limit another’s enjoyment of the resource. Clearly, all these features are species-specific and are a matter of degree in nature, especially excludability.²

The existence of localized, patchy, rivalrous, and partly excludable goods would provide a context for the emergence of fitness-enhancing behaviors geared to maximizing resource extraction, in the context of interaction with organisms that pursue the same goals. This applies not just to territories, but also to such possessions as mates, shelters, and even organisms from other species (Strassmann & Queller, 2014, p. 306).

Fitness optimization results, not in constant fights for appropriation, but relatively stable situations best described in game-theoretic models like the Hawk–Dove game described by Maynard Smith and Price (1973). Given scarce resources, organisms have a choice between Hawk and Dove strategies, that is, engage in fights or leave the terrain. The model predicts a “Bourgeois” equilibrium, in which incumbents (prior possessors)

Table 1 (Boyer). Ultimate and proximate models relevant to ownership intuitions in humans, and pointers to sections in this article

	Competitive acquisition	Cooperative interactions
Ultimate explanations	Fitness maximization through acquisition of resources, Bourgeois equilibria, etc. (see sect. 3)	Fitness maximization through mutualism, selection of partners, punishment, etc. (see sect. 4)
Proximate models	Detection of P() cues, valuation of good, calibration of acquisition motivations, etc. (see sect. 5)	Detection of Min() relations, motivations sustaining cooperative interactions (see sect. 6)

behave like Hawks and outsiders (without a territory) as Doves, which corresponds to observed outcomes in most territorial species (Krier, 2009, p. 149).³ Such situations of pure conflict (with no other elements than cost of winning/losing fights) are somewhat idealized as Bourgeois is not always a stable strategy (Grafen, 1987), and strategies are influenced by players' preferences in the amount they invest in fights (Gintis, 2007). Also, strategic interactions other than Hawk–Dove could lead to stable territorial norms (Kokko, López-Sepulcre, & Morrell, 2006).

The crucial conclusion from evolutionary modeling and observation is that fitness maximization leads to behaviors that optimize the individual use of resources through privatized access to goods (Eswaran & Neary, 2014; Gintis, 2007; Strassmann & Queller, 2014). This applies to many species including humans – see for instance a demonstration of the emergence of territories when human participants extract scarce resources from a virtual environment (DeScioli & Wilson, 2011). When asked to predict the winner in conflicts about resources, young children spontaneously deploy intuitive principles that closely approximate a war of attrition model (Pietraszewski & Shaw, 2015). Most important, these intuitions drive motivations in interpersonal aggression and warfare.

4. Ultimate aspects [II]: Cooperation

Within most human communities, people (to a large extent) “respect property,” so that interaction between agents around resources does not reduce to the Bourgeois equilibrium observed in competitive acquisition. In small-scale societies, for instance, people can set aside their tools or leave their plantations for a while, without others attempting to appropriate these goods. Keeping possessions, at least within communities, does not in general require that one physically threaten others. To better understand this, we need to turn to another domain of ultimate explanations, to do with the emergence of human cooperation.

Humans are clearly exceptional in the extent of cooperation between non-kin, which takes three typical forms. In communal sharing, all members of a group receive a share of resources extracted by some agents, for example, the catch from hunting or fishing expeditions (Kaplan & Gurven, 2005). In collective action, some agents pool effort and other resources to produce goods that are more likely to be obtained through joint effort, and whose benefits may spread to non-participants (Hardin, 1982). Finally, trade allows utility maximization for partners with different preferences (Dillian, 2010; Hoyt, 1968). All these are mutually beneficial interactions for the partners involved, and all of these imply dynamics very different from a Bourgeois equilibrium.

Cooperation may be described as the outcome of partner choice between agents with different cooperation profiles. In this perspective, agents try to find partners who offer the best available terms of exchange. When such strategies are generalized, they tend to result in “fair” allocations of goods (Baumard, André, & Sperber, 2013). An alternative explanation is that cooperation norms are stabilized by punishment and cultural group selection

(Boyd & Richerson, 2009). Here I will not discuss these theoretical proposals but focus on those proximate mechanisms involved in cooperation that support ownership intuitions.

5. Proximate psychology [I]: Competitive acquisition

5.1. Relevant cues

Organisms attend to, store, and combine various kinds of indices that are relevant to the competitive acquisition of resources. I call these P-cues. The psychological evidence would suggest that the following are among the relevant cues:

Contiguity. There is a higher than random number of situations in which the agent and the thing are observed simultaneously. Humans pay close attention to attentive to perceptual cues of contiguity, and this often shows in implicit measures.⁴

Interaction. Common examples would be food that is consumed, shelter that is occupied, etc.

Defense. The organism thwarts other organisms' attempts to interact with the thing. In humans, a whole variety of behavioral reactions can be engaged against intruders or thieves, from verbal rebuke to direct attack or the mobilization of allies.

Modifications to the thing. In many species, organisms modify things in ways that indicate current possession (Strassmann & Queller, 2014). For humans, many modifications are familiar to us, for example, mowed lawns versus wild yards, well-maintained versus derelict houses, etc.

Those cues are *indices* of relations between agent and thing. Many such cues are also *signals*, that is, they occur precisely because of their effect on the receiver. Indeed, any ostensive form of the behaviors listed so far can become such a signal, as when people write their names on objects like books, or on food in communal refrigerators, etc. Leaving one's coat on a train seat would convey similar information.⁵

5.2. Summation of P-cues: The P-intuitions

Human minds can (a) store information about the different cues concerning the agent–thing relation, what we call P-cues, and (b) sum them in such a way as to produce an overall representation of that agent–thing relation.

This is the first premise of the model. I use the term “premise,” here and below, for statements that summarize the state of our knowledge about human behaviors and cognition. They are fairly uncontroversial, as well as unoriginal. Premises (and, further below, hypotheses) are summarized in a notation illustrated in Table 2. The notation serves the purpose of describing the various mental representations involved while avoiding the ambiguities of natural language glosses.

[P1] There is a representation P(A, t, s) that sums up P-indices

Table 2 (Boyer). Examples of summary notation used in formulating the model

A, B, C, X	Different individual agents. X is an unspecified agent, meaning “there is one agent such that...” etc.
P(A, t, s)	A conceptual tag P() associates agent A with thing t, with strength s, see section 5.2.
¬P(A, t, s)	A is represented as not being in a P() relation with thing t and strength s.
Brep [...]	Agent B holds the mental representation that ...
Brep [Crep [...]]	Agent B holds the mental representation that Agent C holds the mental representation that ...
Brep [Min(A)]	Agent B extends minimal cooperation assumptions to agent A. In other words, from B’s viewpoint, A is a potential cooperator, see section 6.1.
L(A, t, s)	A conceptual tag L() associates agent A with thing t with strength s, see section 7.1.
Brep [¬Min(A)]	An agent B cancels minimal cooperation expectations toward A.
Brep [Xrep [Min(A)]]	An agent B represents that there is some (unspecified) agent that represents A as a potential cooperator.

That is, information about some specific situation leads one to entertain the representation that a specific agent A, in one’s environment, is in a specific kind of relation with an identified thing t, and that this relation carries a specific “strength,” a parameter that will be explained below.

We should not attempt to describe this P() representation in rich semantic terms, as denoting what the words possession or property or ownership convey to us. Rather, we can describe it in functional terms, as (a) the result of particular combinations of P-cues, and (b) the precursor to particular downstream representations and motivations, as summarized in Figure 1.

The consequence of a P() tag attached to A and t, in this model, is that it triggers activation of representations and motivations that are relevant to competitions with the agent considered for the resource considered. Any relevant information will be activated in this process. For instance, even if no actual fight is engaged or even considered, cues such as the two partners’ relative formidability would be among the items of information activated.

The P() tag includes a parameter s, that could be glossed as the perceived “strength” of the agent–thing relation. For instance, if the contiguity between agent and thing is more frequent, if defense efforts are more costly, if signaling is louder, etc., this parameter will be adjusted upwards. The term strength is of course just a convenient metaphor. In more precise terms, to the extent that an agent B perceives P(A, t, s) with a higher s, B will be for instance less likely to try to separate A from thing t.

6. Proximate psychology [III]: Cooperation

We now turn to the other aspect of proximate mechanisms relevant to ownership intuitions, those involved in creating and maintaining cooperative interactions.

6.1. The range of potential cooperation: Min() assumption

Some cognitive mechanism in the mind of B describes a particular agent A as either a potential cooperator or not:

[P2] There is a conceptual tag Min(A).

Agent B represents A in such a way that it would be possible for B to engage in one or other of the forms of interaction described above (sect. 4) with agent A, for example, sharing, collective action, trade, etc. This is noted as Brep [Min(A)].

Saying that B represents Min(A) does not entail any actual cooperation between A and B. It just means that if there was a situation in which such cooperation was possible, B could consider interacting with A in that manner, and evaluate the costs and benefits of such interaction. Conversely, if B represents ¬Min(A), that is, the negation of Min(A), this means that B would not consider cooperative interaction even if were available.

One might think that the scope of Min() expectations is in principle unlimited. After all, one may argue, if anyone offers us an advantageous trade or some beneficial collective action,

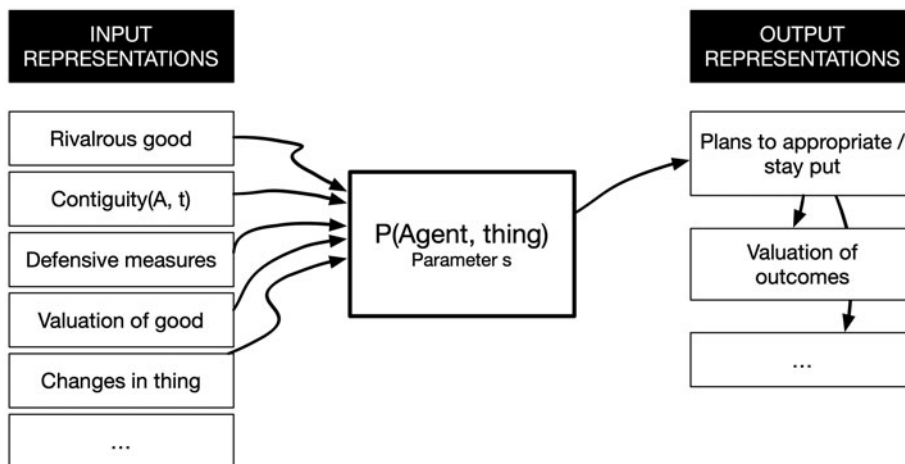


Figure 1. Input–output description of the P() conceptual tag.

we consider the offer and perhaps engage in cooperation. But that conclusion would result from an ethnocentric or time-centric perspective. For most of prehistoric and historic times, humans lived in fairly closed communities, within which intense cooperation, sharing, and trade might occur, but between which these interactions were fairly limited and often hostile (Boyd & Richerson, 2005). Communal sharing is rarely extended to other groups among small-scale foragers and horticulturalist tribes (Kaplan & Gurven, 2005). When it is, the process is fraught with tension, and may actually conceal an ambush (van Creveld, 2013). Collective action was generally limited to small communities (Gurven & Winking, 2008; Hardin, 1982). Although there was long-distance trade for many goods in prehistory (Renfrew, 1969), that was generally the outcome of local, occasional barter, as well as highly codified ceremonial exchanges (Gell, 1992; Posner, 1980). So the question, whether one can extend a Min(A) assumption to particular individuals or a group would have been a relevant question for most of human prehistory.

6.2. The value of cooperators

A person's social environment includes some agents that extend some cooperation expectations, called Min() here. The fact that there are such agents has direct effects on one's fitness, which explains remarkable features of human cooperation, in particular, the fact that it is both forgiving and generous.

Cooperation is forgiving in that lapses from expected cooperative behaviors are often left unpunished, in communal sharing (Bliege Bird & Bird, 1997; Gurven, 2004), collective action (Gurven & Winking, 2008), and trade (McCabe & Smith, 2001). That is because the expectations Min(A) and Min(B) are not just descriptive, they carry a motivational weight:

[P3] Both $\text{Brep}[\text{Min}(A)]$ and $\text{Arep}[\text{Min}(B)]$ are positively valued by B.

That is, in an agent B's mind, there is a preference for states of affairs in which B extends cooperation to A, as opposed to situations in which that is not the case. There is also a preference for situations in which B is considered as potential cooperation partner by A, rather than not.

That is one of the reasons why humans in many situations also tend to start interaction by offering generous cooperation, assuming that gaining potential cooperation partners is a good in itself, and that missing out counts as a cost (Krasnow, Delton, Tooby, & Cosmides, 2013).

6.3. Cooperation extinguished by sustained defection

Naturally, cooperative interactions would not be fitness-enhancing if they resulted in decreased welfare:

[P4] Sustained loss of B's welfare from A's actions $\rightarrow \text{Brep}[\neg\text{Min}(A)]$

That is, if an agent B loses resources from interactions from A, and if that is a recurrent result of interactions with A, agent B may cancel cooperation expectations toward A.

This describes the fact that human cooperation with non-kin is forgiving but not unconditional. Although Min(A) is itself a good for B, that may be canceled when agent B receives a sucker's payoff. There is of course a great deal of variation in the particular conditions under which actual human agents interpret a loss as evidence for defection (Krasnow, Delton, Cosmides, & Tooby, 2016).

6.4. Reputation determines the extension of Min() expectations

Human cooperation requires some measure of partner evaluation, as there is no human group where people would indiscriminately extend cooperation to all other group members. Discriminating between partners obviously depends on the terms they offer. But the choice is also crucially influenced by information about the potential partner's prior behavior, their reputation.⁶ That is why humans are strongly motivated to seek information about others' past interactions (Krasnow, Cosmides, Pedersen, & Tooby, 2012; Sperber & Baumard, 2012). Verbal communication makes this use of the past as a guide to future interactions vastly easier among humans than any other species. Information about an agent's behavior can be broadcast to a large number of people at negligible cost.

As a consequence, agents have to calculate two different sets of costs and benefits from any course of action – direct consequences on their welfare, and further consequences on their status as cooperators in the eyes of other potential partners (André, Debove, Fitouchi, & Baumard, 2022). A fitness-enhancing strategy consists of maximizing the number of potential interaction partners who represent one as a potential cooperation partner.

This reputation strategy creates a "sphere" of cooperation, a range of individuals who could be considered potential cooperation partners by default. As mentioned above, the extent of that "sphere" varies considerably between times and places. This is an additional premise:

[P5] There is a set of agents S, such that $\text{Brep}[X \in S] \rightarrow \text{Brep}[\text{Min}(X)]$

In other words, there are cues in B's representation of an agent X that identify that agent as belonging to a set of potential cooperators. As mentioned above, the extension of Min() expectations varies a lot between modern societies. In many traditional communities, people by default identify S as co-extensive with their tribe, lineage or ethnic group. In some high-trust modern mass societies such as Denmark, people would include almost all their fellow citizens in the set S (Delhey & Newton, 2005; Kim, Helgesen, & Ahn, 2002). By contrast, some modern places are characterized by "amoral familism" where there is virtually no cooperation beyond kin (Banfield, 1958; Umbres, 2022). Most human societies lie somewhere between these extremes.

7. The minimalist model of ownership intuitions

7.1. The notion of a distinct L() tag

The first hypothesis in the model is that a specific conceptual tag associates agent A and a thing t, but is distinct from the P() tag described above.

[H1] There is a conceptual tag $L(A, t, s)$

In the same way as P() tags, the L() tag can be defined as a mental representation characterized in terms of inputs and outputs, summarized in Figure 2 below.

This process includes the inferences described so far, and includes additional elements. The P() representations take as input representations about contiguity, use, defense, etc., which are typically relevant to competitive allocation of resources (described in sect. 5). A distinct L() representation inherits information from the P() cues and take as additional input the cooperation expectations toward the agent(s) concerned, called Min() here.

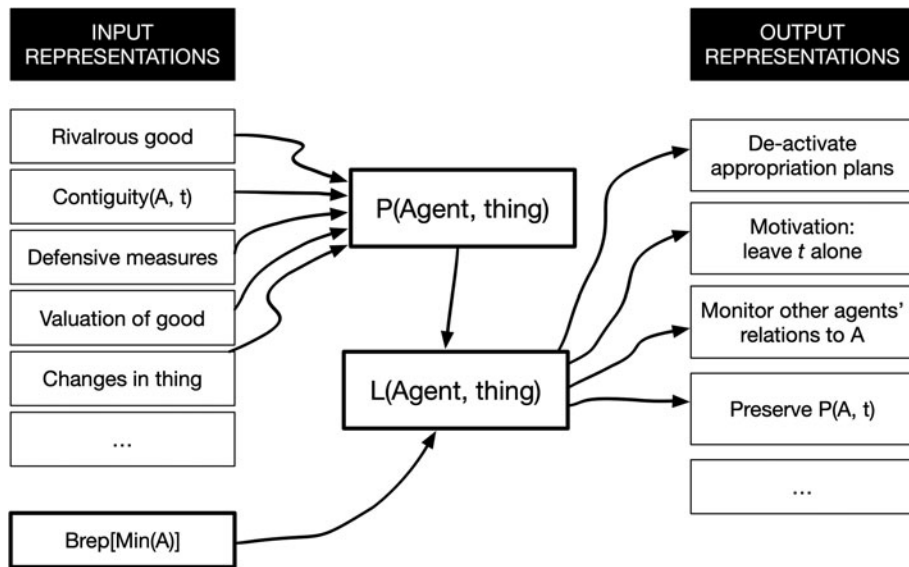


Figure 2. Summary of inputs and outputs for the L() conceptual tag.

The main hypothesis here, then, is that this combination of information from two distinct systems – the P() cues and Min() representations – explains many features of ownership intuitions.

7.2. How Min() tags may lead to infer L() tags

7.2.1. A simple dyadic interaction

Figure 2 above suggests that the activation of a representation Min(A) in combination with a P(A, t, s) representation triggers activation of an L(A, t, s) tag. That is hypothesis 2:

$$[H2] \text{ Brep}[P(A, t, s) \ \& \ \text{Min}(A)] \rightarrow \text{Brep}[L(A, t, s)]$$

That is, an agent B entertains two representations:

- 1) That there are cues suggesting that A is in a P() relation with a thing t, with strength s;
- 2) that B extends cooperation expectations to A. That is, the representation of A triggers a representation Min(A), that identifies A as a possible cooperator for B, with the downstream inferences that become activated in actual situations of potential cooperation.

The arrow points to an inferred representation in B's mind:

- 3) That there is an L() relation between agent A and the thing t, again with a strength s.

The inferential path would follow these steps:

- a) As described above, representations Min(A) and Arep[Min(B)], which describe A as a potential cooperator for B and vice-versa, have a positive valence for B (premise 3). That is, other things being equal, B prefers a situation of counting A as a potential cooperator over the opposite, and prefers to be considered as A's potential cooperator, Arep[Min(B)];
- b) we also assume (premise 4) that a loss of resources for A may result in A switching from a representation Min(B) to ¬Min(B), meaning that A does not extend the minimal cooperation presumption to B anymore;

- c) now the change from P(A, t, s) to ¬P(A, t, s), that is, eliminating the connection between agent and thing, is a loss for A, with the consequence that A would stop extending Min(B) cooperation expectations to any agent B whose behavior causes that loss (from premise 4);
- d) so, given that Arep[Min(B)] has a positive valence for B, we would expect that B avoid courses of action that lead to Arep[¬Min(B)], the elimination of that cooperation expectation. This entails that B would avoid courses of action that lead from P(A, t, s) to ¬P(A, t, s), that is, to canceling A's relation to the thing t.

In other words, the representations included in the L() tag, together with the premises described above, concur to assign a positive valuation, in B's mind, to courses of action that maintain A's enjoyment of thing t, what we would ordinarily describe as B's "respect" for A's property.

This formulation of the hypothesis captures a simple, dyadic situation in which there are only two agents and one thing, and the agents entertain cooperation expectations about each other.

7.2.2. Possible third-party extension of L() tags

As stated in hypothesis 2, extending cooperation expectations Min() to an agent implies that their P() relations with things will also be represented as L(). That can also occur when the agent extends cooperation expectations to an agent who extends such expectations to a third party, with the same consequence of inferring from P() to an L() relation. In our notation:

$$[H3] \text{ Brep}[P(A, t, s) \ \& \ \text{Min}(C) \ \& \ \text{Crep}[\text{Min}(A)]] \rightarrow \text{Brep}: L(A, t, s)$$

In other words, B entertains three representations:

- 1) That A is in a P() relation with thing t;
- 2) that B can extend cooperation expectations to C;
- 3) that C extends cooperation expectations to A.

From these, B can infer that

- 4) the relation between A and t can be represented as L(A, t, s).

This would describe a situation in which B has information about agent A (their use of t) and about agent C (namely, that C sees A as a potential cooperator) and transitively extends the label $L()$ to the relation between A and thing t .

7.2.3. Default extension of $L()$ tags

The most common situation is one in which an agent B has no specific information about A, but infers, from the fact that A enjoys a thing t , that B can represent that relation as an $L(A, t, s)$. This form of default inference is a consequence of hypothesis 3 and premise 5, which stated that

$$[H3] \text{ Brep}[P(A, t, s) \& \text{Min}(C) \& \text{Crep}[\text{Min}(A)]] \rightarrow \text{Brep}: L(A, t, s)$$

$$[P5] \text{ Brep}[X \in S] \rightarrow \text{Brep}[\text{Min}(X)]$$

Hypothesis 4 simply makes explicit the fact that combing two statements creates a default assumption:

$$[H4] \text{ Brep}[A \in S \& P(A, t, s)] \rightarrow \text{Brep}[L(A, t, s)]$$

In other words, if an agent B represents:

- 1) That some agent A (about whom B has no other information) belongs to a “sphere” of cooperation that includes B;
- 2) that there is a $P()$ relation between A and t ;

then B infers that

- 3) barring information to the contrary, B can represent the relation between A and t as an $L()$ relation.

This would trigger the typical motivations described in Figure 2, for example, a suspension of any plans to appropriate the thing t , to cancel $P(A, t, s)$. That may result in further motivations, for instance an intention to help A preserve access to t , or an intention to counter the actions of other agents who may try to thwart A’s access to t , the same motivations that were triggered by the dyadic situation described above in section 7.2.1.

This describes a form of default assumption that governs most ownership situations in our everyday lives. For example, we generally assume by default that most occupants of houses around us are “legitimate” ones rather than squatters. One reason for thinking that is that there is no evidence that others in the relevant community seem to represent them as intruders.

In this model, the extent to which people “respect” others’ property is a consequence of the extent to which they consider them as part of a community within which people extend $\text{Min}()$ expectations to each other.

This description in terms of $L()$ tags and $\text{Min}()$ may seem an overly abstruse or complicated way of describing a situation in which, people simply “respect” each other’s property. But that familiar and vague term simply assumes what needs to be described and explained, namely, the computations required to represent the relation between agent and thing, leading to those specific motivations that we gloss as “respect.”

7.3. Coordination effects of default assumptions

The fact that people can represent $P()$ relations in terms of $L()$ tags by default (at least within a sphere of cooperation) can also give rise to further, more complex inferences, based on meta-representations of other agents’ representations.

Most importantly, within a sphere of cooperation, we can expect that others represent people’s relations to things as $L()$, and we can expect that they expect us to do the same. These are two further combined hypotheses:

$$[H5a] \text{ Brep}[L(A, t, s) \& A, X \in S] \rightarrow \text{Brep}[X\text{rep}[L(A, t, s)]]$$

That is to say, by default, an agent B who represents:

- 1) The relation between agent A and thing t as an $L()$ relation, and
- 2) the fact that both A and X belong to the $\text{Min}()$ domain of cooperation (the set S),

may also infer by default that

- 3) agent X will represent that relation between A and t as $L(A, t, s)$.

That inference may itself give rise to a further meta-representation:

$$[H5b] \text{ Brep} [L(A, t, s) \& A, X \in S] \rightarrow \text{Brep}: [X\text{rep}: [\text{Brep}: L(A, t, s)]]$$

An agent B who represents (1) and (2) as above may also infer by default that (3) agent X will represent that B represents the relation between A and t as $L(A, t, s)$.

These two corollaries, taken together, constitute a minimal configuration for shared social norms, namely (a) I expect others to do x , (b) they expect me to do x , and (c) I expect them to expect me to do x (Bicchieri, 2006, p. 11ff).

These default assumptions deserve mention here because they create coordination points for a potentially large number of agents. If B represents $L(A, t, s)$ and assumes that others represent $L(A, t, s)$, B now has some information about these other agents’ likely courses of action. For instance, B may now assume that, barring information to the contrary, an unspecified agent in the group (represented as X) will prefer to include that agent A in their circle of potential cooperators, in our notation, they will prefer $\text{Min}(A)$ over $\neg\text{Min}(A)$. As a consequence, B would also assume that an agent X will prefer that $P(A, t, s)$ is maintained, that A preserves his/her connection to the thing t . From this, B may infer that a course of action that helps preserve the connection between agent A and thing t , what is called $P(A, t, s)$ here, will probably be approved by most others in the relevant group. Obviously, other agents run similar inferences about each other.

Importantly, the fact that not just B, but others as well may be motivated to maintain A’s access to t , that is, preserve $P(A, t, s)$, has the consequence that it lowers the costs for B to help agent A keep a thing t . That is for two reasons. First, if most people around B share an $L(A, t, s)$ representation of the link between A and t , the cost for each individual to help preserve P’s connection to t is now reduced as a direct function of the number of individuals prepared to help preserve it. Second, the cost is also reduced because the general acceptance of $L(A, t, s)$ lowers the probability that some others would side with an intruder trying to have access to the thing. This reduced cost should strengthen B’s motivation to help preserve A’s relation to the thing t .

These coordination cascades provide a simple description of the “general respect” for ownership that may seem self-evident to members of a community. People do not usually go around challenging each other’s claim to the objects they happen to

use. Such challenges, if they occur, are often met with some resistance and may be costly for the challenger.

7.4. L() tags inherit information from their precursor P() tags

As indicated in Figure 2, the contents of an L(A, t, s) representation include relevant information that triggered the creation of a P(A, t, s) tag for that particular agent–thing relation, which is a distinct hypothesis:

[H6] L(A, t, s) inherits the properties of P(A, t, s)

For instance, consider an agent C associated with a thing t_c and another agent D with a thing t_d. A third party who observe this situation creates representations P(C, t_c, s_c) and P(D, t_d, s_d). Now suppose that C visibly modifies and defends thing t_c, while D does not modify or defend the thing t_d. As a consequence, a third party represents the connections between agent and thing to be different in these cases, as the parameter s that measures the intuitive “strength” of connection (the inverse of separability between agent and thing) as different in these two cases – in other words s_c > s_d in these representations P(C, t_c, s_c) and P(D, t_d, s_d). The (intuitively represented) “strength” of possession is greater for C than for D.

In a situation with no Min() assumptions, that is, no expectation of potential cooperation between the agents, this would trigger P-inferences, such that, for example, it would (all else being equal) be more costly to try to separate C from t_c than D from t_d. That dynamic is indeed observed in competitive acquisition. Unsurprisingly, thieves prefer less well-defended targets.

But once Min() expectations are activated, so that, for a third party, C and D are potential cooperators, the very same pointers to information may be used to adjudicate, whether an agent “really” is the owner of a thing, or to what extent we should treat them as “the owner.”

For instance, if I want to defend Melanie’s entitlement to a garden and persuade others that we should act against Karl’s attempt to pick the flowers, I may mention that “Melanie worked hard on it,” “she built a fence around it,” etc. In cooperation situations with Min() expectations, these cues inherited from the P (Melanie, garden) tag strengthen the L tag and therefore increase our motivation to side with Melanie and frustrate Karl’s attempt.

8. Explaining central intuitions and behavior

8.1. Explaining salient features of ownership intuitions

A central assumption of this model is that ownership intuitions are not derived from a central, consistent set of principles. Rather, as DeScioli and Karpoff put it, “people apply multiple criteria to determine ownership, and these different rules can come into conflict” (DeScioli & Karpoff, 2015, p. 186). Our model aims to elucidate the origin of those multiple criteria in a way that explains the salient properties of ownership intuitions described in section 2.1.

8.1.1. Stable intuitions without a stable coherent theory

The processes that lead to attaching the L() tag to some agent–thing pair are largely implicit. That would explain why people’s explicit attempts at providing general, theoretical descriptions of ownership can remain vague or inconsistent (Noles et al., 2012). When people try to formulate some explicit principle of

ownership (e.g., “someone really owns something if...”), they activate salient cases, “read out” their own intuitive reactions, and try to extrapolate a general principle, leaving out the specific cues that lead to the intuitions.

Our explicit theories may sometimes be inconsistent, as well as being inconsistent with intuitions. For instance, imagine that your neighbor is a vicious criminal. He bought a shirt, which his cousin then stole from the neighbor’s closet. If we were asked to state, in principled terms, who owns the shirt, we might want to say that the neighbor was the legitimate owner, that his cousin’s behavior was wrong, and that he should give back the garment. By contrast, consider intuitions and motivations rather than explicit principles. A plausible empirical prediction is that people in such cases would not be strongly motivated to incur any costs toward restoring the property rights of a repulsive criminal. So what is stated, reflectively, as a consequence of what ownership “really is” may not always drive behavior or indeed intuitions.⁷

Ownership intuitions constitute the material on which people can construct their explicit, reflective representations of ownership. Intuitions are mental representations (e.g., “this is her car”) that do not come with an explanation of the mental processes that support them. Reflective representations provide commentary, explanation, explication, and justification of the intuitions or inferences from them (Mercier & Sperber, 2009). When people entertain and express thoughts such as “you don’t really own what you took by force,” or “if you borrowed something, you do not own it,” and so forth, they are providing an explicit description of what seem to them to be recurrent features of their own intuitions. These reflective representations in turn may provide the main materials for the elaboration of explicit social norms and legal principles of ownership, as summarized in Figure 3 below.

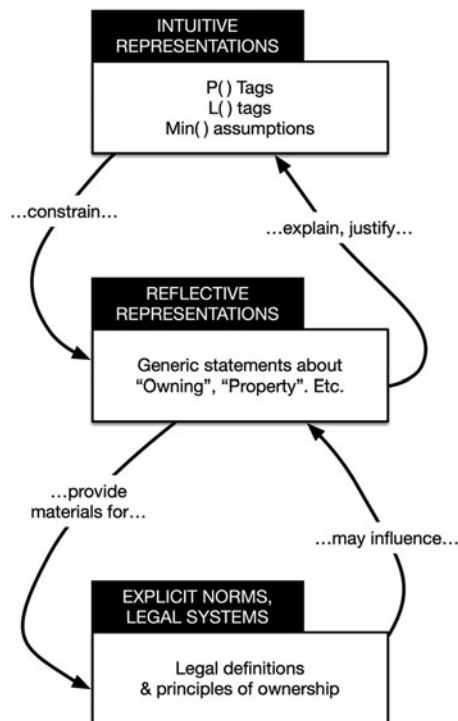


Figure 3. Relations between intuitions, reflective representations, and explicit norms concerning ownership.

8.1.2. A notion of what is “legitimate” possession

Children and adults everywhere have definite intuitions about the distinction between actual use, contiguity, etc., and legitimate enjoyment of things. In the present model, this distinction between situations corresponds to the activation of P() or L() representations, respectively. That is, people’s statements, for example, that the person who stole a horse “doesn’t really own it,” that they “should not be allowed to keep it,” that it is “not right” for the person to keep it, and so forth, are so many ways to express the fact that there is a P(person, horse) but no L(person, horse). The motivation to act in such a way that the P() situation is maintained and the motivation to recruit others in defending that situation are readily expressed in deontic terms, for example, that the person “should” have unhindered access to the thing.

8.1.3. The prior possessor heuristic

In the model proposed here, prior possession matters to ownership because it belongs to those P() cues that trigger a P(A, t, s) representation. Indeed, it is a crucial factor in competitive acquisition of goods and resources. As stated in hypothesis 3, the P() cues are inherited by the L() representations that we usually gloss as “this belongs to her,” “it’s really hers,” etc.

As Friedman and colleagues have demonstrated in careful empirical studies, prior possession heuristics are far more complex than the order of access to a thing (Friedman, 2010). First, the kind of contact between the successive agents and the thing does matter. Second, the actions that turn a thing into a rival good also matter.⁸ As Friedman’s studies demonstrate, people’s reactions show that the “first possessor” is interpreted as the first agent that made the thing an object that can be used (Friedman, 2010).

8.1.4. The relevance of labor

Changes made to the thing possessed, that is, interaction with the thing, are one of the cues that contribute to the strength of s in the P(A, t, s) representation, associating agent A with a thing t that they use. The greater the changes, the more vigorously others can expect the agent to react to intruders. As stated in hypothesis 6, the L(A, t, s) representations inherit the parameters of P(A, t, s). The information that contributed to the strength s of association between the agent and the thing now also justifies claims about the strength of “ownership,” which people will express with comments like “he worked on it a lot, so he deserves to be the owner” or other verbal expressions of L(A, t, s) with a high value for s.

8.1.5. Relevant contextual cues sway intuitions

The minimal model provides a parsimonious account of the change of intuitions that results from extraneous facts, as in the joke scenarios described above (sect. 2.1.5):

- [1] B tells A’s joke.
- [2] B ruins A’s expected success at a party by telling A’s joke first.
- [3] Comedian B steals A’s material.

In the first scenario, cues of first possession are available (one person knew the joke before the other) but the joke is not described as a rivalrous good, which blocks all further P() intuitions and therefore ownership intuitions. In scenario [2], we receive the same possession cues, but (a) we can now infer that the telling of the joke is a rivalrous good (the second teller of a joke gets no social benefit) so that P-cues are activated, and (b) we get a cue that the two characters are in each other’s sphere

of cooperation (at least minimally as they attend the same party), so that Min() would apply as well. That is sufficient to create an L() representation, with the associated motivation against $\neg P(A, t, s)$, that is, against disrupting the connection between agent and thing. In scenario [3], we can activate additional background assumptions, to the effect that, *inter alia*, comedians are paid for providing original material, so that telling someone else’s joke is a violation of the cooperative expectations of trade (Oliar & Sprigman, 2008).

8.1.6. What can be owned?

This may be a confusing question for many people (Noles et al., 2012). The answer depends on time and place, and there are always exceptions to the postulated principles. By contrast, in the minimalist model, the domain of ownership extends to anything that is the object of P() intuitions and cooperation expectations. The potential ownership domain can therefore be extended in unpredictable ways. It is not, however, unbounded – the things concerned must be rival goods, such that the relevant P() cues about competitive acquisition are activated. So the model predicts that ownership intuitions will not be activated when goods are perceived as non-rival – that much is unsurprising – but also that they would be activated once non-rival resources become rival. That seems to be supported by the experimental evidence. People assume that creative work confers ownership, but only if the work is successful and turns the materials into something one may want (Levene et al., 2015). Also, as mentioned above, the first possession heuristic can be reformulated as first contact that successfully makes the thing a potentially rival resource (Friedman, 2010).

The minimalist model explains why institutional innovation in this domain is both possible and easy for people to grasp. When some legal systems instituted copyright laws, ordinary people were not baffled by the notion of applying ownership tags to a melody or a novel, as they should have been, if their intuitions were guided by previous social norms or by a specific mental theory of ownership. They simply accepted that a tune or a story could be owned by a person, if there were (a) possession cues, and (b) cooperation intuitions, such as the motivation not to diminish other agents’ welfare in situations of voluntary trade.⁹ Future contracts are another example of ownership that is totally detached from tangible objects. Agent A’s right to sell B a particular good at a particular price on a particular date, regardless of the market price at that date, is another example of something that can be owned, purchased, sold, etc.

8.1.7. Who can own things?

Human sociality includes many situations of joint ownership as well as public goods and commons. Foragers hold territories as the collective property of a group (but exclusive to that group) (Kelly, 1995) and communities often manage grazing fields, rivers, or fisheries as commons (Ostrom, 1990). Young children also consider possible collective ownership (Verkuyten, Sierksma, & Martinovic, 2015a). Modern joint stock companies and state property are further examples of shared or combined ownership.

An implication of the present model is that agency is required for the mental representation of ownership, as ownership intuitions are grounded in the connection between an agent and a thing, noted here as P(A, t, s). This would imply that ownership intuitions would not be evoked if people do not represent an agent as part of the situation. Conversely, statements about ownership would trigger the inference that an agent must be involved

in some manner (i.e., if told that “this belongs to x ,” people will infer agent-like properties of x).

That seems to be the case. We know that people readily construe corporations as agents, attributing to them such mental states as beliefs, intentions, memory, and even some emotional reactions (Arico, 2010). That is also the case in non-industrial societies, where people see lineages as corporate groups and also as quasi-persons (Fortes, 1953; Kuper, 1982). To the extent that collectives are represented as agents, people can represent that the collectives are the A in such tags as $P(A, t, s)$ and $L(A, t, s)$.

The model would also imply the converse inference, that if some entity is described as owning something, people will derive the representation that the entity is somehow an agent. There is no systematic study of that process, although anecdotal evidence would suggest as much. Being told that “the county” owns this piece of land, we may spontaneously entertain representations such as “Does the county want to sell it?,” “Why does the county need it?,” and so forth, which imply (an intuitive sense of) agency.

8.2. Explaining why people do, and don't, “respect property”

A proper model should specify how different representations may lead to these opposite motivations and behaviors.

8.2.1. People do not “respect” ownership

In our model, people's motivation to preserve a $P(A, t, s)$ relation are the consequence of cooperation assumptions, $\text{Min}()$ tags. That is clear from situations in which the assumptions are suspended. Looting is a good example. People engaged in a riot for instance suspend all expectations of cooperation with, for example, car or shop owners in the neighborhood. Note that a situation like that is not “total anarchy,” as people sometimes describe it, quite the opposite (Quarantelli & Dynes, 1970). That is because P -inferences still regulate the looters' behavior.¹⁰

Some people become professional thieves, an occupation that suggests some denial of ownership. Criminals do not seem to infer $L(A, t, s)$ from the $P(A, t, s)$ of their victims. One might conclude that thieves simply do not entertain $L(A, t, s)$ notions at all. That is not really plausible, as an individual without $L()$ representations would be governed only by $P()$ intuitions, and would therefore steal whenever the expected benefit is greater than the expected cost. That may be true of psychopathic criminals who appropriate what they want when they can (Blair, 1997; Yoder & Decety, 2018). But that is not the case for most career criminals, who have families, friends, and associates whose possessions they do not try to steal (Gambetta, 1993; Sutherland, 1937).

In the minimalist account proposed here, criminals are not at all confused or inconsistent in their ownership intuitions, but they impose definite limits on the application of $\text{Min}()$ tags. They simply do not include the jeweler's store in the range of $\text{Min}()$ cooperation intuitions. It is a familiar observation that most criminals think in terms of us versus them, explicitly differentiate their world from the “regular” world of their victims, and often use special signaling (clothes, accessories, language, tattoos) to convey that distinction (Gambetta, 2011; Sutherland, 1937).

Denial of ownership is most widespread in warfare, which for most of human prehistory consisted of surprise raids on other tribes' settlements, followed by looting and abductions (Gat, 2006; McDonald, Navarrete, & Van Vugt, 2012; Tooby & Cosmides, 1988). While people engaged in such a raid activate P -cues about enemy property, simply appropriating as much as possible, they also maintain $\text{Min}()$ expectations of cooperation

toward their fellow warriors. They would be incensed if some members of the raiding team tried to monopolize the loot. At the beginning of *Iliad*, Achilles is furious to be deprived by his leaders of the sex slave he abducted during the sack of an enemy camp.

8.2.2. People defend “legitimate” possession: a tentative account

People often seem motivated to defend, not just their own connection to a thing, but a third-party's connection. Consider the following situation. A thief manages to snatch an old lady's purse. A witness to that event would experience a strong disapproval of the thief's action, a motivation to stop him, a motivation to get others to help the victim, a motivation to decrease the welfare of the perpetrator, and so forth. The motivations result from deontic representations, that is, by an intuitive sense that the situation in which the thief can get away with his crime should not occur, that one should try to bring about the opposite state of affairs.

In the moral psychology literature, different frameworks account for the occurrence of such motivations (Baumard et al., 2013; Cushman, Young, & Greene, 2010; Greene & Haidt, 2002). The question considered here is orthogonal to these debates about the ultimate causes for moral understandings, as it concerns proximate mechanisms that would determine people's reactions.

In this situations, a witness represents the termination of a possession relation, $\neg P(\text{old lady, purse})$, that is, the link between the old lady and her purse is abolished. An intuition that the situation cannot be tolerated, and a motivation to interfere, may be prompted by any one of several relevant inferences, including the following:

- a) That the old lady is a potential cooperator of the witness under $\text{Min}()$ assumptions (from premises P3, P4, and hypothesis 2);
- b) that some people the witness cooperates with may be among the old lady's cooperators (from premises P3, P4, and hypothesis 3);
- c) that the old lady belongs to the witness's sphere of cooperators (from premise 5 and hypothesis 4);
- d) that siding with the lady against the thief is a likely coordination point, the course of action most likely to be adopted and approved by other members of the group, and therefore the least costly option for the witness (from hypotheses 5a and 5b). Note, also, that a generalized “respect for property” may bring additional benefits for the witness – if it actually is a coordination point in the community concerned, the witness enjoys the advantage of living in a place where stealing is made less likely by such coordination points.

8.3. Explaining contested ownership

The minimalist model provides a straightforward account of situations in which ownership is contested, which should not occur if people shared common social norms or a theory of ownership.

Consider the case of squatters who appropriate some currently unoccupied land or dwelling. In terms of explicit principles of ownership, people would describe this as a case of illegitimate possession and conclude that the squatters have no “right” to the property. This seems to follow from fundamental principles of ownership.

But, confronted with actual cases, people's intuitions as to what to do are often more nuanced. In particular, people consider many aspects of the situation that do stem from principles or norms of ownership.

First, the time elapsed after the squatters' arrival does make a difference. If the squatters have occupied the property for a long time, many people have the intuition that they have increased their right to it. Second, investment matters too. When squatters rehabilitate some derelict property, many outsiders consider that the newcomers have *some* claim to stay in place. Indeed, both children and adults tend to find intrusion into a property "acceptable" if it makes the place better (Stonehouse & Friedman, 2021). Third, squatters are seen as having a stronger claim if the previous owners did not protect the property, or seemed to tolerate the squatters for some time.¹¹ Fourth, many people consider that the intruders' "right" to the property is affected by the moral standing of both squatters and previous owners. For instance, many people will feel no great motivation to defend the rights of a "big," rich corporation whose apartments are occupied by destitute people.

Note that these diverse considerations, which affect our intuitions about the proper way of dealing with the squatters, all derive from cues relevant to our competitive acquisition and cooperation psychology. The three first criteria all stem from P-cues. In competitive acquisition, the time elapsed since one started enjoying a thing, any modifications of the thing, and the previous occupier's defense of the thing, are all relevant in motivating behavior. The fourth consideration mentioned here, for example, to do with "greedy" landowners versus poor squatters, is a straightforward expression of Min() expectations.

So we can explain the uncertainties about who "really" owns the property, and what should be done, in a parsimonious manner by considering acquisition psychology and cooperation expectations, rather than *ad hoc* principles.

Indeed, most of the apparent uncertainty in such situations is driven by conflicting expectations about the extension of the Min() domain. History offers many examples. Colonizers for instance often claimed that they made a conquered country better (e.g., they brought roads, etc.), which in their view implied some form of ownership of the colony (Gilley, 2018; see discussion in Taylor, 2018). It is also possible to try to deny peoples' ownership by excluding them from the scope of Min() expectations. That was the case when colonizers insisted that the colonized population was outside the range of full humanity (Stoler, 2001), therefore outside Min() expectations. The same dynamic applies to the rights of conquered peoples in general, for example, to Native American land rights (Watson, 2010).¹²

9. Explaining (supposedly) peripheral cases

9.1. Informal property, seats, and queues

Someone who left a seat on the train, to go to the restrooms, still "owns" it in the sense that it would be a violation for others to "take" the seat. But if she leaves it unoccupied for a long time, intuitions may change. The same goes for seats at the theater or one's place in a queue.

The present model offers a simple interpretation. The contiguity cue is clear when we "occupy" a seat or a place in a queue. So P-intuitions are clearly activated here. When a person leaves her seat on the train or place in line, she removes the contiguity cues. But that does not guarantee that the "territory" is available. A currently unoccupied territory is an ambiguous state of affairs.

Among many species, the time elapsed since the last observed possession is a crucial cue. Time elapsed affects the parameter s , the strength of perceived possession. Since $L(A, t, s)$ inherits that parameter, time elapsed is naturally used as relevant to deciding whether it is fine to take the seat.

Note that cooperation motivations, by themselves, in the absence of P-intuitions, would not be sufficient to explain our intuitions regarding such situations. Cooperative motivations would require that we contribute to other people's utility. But our intuitions here go further, so that it would seem inappropriate for an agent B to take the seat A left vacant for a short time, even if by doing so B liberated a much better seat.

9.2. A special case: Cultural appropriation

The model may explain why "cultural appropriation" claims appear clearly legitimate to some, while others find them less compelling. In debates about this issue, people seem to be mostly interested in exclusivity and first possession. So claims of appropriation are justified by arguing that one group had the relevant norms or habits before others. Conversely, people who deride the claim of cultural appropriation often point out that the feature is not actually exclusive to or ancient among that group (Young & Brunk, 2012). So it seems that $P(A, t, s)$ cues are the most relevant information here.

But the minimalist model would suggest that cultural appropriation also implies another aspect of the cultural features, to do with cooperation and potential benefits. The model would predict that protests against cultural appropriation will seem legitimate to people who (a) expect others to maintain Min() expectations toward them, and (b) have an intuition that the cultural item "appropriated" conferred them a benefit and that it was a rival good. Actual cases seem to support this. For instance, protests against non-Black people in the US using Black haircuts, language, or other traits assume (a) that Whites and Blacks are in the same cooperation domain, so that Whites are expected to "respect" the interests of Blacks, but also (b) that there is some advantage in minority people having an exclusive use of specific practices. That is for instance the case if the cultural traits constitute ethnic signals. Outsiders who use them devalue their signaling function, and therefore decrease people's utility, leading to the intuition that people have been deprived of some benefit.

9.3. The case of slavery

Slavery was practiced throughout history in the most diverse societies, including empires (China, Rome), city-states (Greek *poleis*), agrarian societies (many African polities), and even foraging communities (some Native American tribes) (Eltis, Engerman, Bradley, Cartledge, & Drescher, 2011). If we assumed that the domain of what can be owned resulted from accepted social norms or from a mental theory of ownership, it would seem that the abolitionist movement that started in 18th century England required a drastic change in conceptions of ownership. But that is not what happened. In the debates on slavery, abolitionists did not much bother with legalistic discussions about the concept of ownership in a person. Their highly successful propaganda emphasized the misery of the slaves' condition and the cruelty of slave drivers (Carey, 2005; Taylor, 2004). Conversely, slave owners did not argue the case for a theoretical notion of ownership in persons, but tried to depict slaves as essentially different from full human beings (Smithers, 2012).

Indeed, in some cases, the people engaged in this trade clearly understood what it implied (humans could be property) while rejecting the application of that idea to their own sphere of cooperation. For instance, when Portuguese traders encountered Kongo kings on the Central African coast in the 1490s, their vast cultural differences did not stop them from understanding each other, as concerned the sale and purchase of slaves. Note, however, that on both sides the scope of potential cooperation (called *Min()* expectations here) was relevant to their activities – the Portuguese would not enslave their fellow countrymen, and the Kongo leaders only sold war captives, that is, tribal strangers (Heywood, 2009).

As many historians have noted (Carey, 2005), the emergence of abolitionism did not result from the adoption of a different mental theory or social norm about the domain of ownership, but from a widening of the “moral circle” (Pinker, 2011; Singer, 1981), that is, from the scope of what we called *Min()* expectations.

10. Ownership and social interaction

10.1. Downstream inferences: Giving, trading, liabilities

10.1.1. Giving and borrowing

Giving is very frequent in humans, in contrast with other species, from an early age (Cowell et al., 2017; Herrmann, Engelmann, & Tomasello, 2019; Paulus & Moore, 2017). It is crucial to informal and formal social interaction (Hann, 2006; Mauss, 1954). If people represent a systematic theory of ownership, that theory should specify when and how people can give things to others. By contrast, in our minimalist model, ownership intuitions reduce to the attribution of *L()* tags to specific *P(A, t)* relations, which by itself carries no implications about giving or borrowing.

Two lines of evidence suggest that the minimalist account might be more plausible here.

First, infants seem to entertain rudimentary notions of giving long before they have detailed representations of legitimate use. Young infants can make a distinction, between transfers that occur as part of an agent’s intention and accidental transfers or the result of fights for possession. This “giving” concept combines two features, (a) the transfer between A and B occurs because that is A’s goal, and (b) the transfer produces an expectation of further social interaction between A and B (Tatone, Geraci, & Csibra, 2015). So “giving” seems to be an early-developed conceptual primitive.

Second, older children are sometimes confused about the consequences of giving. For instance, they seem to assume that there are residual rights over a given thing, that giver A could still use the thing, take it home, etc. (Hook, 1993). This would seem paradoxical. But the solution is that the “giving” concept by itself may not carry any specific implications about residual rights, because it only includes the two features mentioned above. If that is the case, all downstream consequences of giving something to someone are a matter of cooperation parameters, which vary with place or time or context. In our model, the children’s apparent confusion simply means that they have not acquired a full database for the consequences of giving in different contexts. Indeed, children have no difficulty understanding that transfers are final, when the situation includes cues that they know about, for example, the ribbons and balloons that signal birthday gifts (Friedman & Neary, 2008).

Note, also, that the children’s assumption, that giving does not eliminate the giver’s rights in the thing, is in fact very common in

interactions between adults. Most people for instance expect a gift to be “respected” (re-gifting is seen as inappropriate even when it increases overall utility). Philanthropic donations generally come with specific conditions. Also, anthropologists have documented ritualized forms of gift-giving that occurs in many societies. People in these situations consider that some property of the giver adheres to the thing, and therefore constrains the recipient (Hann, 1998, 2006; Mauss, 1954). That would make sense, given the early developed intuition that giving creates an expectation of further interaction (Tatone et al., 2015) and the connection proposed here between ownership and cooperation.

10.1.2. Trading

Trading is both ubiquitous in humans and extremely limited in other species. Human trade can encompass any things that have utility for a trader and are currently possessed by a partner. Clearly, specific cognitive mechanisms are required to produce the required mental representations, including not just A’s valuation of A’s things, but also A’s valuation of some other agent B’s possessions, as well as a mental representation of B’s goals.

One clear implication of the model proposed here, is that *L()* tags are a prerequisite for trade but do not entail exchanges, so that ownership intuitions are necessary though not sufficient for trade. In the absence of *L()* representations, B’s possession of *t* would reduce to a *P(A, t, s)* tag, whose activation excludes the *Min(A)* assumption, and therefore the voluntary transfer of resources to the other agent. This may suggest that capacities for trade may have evolved as an addition to capacities for ownership intuitions.¹³

10.1.3. Externalities and liability

Ranchers are liable for damage caused by their cattle under some ranching regimes (Ellickson, 1991), and industrialists may have to compensate others for pollution (Baumol et al., 1988). Are these obligations directly derived from ownership intuitions? True, people often phrase such duties in that way (“since you own that cow, you must pay for damage to our crops”) but simple statements of that kind are the outcome of tacit computations that we should be able to describe.

Ownership as described here contributes two crucial pieces of information to people’s reasoning in such situations. The first one, which may seem self-evident to us, is that there is one particular agent with the closest relationship to the thing, and that this relationship is recognized by other members of the community. Second, in the same way as in the case of giving, the specific parameters of liability or externalities cannot be directly derived from ownership. That is why there are for instance opposite ranching regimes – either cattle are confined and agriculture is open, or *vice versa* (Ellickson, 1991).

10.2. Generalized trust and informal property

Practices such as standing in line, keeping allocated seats, or even exiting airplanes are deployed in different ways in different places, or at different times in history (Lee, 1984). Why those differences?

The minimalist model suggests that many cultural differences in ownership intuitions stem from differences in the scope of *Min()* expectations. The extension of people’s *Min()* expectations may be correlated with generalized social trust, that is, people’s intuitions about trustworthiness around them (Bauer & Freitag, 2018). Surveys of trust evaluation reveal important differences between places, even between comparable European countries (Albanese

& de Blasio, 2014). While people in Denmark would assume that most people are trustworthy, the situation is very different in Turkey or Southern Italy (Herrmann, Thöni, & Gächter, 2008; Knack & Keefer, 1997; Welch et al., 2005). Experimental studies too report large individual and national differences (Herrmann et al., 2008).¹⁴

So a clear prediction of the minimalist model is that cultural variation in “respect” for informal (and other kinds of) property will not be random, and that it will not depend on cultural models of what ownership “is” or “should be.” Rather, the places where people are most “considerate” in such situations would be the one where the sphere of cooperation is broadest, as manifest in trustworthiness expectations.

11. Cognitive implications

11.1. What do the P() and L() tags mean?

The model is described here in terms of abstract notions like P(), Min(), and L(). It would be natural to wonder what the tags “mean,” for example, whether the P() or L() tags correspond to what we usually name “possession” or “property” or “ownership” or “legitimate possession.” That would be misguided and misleading, as P() or L() are functional concepts that reduce to particular mappings of inputs to outputs, as described above, and summarized in Figures 1 and 2. The expression P(A, t, s) for instance is supposed to designate “the mental state that is triggered by P-cues (*a, b, ... n*) with downstream consequences (1, 2, ... *n*) concerning agent A and thing t.” The expression P(A, t, s) has no other meaning than these functional relations. That is not an exotic situation, as there are functionally defined concepts of this kind in other domains of cognition.¹⁵

In this model, ownership intuitions here result from the particular inputs that activated to the P() and Min() representations, so they can be updated, as an effect of any change in those input cues. That is why ownership intuitions are both tentative and perspectival. That is, an L(A, t, s) is a revisable interpretation of the relation between person and thing, so it is tentative. When people around the possessor have a similar interpretation, we may want to say that they “recognize” the possessor as the owner, but in fact that ownership relation only obtains among the people who see each other as belonging to a Min() sphere of cooperation. In contrast to common explicit understandings, ownership is not an actual relation between a person and a thing, an objective state of affairs waiting to be discovered by people equipped with the right detection instruments.

11.2. Verbal forms under-determine the concepts

The complex ownership psychology described here may explain why there is no straightforward mapping from various ownership concepts and linguistic forms. All natural languages include ways of expressing ownership (Rudmin, 1994). However, it would seem difficult to infer conceptual structures concerning ownership from these forms. In particular, grammatical forms like the English genitive describe a person’s connection to her car and house, but also to her friends, her children, her face and even her shadow, her ideas or her position in space. Such possessive forms denote an abstract form of contiguity (Jackendoff, 1995) that is necessary but not sufficient to representations of possession, ownership, and property. Polysemous lexical forms like “have” in English are equally applicable to all manners of

possession. More restrictively, linguistic forms in many languages mark the distinction between alienable and inalienable possession (Rudmin, 1994). Finally, some lexical items indicate the much narrower field of ownership as “legitimate” possession (Aikhenvald, 2013; Rudmin, 1994). So one can say that “Melanie and I stole cars yesterday – Melanie’s is a red convertible” but not “Melanie and I stole cars yesterday – Melanie owns the red one” (or “the red one belongs to Melanie”).

So it would seem that many languages are content to express P-intuitions (Melanie has usage of the red convertible) in the same way as general contiguity (Melanie’s eyes or parking spot). But special terms are reserved for L() relations between agents and things. As Goddard and Wierzbicka point out, terms like “own” and “belong” are “normative rather than factual” (Goddard & Wierzbicka, 2016, p. 97). These normative implications make sense in terms of the present model. L() relations require Min() cooperation expectations that are intrinsically normative, as they provide people with representations of the courses of action they should follow to maintain cooperation.

11.3. Is there a mental theory of ownership?

Should we assume that people entertain a mental theory of ownership? Leaving aside purely terminological disputes about what counts as a theory, the minimalist model would suggest that we do not need to think of ownership psychology as based on a set of principles that, for example, specify the domain to which ownership intuitions apply, the rules that allow one to determine whether A owns t or not, the consequences of specific ownership attributions, and so forth.

That is the main point on which this minimalist model diverges from the account proposed by Nancekivell et al. (2019), the most important attempt to describe the cognitive underpinnings of ownership intuitions. The principles described in that proposal are all theoretically motivated and empirically validated. They are all taken as valid in the present account. But the minimalist model also implies that we can explain these general features of ownership intuitions as consequences of the activation of two cognitive systems dedicated to managing competitive acquisition and cooperation, respectively.

There are two main arguments for this minimalist understanding. First, it makes it possible to explain the parameters of the postulated mental theory (e.g., why labor matters, or why priority is relevant and when, why context would influence joke-ownership, etc.). Second, the minimalist perspective is parsimonious, as we do not have to postulate special systems beyond those involved in competitive acquisition capacities and human cooperation psychology, for which there is massive prior evidence, independent of matters of ownership (André & Baumard, 2011; Boyd & Richerson, 2009; Gintis, 2007; Tooby, Cosmides, & Price, 2006).

12. A cognitive adaptation: Summary and implications

12.1. The empirical bet of a minimalist explanation

The goal in proposing this model of ownership psychology is to provide the first steps to a computationally tractable description of the representations and inferences engaged, that accounts for the evidence in a parsimonious manner, without resorting to special, *ad hoc* stipulations. The central assumption is that the combination of human competitive acquisition psychology with our cooperation psychology is sufficient for the task. As a

consequence, the proposal ought to be modified or abandoned, if it turns out that important aspects of ownership intuitions are entirely unrelated to these two cognitive systems.

12.2. Ownership psychology as an adaptation

We can describe the mechanisms governing ownership intuitions as a cognitive adaptation, consisting of computational connections established between two prior cognitive systems. These systems plausibly evolved separately as responses to different selective pressures, which is why they are computationally independent. Human cooperation extends far beyond ownership-based interactions, as, for example, when humans engage in helping others, or in collective action like hunting or warfare. Conversely, possession psychology can be activated outside cooperation, as in theft and conquest, and it is phylogenetically much older than cooperation behaviors.

So ownership psychology, the establishment of principled links between these two independent cognitive systems, is not a mechanical by-product of their existence. It constitutes a computational innovation, which may have been the target of positive selection because of its impact on the fitness of individuals with some version of this innovation, and is therefore an adaptation.

This establishment of computational links between systems seems to match general conditions for thinking of some trait as adaptive (Barrett, 2015; Pinker & Bloom, 1990; Williams, 1966), in that the computational machinery described here is both improbable – neither the features of cooperation, nor those of competitive interaction, require a connection to the other system – and plausibly fitness-enhancing, as interaction with agents who “respect ownership” enlarges considerably the domain of mutually beneficial interactions.

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Notes

1. In studies by Rochat et al. (2014), the effect of first possession seems to be less important in some cultures – however, this may result from using only a “prior contact” between agent and thing as the cue of first possession, as that may be a weak cue of an agent’s connection to an object (Kokko et al., 2006). The question remains open, what local cues may influence the expression of ownership intuitions and to what extent they do, see discussion in Rochat et al. (2014).

2. In some species, an organism can stop others from accessing its mates, in which case access to mates is not just rivalrous but also excludable. In other species, that is not the case. This is a matter of degree. There is a certain amount of mate-guarding in humans (Buss & Shackelford, 1997), and much more in mandrills (Setchell, Charpentier, & Wickings, 2005). Costs matter as well. Mate-guarding provides mating exclusivity but it comes with heavy opportunity costs – for example, in time not spent acquiring food (Setchell et al., 2005).

3. On formal grounds, there could also emerge a “paradoxical” equilibrium, in which incumbents always abandon their possessions and intruders always get

them if the loss is very small (see discussion in Smead & Forber, 2020, p. 882). Skyrms (1996, p. 79) argues that such equilibria would be unlikely, given the common fitness costs of abandoning possessions. See also Kokko et al. (2006) for an evolutionary mode, based on feedback between strategies and population structure that excludes paradoxical equilibria.

4. For instance, detecting that a human agent somehow controls or touches an object results in faster, implicit judgment that the agent will interact with that object (Scorolli, Borghi, & Tummolini, 2018). In a context of territorial competition, people can identify whether a soccer team is playing away or on its own field, on the basis of fragments of video showing the players’ gait and gestures (Furley, Schweizer, & Memmert, 2018).

5. As human communication relies on ostensive cues of communicative intentions rather than on semiotic codes (Scott-Phillips, 2014; Sperber & Wilson, 1995), indefinitely many behaviors may convey what we commonly call “possession,” “property,” “ownership,” etc., when the context allows the receiver of information to infer that such inference was the agent’s intention. That is why explicit signage, placards, etc., are only a very small part of the domain of ownership signaling.

6. This also applies to other species with markets for cooperators, see for instance Bshary (2002) and Bshary and Grutter (2006) for cleaner–fish/client interactions.

7. Indeed, some legal systems not only accept this lack of motivation but push it further, as they allow the seizure of criminals’ property as part of their punishment (Monti, 2012). This odd connection (“He assaulted someone, so he’s not entitled to his car any longer”) may seem appropriate because of our ownership intuitions. In terms of the present model, once the Min(A) tag is cancelled, people do not see A as a potential cooperator any longer. As a consequence, they no longer represent L(A, t, s) with its implications of “leaving alone” the relation between A and t. So cancelling P(A, t, s), disrupting the connection between A and the thing t, does not seem to carry costs any longer.

8. For instance, consider a scenario in which Dave is walking by the bottom of a cliff and finds on the ground a gem that Mike had just dislodged from the cliff wall and dropped involuntarily. It may seem that Mike has a better claim to possession, even though Dave is the first person to actually touch and handle the object. Typically, participants faced with these ambiguous scenarios attend to Mike’s intentions. If he actually had the intention of dislodging the stone from the rock, his claim to ownership seems stronger (Friedman, 2010, p. 84; Friedman, Neary, Burnstein, & Leslie, 2010).

9. Note that the costs involved in violating literary copyright are not just pecuniary – indeed, most plaintiffs in such cases are motivated by the notion that their authorship has been “stolen” (Buccafusco, 2016). This suggests that people see copyright mostly as a way of guaranteeing the reputational benefits of authorship – as more generally demonstrated in Altay, Majima, and Mercier (2020) for proprietary attitudes to ideas.

10. For instance, people are quite selective in the places they loot (Rosenfeld, 1997). Also, looters generally respect each other’s prior possessor position. Once a store is completely looted, people move on to another available one rather than trying to steal from other looters (McPhail & Wohlstein, 1983).

11. Indeed, many legal systems codify that intuition, stating that one cannot claim ownership to, for example, land that was not properly defended or was left unattended for a long time – the common law principle of *laches* (Robinson, 1976).

12. In a more complicated way, the discovery of natural resources in many countries lead to conflicts about who is entitled to royalties – the local communities, a tribe, a region, the whole country (see, e.g., Gustafson, 2020, for natural gas in Bolivia). These debates all revolve around the extension of Min() expectations, though they are generally expressed in terms of general claims about ownership, which by themselves cannot provide any definite answer.

13. Some archaeological models describe the difference between Neanderthals and anatomically modern humans (AMH) in terms consistent with this scenario. Neanderthals had group living and some level of social cooperation. But they also seem to have used mostly locally sourced tools, in contrast to AMH with their long-distance trade networks (Dillian, 2010) that suggest capacities for trade.

14. This is not just a matter of “culture” either. Daniel Nettle’s experimental and observational studies reveal large differences in the extension of cooperation to strangers, between neighborhoods of the same city (Nettle, 2010; Nettle, Colléony, & Cockerill, 2011). In other words, generalized trust should not be

treated as an independent, unexplained variable, as it probably constitutes an optimal response to particular conditions and incentives (Nettle, 2009).

15. For instance, in all human cultures, people entertain distinct attitudes toward people who are/are not perceived as genealogically connected (and often many distinct attitudes based on different genealogical connections). So there is a mental concept of the K(self, other) connection that regulates such attitudes on the basis of specific cues – but it would be misleading to see that concept as equivalent to the English “kinship” (Lieberman, Tooby, & Cosmides, 2007). In a similar way, humans represent some animals in the environment, in some situations, as special because one could chase and kill them for food – a concept that one may want to gloss as “prey” for convenience, but is constituted by the connections between specific cues and specific motivations (Barrett, 2005).

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Open Peer Commentary

Reciprocal contracts – not competitive acquisition – explain the moral psychology of ownership

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Abstract

We applaud Boyer's attempt to ground the psychology of ownership partly in a cooperative logic. In this commentary, we propose to go further and ground the psychology of ownership solely in a cooperative logic. The predictions of bargaining theory, we argue, completely contradict the actual features of ownership intuitions. Ownership is only about the calculation of mutually beneficial, reciprocal contracts.

We welcome Boyer's paper because, to our knowledge, it is the first to suggest that ownership derives not only from a competitive but also, in part, from a cooperative logic. In this commentary, however, we propose that it is possible to go even further and discard the competitive logic altogether to explain ownership. The perception of an individual's ability to monopolize a thing by force, we argue, is only at the origin of possession (P(.) in Boyer's framework), and it does not at all explain ownership (L(.) in Boyer's framework) as a moral right.

Alongside a critique of the competitive half of Boyer's theory, our commentary is thus above all an opportunity to emphasize, in agreement with Boyer, the extent to which the usual competitive theories fail to explain ownership.

Competitive theories of ownership are based on the Hawk-Dove-Bourgeois game (Maynard-Smith & Parker, 1976) or the Asymmetric War of Attrition (Hammerstein & Parker, 1982), and more generally on the notion of correlated equilibria (Aumann, 1974). They interpret ownership as an evolutionarily stable outcome of a bargaining game in which individuals use a symmetry break to allocate resources while avoiding costly disputes. Many researchers have argued that this logic explains not only the resolution of resource conflicts in nonhuman animals, but also human intuitions about ownership (DeScioli & Wilson, 2011; Gintis, 2007; Hoffman & Yoeli, 2022).

However, as Boyer also explains, the simplest form of this theory does not explain ownership *per se*. Rather, it explains the existence of any arbitrary convention for allocating resources. In particular, the conflict between an owner and an intruder can be resolved either by a convention that favors the owner (the private property strategy) or by a convention that favors the intruder (the anti-private property strategy), and nothing favors the private property equilibrium over the anti-private property one (Mesterton-Gibbons & Sherratt, 2014). For the private property strategy to prevail, the owner and the invader must be asymmetric in their bargaining power, for example, because the owner has a greater resource holding potential or benefits more from the resource and is therefore more interested in defending it (Fayed, Jennions, & Backwell, 2008; Kemp & Wiklund, 2004; Kokko, 2013). In this case, the anti-private property equilibrium sometimes disappears in favor of the private property equilibrium.

We agree that this set of theories explains how conflicts can be resolved in nonhuman animals. We also agree that it explains *possession* of resources in humans – that is, that people sometimes have exclusive access to resources in the sense that no one is *able* to take these resources from them. This set of theories, however, completely contradicts human intuitions about *ownership* – that is, intuitions that people are the *legitimate* owners of some resources.

Most strikingly, bargaining theory explains ownership as a consequence of power asymmetries. Thus, it predicts that being stronger than someone else, or having more interests in defending a resource, should not only provide the *possibility* to access that

resource, but should also always make that gain *morally legitimate*. Yet being stronger than someone else, or needing a resource more than they do, does not give you a legitimate right to access that resource. It makes it possible to *steal* that resource by force, but people see this precisely as a *violation* of ownership, not as a consequence of it.

Sure, in some specific cases, power struggles and property rights coincide. Sometimes, the first person to arrive at a resource both (i) is the legitimate owner of that resource, and (ii) has a bargaining advantage due to a structural asymmetry. Similarly, sometimes the person who has invested in the processing of a resource both (i) is the rightful owner of that resource, and (ii) has a bargaining advantage because she has more to lose if she was deprived of that resource.

But these are only special cases. Most resources do not give rise to any significant bargaining asymmetry between the first and second discoverer. Yet people consider the first discoverer to have a right to the thing he found. Likewise, anterior investments into a resource are most often sunk costs that do not increase the marginal benefit of further fighting over this resource. Yet people view individuals who have invested in a resource as their legitimate owners even if their investments are sunk. People intuit that others remain the rightful owners of their property even when they temporarily leave it *physically*, that is, even when they entirely give up any bargaining advantage. By contrast, non-human animals, which have no *ownership rights* but only *possessions*, must permanently maintain a favorable bargaining position to defend their resources.

Rather than from an interplay between competition and cooperation, ownership intuitions emerge from computations of a full-fledged cooperative contract. Ownership is one of many manifestations of a more general psychological mechanism, namely moral cognition, whose evolved function is to maximize the mutual benefits of reciprocal interactions, independently and often in contradiction with immediate bargaining power (André, Fitouchi, Debove, & Baumard, 2022).

When we intuit that some people have privileged rights of access to things, we do the same computations as when we calculate that people deserve to receive their fair share of a cake they contributed to produce. In the case of ownership, the mutually beneficial contract is the following (see André et al., 2022 for more details). Each individual prefers to refrain from exploiting things produced by others provided that others, in return, are willing to grant them exclusive access to things they found or produced. This reciprocal contract is mutually beneficial in that each party prefers being guaranteed the fruits of his labor than not being guaranteed those fruits while being allowed to exploit others' resources.

This purely cooperative view of ownership intuitions explains their fine-grained design features better than a partly competitive theory. In particular, it explains the fact that ownership is often tied to prior investments in things, since it is especially in the area of investment protection that private property is mutually beneficial (see André et al., 2022 for more details).

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The evolutionary psychology of ownership is rooted in the Lockean liberal principle of self-ownership

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Abstract

The psychology of ownership is rooted in self-ownership. The human brain has an evolved interoceptive sense of owning the body that supports self-ownership and the ownership of external things as extensions of the self-owning self. In this way, evolutionary neuroscience supports a Lockean liberal conception of equal natural rights rooted in natural self-ownership.

Boyer argues persuasively for the interaction of two cognitive systems to explain the psychology of ownership. But in doing this, he fails to recognize that there is a third cognitive system for *self-ownership* that is the true root of the evolutionary psychology of ownership. In explaining “the interaction of cognitive systems that are not about ownership as such,” Pascal ignores the evolved intuitive psychology of self-ownership, which really is “about ownership as such.”

At the center of Boyer's model is the “conceptual tag” of “(Agent, thing).” This assumes without explanation that human beings have an intuitive sense of themselves as *agents* who claim *ownership* of *things*. He provides no evolutionary explanation for why and how human beings have this intuition. The best explanation for this is the evolved neurobiology of self-ownership and self-owning agency: If human beings did not have any sense of owning themselves, they could not claim ownership of things external to them as extensions of their self-owning selves.

John Locke saw that the natural desire for ownership or property was rooted in the natural psychology of self-ownership – that “every Man has a Property in his own Person,” and this “no Body

has any Right to but himself” (1988, p. 287). Boyer points to Locke’s theory of property in explaining why labor is relevant to ownership. But Boyer fails to see the importance of Locke’s claim about self-ownership in supporting the natural right to property as the fundamental principle of Lockean liberalism, and how evolutionary psychology can explain this as grounded in the evolved neurobiology of the human brain.

Lockean liberals have seen slavery – the institution by which one person can own another person – as the most radical denial of the natural right of everyone to own oneself. In considering the case of slavery, Boyer explains abolitionism as a widening of the “moral circle” to include slaves, but he does not acknowledge that at the center of that “moral circle” is the self-owning human being recognizing other human beings as self-owners.

This was made clear by abolitionists such as Frederick Douglass, who ran away from his enslavement and became a leading abolitionist orator. Douglass said that even in childhood, he held onto one idea for freedom and against slavery: “Every man is the *original, rightful, and absolute owner of his own body*; or in other words, every man is himself, is *his* self, if you please, and belongs to himself, and can only part from *his* self-ownership, by the commission of a crime” (1991, p. 42).

Now we can see how this sense of each person’s self-ownership arises in the evolved neuroanatomy of the brain to serve the survival and well-being of the human animal. We can understand this as expressing interoception – the neural perception of the state of the body (Ceunen, Vlaeyen, & Van Diest, 2016).

The research on interoception shows that our self-awareness arises from the feelings that we have from our bodies as a neural integration in insular cortex of the signals of the condition of the body. The interoceptive neural network, having its core in the anterior insular cortex and the anterior cingulate cortex, provides the basis for the subjective awareness of our bodily emotions and social feelings, including pleasure, anxiety, trust, and anger (Craig, 2015).

The brain’s interoceptive feeling of self-ownership includes feeling whether other people are likely to be helpful or harmful to oneself, as in the brain’s ability to discriminate trustworthy faces and untrustworthy faces, or the propensity to punish people who make unfair offers in an ultimatum game. Our brains evolved to protect ourselves from threats and to seek out cooperative relationships in ways that secure our survival and well-being.

This explains the evolved basis in the brain for Douglass’s Lockean liberal principle of self-ownership in human nature. In running away from his slave master, and then in arguing for the abolition of slavery, Douglass expressed the evolved natural propensity of the human brain for self-ownership and for moral resentment against those who would threaten the natural human right to self-ownership. Moreover, Douglass extended this liberal principle of natural human equality in self-ownership to support other natural human rights – including women’s rights, the rights of immigrants, and religious liberty (Buccola, 2012).

Brain disorders can disrupt this sense of bodily self-ownership. One example of this is *somatoparaphrenia* (derived from three Greek words denoting “body outside the mind”). People who have had strokes in the right hemisphere of the brain sometimes suffer through a short period in which they deny that their left leg or arm belongs to them. They can *see* that their left arm or left leg is attached to their body, but it doesn’t *feel* like it’s part of their body (Antoniello & Gottesman, 2017; Feinberg, Venneri, Simone, Fan, & Northoff, 2010; Gandola et al., 2012; Vallar & Ronchi, 2009).

Comparing the studies of somatoparaphrenia, similar bodily disorders, and illusions such as the rubber hand illusion, in which the brain is tricked into feeling that a rubber hand is one’s own hand, provides evidence for what Frédérique de Vignemont (2020) calls the Bodyguard Hypothesis: The brain has evolved to protect the body through neural circuits that have a protective body map that creates a sense of bodily ownership and affective motivation to behave in ways that protect the body identified in the body map. Syndromes of disowning one’s body occur when the body map does not represent a limb that feels alien. Illusions of body ownership occur when the body map mistakenly represents something as a body part.

Evolution by natural selection favors those psychological propensities rooted in the brain that enhance our chances for self-preservation, which includes a sense of personal identity expressed in our owning and protecting our bodies, and then extending that sense of self-ownership into the ownership of external property that belongs to us. In this way, evolutionary neuroscience supports a Lockean liberal conception of equal natural rights rooted in natural self-ownership (Arnhart, 1995, 1998, 2016).

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Ownership is (likely to be) a moral foundation

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Abstract

Boyer presents a compelling account of ownership as the outcome of interaction between two evolved cognitive systems. We integrate this model into current discussions of moral pluralism, suggesting that ownership meets the criteria to be a moral foundation. We caution against ignoring cultural variation in ownership norms and against explaining complex, contested moral phenomena using a monist approach.

Moral foundations theory (MFT; Graham et al., 2013; Haidt & Joseph, 2004) was created to explain cross-cultural variation as well as cross-cultural similarities in moral judgments. MFT has four central claims: (a) There is a first draft of the moral mind (i.e., evolutionary processes created a universal initial configuration, not a *tabula rasa*); (b) the first draft of the moral mind gets edited during development within a culture; (c) intuitions come first, deliberative justifications come later; and (d) there are many psychological foundations of morality (see Graham et al., 2018). While the bulk of existing research has examined the initial list of five foundations (care, fairness, loyalty, authority, and purity), the founders of MFT have emphasized “moral pluralism” (i.e., that morality is more than one thing) rather than insisting on a fixed number of foundations. In fact, they have explicitly encouraged new foundations to be explored and added to MFT. Graham et al. (2013, p. 58) paraphrased Isaiah Berlin in writing that they “do not know how many moral foundations there really are. There may be 74, or perhaps 122, or 27, or maybe only 5, but certainly more than one.” Graham et al. (2011) posited that their original map of the moral domain (the five foundations) was “surely incomplete” (p. 382). So, what are these other foundations?

Since MFT was first described in 2004 (Haidt & Joseph, 2004), we have tried to identify the candidate foundations for which the empirical evidence was strongest. We proposed five criteria for foundationhood (Graham et al., 2013): (a) Being common in third-party normative judgments; (b) automatic affective evaluations; (c) being culturally widespread though not necessarily universal; (d) evidence of innate preparedness; and (e) a robust pre-existing evolutionary model. As we proposed these criteria, we solicited criticism and feedback from our colleagues and even offered a prize to researchers who could demonstrate the existence of a new foundation or the need to re-arrange the old ones. Three potential candidates were winners of the challenge, and so at the time we thought “that Liberty/oppression, Efficiency/waste, and Ownership/theft [were] all good candidates for foundationhood” (Graham et al., 2013, p. 104). More recently, other researchers have also built upon MFT, developing different typologies of moral judgments with slightly different lists of foundations. Among these efforts is an interesting line of work by Curry, Mullins, and Whitehouse (2019), where they make the case for seven moral foundations: Family, group, reciprocity, bravery, respect, fairness, and property (which is the same as ownership). All in all, ownership has been on the radar of moral psychologists for a long time, and yet it remains one of the least studied constructs in this literature.

Boyer proposes a useful model of ownership as the outcome of interaction between two evolved cognitive systems, namely, competitive acquisition (i.e., competition for resources) and cooperation (e.g., sharing, trade). Boyer’s minimalist model advances moral psychology and we largely agree with his claims. He

effectively reviews ownership’s foundationhood criteria: (a) Ownership is strongly present in third-party normative judgments (e.g., Gelman, Manczak, Was, & Noles, 2016); (b) consistent with the Social Intuitionist Model (Haidt, 2001), intuitions about ownership come quickly and without much deliberation; (c) ownership intuitions and norms are culturally widespread; (d) schemas of ownership appear in human infants (e.g., Noles, Keil, Bloom, & Gelman, 2012; Tatone, Geraci, & Csibra, 2015); and (e) human intuitions about ownership (not just of land and objects, but of mates and children) have obvious parallels in other animals, and respect for property is an evolutionarily stable strategy. Boyer’s model also offers a novel account of the evolution of ownership intuitions (which can interact with ecology and historical dynamics; see Bowles & Choi, 2013; Haynie et al., 2021).

Here, we suggest an expansion of Boyer’s model to explicate substantial cross-cultural variation in the domains of ownership. Then we caution against attempting to account for highly complex social issues and moral phenomena such as slavery via a monist approach that ignores the plurality of moral concerns.

Boyer is not particularly attentive to culture in this target article. The actual “domain” of the ownership foundation can vary quite a bit across cultures. Resources such as water and land may be owned communally, individually, organized around kinship boundaries, or not at all. Intangibles such as intellectual property can be owned in modern societies, although the ownership foundation seems rather unresponsive to thefts of intangibles (e.g., downloading music illegally) compared with thefts of physical objects (e.g., music CDs in stores). In Western societies, differential endorsement of the ownership foundation is almost definitive of the left–right political axis. Marx’s slogan “From each according to his ability, to each according to his need” is a beautiful ideal if you are an extreme communitarian and extreme egalitarian. But if your moral matrix rests heavily on the ownership and proportionality foundations (see Atari et al., 2022, for proportionality), then communism is an abomination that tramples on two foundations. Even the far milder versions of socialism and wealth redistribution that are supported by the left in most Western nations reveal that the left does not rely upon the ownership foundation as much as does the right. We have empirical evidence for this statement from several items we have tested at YourMorals.org in our exploration of a potential ownership foundation. For example, this item correlated $r = 0.30$ ($N = 6459$) with being on the left, politically: “If a person really needed to visit a friend in the hospital, and so he borrowed a stranger’s bicycle for an hour, and the owner never found out, I would say this was OK.”

We also would like to give a cautionary note against analyzing morally reprehensible acts such as slavery from a monist perspective (as opposed to a pluralistic approach such as MFT’s). As an alternative explanation to Boyer’s theory about “contested ownership” and special cases such as slavery, we argue that intuitions in response to such transgressions can in fact be the outcome of tension between multiple moral foundations. For example, care, equality, proportionality, and liberty intuitions are strongly violated by slavery, as is evident in abolitionist literature and imagery.

In sum, Boyer’s target article provides strong arguments that ownership is a moral foundation that should be incorporated within the broader MFT framework. More empirical evidence is needed to determine how this foundation develops, varies across cultures, and applies in contested domains. Intuitions about ownership seem to exist across human populations, although with enough variations in their scope and application to keep moral psychologists busy for a while.

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Beyond personal ownership: Examining the complexities of ownership in culture

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Abstract

We argue that ownership is a highly flexible concept, shaped by both innate and learned aspects, and heavily influenced by culture. Boyer's model focuses solely on universal personal ownership, neglecting other forms such as shared ownership, fractionalized property rights, and the ownership of the meanings and memories attached to possessions. A comprehensive understanding requires considering diverse human relationships with objects.

Boyer gives a reductionist account of the effects of culture. He claims near or total cultural universality for several effects (e.g.,

ownership, trusting kin over strangers). But cultural differences are much richer. For example, Boyer asserts that there is a widespread tendency for men to have a proprietary attitude toward partners. But there are significant differences between the manifestations of this attitude, which range from older and wealthier men collecting wives in Fiske's (1991) authoritarian ranking societies versus egalitarian matching of wives in his equality matching societies. There are few, if any, cultural universals.

Ownership intuitions have a mix of innate and learned aspects, as evidenced by the significant variations in ownership practices across cultures. In some cultures, personal ownership is frowned upon and taking possession of even small personal items is disapproved (Woodburn, 1982). Ownership intuitions may even reverse, such as when a tribe perceives the forest as being their owner, rather than their possession (Rochat, 2014). In some cultures, unattended objects, such as shoes left in front of a house, are regarded as available for use and subsequently passed on to the next individual in need (Rochat, 2014). The meaning of ownership is fluid and changes over time in response to the current social and economic structures. People learn and unlearn what can be owned, with examples such as slaves, personal data, and cryptocurrency becoming subjects of ownership in different times and contexts (Belk, 2020).

In brief, ownership intuitions are highly flexible and heavily influenced by culture, making any model that disregards the learned aspects of ownership intuitions overly simplistic. If Boyer's model is consistent with all these varied and sometimes conflicting intuitions, then the model's ability to explain is limited and its falsifiability is questionable.

Boyer also suggests cultural dichotomies (e.g., groups are either competitive or cooperative [with some variability]). Rather than just competition and cooperation (together with their mirror effects in trading vs. giving), there is shared ownership in which things are not only mine or yours, but also ours. Children as well as parents in a household are apt to regard most items in the household this way, even though the home, furnishings, and appliances are legally owned by the parents. *Nota bene*, such households are not merely collectivities with a single agent, as there is no legal joint ownership or transfer of property rights in sharing.

In essence, Boyer's model only accounts for personal ownership, specifically an individual's recognition and respect for another person's claim to an object. Inasmuch as Boyer's goal is to understand the origin of ownership intuitions as a fundamental aspect of human psychology, limiting the focus to just personal ownership is idealistic. Personal ownership only gained prominence recently in human history, starting with the advent of agriculture and becoming more pronounced with industrialization and market economies (Widlok, 2017). On the other hand, shared ownership was the norm for most of human history, as evidenced by the practices of hunter-gatherers (Widlok, 2017). It is important to note that shared ownership is different from the transfer of personal ownership through gift-giving.

Moreover, forms of ownership beyond personal ownership exist not only in the past or in non-industrial societies, but also in contemporary industrial societies. There are new forms of human relations with objects. Examples include the (1) so-called sharing economy (which is actually short-term rental), (2) digital objects such as avatars in virtual worlds, metaverses, and online games, (3) ownership with fractionalized property rights and residual seller rights to a fraction of future sales as with some non-fungible tokens (NFTs), and (4) online streaming services such as

music, TV/film, and luxury accessories, where access is a new form of *de facto* ownership as long as monthly fees are paid. Thus, ownership cultures are becoming much more complex than the forms considered by Boyer. Artist resale rights are an example. By means of a self-executing smart contract tied to the blockchain (which is also specified as the means by which ownership of the NFT of a digital artwork is transferred), the artists and their heirs in perpetuity are entitled to a share (typically 10%) of the escalation in the value of the NFT when it is next sold. The artist does not participate in any decline in value however; the sellers of a serial edition of the digital copy (the NFTs) bear such losses. Meanwhile, the owners of these NFTs lack any right of exclusion and copies of the digital artwork circulate freely online. Boyer's model cannot account for such fractionalized property rights based on copies of the original digital artwork for which full property rights remain with the artist.

Finally, Boyer uses the concept of "possession" more than 50 times without once acknowledging that our possessions can carry special meanings and memories that result in greater value due to attachment feelings. He is so focused on the fact of possession/ownership that he fails to appreciate the meanings of possessions. He selectively uses culture-specific behavior to build a case for an idealized core influence on ownership intuitions.


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A developmental perspective on the minimalist model: The case of respect for ownership

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Abstract

The developmental evidence for children's respect for ownership reveals that children will enforce the property rights of third parties before they themselves respect other's property. This pattern of development suggests the need for clarification or modification of the minimalist model. Here, I consider three explanations for the gap between knowledge and behavior for respect of ownership.

Boyer's computational model of ownership integrates a wide array of evidence and will generate fruitful discussions and research. However, clarification is needed to explain a key feature of human ownership: Respect for others' property. In the minimalist model, B's respect for A's property is defined in terms of the cooperative system, and respect can vary based on the strength of A's affiliation with B's cooperative community. The set of representations defined in hypotheses 2–4 describe how the representation for B's respect for A's property can be extended to a third party C and to a default assumption of respect for the property of all within the cooperative sphere. While this describes a mature state of the psychology of ownership, consideration of how these representations develop can help to elucidate the model.

Children are not born respecting the property of others. In the first two years of life, toddlers frequently grab toys from peers leading to conflicts (Chen, Fein, Killen, & Tam, 2001; Hay et al., 2021; Licht, Simoni, & Perrig-Chiello, 2008). By about 3 years of age, children will defend another person's property, suggesting a third-party representation of respect for others' property (Rossano, Rakoczy, & Tomasello, 2011). However, observational studies conducted in daycares, preschools, and elementary schools have found that conflicts over property continue into middle childhood (Bakeman & Brownlee, 1982; Putallaz & Sheppard, 1990; Shantz, 1987). Given that children as young as 3 years of age will enforce respect of property for others, why do they, and older children, fail to respect property themselves?

This developmental pattern has implications for the relations between the representations in Boyer's model. According to the minimalist model, the dyadic representations of hypothesis 2 provide a foundation for the more complex third party (hypothesis 3) and default (hypothesis 4) representations. In other words, children should respect the property of A before they defend the property of A from third parties. However, given the evidence above, this order of development is actually reversed. This raises the question of where the third-party representation comes from and how the gap between what one should do and what one does closes with age. In this commentary, I will focus only on the second issue and consider three possible explanations.

First, it is possible that children are only dis-respecting the property of peers who are not in their cooperative network. In terms of the minimalist model, a certain agent A may have a lesser status in the cooperative network, relative to agent B, such that $\text{Min}(A) < \text{Min}(B)$. The lower status of A would make them more susceptible to disrespect than B. While plausible, this seems unlikely given that, in the first 2 years, children both take from and give to the same peers when observed over time (Chen et al., 2001; Hay et al., 2021). However, it is possible that as affiliative groups become more clearly defined with age, children begin to treat those on the fringes of the cooperative network differently.

An alternative explanation is that children may perceive other children's ownership claims as having less strength than their own claims. Evidence for this possibility comes from research in which children are given an option to take resources from others. For example, when 4–7-year-olds were told that they could take objects that had been made (stronger claim) or found (weaker claim) by another child, they took more of the found objects, seemingly respecting a stronger claim for the made objects (Davoodi, Nelson, & Blake, 2020). Other studies have found variation in respect based on strength of claim for younger children (Pesowski, Kanngiesser, & Friedman, 2019). Although there is limited evidence for this possibility thus far, it would fit with Boyer's model by varying the "s" term for self and other.

A third explanation for children's lack of respect for ownership implicates a more general pattern of development that applies across the domain of moral cognition. Put simply, children recognize moral transgressions among third-party actions before they follow those moral norms themselves. One well-replicated case concerns norms for the fair distribution of resources. When 3-year-olds are asked how many stickers they should share with a peer, they typically say half. However, when given a chance to share with a peer in the exact same situation, they keep more for themselves (Smith, Blake, & Harris, 2013). The so-called knowledge behavior gap takes several years to close at which point children give what they know they should (Blake, McAuliffe, & Warneken, 2014), but some studies suggest that the gap continues into adulthood (Keller, Gummerum, Canz, Gigerenzer, & Takezawa, 2013). Multiple, general developmental processes may facilitate the alignment of behavior with normative beliefs, including, for example, behavioral control (Steinbeis & Over, 2017). However, it is also possible that the underlying representations for first-person behavior and third-party norms remain distinct. If this is the case for ownership, then the minimalist model may need to be adapted to account for when and how first-person respect for others' property connects with the representations for respect among third parties.

In summary, the development of children's respect for other's property offers a key case for understanding the relations among the components of the minimal model. I believe that this case presents an opportunity to test specific elements of this new theory and refine our understanding of how children attain the mature psychology of ownership.



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Not by intuitions alone: Institutions shape our ownership behaviour

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Abstract

Every day, people make decisions about who owns what. What cognitive processes produce this? The target article emphasises the role of biologically evolved intuitions about competition and cooperation. We elaborate the role of cultural evolutionary processes for solving coordination problems. A model based fully on biological evolution misses important insights for explaining the arbitrariness and historical contingency in ownership beliefs.

Boyer's target article investigates the evolved cognitive mechanisms that produce beliefs about ownership. Agents who want to use the same scarce resource, he points out, have conflicting interests: They want to obtain the resource and at the same, they want to avoid incurring the cost of fighting others for the resource. The target article argues that intuitions about competition and cooperation interact to eventually assign ownership. We enrich the target article in two ways. First, we describe in detail the problem of scarce resource use in terms of a coordination game. We note that agents rely not only on core intuitions but on cultural beliefs and institutions too, to solve the coordination game. Second, we advocate studying biologically evolved intuitions and culturally evolved institutions in beliefs about ownership together.

Ownership attribution has the payoff matrix of a complementary coordination game (Hindriks & Guala, 2015). In such games, agents earn a better payoff when they select a course of action that is different from their partner's. In the game of ownership attribution, one is better off with an exclusive access to a resource ("usage" in Fig. 1). If another agent claims this exclusive access, then one is better off avoiding conflict and respecting their exclusive access ("no usage"). This is because conflicts come with several costs: Fight, punishment and reputation costs in the community. With this payoff matrix in mind, how do agents choose between "usage" and "no usage"? How do they manage to coordinate on who owns what?

Correlation devices can help agents choose between "usage" and "no usage" (Hindriks & Guala, 2015). A correlation device is any mechanism or procedure that reliably signals to the agents which equilibrium strategy to choose in the game. For instance, a traffic light is a correlation device that drivers use to decide whether to stop or to go ahead. The exact content of the correlation device (such as the colour of the traffic light) can be arbitrary. However, the rules prescribed by the coordination device must be followed by a high enough number of agents for successful coordination. If this condition is met, then the coordination device can become an institution (Clarke, 2017; Guala, 2016).

Beliefs about ownership help decide how to allocate exclusive right of usage. When shared by many within a cultural group, they act as correlation devices. A common belief is the first

	Usage	No usage
Usage	-1	0
No usage	1	0

Figure 1 (Blazsek and Heintz). Payoff matrix for the game of ownership. If both agents try to use the same resource simultaneously, they both incur costs by fighting each other (Usage; Usage). If neither agents use the resource, they miss out on the benefits the resource will bring to them (No usage; No usage). Thus, the best outcome for both is either agent A uses the resource and agent B does not (Usage; No usage), or agent A does not use the resource and agent B does (No usage; Usage). This prevents incurring the costs of conflict, and it increases the probability of future mutually beneficial relationships by signalling that one is able and willing to cooperate.

possession assumption: The first person known or seen to handle an item owns the item (Fabbri, Rizzolli, & Maruotti, 2021; Friedman, 2008; Friedman & Neary, 2009). This assumption has formed the basis of rulings in property law (classically, *Pierson v. Post*, 1805; Rose, 1985) and claims to territory (Martinovic & Verkuyten, 2013; Verdery, 1998). The first possession assumption is likely to have origins in biologically evolved cognition (Nancekivell, Friedman, & Gelman, 2019). However, it has limits and therefore cannot be applied to every situation. There is, in fact, a rich and culturally diverse set of beliefs and principles that act as correlation devices in the game of ownership attribution. In other words, there are rich and diverse institutions of ownership.

A great deal of cultural and historical diversity can be observed in who ends up with exclusive right of usage and under what circumstances. For example, inheritance rights may depend on whether a society is patrilineal or matrilineal (Chimhowu, 2019; for a comparison between Malawi and Norway, see Berge, Kambewa, Munthali, & Wiig, 2014). There is abundant ethnographic evidence about culture-specific norms of giving and sharing (Crittenden & Zes, 2015; Lightner, Pisor, & Hagen, 2022). These norms prescribe how ownership may be transferred and consequently, they shape beliefs about ownership. Major historical changes in society may generate changes in attitudes towards ownership. For instance, during the transition period of post-socialist countries, former state-owned property became private property, which gave considerable freedom as well as responsibility to new owners (Kovács & Herfert, 2012; Savas, 1992). The historical and cultural diversity and the arbitrariness of ownership institutions suggest that a model based solely on intuitions of cooperation and competition does not fully explain how people decide who owns what.

Both biologically evolved intuitions and culturally evolved institutions play a crucial causal role in shaping how people decide who owns what. Therefore, a model based fully on one or the other is bound to miss important insights. While Boyer does acknowledge

that beliefs about ownership are sensitive to contextual cues (target article, sect. 2.1.5), the observed cultural diversity in ownership institutions is explained in terms of evoked cultural phenomena (Tooby & Cosmides, 1992). This model does not account for the arbitrariness in beliefs, historical contingency and path dependence.

Another account of the evolution of ownership intuitions implies that they emerge through the internalisation of culturally evolved social norms. The relevant social norms of ownership evolve as correlation devices for solving the coordination game (Binmore & Samuelson, 1997; Hindriks & Guala, 2015). Within this account, Guala (2016) uses a hypothetical example to illustrate the path dependency of institutions. Imagine that two communities happen to occupy the land on opposite sides of a river. It is not possible to cross the river, so the communities have no choice but to graze their cattle on the side of the river they first occupied. The river eventually dries up. The next generation of the two communities could now choose another territory, but they continue to stick with their respective sides out of convention. While this model accounts for historical contingency, it is limited because it does not consider the role of evolved intuitions. Indeed, Boyer's target article shows that several evolved cognitive capacities influence how institutions of ownership culturally evolve.

In view of these arguments, institutions of ownership might be better analysed as the result of a cultural evolutionary process that recruits biologically evolved intuitions (Heintz, 2014). Such an account would combine insights from economics and cognitive and evolutionary psychology. We contend that it has better explanatory power for the analysis of ownership institutions as well as their psychological foundations.

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Ownership psychology as a “cognitive cell” adaptation: A minimalist model of microbial goods theory

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Abstract

Microbes perfect social interactions with intuitive logics and goal-directed reciprocity. These multilevel, cognition-resembling adaptations in Dictyostelid cellular molds enable individual-to-group viability through public/private bacterial farming and dynamic marketplaces. Like humans and animals, Dictyostelid livestock-ownership depends on environmental sensing, cooperation, and competition. Moreover, social-norm policing of cosmopolitan colonies coordinates farmer decisions, phenotypes, and ownership identities with bacteria herding, privatization, and consumption.

Boyer, using what he describes as a sound computationally tractable logical calculus, tries to deconstruct then rebuild decades-old dueling sociocultural and cognitive theories of ownership psychology, rendering a so-called minimalistic or reductionistic cognitive systems explanation of agent-driven market behavior. Historically, advocates of strictly social or cognitive economic models fail to capture the full complexity of public, common-pool, private, and club systems of ownership and goods exchange (cf. Kagel, Battalio, & Green, 1995). Boyer’s account is no different and needlessly further skews the narrative of agent economic perceptions and interactions by favoring an *a priori* narrow anthropocentric framework of ownership intuition. Markets for exclusive and nonexclusive goods are observed within and across systematic classifications to include microbe to animal sociality (Ben-Jacob, Becker, Shapira, & Levine, 2004; Chung, Alós-Ferrer, & Tobler, 2021; Clark, 2010a, b, 2012, 2013, 2015, 2021c; Crespi, 2001; Dunny, Brickman, & Dworkin, 2008; Hellingwerf, 2005; Lyon, 2015; Marsh & Kacelnik, 2002; Pion et al., 2013; Ross-Gillespie & Kümmerli, 2014; Schultz, Stauffer, & Lak, 2017; Velicer & Vos, 2009). Such phylogenetic and sociogenic breadth of economics expression requires more details about the nature of ownership inferences and decision making than found in Boyer’s proposal. The author, eschewing any contributions from supposed *ad hoc* social norm influences, argues ownership intuitions emerge from the workings of and relationships between two human cognitive systems. One system processes aspects of agent competition associated with resource possession and scarcity, such as rivalry-motivated goods privatization. The other system processes mutually beneficial cooperation between agents, such as communal sharing and collective bargaining and trade. According to Boyer, these human neuro-cognitive systems enable agent attention to specific environmental cues and produce definite agent intuitions about ownership status, providing a testable paradigm for identifying, defining, and understanding conventional, edge or boundary, and unusual sorts of ownership conditions. Conditions may include, for instance, those linked to simple physical and intellectual property cases, intricate and possibly controversial human rights cases, and fuzzy cases involving disputes over ridership claims to public transportation seating or patron placement in public service or resource queues. Although Boyer’s framework succeeds in representing some credible features of human psychology and economic markets, it lacks external validity, power, and thus relevance for nonhuman ownership scenarios, leaving his computational model fundamentally incomplete for adaptive organisms without brains or even nervous systems, such as social amoebae and ciliates in Earth and possible extraterrestrial biospheres.

Evolutionary psychology weaknesses in Boyer’s framework may be isolated and challenged by a well-known comparative economics model of social eukaryotic microbes – Dictyostelid primitive livestock agriculture (Brock, Douglas, Queller, & Strassmann, 2011; Brock, Read, Bozhchenko, Queller, & Strassmann, 2013; Clark, 2019, 2021a, b; Stallforth et al., 2013; Werner et al., 2014). Application of economics theory in sociobiology often excites scientists as a means to explain and predict the evolution and behavior of organismal clades older than the Ecdysozoa–Lophotrochozoa divergence, such as taxa of social bacteria, protozoa, and roundworms (Tarnita, 2017; Thutupalli et al., 2017). Analogous to human and animal phenomena, microbes perfect social interactions through intuitive social logics and flexible goal-directed social reciprocity mediated by cell–cell communications (Clark, 2015). These cellular decision-making capabilities,

sometimes termed “conscious cell” or “cognitive cell” adaptations (e.g., Lyon, 2015; Margulis, 2001), enable careful scientific examination of microbial economics theory. Microbial economics typically involve the same kinds, yield, transfer, and possession of goods as commonly ascribed to human and animal foragers, hunters, cultivators, and harvesters. For example, private and club goods compel property owner rights or some level of excludability, whereas public and common-pool goods exhibit nonexclusive possession traits. Commodities scarcity drives rivalry between consumers and may affect acquisition of private and common-pool goods. Alternately, public and club goods encourage little-to-no property rivalries. Notable findings reported for Dictyostellid cellular slime molds suggest multilevel selection pressures force individual-group economic tradeoffs supporting exploration–exploitation strategies and specialized cell-response systems, which sustain cell, colony, and kin viability through both public and private bacterial farming over ecoevolutionary timescales. Like Boyer’s cognitive view of human property ownership, Dictyostelid ownership of bacteria depends on environmental sensing as well as social cooperation and competition. But, Dictyostelid social norm policing, far from being an unwanted *ad hoc* sociocultural stipulation, also plays central roles in switching farmer phenotypes and cell decisions, in determining ownership identities, and in herding, privatizing, and consuming bacterial livestock.

Dictyostelid markets, and therefore property ownership, rely on microbial symbioses restricted to caste-like cosmopolitan (super)colonies (Brock et al., 2011, 2013; Stallforth et al., 2013). Social mobility, induced by supply stressed environmental resources and cell–cell communications reporting community-transformation needs, obliges management of individual-group tradeoffs to optimize survival and reproduction. Sometimes individual or group goals are achieved through ruthless, selfish Machiavellian-type rivalry and deception and other times more peaceable, honest altruistic actions are taken. These remarkable social constraints permit Dictyostelids to harness intracolony resources to cope with their niche and to conquer additional ones. Dictyostelid farming evolved as a clone-specific trait that influences life history and fitness. While Dictyostelids cannot match the farming technology and financial market sophistication of humans, their prowess to survive, reproduce, and establish kin-dependent niche dominance via complex strategies and behaviors is impressive. Dictyostelid farmers proliferate in ecological conditions of low nutrient availability, when solitary hunting becomes abandoned and ordered motile social collectives, called slugs, are formed to begin fruiting body differentiation and sporulation. Slugs comprised of farmers, rather than non-farmers, migrate shorter distances to relocate in more favorable, if imperfect, ecological settings. They also prudently harvest bacteria to reserve stores for later consumption during spore codispersal. Farmer–livestock symbiosis is furthermore selective. Farmer amoebae carry proportionately higher populations of preferred-eating bacteria, with additional mixed populations of herd–dog bacteria to help secure and privatize livestock. Together, qualities of Dictyostelid primitive agriculture support dynamic consumer marketplaces, with structural and operational capabilities of kinship groups effecting sound trading partner choices, creation of strong local business connections, efficient diversification and specialization, high-return indispensable partnerships, ruthless competition elimination, and prudent saving for lean times (Werner et al., 2014). As such, a “cognitive cell” systems approach to Dictyostelid ownership addresses competition, cooperation,

and social norms in ways that help rectify, translate, and extend the essential points of Boyer’s human-cognition interpretation of ownership into a more universal species-invariant ownership framework.

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Ownership psychology and group size

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Abstract

Human group size seemingly has no limit, with many individuals living alongside thousands – even millions – of others. Non-human primate groups, on the other hand, cannot be sustained past a certain, relatively small size. I propose that Pascal Boyer's model of ownership psychology may offer an explanation for such a significant divergence.

Pascal Boyer offers a compelling and nuanced model of the evolution of ownership psychology. I want to suggest that such a model might help explain why humans have been able to live and thrive in increasingly large groups, while other, non-human primate groups cannot be sustained past a certain, relatively small size.

Humans, non-human apes, and the majority of non-ape primates evolved to live in social groups (Tomasello, 2020). However, human group size is almost always substantially larger than that of non-human primates. Gorilla groups average around 9–10 members (Meder, 2013); chimpanzee groups 40–45 members (with a range of 20–150) (Lehmann & Boesch, 2003); and baboon groups (*Papio cynocephalus*) usually range from 20 to 100 members (Markham, Gesquiere, Alberts, & Altmann, 2015). Occasionally, primate group size can reach up to 800 members – such as in Mandrill populations – but this is likely the maximum stable group size seen in non-human primates, and such “hordes” are rare (Abernethy, White, & Wickings, 2002). Humans, on the other hand, regularly form groups of thousands, and even millions, of individuals, and there is no reason to believe that such groups won't continue to grow.

Why is there such a substantial difference between human and non-human primate group size? Boyer's model of ownership psychology may provide an explanation. To see how, we first need to consider why it is that non-human primate group size cannot be sustained past a certain point. One well-supported explanation pertains to intragroup resource competition (Chapman & Chapman, 2000; Chapman & Teichroeb, 2012; Ganas & Robbins, 2005; Janson & van Schaik, 1988; Krause & Ruxton, 2002; Markham et al., 2015; Snaith & Chapman, 2007; Teichroeb & Scotte, 2009). There are many benefits to living in

a social group – including decreased predation risk, cooperative infant care, and the sharing of information (Markham et al., 2015). However, increased group size also means more competition for resources. Indeed, the larger the group, the further individuals will need to travel to gather resources (Snaith & Chapman, 2005), and the more individuals will need to compete over resources once they are found – that is, fight to get hold of the resource and then defend the resource from others who attempt to take it (Chapman & Teichroeb, 2012; Janson & van Schaik, 1988; Krause & Ruxton, 2002; Markham et al., 2015). At a certain point, the costs of intragroup competition become so high that they begin to outweigh the benefits of group living. This then motivates individuals to leave the larger group to fuse with smaller ones, where the costs and benefits of group living are more equally balanced (Chapman & Teichroeb, 2012; Markham et al., 2015).

However, if Boyer's model is correct, this may have changed the fission–fusion dynamic of ancestral human populations. In particular, if individuals were cued to recognize and respect ownership of resources, and property that housed resources, less energy would have been spent actively competing over resources. To take a specific example, one of the primary cues to ownership that Boyer discusses is prior possession (target article, sects. 2.1.3. and 8.1.3.). In ancestral populations, this would have meant that when individual A gained possession of a resource t, it would have triggered a P(A, t, s) representation, and as a result, other group members would have been less likely to attempt to separate A from resource t. This would have greatly reduced the energy that A would have otherwise needed to spend on defending resource t.

Boyer's model also gives us an account of the “general respect” for ownership within a community (target article, sect. 7.3.). If B represents L(A, t, s), B can expect – barring information to the contrary – that others in the community also represent L(A, t, s), and that those others expect B to represent L(A, t, s). This mutual expectation creates an atmosphere that aspires to preserve the connection between A and resource t, which, in effect, decreases the need for A to monitor and protect the resource within the community. It also reduces the need for B (who, let's say, is a close ally or kin of A) to expend energy in assisting A in protecting the resource.

In sum, a plausible consequence of the kind of ownership psychology that Boyer describes would be a decrease in intragroup resource competition. This would reduce the costs of living in increasingly large groups and, in turn, reduce individuals' motivation to leave such groups. As a result, group size would continue to grow.

Of course, much work needs to be done before this hypothesis can be said to be empirically credible. Perhaps most saliently, the archaeological record would need to show that group size started to grow in ancestral human populations at some point (soon) after ownership psychology evolved. If it did turn out to have empirical plausibility, however, it would have significant implications for our understanding of human groups. For one, it would mean that human group size originally came about as an evolutionary by-product. This might then shed light on why there is such a difference between the size of human groups and the actual number of people with whom we can maintain meaningful and stable social relationships (Dunbar, 1992).

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Computational theories should be made with natural language instead of meaningless code

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Abstract

The target article claims that we should speak in code to understand property, because natural language is too ambiguous. Yet the best computer programmers tell us the opposite: Arbitrary code is too ambiguous, so we should use natural language for variables, functions, and classes. I discuss how meaningless code makes Boyer’s theory too enigmatic to properly debate.

Boyer has made some of the deepest insights into the psychology of property (Boyer, 2015, 2018). The target article probably adds to these insights if someone can decipher the scrolls of cryptic notation, such as P() tags, Min(A), and Brep[Xrep[Min(A)]].

The article goes wrong with the notation introduced in Table 2. On its face, we should be skeptical that speaking in code will help us understand property. Throughout academia, scholars are mesmerized by secret codes, encrypted texts, and appearances of technicality. So we need to ask whether an artificial code is actually useful or yet another indulgence in scholarly solipsism.

On this point, the author provides little justification: a single sentence which claims that the notation helps by “avoiding the ambiguities of natural language glosses” (target article, sect. 5.2). The claim echoes a common refrain among modelers and jargon peddlers of many persuasions. Natural language is too ambiguous, they say, and arbitrary terms like Min(A) and Brep[] make ideas clearer. But this claim is dubious.

Cognitive scientists know that natural language is an evolutionary marvel of expressive power. Yes, language can be ambiguous; so can reality itself. But arbitrary code is far more ambiguous than language. Its meaning is hidden in the author’s mind, it lacks the advantages of words and grammar, and it is untested by the demands of daily use. Besides, the author’s notation does not escape natural language. Instead, readers must memorize a table of definitions in language, and then mentally substitute words for notation while reading, adding ambiguity in translation.

Consider the advice of professional programmers, whose computational programs need to actually run, and who therefore put the greatest premium on precision and clarity. Programmers constantly complain that they cannot understand each other’s code, due to the bad habit of arbitrary notation. The best programmers tell us the remedy is natural language. For instance, the prominent guide *Clean Code* advises programmers to use informative names for variables and functions (Martin, 2009). In chapter 2, “Meaningful names,” Martin advises programmers to replace ambiguous variables like “d” with names like “daysSinceCreation,” and to replace general labels like “theList” with specifics like “gameBoard” (p. 18). Google and Microsoft agree (Fig. 1). More particularly, the book recommends noun phrases for classes and objects, such as “Customer” and “addressParser,” and verb phrases for functions and methods, such as “deletePage” and “postPayment” (p. 25).

In fact, Martin (2009) applies evolutionary psychology to make the case. The section, “Use pronounceable names,” explains:

Humans are good at words. A significant part of our brains is dedicated to the concept of words. And words are, by definition, pronounceable. It would be a shame not to take advantage of that huge portion of our brains that has evolved to deal with spoken language. So make your names pronounceable. (pp. 21–22)

Continuing, Martin explains that arbitrary strings are difficult to discuss.

If you can’t pronounce it, you can’t discuss it without sounding like an idiot. “Well, over here on the bee cee arr three cee enn tee we have a pee ess zee kyew int, see?” This matters because programming is a social activity. (p. 22)

Indeed, cognitive science is also a social activity, requiring a fluent vocabulary. We cannot fully debate a theory while tongue-

Disallowed:

```
n // Meaningless.
nErr // Ambiguous abbreviation.
nCompConns // Ambiguous abbreviation.
wgcConnections // Only your group knows what this stands for.
pcReader // Lots of things can be abbreviated "pc".
cstmrId // Deletes internal letters.
kSecondsPerDay // Do not use Hungarian notation.
```

✔ DO favor readability over brevity.

The property name `CanScrollHorizontally` is better than `ScrollableX` (an obscure reference to the X-axis).

✘ DO NOT use abbreviations or contractions as part of identifier names.

For example, use `GetWindow` rather than `GetWin`.

Figure 1 (DeScioli). Rules for naming from Google's Style Guide, left, and Microsoft's Naming Guidelines, right (<https://google.github.io/styleguide/jsguide.html#naming>, <https://learn.microsoft.com/en-us/dotnet/standard/design-guidelines/general-naming-conventions>).

tied in twisters like, “how do pee parentheses tags relate to bee rep open bracket min parentheses ay close bracket?”

Just as the programmers warned, Boyer's arbitrary code spawns confusion. First, what is a P() tag? Does the “P” allude to “property,” “possession,” or something else? Is a P() tag the same as a P() representation, P() relation, or P-intuition, and are P-cues the same as P-indices? If so, synonyms multiply the ambiguous jargon. The author seems to prefix “P-” to any word, blurring technical terms with ordinary words bearing an arbitrary prefix. I cannot tell whether the model of P() in Figure 1 makes specific claims because the inputs and outputs are open-ended.

Second, what is Min(A)? If it means that A would cooperate with someone, then we have adjectives like *cooperative*, *friendly*, and *nice*, which has served as a technical term for cooperative strategies (Axelrod, 1984). Nearby, “Brep[]” seems to mean that B believes something, which can be expressed with verbs like *think* or *believe*. “Brep[Min(A)]” in natural language means “B thinks A is friendly.” Overall, I cannot tell whether the code introduces new ideas about cooperation or expresses familiar ideas in Min(A) and Brep[].

Third, what is an L() tag? What does the “L” allude to? L() combines the previous elements, compounding the confusion. The discussion enumerates lists of familiar ideas expressed in code and tortuous language. For instance, “A is in a P() relation with thing t” (target article, sect. 7.2.2) is not more precise but merely a circumlocution for “someone owns something” or “someone has something,” convoluted by the extraneous concepts of *be*, *in*, *relation*, and *with*.

The main point of L() seems to be that people weigh the value of a cooperative partner when deciding whether to respect or defend that person's property. What is notable about this claim? Later, the author argues that thieves do not infer their victims' ownership (target article, sect. 8.2.1). But then the thief would not hide their thievery. A skilled thief needs the ability to judge ownership impartially to anticipate the moves of owners and observers.

Boyer acknowledges these terms are meaningless and argues that saying what they mean “would be misguided and misleading” because they refer to “mappings of inputs to outputs” (11.1). This amounts to saying, “I have a theory but it would be misleading to tell you what it is.” That sort of theory is incomprehensible and thus unfalsifiable. Again, the author's justification assumes that meaningless code is less ambiguous than language and does not require translation to language to be understood. This assumption does not hold for real programs that map inputs to outputs, nor for theoretical programs in the mind.

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A cooperative–competitive perspective of ownership necessitates an understanding of ownership disagreements

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Abstract

Boyer's cognitive model of ownership, based on cooperation and competition, underscores the importance of studying disagreements in ownership. We argue that exploring the factors that can lead to different perceptions and experiences of ownership will uniquely inform our understanding of legal, psychological, and perceived ownership beliefs.

Boyer proposes a cooperative/competitive framework to understand ownership, arguing that ownership intuitions are derived from competing cognitive systems grappling with the need to allocate resources across people in a society. The idea that cooperation and competition serve as drivers of ownership (legal, psychological, and perceived) brings to light an underexplored area of research on ownership: disagreements in ownership. Indeed,

despite the growing literature on what gives rise to perceptions or feelings of ownership, there has been relatively little attention given to understanding what can lead to disagreements in ownership beliefs.

Broadly speaking, ownership can be studied in three forms: legal or “rightful” ownership, psychological ownership, or perceptions of ownership. Legal ownership is based on property rights and liabilities recognized by the law and enforced by the government (Honoré, 2013). Ownership beliefs refer to perceptions about who owns something. They can be informed by legal ownership but are also shaped by factors such as social norms, cultural expectations, and possession (Friedman, 2008). Finally, psychological ownership refers to the feelings of ownership that a person experiences over a target. Although psychological ownership shares some similarities with ownership beliefs, psychological ownership is typically conceptualized as the extent to which someone feels ownership over a given target rather than a judgment about which entity owns a given target (Pierce, Kostova, & Dirks, 2001).

Research exploring ownership beliefs and psychological ownership has examined factors that contribute positively to ownership beliefs across the lifespan (e.g., Friedman & Neary, 2008; Norton, Mochon, & Ariely, 2012; Palamar, Le, & Friedman, 2012; Peck & Shu, 2009; Pesowski, Nancekivell, Tasimi, & Friedman, 2022; Pierce et al., 2001; Ross, Friedman, & Field, 2015). Notably, these factors can range from simple physical interactions with an object to more complex psychological experiences. Researchers have also examined the consequences of ownership such that ownership, or beliefs of ownership, increase valuations of what is deemed to be owned (e.g., Atasoy & Morewedge, 2018; Beggan, 1992; Thaler, 1980), positively influence stewardship over what is deemed to be owned (e.g., Peck, Kirk, Luangrath, & Shu, 2021; Preston & Gelman, 2020), and increase interest in obtaining and using resources with higher perceptions of ownership (e.g., De La Rosa, Sharma, Tully, Giannella, & Rino, 2021; Sharma, Tully, & Cryder, 2021). Missing from the current knowledge are factors that lead to disagreements in ownership perceptions, and the consequences of those disagreements.

It is important to explore and understand the factors that influence disagreements in ownership as disagreements over ownership can have far-reaching consequences and can cause conflicts in a variety of contexts, including personal relationships, between organizations, or even between nations. For example, after Prince died in 2016, various parties claimed ownership over his assets and intellectual property. The legal disputes between Prince’s family members over the estate caused significant strife within the family (Carlson, 2021). Apple Inc. and Samsung Electronics Co. serve as an example of the consequences of ownership disagreements between organizations. Disputes about ownership of product design between these companies led to a significant, long-running legal battle with estimated costs running into the hundreds of millions of dollars (Samsung Electronics Co., Ltd., et al. v. Apple Inc., 2016). Finally, the ongoing conflict in Ukraine is just one example of the consequences of disagreements in ownership between nations. In 2014, Russia annexed Crimea, a region in Ukraine; however, Ukraine and many Western countries consider the annexation to be illegal and claim that Crimea is part of Ukrainian territory. This disagreement over land ownership has since escalated into a larger war and remains a source of ongoing disagreement and conflict. These examples highlight that disagreements about ownership can lead to disputes, which can escalate into larger conflicts and can cause harm to individuals and communities.

Understanding the underlying factors that contribute to disagreements over ownership may help prevent conflicts, promote social harmony, build trust and cooperation, and foster positive relationships between individuals, communities, and nations. Moreover, understanding the factors that contribute to disagreements over perceptions of ownership can also inform policy-making and legal decisions. By accounting for the subjective and cultural dimensions of ownership, it may be possible to design and implement more effective policies and legal frameworks that recognize the diversity of ownership experiences and promote equitable outcomes.

Boyer’s cooperative/competitive framework should thus encourage researchers to rethink the existing approaches to studying ownership. Indeed, if we think about cooperation and competition as the source of ownership intuitions, factors that lead to disagreements in perceptions of ownership should be just as, if not more important than, agreements in perceptions of ownership. Disagreements may be with respect to whether a target can be owned. Disagreements may also occur across types of ownership, such as when one’s perceptions of ownership do not match their legal ownership status. Finally, disagreements may also be within a specific type of ownership, such as when two individuals differ with respect to perceptions of ownership over a specific target. It is important to note, however, that not all “disagreements” will lead to conflict. For example, an artist may feel psychological ownership over a piece of art they have sold to a buyer while recognizing that they are not the legal owner, and this discrepancy may not lead to negative conflict even if the buyer feels a similar level of psychological ownership over the artwork.

The likelihood of disagreements over ownership may, in part, be predictable. We suspect that this likelihood may be greater for targets of ownership that are intangible since physical possession cues may be more difficult to ascertain for these targets. Similarly, we believe that ownership disagreements are more likely to arise when individuals, organizations, or nations lack similar cultural norms and beliefs, albeit which norms or beliefs are most critical remains unknown. Thus, we strongly encourage researchers and scholars to more seriously consider the role of disagreement in ownership, and appreciate the framework provided by Boyer for bringing this dearth of research to the forefront.

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On intuitive versus institutional accounts of ownership

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Abstract

We contrast Boyer's intuitive account of ownership with formal legal accounts based on institutions of ownership. Boyer's emphasis on social aspects of ownership intuitions may have a bearing on recent arguments that property institutions are justified by their capacity to promote human flourishing. Moreover, Boyer's account of property intuitions facilitates the study of acquisition and mental representation of formal ownership concepts.

Boyer proposes a computational model that derives *intuitions* about ownership from two sets of cognitive systems, one having to do with competitive acquisition of resources and the other concerned with co-operation with respect to those resources (sharing, trade, etc.). By contrast, legal literature on ownership is much more concerned with *institutions* of ownership, that is to say, with those relations between persons and things that find formal expression in the juridical structures of law (Dagan, 2011). For example, on an orthodox legal account, where B is owner of *t*, the “content” of B's relation to *t* consists of a general duty owed by everyone else in the world not to interfere with B's control of *t* (McFarlane, 2008). The existence of this general duty, which often finds doctrinal expression in the law of civil wrongs, preserves a sphere of freedom for B to do what she likes with *t* (to sell it, give it away, let A use it for a while, and so on); and so creates the legal conditions for B to set the agenda for the use of *t* through exercise of an open-ended set of privileges in respect of *t*'s use (Harris, 1996; Katz, 2008).

It strikes us as interesting that, in Boyer's model, the proposed representations of ownership have much more to do with B's perception of A's relation to *t* (and its strength, etc.) rather than any intuitions that B may have about B's things. This may be an important point of distinction between cognitive accounts of ownership and legal accounts of the institutions of ownership. While Nancekivell, Friedman, and Gelman (2019) have observed that there is no necessary conflict between an institutional account of ownership and an account of how ownership is represented psychologically, they also emphasise that institutional accounts neglect non-normative aspects of ownership. It might equally be the case that representations of ownership, focused on cues apparent to B from the interactions of A with *t*, underemphasise those dimensions of B's agenda-setting authority in respect of B's things which property theorists consider to be vital to an explanatory account of ownership as a legal and social institution.

This could be important, because in law there are currently significant debates concerned with the scope of B's authority and the extent to which it might be limited by countervailing legal obligations. “Progressive property” theory (Alexander, Penalver, Singer, & Underkuffler, 2009) seeks to argue that property institutions are justified by their capacity to promote human flourishing, and this entails that B's agenda setting authority is tempered by social obligation norms conditioned to promote other-regarding behaviour that squares B's autonomy in dealing with things with a broader sense of responsibility to her community (Alexander, 2018). This account of property has far-reaching implications for the use of resources, in contexts as diverse as compulsory land acquisition by governments and the regulation of food waste. To the extent that it is predicated on the idea that owners have obligations to the members of their community, it seems to offer a frame for thinking about ownership that resonates with Boyer's emphasis on co-operative interactions. There might be much to be gained from increased co-operation between property lawyers and psychologists on these themes.

Although we have focussed thus far on the contrast between intuitive and institutional understandings of ownership, there are also important psychological questions about how those understandings might be related in the mind of the understander. There are precedents in cognitive science for seeking to elucidate psychological relations between formal and informal theories of a number of domains. For example, cognitive scientists of science have shown that scientific and intuitive understandings of the physical world coexist (Shtulman & Lombrozo, 2016), so that even professional scientists display vestiges of their earlier intuitions when verifying scientific facts (Kelemen, Rottman, & Seston, 2013). Moreover, work in science education has explored how intuitive understanding interferes with the acquisition of formal scientific theory (e.g., Coley & Tanner, 2015) and how such influences might be overcome (Ronfard, Brown, Doncaster, & Kelemen, 2021).

In addition to considering implications of accounts of ownership intuitions for institutional accounts, and vice versa, property lawyers and psychologists might also consider the psychological relations which hold between intuitions about property relations and more “formal” legal understandings based on institutions of ownership. One possibility is that these understandings coexist in the minds of people who have undergone legal education. To test this, we might ask whether property lawyers behave in ways consistent with the coexistence hypothesis, such that their judgments about property relations might be affected by both institutional and intuitive notions of ownership. Relatedly, we might ask

whether an institutional understanding of property relations is present in people who have not received any legal education. Unlike science, law is not usually taught until third level, and so the developmental pattern may be different in the two domains. Moreover, once students do begin their legal education, it may be worth exploring in detail the overlap between intuitive and institutional notions of property relations so as to uncover any aspects of the former which make the acquisition of an institutional understanding more difficult than it might otherwise be.

We realise that the primary audience for Boyer's paper consists of cognitive scientists interested in the ontology of ownership intuitions. But the work it describes may have implications for the foundations of legal understanding of property, as well as for legal pedagogy. It deserves to be read by legal scholars as well as by cognitive scientists.


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No single notion of cooperation explains when we respect ownership

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Abstract

Cooperation is fundamentally moderated by the form of relationship between the actors involved, as is normative resource distribution. We argue that possessions are likely treated differently across different types of cooperative relationships. Whereas Boyer's computational model might in principle account for this, the theory would benefit from a specification of how different cooperative contexts can shape the representation of ownership.

We applaud Boyer's attempt to provide a simple, computational, functional theory to account for all cases of ownership representations across cultures, including novel and historical phenomena. Boyer posits that there are no dedicated, evolved, core ownership representations *per se*, but that an intuitive notion of ownership is produced by evolved cognitive systems for (a) competitive interactions for the possession of resources and (b) expected mutually beneficial cooperation between agents. However, we posit that there is no one-size-fits-all form of cooperation. That is, cooperation is fundamentally moderated by the form of relationship between the parties involved, as is normative resource distribution. Thus, it is unlikely that one minimal cooperation tag will suffice in explaining our ownership psychology.

Boyer argues that whether one represents possession as *legitimate* ownership that should be respected will depend on whether an agent possessing the resource is seen as a *potential cooperation partner*, conceived broadly. It follows that any individual who fulfills this minimal requirement might be a legitimate owner, given a sufficient strength of the association between possession cues and that person. Further distinctions between types of cooperation or types of cooperation partners are not made. In other words, how one perceives ownership should not necessarily differ between a distant, but possibly cooperative stranger, a close friend, or a family member with whom one engages in regular cooperation.

Whereas this is theoretically possible, ownership behavior in close or long-term cooperative relationships constitutes an important counter-example to Boyer's claim that agents will respect (and represent as legitimate) possessions as far as they are held by cooperation partners. In fact, we may be less likely to respect the personal possessions of particularly close cooperation partners as compared to more distant cooperators. Presumably, one would be less reluctant to take an object from a close family member without asking than from a stranger. That is the point of communal sharing (see Fiske, 1991, for ethnographic review) – not that you share in the community, as Boyer appears to use the term, but that resources (such as food or land) are shared communally, belonging to everybody and none in particular within a relationship of *oneness* or social unity. In addition to kin and kin-like relations, high degrees of generalized reciprocity within the group likely also makes this possible. Indeed, people who engage in frequent reciprocal sharing plausibly take each other's possessions sometimes (e.g., “borrowing” milk in the office refrigerator from a close colleague without asking, who may in turn borrow from someone else on another occasion).

These challenges to Boyer's theory may arise from Boyer's assumption that a loss of a resource is always more costly than beneficial for the owner. Following the logic of inclusive fitness (Hamilton, 1964) and reciprocal altruism (Trivers, 1971), the costs imposed upon an agent who loses a possession to close kin or someone who is likely to reciprocate might not outweigh the long-term benefits of the relationship. If so, the agent should not refrain from future cooperation. Boyer does not consider the cost of losing cooperation partners borne by *owners*, which would indeed be moderated by the strength and duration of the cooperative relationship: It would not be very costly to halt future cooperation with a stranger taking one's pen, but the costs would be substantial by ending the relationship with a close friend who did the same; it is annoying to return from a vacation to find that elderly neighbors "helped out" by picking and cooking for themselves all the apples of your garden while you were gone, but maintaining otherwise helpful and cordial cooperative relations for years to come is worth more than a harvest of apples and likely keeps you from making a fuzz about it. The difference between closer and distant relationships in this regard might be qualified by resource value. Although the benefits associated with close, cooperative relationships may allow individuals to respect ownership less than in more distant relationships, consequences will most likely be inevitable if the resource is of great value, even among friends and family members (witness devastating inheritance conflicts within families, for instance). Taking a possessed object of great value would likely yield a cost too high for the owner and end most cooperative relations. An evolved computational mechanism to represent legitimate ownership would likely adaptively consider how costs and benefits of resource loss vary across relational contexts.

A counter-argument from the perspective of Boyer's model might be that cues of possession are simply weaker in the context of close cooperative relationships, and thus permit ownership not to be respected. For instance, one might argue that the shared use of resources within one family home may undermine the overall impression of possession, which would be necessary to form any representation of legitimate ownership. Yet, even if this counterargument can explain how we fail to represent the ownership of *others* in close cooperative relationships (and, speaking against it, at least Scandinavian siblings appear acutely aware of who owns what toys or makeup, even if they lend them to each other), it does not consider why and when the *owner* (who presumably knows whether a resource is hers) might represent a shift in possession as permissible. This suggests that the psychology governing how we deal with our *own* possessions must also be relationship-specific beyond a simple distinction between potential cooperators and non-cooperators. In sum, a computational theory of ownership representations and motives must account for the manner in which ownership plays out in different kinds of cooperative relationships, including how ownership-related motives manifest in the minds of owners across relational contexts.

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Ownership and willingness to compete for resources

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Abstract

Boyer proposes that ownership intuitions depend on tracking cues predictive of agents' motivations to compete for resources. However, the account may mis-predict people's intuitions about ownership, and it may also be too cognitively costly to be feasible. Even so, alternative accounts could benefit by taking inspiration from how the account handles thorny issues in the psychology of ownership.

Boyer's account is ingenious and elegant, and a major advance in theorizing about the psychology of ownership. An "invisible hand" account of ownership intuitions – an account showing how these intuitions could arise from cognitive systems not specific or dedicated to ownership – is more satisfying than explaining ownership in terms of concepts and principles specific to it. Boyer dispenses with ownership-specific principles by suggesting that ownership intuitions like *Anna owns the shovel* are rooted in processes that also support assessments of agents' motivation to compete and fight for resources. Both kinds of assessments depend on a system that keeps track of various agents' dealings with objects – for instance, the extent to which an agent has been seen with an object, defended it, and modified it. This system outputs a summary of how strongly related the agent is to the object, and strong relatedness can lead to ownership intuitions or to the sense that the agent would fight for the resource.

But one worry is that the account will mis-predict intuitions. An agent's motivation to compete for a resource will depend on its value to the agent and on the agent's likelihood of prevailing. Children aged 6–8 consider these factors when predicting who will win a fight over a resource, and who will spend more time searching for it (Pietraszewski & Shaw, 2015). But these factors are less relevant for ownership. Young children recognize that people own things they don't like, want, or value (Goulding & Friedman, 2018; Noles & Gelman, 2014) and whereas young children across many cultures ascribe ownership to the agent who created a resource, for the most part they do not ascribe ownership on the basis of neediness (Rochat et al., 2014). Hence, *accurate* summaries of others' willingness to compete for rivalrous goods are unlikely to be viable source for ownership intuitions.

Similar concerns arise if we start with ownership intuitions and try to predict willingness to compete. Suppose Anna tries to catch a butterfly and Beth sees this but then succeeds in catching it. Adults, children, and legal rulings typically see Beth as the owner in these

kinds of disputes (e.g., Friedman, 2010; Pierson v. Post, 1805; Shaw, Li, & Olson, 2012). But it's uncertain whether people would similarly think she is more motivated than Anna to compete for the butterfly. It's true that in one series of studies, 6–8-year-olds expected owners would prevail in fights over property (Pietraszewski & Shaw, 2015). But children no longer expected this when provided with additional details, such as information that the non-owner was hungry (if the resource was food). The link between ownership and agents' motivation to compete is weak.

Another worry is that basing ownership intuitions on a system for tracking motivation to compete for resources is too cognitively pricey to be feasible. It could be worthwhile to have a sense of others' motivations to compete for highly desirable resources. But it would be overwhelming (and probably pointless) to try to get a sense of this for all the objects and people we encounter. Some accounts of ownership paint an almost opposite picture, wherein ownership reflects principles that minimize information costs (Smith, 2012). For example, once we judge that Beth owns some land, we can assume that she owns things within its confines, including things she doesn't even know about (DeScioli & Karpoff, 2015; DeScioli, Karpoff, & De Freitas, 2017; Goulding & Friedman, 2018; also see Espinosa & Starman, 2020). This means we generally don't need to keep track of her ongoing dealings with her land and the objects on it, or anyone else's either. Although many kinds of information can be useful when first deciding who owns some thing, much of this information is no longer relevant afterwards – we only need to lookout for specific events (e.g., ones that could signal rival claims or changes in ownership). What's more, while the cost-saving shortcuts we use to track ownership (e.g., Beth owns everything in her territory) could be adapted for assessing people's motivation to compete for resources, this would produce inaccurate assessments. Beth might be strongly motivated to fight for some things on her land, but her land will also hold many things she would gladly give up.

Irrespective of whether these worries are warranted, Boyer's account is, again, a major advance, and it grapples with issues (so far) inadequately addressed in other psychological work on ownership – including the proposal that people have a naïve theory of ownership (Nancekivell, Friedman, & Gelman, 2019). Perhaps most important is its explanation of cases where an agent is not seen as a “true” or full-fledged owner, but is nonetheless treated as having many hallmarks of ownership – as when train passengers are seen as having some claim to their seats, or when illegal squatters are denied ownership of the land they occupy while also being accorded some rights to it nonetheless (for many more examples, see Heller & Salzman, 2021). At the same time, Boyer's explanation of these cases could inspire an alternative approach founded on principles of ownership (i.e., rather than on representations of strength of relation to a resource). For instance, one might maintain that people use ownership-specific principles (e.g., creation → ownership), but acknowledge two caveats. First, these principles do not form a coherent set and therefore can produce contradicting conclusions. Indeed, this is the rule with naïve theories (e.g., Keil, 2010). Second, whereas applying ownership principles typically produces ownership intuitions, this is not always enough to fixate ownership beliefs. Hence, we can have conflicting intuitions about who owns some resource, and we can entertain feelings that agents own resources (and respond in kind), without treating these as reflecting settled beliefs.


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Similarity and the coordination of ownership

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Abstract

We discuss and expand Boyer's idea of ownership coordination. Interpersonal similarity, we suggest, can moderate the attainment of coordination: Perceived similarity predicts coordination costs, whereas actual similarity dictates coordination success and the severity of illusory assumptions regarding a shared understanding of ownership. The example of similarity highlights the complexity of the social projection process uncritically assumed behind ownership coordination.

In this commentary, we reflect on Boyer's idea of the coordination of ownership. His model of coordination presupposes a shared

understanding between parties to establish what belongs to whom. Ownership, like any other social norm that is agreed upon among individuals, requires a minimum of social projection. Social projection is the psychological process through which an individual expects behaviors or attitudes of others to be similar to their own. This process is the central force driving networks of mutual understanding of shared responsibilities and rights. However, the author's idea of coordination appears to be largely uncritical of the complexity of such projection processes. We seek to elucidate this complexity by noting the moderating role of perceived and actual similarity between individuals for projection processes. We focus on the consequences of different degrees of both types of similarity on the coordination of ownership.

Mental models of a goal or objective accurately shared between members are critical for any effective team coordination (e.g., Fisher, Bell, Dierdorff, & Belohlav, 2012). Since ownership coordination is presumably a specific case of team coordination, the impact of similarity on the non-communicative and automatic processes of the latter are seamlessly transferable to the former. We argue that perceived similarity moderates the efficiency and speed with which networks of mutual agreement are coordinated by regulating the likelihood of conflict between individuals' different norms. To illustrate with the author's example of collaboratively owned fisheries, originally introduced by Ostrom (1990): The establishment of community fisheries – that is, ponds and tools to be used for cleaning, fishing, and preparing the catch – requires agreeing on and recording responsibilities and rights that are shared among the involved parties. This process relies on communication between the parties. In cases of high similarity, mutual understanding of responsibilities and rights is abundant and communication can be restricted to a minimum. The result is resource- and time-efficient coordination. In contrast, low perceived similarity induces parties to be more cautious in defining their duties. As a result, coordination takes on a different character: Each party's property rights (e.g., using the pond and a certain set of fishing gear) and responsibilities (e.g., cleaning pond and gear) have to be defined and discussed in detail.

Among other scenarios, the above insight is important for groups of individuals considering shared ownership and for lead coordinators responsible for organizing ownership. That is, considering perceived similarity in ownership coordination is particularly relevant in instances of new group formations (e.g., establishing a new co-owned fishery) and reformations (e.g., adding new parties to an existing fishery agreement). The perceived similarity between individuals determines the to-be-expected cost of the planned coordination and should therefore be carefully considered. Beyond the fisheries example, situations of new or re-formation are becoming increasingly common with the expansion of the digital space where new people meet by the minute.

Actual interindividual similarity can further complicate the scenarios outlined above. In a functional case, actual dissimilarities between parties lead to an emerging ownership network either being stopped in its early tracks of realization or limited to basic pillars of ownership. That is, either initial coordinators will decide to let go of the idea of co-owned fisheries or the parties involved will agree on a low-level ownership structure – for example, only coordinating the times of individual and collaborative fishing at the pond among contributors, and foregoing more complex agreements (e.g., tool use and renewal). These cases are most likely when the low level of actual similarity matches with the interindividually shared perception of similarity. However, let us turn to more problematic scenarios:

Low similarity is particularly dysfunctional when it deviates substantially from the level of similarity perceived by individuals in the network. In this case, the low actual similarity between individuals can substantially mislead ownership coordination so that the resulting network and its associated co-owned property and responsibilities are only apparently shared: Contributor A might understand the use of the co-owned pond and the fulfilment of related duties (e.g., cleaning the fishing gear) as alternating between the parties on a weekly basis. In contrast, contributor B might see pond and related responsibilities as being shared permanently. The incorrectly perceived similarity in understanding property rights and responsibilities leads to ingroup conflicts that can escalate to substantial consequences (e.g., dissolution of the joint ownership of the fishery).

In conclusion, we welcome Boyer's presentation of an intriguing and novel framework for the coordination of ownership. However, we argue that he underestimates the complexity of the projection process to be assumed behind every mutual understanding of what belongs to whom. We highlighted this complexity by illustrating the impact interindividual similarity has on the coordination of ownership. Perceived similarity among parties is a central variable to consider in predicting the costs (in terms of resources and time) of coordinating the target ownership. In addition, if actual similarity is low, the coordination of ownership fails when matched with low perceived similarity. Assuming high perceived and low actual similarity, individuals form a network that stands on the false assumption that an understanding of property and responsibilities is mutually shared. While the former outcome is only disappointing, the latter is what leads to many of the existing intragroup conflicts we observe in companies, politics, or sports, and have illustrated here with the example of fisheries. This commentary is to demonstrate that the coordination of ownership cannot be assumed uncritically. Instead, studying its social projection process should be a central effort of the emerging research agenda on ownership.

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Ownership as a component of the extended self

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Abstract

Ownership of resources can be established by evolved competitive and cooperative mechanisms as explained by the target article. However, there is one aspect of ownership that is not captured by computational models which is important to identity, namely the role of owned items as components of “the extended self” hypothesis.

As the author correctly points out and the evidence indicates, ownership cannot be fully accounted for by absorbing social norms. This target article makes considerable progress in solving this problem by advocating a computational model primarily based on the interaction of two sets of cognitive systems, competitive acquisition and cooperation interaction.

While the model may explain many ownership examples, not all possessions are fungible commodities to compete and cooperate over but rather can be components of identity as proposed by “the extended self” hypothesis (Hood, 2019). Variations of the extended self hypothesis can be found in the writings of William James (1890), Jean Paul Sartre (1943) and more recently Russell Belk (1988), to capture the way that the concept of personal identity includes what we own. These may be desirable possessions to compete and cooperate over and hence raise status, but they can also be items, ideas or other owned things that are of relative significant value only to the owners. Owned items can represent part of one’s identity and hence, trigger different intuitions and mechanisms not captured in the computational model. How else can we explain the need for ownership and value that individuals place on otherwise worthless sentimental objects, sacred artefacts or memorabilia? Not only are these items of significant value to the owner but that significance is conferred by virtue of unique identity (Hood & Bloom, 2008) and in the case of memorabilia, physical contact with the previous owner (Newman, Diesendruck, & Bloom, 2011). Individual essentialism or haecceity to be more specific (Hood, 2014) explains why such items are non-fungible and indeed why some even induce magical contagion beliefs related to essences (Hood, 2009).

Another example beyond sentimental items is the ubiquitous endowment effect (Kahneman, Knetsch, & Thaler, 1991). Simply stated, once an item is owned, its value to the owner is increased. This has been explained by prospect theory (Kahneman & Tversky, 1979) but there are aspects of the endowment effect which indicate that an individual’s self-concept plays a role. For example, Maddux et al. demonstrated by manipulating the self-construct of individuals who identified with both the individualistic Western culture and the interdependent Eastern culture would moderate the endowment effect as their self construct changed (Maddux et al., 2010). In the traditional Hazda Bushmen of Northern Tanzania where ownership is more collective, the endowment effect has been reported absent in those who do not have experience of trading with others outside of the tribe (Apicella, Azevedo, Christakis, & Fowler, 2013).

Normally, the endowment effect is not observed in Western children until they are around 5–6-year old (Harbaugh, Krause, & Vesterlund, 2001), but it can be induced in younger 3–4-year-old children using a paradigm to manipulate their self-concept (Hood, Weltzien, Marsh, & Kanngiesser, 2016). Children were asked to compare toys and give a preference

value to each. Identical toys that were given an equal preference value were then distributed to the child and the experimenter. Children were then divided into groups that either constructed a picture of themselves and talked about themselves, made a picture of their best friend and talked about them or a farm-yard scene and asked to describe it. Children were then asked to rate the identical toys again. The group that had been primed to think and talk about themselves showed an endowment effect that was absent in the other groups supporting the notion that possessions are an extension of the self concept when this notion is primed. The development of the ownership concept is linked to the emerging self concept and how that is shaped by culture. This may also explain why individuals with autism lack an endowment effect as their self concept differs from typically developing children (Hartley & Fisher, 2017).

Arguably, self-related possessions represent a separate category of ownership. It is likely to have emerged subsequently to mechanisms of competition and cooperation addressed by the computational model, but this category of ownership is one that individuals and groups will fight vigorously over. How else can we explain why territory that is otherwise worthless or strategic can become the focus of conflict because it represents core identity for the groups involved? One could fit this conflict and competition within the computational model suggested but much harder are the sentimental and non-fungible items that are only of significant value to the individual.

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The missing link? How do non-human primates fit in the minimalist model of ownership?

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Abstract

Can Boyer's model of ownership psychology provide useful insights for comparative research? I apply his model to argue that we currently have evidence for possession psychology (based on competitive resource acquisition) in non-human primates, but not for ownership psychology.

Central to Boyer's model is the claim that human ownership psychology results from the interaction of two distinct cognitive systems, one for the competitive acquisition of resources and one for cooperative interactions. He fleetingly notes that ownership intuitions may be "specific to humans" (target article, sect. 2.1.2.) and that possession psychology (based on competitive resource acquisition) is "phylogenetically much older than cooperation behaviors" (target article, sect. 12.2). Boyer does not elaborate much on these points, likely, because he is primarily concerned with explaining human ownership psychology. But these claims could be evaluated by looking at relevant studies with non-human primates, who are – phylogenetically speaking – humans' closest living relatives.

Let us start by looking at whether there is evidence in non-human primates for Boyer's possession psychology. There are two components to consider here: (1) Whether non-human primates value their possessions, and (2) whether they respect others' possessions. First, research on the endowment effect (i.e., that one values things in one's possession more than things one does not possess) has shown that capuchin monkeys and all four great ape species value food in their possession (Brosnan et al., 2007; Kanngiesser, Santos, Hood, & Call, 2011; Lakshminaryanan, Chen, & Santos, 2008). They also value tools that can be immediately used to acquire food (Brosnan, Jones, Gardner, Lambeth, & Schapiro, 2012). Yet great apes do not show endowment effects for tools when there is a short delay before food can be retrieved (Kanngiesser et al., 2011), and they are also willing to give up toys in their possession (Brosnan et al., 2007; Drayton, Brosnan, Carrigan, & Stoinski, 2013; Flemming, Jones, Mayo, Stoinski, & Brosnan, 2012). Non-human primates thus value things in their possession if they are of immediate use (like food), but do not exhibit the same range of possessive behaviors that we commonly find in humans. Second, respect for others' food possession has been studied in non-human primates for both conspecific and human competitors. Sigg and Falett (1985) found that dominant hamadryas baboons respected subordinate's food possession in male–male pairs, probably to avoid risk of injury during take-over events (e.g., male baboons have large canines). They observed more frequent take-over events in female–female pairs, and these

events were associated with larger differences in rank. Studies with long-tailed macaques showed that subordinates were more likely to keep mobile than fixed food sources because they were able to transport mobile possessions and dominant individuals rarely gave chase (Kummer & Cords, 1991). Moreover, when confronted with a human competitor, free-ranging rhesus monkeys avoided food that was physically connected to the human by a rope (Russ, Comins, Smith, & Hauser, 2010). These findings suggest that non-human primates use physical proximity and control as possession cues, and that their respect for possession is primarily based on risk of injury, rank order, or opportunities to escape with the food. All in all, the current evidence for non-human primates is compatible with Boyer's possession psychology.

What distinguishes ownership psychology from possession psychology in Boyer's model is the addition of cooperative expectations. Is there evidence for ownership psychology in non-human primates? One way to tackle this question would be to focus on whether relatedness between individuals affects their respect for others' possessions, as one can reasonably assume that non-human primates have more cooperative inclinations toward kin than non-kin. However, Kummer and Cords (1991) found that relatedness had no effect on long-tailed macaques' respect for food possession. Another avenue would be to create test situations that remove risk of injury (e.g., by preventing direct interactions between individuals) and prevent direct physical control of resources. In a recent study, chimpanzees were in separate rooms with an apparatus placed between them: Each chimpanzee pushed food rewards (wrapped in differently colored paper) toward the middle of the apparatus where they dropped onto trays; individuals could then pull the trays to their side to retrieve the rewards (Kanngiesser, Rossano, Frickel, Tamm, & Tomasello, 2020). When both individuals had simultaneous access to the trays, they retrieved food irrespective of who had worked for it. When one individual's access was delayed, the first mover usually took all the food. In comparison, when German 4-year-olds were tested with a similar set-up, they mostly retrieved the things they had worked for and respected their partner's claims (Kanngiesser et al., 2020). To date, there seems to be no convincing evidence for non-human primates that would fit Boyer's ownership psychology (but clearly more studies are needed).

One can assume, nevertheless, that both systems that Boyer requires for his model are present in non-human primates. Numerous studies have shown that non-human primates are able to cooperate under some conditions (Duguid & Melis, 2020). Yet, unlike in humans (if Boyer's model is correct), the systems for competitive resource acquisition and for cooperative interactions may not be linked in non-human primates and operate independently. It is possible that Boyer would agree with this assessment. But even if he does not agree, his model may still inspire further comparative research on possession and ownership psychology in humans and non-human primates.

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Ownership language informs ownership psychology

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Abstract

Many languages grammatically distinguish between alienable and inalienable possessions. The latter are sometimes restricted to body parts, but they often include other kinds of personally significant entities too. These cross-linguistic patterns suggest that one's most precious owned objects tend to fall within a complex self system that includes not only the core (corporeal) self, but also the extended (noncorporeal) self.

In section 11.2, Boyer acknowledges that all languages have “verbal forms” that express ownership in one way or another, but he also claims that “it would seem difficult to infer conceptual structures concerning ownership from these forms,” and that the meanings of such forms are “not sufficient for representations of possession, ownership, and property.” In contrast, I maintain that cross-linguistic patterns involving ownership provide a unique source of insight into the psychology of ownership, with special relevance to selfhood.

As Boyer notes, English uses the same suffix to indicate possession of all kinds of entities, including body parts (e.g., *John's foot*), blood kin (e.g., *John's father*), affinal kin (e.g., *John's wife*), attributes (e.g., *John's pride*), associations (e.g., *John's country*), and objects (e.g., *John's car*). He also mentions that many other languages use separate grammatical constructions to distinguish between two conceptually distinct types of possession that are usually called “alienable” and “inalienable.” Unfortunately,

however, he neglects to consider the most interesting aspect of this distinction – namely, that even though different languages draw it in different ways, such variability is far from random, since the inalienable category tends to be reserved for possessions that are construed as integral to their owner's identity, whereas the alienable category covers all sorts of unessential possessions.

For present purposes, the most pertinent findings are as follows (for detailed data and discussion, see Aikhenvald & Dixon, 2013; Chappell & McGregor, 1995; Dixon, 2010; Nichols, 1988; Stolz, Kettler, Stroh, & Urdze, 2008; Velazquez-Castillo, 1996). First, body parts are almost always marked as inalienable, with exceptions typically limited to detached body parts, bodily excretions, and body parts that are uncontrollable, like hair. Second, some languages extend the domain of inalienable possession to blood kin, and some extend it further to affinal kin. Third, some languages incorporate into their inalienable category certain attributes of a person, such as physical properties (e.g., height, smell, shadow), mental states/traits (e.g., pride, honesty, anger), or other characteristics (e.g., fame, wealth, luck). Finally, some languages also treat as inalienable particularly important associations of a person, such as certain non-kin social relations (e.g., friend, master, shaman), certain habitats (e.g., house, homeland, grave), or certain artifacts (e.g., canoe, spear, ring).

Taken together, these cross-linguistic findings suggest that inalienability reflects what Bally (1926/1995) calls the “personal sphere,” a malleable realm that embraces, for a given speech community, possessions conventionally construed as being central to selfhood. More precisely, the data point to a complex self system with two components. First, the core self is grounded in body ownership, and this may be why the kinds of possessions most frequently marked as inalienable are body parts, with some languages even restricting their inalienable construction to these objects. Second, the extended self includes noncorporeal possessions that are vital to one's identity, and this may be why many languages apply their inalienable construction not only to body parts, but also to other classes of personally significant entities, like family, friends, and certain kinds of valued things. This notion of a complex self system fits nicely with William James' (1890, p. 291) observation that “between what a man calls *me* and what he simply calls *mine* the line is difficult to draw. We feel and act about certain things that are ours very much as we feel and act about ourselves” (see also Belk, 1988, 1991). It's also notable that the neural substrates of the core and extended components of the self have recently begun to be studied (Abraham, 2013; Aglioti, Smania, Manfredi, & Berlucchi, 1996; Blanke, 2012; Ehrsson, 2012; Kim & Johnson, 2014; Serino et al., 2013).

These points have implications for Boyer's model. For one thing, while his “P-tags” do include a parameter for the strength of the possessive relationship, the model as a whole does not explicitly recognize that some owned things are typically treated as more significant than others. As described above, the cross-linguistic patterns suggest – in keeping with other findings from psychology and neuroscience – that the most precious owned things tend to fall within a complex self system that includes not only the corporeal self but also the extended self, which encompasses certain closely related people and objects. In addition, even though the cross-linguistic patterns don't directly reflect any of the intuitions about ownership that Boyer seeks to explain, speakers have clear intuitions about how alienable/inalienable possessive constructions should be used, and these intuitions are based on social conventions or norms regarding

the conceptualization of ownership for communicative purposes. Finally, one goal of Boyer's model is to explicate the "general respect" for ownership that community members take for granted. In this context, the cross-linguistic data lead to an interesting question: In communities where the dominant language requires that certain treasured objects are obligatorily marked as being inalienably possessed by their owners, do people accord those objects greater respect than objects that are inalienably possessed? I'm not aware of any research on this topic, but it seems relevant to Boyer's concerns.


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When it comes to taxes, ownership intuitions abide by the law

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Abstract

Boyer suggests that laws cannot account for ownership intuitions, but there may be situations when intuitions hew to laws almost perfectly. Laws granting governments taxation powers provide an interesting case study. We report data here suggesting that people's intuitions track law very closely, and are unaffected by manipulating a P() tag input. We propose two hypotheses to explain this finding.

In section 2.2.1 of the target article, Boyer claims that norms and laws cannot adequately account for ownership intuitions. We agree, but think it would be unwise to dismiss norm-based accounts entirely. In many cases, intuitions will conflict with norms and laws, but in others, intuitions may hew to norms and laws almost perfectly, leaving little room for P(Agent, thing) and Brep[Min(A)] representations to perform additional causal work. We think laws that give governments taxation powers provide an interesting case study.

We recently explored this case study in an experiment with 200 Prolific workers ($M_{\text{age}} = 36.8$, 48% female). In the first phase, participants learned that United States homeowners are subjected to a federal capital gains tax when they sell their homes. Next, participants read a vignette about a couple who owned a house and were planning to sell it. The neighborhood where the house was located had greatly improved during their ownership tenure; consequently, the couple was set to make \$100,000 more in profit than they would have otherwise.

To manipulate one of the input representations that P(Agent, thing) inherits – “changes in thing” – we randomly manipulated participants' beliefs about the *cause* for the neighborhood improvement: Some subjects learned that the owners invested their personal time and resources into improving the neighborhood (Owners), others learned that wealthy neighbors had invested time and resources (Neighbors), and still others learned that the federal government had invested time and resources (Government). Subjects in a control condition received no such information (Control). Clearly, the homeowners were responsible for the additional profit (i.e., they improved the neighborhood) only in the “Owners” condition. We then asked participants to provide their opinions about: (1) The degree to which the couple was “responsible” for the additional profit, (2) the degree to which the couple was “entitled” to the additional profit, (3) the percentage of additional profit that “rightfully belongs” to the owners, and (4) the percentage of additional profit the government should receive in taxes. As a reference point, we informed participants that Americans generally pay 25–30% of their earned income in taxes.

Our first measure, perceived responsibility of the couple, confirmed that participants believed that the input of the homeowners' labor increased their “responsibility” for the additional profit. Participants who were told the owners had invested time and effort in the neighborhood reported significantly higher levels of owner responsibility for the profit than did subjects in any other condition (all pairwise comparisons with Owners condition $p < 0.001$; effect size for the difference between the Owners condition and all other conditions combined was Cohen's $d = 0.99$). No other pairwise comparison (e.g., Neighbors vs. Government conditions) was statistically significant. This result confirms that people attributed the increased profits to the owners when it was the owners who had in fact improved the neighborhood.

Despite the large effect on perceived responsibility, however, none of the four groups differed on the three other variables. Specifically, our manipulation of responsibility had *no effect* on whether participants believed that windfall “rightfully belong [ed]” to the owners ($p = 0.49$), the percentage of the windfall the owners ought to keep ($p = 0.42$), or the degree to which the owners were “entitled” to that windfall ($p = 0.58$). Given the important role Boyer gives to “changes in thing” as an input to P() representations, this set of findings is surprising.

Two explanations seem promising. Our first clues are the mean scores reported on the two measures that used percentage scales, “percent owners should keep after tax” ($M = 78.7\%$) and “percent rightfully belongs to owner” ($M = 73.2\%$). Given that we provided “25–30%” as a reference point for what the typical American pays in tax, these values are surprisingly close to what one would expect if subjects merely subtracted the typical rate of taxation (25–30%) from the total profit (100%). That is, our participants’ estimates of what *ought* to occur for distributing this windfall were nearly identical to what tax law specifies (and enforces), and seemed unaffected by which agent’s “changes in thing” generated the windfall: Perhaps subjects simply acknowledged the fact that the government generally takes 25–30% of earned income, combined this fact with a pre-existing belief that “other people must follow the law,” and then concluded that the homeowners did not rightfully own, and thus were not entitled, to all of the profit, even though they were causally responsible for all of it.

Here is an alternative interpretation that Boyer might prefer. Perhaps people construe governments as agents – a not unreasonable surmise since people conceptualize governments as entities that possess psychological attributes such as the capacity to know, predict, forbid, allow, encourage, and negotiate – which in other work Boyer (1996) has argued are the types of psychological properties that most fundamentally lead to perceptions of agency. If so, our participants might have construed our questions about ownership of the homeowners’ profits as questions about *contested ownership* between two agents, and not just as questions about how we infer norms and determine how we should respond to them. Drawing on Boyer’s section 8.3, if our subjects perceived the government not only as an agent, but also as an agent *with whom they themselves were in a cooperative relationship* – that is, they possessed high values of $Brep[Min(A)]$ for the government – then they might have interpreted the government’s *ability* to appropriate a share of the profits *as evidence of the government’s legitimate ownership*.

We regret that we didn’t collect data to adjudicate between an explanation based on a psychology of norm adherence and an explanation based on Boyer’s account. We might have, for example, manipulated whether subjects viewed the government as a friend or foe. Although this seems to us like a useful direction for future work, for now we will be content with reading Boyer’s reactions to the ideas we have raised here.


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Invested effort and our open-ended sense of ownership

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Abstract

Pascal Boyer achieves a felicitous integration of what is known about human ownership psychology by deriving ownership intuitions from the interaction of resource acquisition and our cooperative sociality. By exploring the sense of ownership already present in the domain of resource acquisition, I sketch an evolutionary path to the open-ended nature of the specifically human version of that sense.

Pascal Boyer presents a masterly survey of what is known about human ownership psychology, drawing on a diverse literature in the life and human sciences, spanning from biology, psychology, and anthropology to jurisprudence and philosophy. He achieves a felicitous integration of this welter of information by casting human ownership intuitions as the joint product of constraints from our competitive resource acquisition propensities interacting with our distinctive human sociality, yielding our intuitions of legitimate ownership as its outcome. By generating ownership intuitions/judgements at the interface of these independent functional domains, rather than from a specialized set of principles dedicated to ownership, his model effortlessly incorporates a variety of contextual and cultural variables in accounting for a wide range of human ownership intuitions/judgements, including non-obvious and subtle ones. This marks a major advance in our understanding of human ownership psychology on which Boyer is to be congratulated.

Given the many significant roles that ownership, property relations, and proprietary attitudes play in human affairs, this is no small matter. With potential implications for and applications to issues ranging from our self-understanding to the institutional arrangements under which we live, Boyer’s model merits close attention and scrutiny. Here I would like to highlight the utility of distinguishing between intuitions and judgements of legitimate ownership on the one hand, and the personal sense of proprietary possession or owning, that is, the subjective sense of owning something (henceforth “sense of ownership”), on the other.

As Boyer shows, the former are generated at the interface between resource acquisition and cooperative sociality. Our *sense of ownership* itself and as such, however, is already part of our resource acquisition capacity, where at a minimum it figures in the form of our sense of ownership of our bodies as the central invariant of resource acquisition (try taking someone’s fingers away!). From there the sense of ownership extends out, on a species-specific basis, to various extra-corporeal objects and circumstances in which a sense of ownership may be invested. This extra-corporeal sphere is particularly capacious in humans, as Boyer notes, but it occurs with narrower compass in animals as well (territories, nests, burrows; Strassmann & Queller, 2014).

Among these extra-corporeal targets of a sense of ownership, animal territoriality occupies a conspicuous position. Territorial animals, *whether social or solitary*, behave in every respect as if they were the owners of the territory they defend. They patrol its borders, engage intruders agonistically, and some species mark territory with urine or special scent glands. Territorial defense has been a significant focus of modeling and controversy in biology (Gintis, 2007; Grafen, 1987; Kokko, López-Sepulcre, & Morrell, 2006; Krier, 2009; Maynard Smith, 1982). The issues in this controversy can be integrated, I suggest, into a biological account of a sense of ownership general enough to include the expansible human one by recognizing the role of resource investment in rendering extra-corporeal targets subject to a sense of ownership.

The exigencies of survival and reproduction dictate that an animal's decisions regarding territorial defense should maximize future payoffs of its current investment, rather than be based on how much of such efforts it has expended in the past ("sunk cost fallacy", for which see Gintis, 2007, and references therein). However, as noted by Alan Grafen in his critique of John Maynard Smith's bid to account for the advantage conferred by "prior possession" on territory holders (Maynard Smith, 1982), future payoffs are contingent on circumstances beyond the bounds of a given territory and its owner's informational horizons. They include factors like the over-all density of high-quality territories, the cost of search for a new territory, and the distribution of strategies adopted by other members of the population (Grafen, 1987).

How does an animal, anchored to its territory by the need to defend it, take these extra-territorial circumstances bearing on its defensive efforts into account? Given the opacity of the future, and the animal's limited informational horizons, the principal proxy of the needed information can only be the animal's own past experience – specifically the frequency and strength of past intrusions, its own history of success in fending them off (sustained by the resources of its territory), and the like. An animal would accordingly do well to keep a cumulative running record of the outcome history of its investment of effort in defense of its territory, presumably stored as implicit memory in its prefrontal–basal ganglia system through procedural learning. Assume, in keeping with the above, that the time integral of that record constitutes the animal's *sense of territorial ownership*.

The same logic is readily extended to the investment of effort in other extra-corporeal objects of potential future benefit such as nests, burrows, and even movable assets. The latter are rare in the animal kingdom (see Strassmann & Queller, 2014), but the investment logic would apply with particular force to a toolmaker. The extent to which fashioning a tool requires time, effort, and skill is the extent to which it pays to keep that tool for repeated use in the future, and to defend its possession. The twigs used by chimpanzees to fish termites, or the unworked bashing stones they use to crack nuts hardly qualify in this regard, while the skilled labor needed to fashion a stone tool does.

Ancestral *Homo* accordingly can be assumed to have evolved a motivational propensity to keep and defend the tools it fashioned and, by extension – as cerebral capacity expanded in our ancestry – anything else of prospective utility into which we invest labor and deliberate effort, summarized in a tacit sense of ownership. The contrasting bearing of "invested effort" on ownership in humans and great apes is tellingly illustrated by a comparative experimental study cited by Boyer (Kanngiesser, Rossano, Frickel, Tomm, & Tomasello, 2020; see also Rochat et al., 2014).

I suggest, in other words, that that into which we invest our deliberate efforts, whether in the form of labor, resources, thought, commitment, or care, comes to matter to us in a proprietary sense, and as such supplies the ultimate foundation for the uniquely open-ended human *sense* of proprietary ownership. It comes to us as part of our resource acquisition capacity itself, ready to be shaped and channeled into intuitions of legitimate ownership in interaction with our social-cooperative propensities, in good agreement with Boyer's model.

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How the minimalist model of ownership psychology can aid in explaining moral behaviors under resource constraints

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Abstract

The model of ownership psychology as a cognitive adaptation proposes that people flexibly navigate cognitive systems of cooperation and competition, thus enabling them to justify unethical behavior. We discuss how this model captures previous accounts of unethical behavior and propose that a disengagement heuristic can help us understand recent findings in the interconnection between scarcity psychology and unethical behavior.

Central to the model of ownership psychology as a cognitive adaptation is the assumption about general respect of ownership as a consequence of cooperation expectations (Boyer, 2022). Boyer suggests that ownership is derived from the interaction of two cognitive systems, one that handles competition for resources and another that handles anticipated cooperation. These systems are argued to account for the flexibility of people's intuitions about ownership. This flexibility in turn allows criminal agents not to be inconsistent in their ownership intuitions, but simply to not include their unethical behavior "in the range of cooperation intuitions" (Boyer, 2022, p. 32). As Boyer argues: "It is a familiar observation that most criminals think in terms of Us vs. Them, explicitly differentiate their world from the 'regular' world of their victims" (Boyer, 2022, p. 32).

There are two previous accounts on (im)moral behavior that we see as interestingly connected by Boyer's theoretical framework; (1) the theory of morality-as-cooperation, which argues that morality promotes cooperation (Greene, 2015) and has evolved to solve recurrent problems of cooperation and therefore that certain moral behaviors (e.g., reciprocating, helping kin) are considered universally "good" across societies, as they facilitate cooperation (Curry, Mullins, & Whitehouse, 2019) and (2) moral disengagement, a cognitive heuristic, which influences people's justifications for engaging in (im)moral behavior by reducing anticipatory guilt, when individuals distance themselves from the potential consequences of their decisions and act in ways that do not involve their own identity (Bandura, 2017). Boyer's framework on ownership links these two accounts of moral decision-making, by identifying that ownership cognition handles cooperation versus competition problems, while at the same time allowing for some degree of flexibility between behaving ethically (vs. unethically), which in turn allows for justifications and disengagement to kick in.

A general limitation of the model is not in the perspective it presents, but rather in what it leaves out. Here, we provide a perspective on how Boyer's model of ownership could explain how and why people decide to engage in unethical behavior by using a *disengagement heuristic* to rationalize their unethical behavior (Shu, Gino, & Bazerman, 2011), particularly when *contextual cues of resource scarcity (vs. abundance)* (Elbaek, Mitkidis, Aarøe, & Otterbring, 2021a, 2021b; Elbaek, Mitkidis, Aarøe, & Otterbring, 2022; Mitkidis et al., 2022) and *competition (vs. cooperation)* (Kilduff, Galinsky, Gallo, & Reade, 2016; Schurr & Ritov, 2016) are available and influence people's downstream unethical behavior. For example, if the situation is one in which resources are scarce and/or competition is high, agents may adopt a competitive *maximizing mindset* (Goldsmith, Roux, & Ma, 2018), making them more likely to prioritize their own interests and possessions over those of others, thus discounting the potential benefits of cooperation. Conversely, if the situation is one in which resources are abundant and/or cooperation appears beneficial, people may be more willing to share resources.

In relation to resource scarcity (vs. abundance) it should here be noted that material resource scarcity can be categorized in different states (chronic vs. acute) and types (i.e., financial, physiological, low socioeconomic status [SES]) with a recent meta-analysis stating the mixed nature of results on the impact of material scarcity on unethical behavior and finding that acute (vs. chronic) scarcity can increase unethical economic behavior (Elbaek et al., 2021a). Boyer's theoretical framework might be

able to theoretically explain this finding, as acute scarcity could function as a disengagement heuristic, in turn activating competitive attitudes for scarce resources. That is, as the acute experience of scarcity can trigger a competitive mindset aimed at regaining resources in the short-term, this allows individuals to morally disengage from unethical actions as such can serve to restore resources instantly, which cooperation might not. Previous research on how competition might increase agent's propensity to engage in unethical behavior, and provides justifications for such, corroborates this hypothesis (Goldsmith et al., 2018; Kilduff et al., 2016; Schurr & Ritov, 2016).

At the same time, recent large-scale cross-cultural research, across 67 countries, on how chronic material scarcity affects moral judgment and decision-making suggests that low SES and income inequality, as forms of chronic material scarcity on the individual and macro-level, respectively, are associated with increased focus on acting according to universal moral behaviors as outlined morality-as-cooperation (e.g., reciprocating, helping kin) and increased prosocial intentions aimed toward others (i.e., donating to charities) (Elbaek, Mitkidis, Aarøe, & Otterbring, 2021b). This line of work highlights that when resources are persistently scarce, cooperative attitudes might be activated to deal with the chronic form of scarcity, as cooperation can aid in generating better outcomes for resource-deprived individuals. This concurs with previous research on how chronically resource-deprived individuals increase their social orientation and act less individualistic in contexts of resource scarcity, as an adaptation to harsh environments substantiates this hypothesis (Kraus, Piff, Mendoza-Denton, Rheinschmidt, & Keltner, 2012; Piff, Kraus, Côté, Cheng, & Keltner, 2010).

In sum, we propose that Boyer's (2022) model of ownership psychology as a cognitive adaptation can aid in further understanding inconsistencies in the current state-of-the-art on how experiences of resource scarcity might influence people's propensity to either engage in immoral behaviors (e.g., stealing resources) or cooperative behaviors (e.g., sharing resources). That is, acute resource scarcity can highlight competition and in turn probe the activation of a maximizing mindset (Goldsmith et al., 2018), which can lead individuals to morally disengage from unethical actions aimed at regaining resources (Elbaek et al., 2021a, 2021b), while chronic resource scarcity can probe cooperative behaviors, because agents can observe that such investments can aid prospective resource acquisition.

Yet further work is needed in the field of psychology of scarcity and behavioral ethics, exploring, for example, how different states (chronic vs. acute) or forms (financial scarcity, physiological scarcity, and lower social class) of resource scarcity interact with ownership intuitions and correspond to different behavioral outcomes. We believe it is worth expanding on possible interactions of the formal model's predictive outcomes, to propose both theoretical and practical recommendations for future research and policy making.

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Psychological ownership: Actors' and observers' perspectives

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Abstract

Psychological ownership may be judged differently or similarly for self and others. Potential differences in how ownership is evaluated by actors and observers raise important questions about the concept of ownership (what is Mine, Ours, and Theirs) and how to resolve conflicting perceptions.

Psychological ownership – whether a thing feels like it is Mine – has been studied by philosophers for centuries and by psychologists dating back to James (1890). Theorists argue that the driving predictor of whether people feel psychological ownership for a thing *t* is the degree to which *t* is associated with the self (Beggan, 1992; Belk, 1988; Morewedge, 2021; Weiss, 2022). They posit that factors within the stimulus, context, and judge that facilitate or inhibit the association between a thing and the self determine which objects feel “Mine” and when objects will feel “Mine” (Atasoy & Morewedge, 2018; Shu & Peck, 2011;

Weiss & Johar, 2016). People are more likely to feel psychological ownership for an object such as a coffee mug with their university logo than a plain mug, for instance, because the university logo facilitates the association between the mug and self (Dommer & Swaminathan, 2013). This literature also identifies the driving predictors of the perception of shared or collective ownership (“Ours”) as the degree to which a group of individuals (e.g., coworkers, students, neighbors) (1) share a sense of “us” and (2) form an association between the group and the thing (e.g., Pierce & Jussila, 2010; Verkuyten & Martinovic, 2017). We dub these interpersonal theories because they pertain to judgments made from the first-person perspective of the actor (Morewedge, 2021).

Boyer proposes a theory of how ownership is evaluated from the perspective of an observer. Boyer’s theory complements earlier work by predicting when observers perceive a thing as owned, by whom, and how strong is the ownership connection (“Theirs”). Drawing on resource competition and cooperative models of resource sharing, Boyer identifies cues that observers may use in interpersonal judgments of the ownership felt by agent A toward thing *t* (contiguity, modifications, interaction, defense). Some of these cues overlap with cues used in intrapersonal judgments. Others are new.

Comparisons between these intrapersonal and interpersonal perspectives raise three new questions about the evaluation of ownership. An obvious first question is the degree to which intrapersonal and interpersonal judgments are distinct. Many of the factors identified by Boyer, such as contiguity, use, and defense, already are factors assumed to be essential to intrapersonal judgments of psychological ownership. An important difference between psychological ownership from the perspective of an observer versus an actor pertains to the conditions under which each should ensue. Boyer predicts that observers’ intuitions about ownership and ownership violations should only ensue when a thing *t* can be considered a rivalrous good. In contrast, intrapersonal theories of individual or group psychological ownership suggest and have shown that psychological ownership for a thing develops whether it is rivalrous or not (e.g., a home vs. a public park). Research is needed to discern if Boyer’s theory identifies new facets of a single process by which people evaluate ownership for self and for others, or if people do use different processes to evaluate what they own and what others own. This work has the potential to contribute to the considerable literature on judgments of self and others (Alicke, Dunning, & Krueger, 2013; Pronin, 2008).

A related second set of questions pertains to the circumstances in which intrapersonal and interpersonal judgments will not align, and implications of these misalignments. Observers’ judgments, as captured through Boyer’s model, should accurately predict their own behavior (e.g., whether an observer would try to separate thing *t* from agent A or would help agent A to protect thing *t*) but may not predict the behavior of the observed agent (e.g., whether agent A will respond aggressively to an attempt to separate thing *t* from that agent). Similarly, the agent’s judgment, as captured by extant research on psychological ownership, should accurately predict the agent’s but may not predict the observer’s behavior.

Consider the consequences for negotiation in a case where two people, Yasser and Yitzhak, dispute who owns a plot of land bordering their homes, and a third observer, Bill, serves as an arbiter. Yasser and Yitzhak would each evaluate their ownership of the disputed land using the intrapersonal

model. Bill would use Boyer's interpersonal model. Yasser and Yitzhak may also use Boyer's interpersonal model to assess each other's ownership, or some variation on the intrapersonal model. These different perspectives may lead Yasser and/or Yitzhak to underestimate how strong is the other's psychological ownership for the land. Bill may underestimate this for the both of them. Their underestimation may increase the likelihood that the parties will attempt to negotiate their ownership claims, but also reduce the likelihood that negotiation will resolve their dispute. All parties may overestimate the likelihood of a resolution and underestimate the difficulty others will have making concessions.

A third question is how different processes of evaluating ownership for self and others informs (and should inform) law and policy regarding property rights and resolutions of legal and political disputes. Are the sticks in the bundle of property rights associated with legal ownership (i.e., accessing, controlling access, modifying, profiting, transferring rights, destroying; Morewedge, 2021), grounded in the evaluations of ownership made by actors or observers? Do and should the courts treat these evaluations as complementary, are courts guided by one perspective, or do and should courts treat intrapersonal and interpersonal evaluations as substitutes? How do these evaluations play out in business or political negotiations and disagreements about disputed land, objects, and ideas, and how might they be used together to help resolve those disputes?

We are excited by this shift in perspective from self to other and its potential to enrich and inform a scientific understanding of ownership and approaches to resolve disagreements about what is Mine, Ours, and Theirs.

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Ownership as an extension of self: An alternative to a minimalist model

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Abstract

Our commentary challenges Boyer's model by arguing that the extended-self is a more likely basis for ownership psychology. We outline how self-based principles of investment and control might structure thinking about ownership and related rights. We end by expanding the extended-self account to include *welfare*, as a way of understanding the contexts under which ownership is upheld or violated.

Boyer's article presses the field to address oft-overlooked questions about ownership psychology. He provides compelling evidence against *ad-hoc* social norm accounts of ownership, and proposes a novel minimalist model wherein ownership psychology is the result of interactions between cognitive systems dedicated to cooperation and competition.

In this commentary, we challenge Boyer's model by discussing ways that the self might be a more likely cognitive foundation of ownership intuitions (Belk, 1988; Locke, 1978[1690]). Under an extended-self account, people extend themselves to their objects and then subsequently regard their property as parts of themselves (Belk, 1988; Locke, 1978[1690]). Ownership has deontic normative implications (see target article, sect. 8.2.2) because transgressions against property are viewed in the same light as any other (moral) transgression against someone's body. For instance, work shows young children and adults reason in similar ways about violations to people's bodies and property (Van De Vondervoort & Friedman, 2015; Van de Vondervoort, Mainz, & Friedman, 2017). Other work further supporting this account shows that self-owned objects are privileged in human cognition (e.g., Cunningham, Vergunst, Macrae, & Turk, 2013; Gelman, Manczak, & Noles, 2012) in ways similar to other kinds of self-relevant stimuli (e.g., Symons & Johnson, 1997). For instance, children preferentially track and remember their own property over others' property (Cunningham et al., 2013; Gelman et al., 2012), but individuals with differences in self-representation, such as those diagnosed with autism spectrum disorder, do not tend to show these behaviors (e.g., Grisdale, Lind, Eacott, & Williams, 2014; also see Hartley & Fisher, 2018).

At the core of this extended-self account are principles that signal the *strength* and *boundaries* of ownership relations – control and investment. Let us first consider control. Just as people freely control parts of themselves (e.g., their arms), they are thought to freely control their property (Belk, 1988). This means that establishing control over an entity often leads it to be viewed as property (e.g., Belk, 1988; Furby, 1978; Morewedge, 2021; Rudmin & Berry, 1987). For instance, psychological ownership can be

signaled simply by controlling an entity like moving a cup in a restaurant (e.g., Kirk, Peck, & Swain, 2018). This principle also explains judgments regarding ownership *boundaries* or what can/cannot be owned (see target article, sect. 9.3). For example, agents described as autonomous are viewed as less ownable because their autonomy conflicts with owners' abilities to control them (Starmans & Friedman, 2016; also see Espinosa & Starmans, 2020, for related work with children). As Starmans and Friedman (2016) posit, this reasoning could explain intuitions about slavery. Next, we consider investment. As Boyer suggests, ownership is often attributed after personal investment because it causes property to be incorporated into the self (e.g., Belk, 1988; Locke, 1978 [1690]). However, investment should be construed as broader than Boyer's discussion of physical labor, as it can include emotions, ideas, and (non-labor) time. Indeed, the psychological ownership literature suggests that many of these types of investments are sufficient to trigger *feelings* of ownership (see, e.g., Peck & Luangrath, 2023, for an overview).

Taken together, these principles also provide insight into why sometimes ownership is contested, such as Boyer's squatter example (target article, sect. 8.3). Intuitively, a squatter's ownership status is ambiguous as the principles of control and investment do not lead to clear-cut judgments: On one hand, the squatter could be the owner as they have invested labor in the property and by doing so demonstrated control over it. But on the other hand, the constructs of investment and control are abstract and difficult to measure. Namely, how much of the "self" the squatter has seemingly invested as opposed to the initial owner cannot be precisely calculated by our intuition. Differences in these intuitive calculations then lead to inconsistency in supporting the squatter's claim. Adding to this intuitive noise, under a legal framework, the property's ownership status is also ambiguous: Ownership was not formally transferred to the squatter. Thus, we contend that noise in people's judgments about ownership should simply be taken as evidence that people are responding to noisy input, and not evidence against specific intuitive principles. Indeed, in other domains of reasoning, researchers have found that intuitive principles are often imprecise (e.g., Keil, 2010) and conflict with non-intuitive explanatory frameworks like scientific (e.g., Gelman & Legare, 2011; Shtulman & Legare, 2020) and legal ones (Sommers, 2021).

A core question we have not yet addressed is what predicts *when* people choose to respect ownership once it is established. As Boyer (target article, sect. 8.2) points out, people sometimes do not respect others' ownership rights. We propose that by extending oneself onto property, the property is then subsumed into the owner's overall *welfare*. Specifically, people likely engage in a cost-benefit analysis which allows them to predict and explain the contexts where ownership is upheld. That is, people would expect agents to transgress if the agents' cost-benefit analysis is net positive. For instance, people might predict a transgression if the perceived benefit of obtaining a stolen resource is particularly high, or if the cost to the owner (or themselves) is low. Related to this point, children believe it is more acceptable to take resources from the rich to give to the poor than the reverse (Echelbarger, Roberts, & Gelman, 2022; Essler & Paulus, 2021) likely because the perceived cost to the rich is lower than the poor's benefit. This account also explains when agents will heed ownership. Namely, when the cost of transgressing is too high, or when the benefit to the transgressor is too low, there is no motive to violate owners' rights and ownership should be heeded. Importantly, these cost-benefit analyses do

not rely on competitive or cooperative factors and could be computed by a domain-general mechanism interacting with ownership information.

In sum, it seems to us that the self is arguably a more minimalist explanation for ownership intuitions than one that requires coordination among cooperative and competitive systems. Nonetheless, a pressing direction for future work will be to tease apart which cognitive system(s) is/are *necessary* and *sufficient* to explain the heart of ownership psychology.

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Development, history, and a minimalist model of ownership psychology

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Abstract

Boyer's minimalist model is a compelling account of ownership psychology that is more efficient than previous models. However, it is unclear whether the two simple systems that make up this model – acquisitiveness and cooperation – are sufficient to both explain the nuanced development of ownership concepts and to account for the prominent influence that history has on ownership psychology.

Boyer suggests that two simple cognitive systems – acquisitiveness and cooperation – might be used in combination to explain humans' rich and varied intuitions about ownership and property. The two main arguments in favor of the minimalist model articulated by Boyer are that the model is parsimonious and that these two systems can be used to explain human intuitions about ownership. At face value, the first argument is clearly supported. Boyer's model is far simpler and more specific than previous proposals, including the Naïve Theory of Ownership proposed by Nancekivell, Friedman, and Gelman (2019). The characteristic of Boyer's model that allows it to be so lean and efficient is that it situates ownership judgments as a process of navigating relationships between agents, setting aside other considerations. The idea that concepts of ownership and property are really about the relationships between people is not new, but the minimalist model takes the idea to its logical extreme. This formulation respects the ubiquity, universality, and salience of ownership concepts while attempting to explain ownership psychology as simply as possible.

In contrast, it is unclear whether the second argument – that the minimalist model can explain ownership intuitions – is fully supported. In principle, the minimalist model can be effectively mapped onto the early emergence of ownership psychology, and it can explain ownership intuitions that are simple (e.g., identifying property and owners) and complex (e.g., intuitions about property creation, humor, and morality). However, two important findings that may be difficult for the minimalist model to explain are downplayed in the current proposal. The first is that mature intuitions about property exchanges develop over a relatively extended period of time, and the second is that concepts of ownership incorporate notions of object history. Each of these findings is addressed very briefly in the target article, but the scope and

effectiveness of the proposed model are difficult to evaluate without more specific information about how the model addresses them.

Although much of the target article's focus is on the early emerging and ubiquitous nature of ownership psychology, Boyer briefly notes that adult-like intuitions about property exchanges take time to develop, suggesting that "children's apparent confusion simply means that they have not acquired a full data-base for the consequences of giving in different contexts" (target article, sect. 10.1.1). This conclusion is misaligned with findings in the literature. Friedman and Neary (2008) found that children exhibited a "first possessor bias," a tendency to conserve ownership with an initial owner, in every scenario except when objects were giftwrapped and described as "a present." Noles and Keil (2019) found that this bias persisted until at least age 9, but at the same time, even children as young as 4 exhibit adult-like intuitions when making judgments about other interactions with property (e.g., see Nancekivell, Davidson, Noles, & Gelman, 2023). Similar findings have been reported with respect to children's intuitions about property rights (Kim & Kalish, 2009). It is unclear why some aspects of ownership psychology, specifically those most germane to acquisition, take so long to develop while other complex intuitions about ownership appear early in development and change very little. Simply suggesting that children need more time and experience fails to reconcile the minimalist model with the long and nuanced development of some, but not all, of children's intuitions about ownership.

The second finding that is not fully addressed in Boyer's proposal is the observation that concepts of ownership incorporate notions of object history that extend beyond the features, affordances, and value of objects. In the target article, section 7.4 addresses the idea that representations "inherit information" about interactions with people and property, but the brevity and vagueness of this premise fail to capture the centrality of object history to ownership psychology. The special attention that people pay to object history is apparent in diverse phenomena. Toddlers spontaneously connect owners to property and use spatiotemporal cues to monitor ownership when owned objects are identical (Gelman, Manczak, & Noles, 2012; Hood & Bloom, 2008), and absent spatiotemporal cues, children and adults will search for traces of object history to guide their ownership judgments (Gelman, Manczak, Was, & Noles, 2016). Young children and adults treat property as nonfungible (McEwan, Pesowski, & Friedman, 2016), and they go to great lengths to avoid violating others' property rights.

Object history also powerfully influences value judgments. Children and adults exhibit an endowment effect, wherein owned objects are judged to be more valuable than other objects, even if they are identical (Hood, Weltzien, Marsh, & Kanngiesser, 2016). Children prefer "their" object and its associated history to newer, nicer items, and special histories affect the value of objects. For example, possession by a famous figure enhances an object's value (Gelman, Frazier, Noles, Manczak, & Stilwell, 2015) and association with a despised celebrity diminishes an object's value (Newman, Diesendruck, & Bloom, 2011). History also influences moral judgments: Young children judge that it is wrong for items to be switched between owners, even if the items are identical and the owners are unaware of the substitution (Nancekivell et al., 2023).

Although there are many studies of ownership psychology, there are relatively few detailed theories about what ownership actually is. The minimalist model proposed by Boyer is interesting and more parsimonious than the Naïve Theory of Ownership

proposed by Nancekivell et al. (2019), but does this simplicity come at the cost of explanatory power? It is unclear whether the two simple systems that make up this model are sufficient to both explain the nuanced development of ownership concepts and to account for the prominent influence that history has on ownership psychology.

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The origins of property law

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Abstract

Research is increasingly suggesting that human intuitions form the core of many laws. Laws, therefore, can serve as one potential testing ground for new theories about the content and structure of intuitions. Here the model of ownership psychology as an evolved cognitive adaptation is evaluated against long-standing features of property law.

A growing body of research is demonstrating that human intuitions often align with the various statutes, codes, and judicial decisions that constitute law (e.g., Cosmides & Tooby, 2006; Jones, 2001; Patrick & Lieberman, 2017; Patrick & Lieberman, 2018; Robinson, Kurzban, & Jones, 2007; Williams & Patrick, *in press*). This effect has been demonstrated even where the person's intuitions and the laws in question originate from completely different cultures and time periods, suggesting that it is not the laws that are shaping the intuitions of the populace, but rather that evolved species-wide aspects of cognition are, and have been, shaping the law (Lieberman & Patrick, 2018; Sznycer & Patrick, 2020).

Though much of the research in this area has focused on the link between moral judgments and criminal law, many of the intuitions humans have regarding possession, ownership, and trade also have clear legal analogs in the law of property (Stake, 2004). For example, the intuition that prior possession strengthens a claim of ownership is embodied in the long-standing legal doctrine of first possession, which grants ownership over a previously unowned resource – a hunted fox; a patent – to the first in time to possess it (e.g., *Pierson v. Post*, 1805). Likewise, the intuition that labor and investment in property can supersede first possession in claims for ownership is reflected in the legal concept of accession, which grants ownership to mistaken improvers of personal property (e.g., *Wetherbee v. Green*, 1871).

Boyer's minimalist model of ownership psychology – which purports to explain ownership intuitions in terms of an interaction between a resource-competition system and cooperation-maintenance system – goes further than existing cognitive models in its depth of computational description. As a result, it also offers more specific predictions regarding ownership intuitions: Namely, that they balance the perceived strength of someone's hold on a piece of property with indexes of any cooperative benefits that individuals might confer (via future sharing, trade, exchange, collective action, etc.).

In turn, these more specific predictions can be checked against what humans do in their actual rules governing property. If we assume that minds make societies, then we should expect, *ceteris paribus*, for these specific parameters of ownership psychology to be reflected in property law and other laws regulating ownership (Boyer, 2018). Although a systematic review is not feasible for a commentary of this length, early returns look promising. In certain instances, the rules not only match up in principle, but the elements of laws often align closely with the specific parameters of the proposed cognitive adaptation.

Consider the example of squatters. Under Boyer's model, our evaluations of squatters who occupy someone else's property trigger intuitions that balance the relationship between squatters and their property with any cooperative expectations we might register toward the landowner or squatter. The result is not a bright line intuition (landowner always wins) but rather a varying set of context-specific intuitions that balance, among other things, how long the squatters have squatted, whether the squatters improve the property, and whether the landowner has been tolerant of the squatter or attempted to protect the property from squatting.

The law carves along many of the same joints. The doctrine of adverse possession establishes that individuals can acquire ownership of another's real estate in cases where they can show that they have occupied the property (1) openly, (2) without the owner's permission, (3) exclusively, and (4) continuously for a statutorily determined number of years, all without the landowner taking measures to evict the squatter or assert their property rights

(Powell, 1949). For example, courts tend to look more favorably on the adverse possessor when they have constructed a building, erected a fence, or planted a crop on the property (e.g., *Cousins v. McNeel*, 2010). By the same token, courts tend to look less favorably on adverse possessors when they conceal their occupation, or where the landowner has given them express permission to use the land (e.g., *Houghton v. Johnson*, 2008). As one court phrased it, the adverse possessor “must unfurl his flag on the land, and keep it flying so that the owner may see, if he will, that an enemy has invaded his dominions and planted his standard of conquest” (*Barrell v. Renehan*, 1944, p. 333).

Notice two things. First, the possession cues that Boyer proposes as relevant for resource competition (contiguity, interaction, defense, and making modifications) map closely onto the elements required to establish adverse possession. Second, these elements are not considered in a vacuum, but instead are considered in light of the forthrightness (read: Cooperative expectations) of the landowner and adverse possessor.

These same elements appear in cases evaluating an owner’s liability for damage done by the things they own (as in a falling tree, or a biting dog). Here the law tends to balance the dominion that the owner extends over something with judgments of the owner as a past and potential cooperator. For damage caused by fallen trees, the law considers possession cues such as who owns the property the tree is located on, as well as cooperation cues such as whether the property owner was aware of a tree’s poor health and did nothing to prevent it (*Klein v. Weaver*, 2004). For damage caused by pets and other animals, legal rules balance the domesticity of the animal (read: Possession cues) with the owner’s knowledge of any propensity for dangerousness and their diligence in keeping the animal in check (read: Cooperation cues) (e.g., *State ex rel. Smith v. Donohue*, 1887).

Given the distance between an intuition and the passing of a law, we wouldn’t expect this framework to map cleanly onto every aspect of property law, and there are often sound reasons why we would not want it to (Patrick, 2023). Moreover, Boyer’s model doesn’t explicitly rule out other potential explanations that could also account for the intuitions of ownership or features of property law that we observe. As of now, however, it does represent the state of the art in both reconciling much of the psychological literature on ownership and explaining why certain recurrent elements span many disparate areas of the law of property.

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Primordial feeling of possession in development

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Abstract

Boyer’s minimalist model of human ownership psychology overlooks important cues that children provide in their development leading them from pre-conceptual to conceptual (symbolic) expressions of the basic feeling experience of control over things, qua ownership in the most basic psychological sense. Appeal for innate core knowledge and evolutionary logic blows out the light of this rich and unique ontogenetic progression.

Pascal Boyer’s impressively tight and thorough model of ownership intuitions may be missing important cues provided by children in their development. Here, I want to argue that attempts at formulating what would be the basic intuitions underlying human ownership psychology outside of a developmental context, especially with an appeal to innate core knowledge and ultimate evolutionary logic, may throw the baby out with the bathwater.

From a psychological standpoint, the necessary minimal condition for any heuristic intuitions about ownership is the basic experience of having control over things (i.e., to possess). As a case in point, possession comes from the Latin verb *possidere*, which means to put one’s foot or weight over something. The feeling experience of control over things (putting one’s weight over something) is shared by all social animals, and this should be the starting point of any psychological account of ownership.

The feeling experience of possession is indeed the necessary psychological pre-requisite of any intuitions about who owns what and why. All creatures striving to possess and assert control over things develop implicit intuitions and heuristics about it, starting with the detection of sheer physical dominance (lion share principle). What is special about human possession and

ownership, however, is that as a species we evolved unique symbolic ways to become explicit about possession.

Between birth and approximately 5 years, the development of ownership psychology can be construed along three main matrices (see Rochat, 2014). First, there is the ontogenetic transformation from a preconceptual (birth to 18 months) to a conceptual sense of ownership (18 months and older). Second, from birth, this evolution takes the child toward a progressive objectification of ownership. By the end of the second year, ownership of possession starts to be *recognized* by children who begin to objectify it as an extension of self via a dual process of identification (“that’s mine,” part of the general emergence of possessives in language development, see Tomasello, 1998) and projection (“not yours,” see Bates, 1990). Finally, and most importantly, the earlier form of possession which is primarily inalienable (non-shareable ownership via clinging and binding to the thing), driven toward an absolute control over things, starts from the end of the first year to become alienable in its expression. Indeed, from around 9 months, the typical child starts manifesting preconceptual signs of an alienable sense of possession and ownership via first offering gestures (Choi, Wei, & Rowe, 2021) or game of losing, giving, then regaining control over an object (Cameron-Faulkner, Theakston, Lieven, & Tomasello, 2015).

By the middle of the second year, absolute and inalienable claims now dominate with imperative like “That’s mine!” that is the trademark of the terrible two’s. It appears that the differentiation of alienable possession observed at 9 months at a preconceptual level is recapitulated at a conceptual level between the second and the third year, somehow re-described as children become efficient speakers and begin to care about their own reputation (Rochat, 2014, pp. 200–201; Rochat, 2018). At a symbolic, abstract, and conceptual level now, children discover the social affiliative power of alienable possession in cooperation, bartering, and other alienable gift giving.

This development is universal yet may vary in its expression, depending on children’s character and temperament, their social circumstances, as well as the variable characteristics of their developmental niche, a central problematic of ownership psychology that begs answers and for which Boyer’s model is rather mute. Such answers may be best generated by adopting a developmental perspective. Again, upstream to what would be core intuitions of agent–thing relations, there is necessarily a universal, primordial feeling experience of *control over things*. This feeling experience changes in human development to become symbolic in its expression. That is the main developmental conundrum that any true theory of “ownership psychology” should be able to account for. Boyer’s minimalist model overlooks this crucial aspect of human ownership psychology that is best captured by considering the developmental transformations briefly described above. An account of human ownership psychology has to be grounded in development rather than guided by evolutionary logic and a presumed innate core-knowledge perspective.

Ownership psychology is nothing but primarily the psychology of control and agency over things. That is the context in which the origins of ownership intuitions and our sense of entitlement find their developmental roots. As a case in point, there is empirical evidence that preschoolers (3–5-year-olds) from all over the world and growing up in highly contrasted developmental niches (seven urban and rural traditional cultures) tend to reason about who should own what and why, primarily on a *labor* principle. It appears that this principle is used universally by young children to determine explicit ownership for self and

others. Such primary principle is specifically linked to agency in terms of labor (creation). The use of other principles in the determination of ownership in the same population of children such as first contact, familiarity (i.e., neighborhood object), or first experience (i.e., saw it first) is found to be less culturally universal or to become more prevalent in later development (see Rochat et al., 2014).

The ontogeny of children’s understanding of who owns what and why is, overall, remarkably predictable across cultures, yet may vary in its expression depending on the child’s general temperament and developmental niche, including the group culture in which the child is born and raised, with more prevalence of one ownership principle over another, more or less propensity to share what is owned (Rochat et al., 2014).

Contrary to the young of any other species, the typical human child develops to become symbolic (referential) and self-conscious (able to objectify oneself through the evaluative eyes of others). Becoming symbolic, engaging in recursive thinking, and caring about reputation are, in a nutshell, major pillars of what makes us human. Each typical child demonstrates these unique adaptive features starting from the middle of the second year. This developmental context is primordial and cannot be overlooked when thinking about human ownership psychology.



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The recursive nature of ownership intuitions

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Abstract

The proposed model overlooks the self-referential and self-perpetuating nature of ownership intuitions. Human knowledge is primarily formed through social interaction within power dynamics. Accordingly, we suggest that legitimate ownership of one object can influence perceptions of legitimate ownership of another object. Ultimately, we argue that ownership intuitions are not independent but embedded in a self-referential system that perpetuates inequality.

It is difficult to imagine a world without possessions. The notion of ownership is ubiquitous in our lives, and understanding how it emerges is key to understanding conflict and inequality, as noted in the laudable target article. However, we believe that the proposed model of ownership intuitions misses a fundamental aspect of the psychology of ownership – and of social organization more generally; namely, the idea that ownership intuitions are *self-referential*, and as a consequence, are *self-perpetuating*.

This point is most apparent when it comes to the designation of property rights in humans. According to the social constructivist perspective (e.g., Berger & Luckmann, 1966), human knowledge, including common sense knowledge about everyday life, is fundamentally socially constructed. These social constructions often have the property of being self-referential (see Searle, 2010). For example, “cryptocurrency has value” because other people *believe that* “cryptocurrency has value.” Similarly, the statement “person A owns property t” is true if and only if people *believe that* “person A owns property t.” In other words, in human society, the designation of property rights is fundamentally dependent on intersubjective agreement, rather than on physical aspects of the person, the property, or their relation.

This idea is best explicated by relying on one of Boyer’s examples:

... if I want to defend Melanie’s entitlement to a garden and persuade others that we should act against Karl’s attempt to pick the flowers, I may mention that “Melanie worked hard on it”, “she built a fence around it”, etc.

But what if Karl was the landowner and Melanie his gardener? According to the rules and norms in a capitalist society, the labor that Melanie put forth in the garden does not give her ownership of the produced goods. Karl, being the owner of the means of production (the land), would be perceived as the legitimate owner of the goods (flowers), rather than Melanie the laborer who may live on this land, protect it, and nourish it. Thus, ownership intuitions primarily rely on social constructions rather than on physical properties.

Importantly, as highlighted by social thinkers (e.g., Foucault, 1976), such social constructions (e.g., A is entitled to t) are established within and are consequence of social power dynamics. Because social power is often a function of existing resources, this gives rise to a self-reinforcing dynamic wherein the question of property ownership is largely determined by existing ownership (e.g., Gramsci, 1971; Marx, 1875). For example, in numerous societies, the wealthy often occupy prominent positions that allow them to shape the norms and regulations governing the fair distribution of resources. For instance, they may determine the relative significance of property rights compared to human rights such as healthcare and the taxation rate on capital versus labor. As a result, their wealth gives them a greater capacity to accumulate even more wealth.

Thus, we suggest that one of the most important factors in determining who owns what is what people already own. Using the present model and its notation, we suggest that the legitimate ownership of object t1 greatly affects the likelihood that object t2 will be perceived as legitimately owned: $[P(A, t2, s)] \& \text{Brep}[L(A, t1, s)] \rightarrow \text{Brep}[L(A, t2, s)]$.

Empirical evidence for the process wherein ownership status serves as a cue for entitlement of further resources can be found in research that examined whether conspicuous consumption (i.e., owning product for social favors) actually works. In their research Nelissen and Meijers (2011) had shown that people who own luxury items experience more social benefits than people who do not own luxury items. For example, in one experiment they found that participants who were (allegedly) paired with a partner who wore a polo shirt with the “Lacoste” brand mark received significantly higher endowments in a dictator game than a participant who wore the same shirt but unbranded.

In fact, this self-perpetuating structure of ownership intuitions is not limited to human psychology, as demonstrated by the psychology of territorial ownership. Much research has shown that animals who reside on their own territory have a “prior-residence advantage” (e.g., Braddock, 1949; Smith & Parker, 1976); namely, the tendency of resident animals to win fights over resources in their own territory (see Kokko, López-Sepulcre, & Morrell, 2006), and the tendency of interloper animals behave in a more submissive manner or refrain from contesting the resident animal at all. Importantly, findings on prior resident effects show that resident advantages in the animal kingdom are not restricted to situations wherein the resident has a realistic strategic advantage and interloper is inherently disadvantaged (i.e., a so-called “correlated asymmetry”; Smith & Parker, 1976). Instead, it was found that territory ownership provides a coordination cue (i.e., focal point; Schelling, 1958) based on which additional resource allocation problems can be settled.

To conclude, according to Boyer’s model, ownership intuitions develop independently of one another, one object at a time. In this commentary, we shed light on the power dynamic that fosters ownership intuitions and how they are embedded in a self-referential system that is responsible for many of societal inequalities.

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Autonomy, the moral circle, and the limits of ownership

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Abstract

Why can't we own people? Boyer proposes that the key consideration concerns inclusion in the moral circle. I propose an alternative, which is that specific mental capacities, especially the capacity for autonomy, play a key role in determining judgments about human and animal ownership. Autonomous beings are viewed as owning themselves, which precludes them from being owned by others.

One of the many interesting applications of Boyer's theory concerns the reprehensible practice of slavery. He notes that a view of ownership intuitions as based on accepted social norms or from a mental theory of ownership would necessitate that "the abolitionist movement that started in 18th century England required a drastic change in conceptions of ownership." Boyer argues that, instead, those in favor of retaining the practice of slavery focused on "depicting slaves as essentially different from full human beings (Smithers, 2012)," and that "As many historians have noted (Carey, 2005), the emergence of abolitionism did not result from the adoption of a different mental theory or social norm about the domain of ownership, but from a widening of the 'moral circle' (Pinker, 2011; Singer, 1981)".

One concern, though, is that Boyer might be too quick to conflate the categories of "falling within the moral circle" and "not being property." Consider studies that ask people to morally evaluate others and designate them as falling into different points within the moral circle. These studies find that we ascribe most moral standing to our family and friends, followed by human in-groups and outgroups, then animals, then plants, and, finally, monstrous people like murderers (see, e.g., Crimston, Bain, Hornsey, & Bastian, 2016; Neldner, Crimston, Wilks, Redshaw, & Nielsen, 2018). As such, both animals that are seen as highly sentient (dolphins, chimpanzees, and dogs) and those seen as less sentient (chickens, fish, and bees) are closer to the center of the moral circle than human murderers and child molesters. (If anything, this underestimates how we think about certain animals. One poll finds that about one in three British pet-owners would choose to keep their pet over their romantic partner.) Yet, despite all the moral weight given to these creatures, we are fully comfortable seeing them as property. Conversely, however much we despise murderers and child molesters, we do not usually see them as entities that can be owned.

This suggests that it's not simply the degree of moral standing that we give to living beings that determines whether we view them as ownable. Instead, research suggests that the attribution of specific mental capacities may be closely linked to judgments about human and animal ownership. While some have explored the role of a capacity for intelligence (Caviola, Schubert, Kahane, & Faber, 2022; Wilks, Caviola, Kahane, & Bloom, 2021), sentience (Gray, Young, & Waytz, 2012; Leach, Sutton, Dhont, & Douglas,

2020; Rottman, Crimston, & Syropoulos, 2021), or morality (Piazza, Landy, & Goodwin, 2014), research that I've done with my colleagues and students suggests that our judgments about whether an animate being can be owned depends in large part on the degree to which we believe it has the capacity for *autonomy*.

One series of studies investigated the role of factors such as intelligence, emotional capacity, reflection and self-awareness, and autonomy in adults' judgments of whether adult humans, robots, aliens, and other creatures could be owned if they were purchased by another person (Starmans & Friedman, 2016). Among these capacities, only autonomy had a significant impact on ownership judgments. Participants were less likely to judge that any of these entities were owned when they were described as having the capacity to make their own decisions, resist the instructions of others, and being responsible for their own actions.

Why might autonomy be special? One proposal, in line with arguments made by Locke (1690) and others, is that autonomous beings might be seen as possessing the property of self-ownership. If you own yourself, then you cannot be owned by another. Consistent with this, Starmans and Friedman (2016) found that the one circumstance in which a human was viewed as owned was when the transaction respected the autonomy of the person: An adult who willingly sold himself into slavery for his own reasons was judged to be owned by the purchaser.

Does this autonomy principle apply to living beings more broadly? Espinosa and Starmans (2020) showed that even 4- to 7-year-old children use principles of control and autonomy to reason about the ownership of familiar and novel animals. At all ages tested, children were more likely to say that a typically wild animal (e.g., a bear) or a novel alien animal was owned if a homeowner had controlled its movements by putting it in a cage, or if the animal inherently had the ability to escape the backyard (e.g., fly or jump).

This autonomy principle also has interesting implications for how human children are viewed, since young children lack autonomy, and are not viewed as having the capacity to make decisions for themselves. As such, autonomy-based reasoning might lead to the intuition that children are owned by their parents. While modern adults are unlikely to explicitly endorse this claim, Starmans & Friedman ([under review](#)) explored the origins of these intuitions by asking 4- to 7-year-olds about their views. We found that across all ages, children judged that parents owned children, but children did not own parents, teachers did not own students, and students did not own teachers. The one exception was when children considered a "Pippi Longstocking"-like character, who was autonomous, lived next door to her parents, and made all her own decisions. Now, she was not seen as owned by her parents.

One question that arises from this analysis is why adults do not affirm that children, or physically or mentally incapacitated adults, can be owned. We explain this in terms of an overriding general principle that modern adults (at least *weird* ones) possess: With certain exceptions, such as when a person chooses to be owned, people cannot be owned, regardless of how autonomous they are. The ownership of people isn't merely a grotesque moral wrong, it is also a conceptual impossibility.

If this is right, how can we explain the historical change in intuitions about the ownership of people? Here, I agree with Boyer that this is not best thought of as a "drastic change in conceptions of ownership," but I propose that instead it represents a drastic change in the conception of *people* – that is, in a shifting recognition that the historically enslaved individuals had the very same capacity for autonomy, and thus self-ownership, as those who would attempt to enslave them.

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What do infants need an ownership concept for? Frugal possession concepts can adequately support early reasoning about distributive dilemmas

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Abstract

Boyer's model posits that ownership intuitions are delivered by combining input representations of resource conflict and cooperative value, necessary to solve coordination dilemmas over resource access. Here I evaluate the implications of this claim for early social cognition and argue that cognitively frugal possession concepts can be leveraged to the same inferential end, making the ascription of ownership proper unnecessary.

At the core of Boyer's model lies the idea that ownership intuitions result from the interaction of two cognitive systems: One dedicated to handling conflicts over the access and use of rival goods, and another dedicated to sustaining cooperative interactions. Under this account, ownership intuitions spontaneously emerge from combining two types of input representations, respectively tracking an agents' resource control and their cooperative potential. This claim can be leveraged to generate novel predictions for the developmental emergence of ownership attributions, which I discuss below.

Two lines of evidence are relevant to this discussion. On one hand, there is currently no clear experimental evidence that infants ascribe ownership relations, intended as stable agent-object associations capable of surviving disruptions of physical control and temporary possession changes (Blake & Harris, 2011). While such empirical gap should not be interpreted as evidence of absence, it nevertheless begs the question whether the concept of ownership is within the province of infant cognition. On the other hand, there is a burgeoning literature showing that infants are adept interpreters of interactions based on the transfer of objects (e.g., giving, taking, sharing; Geraci & Surian, 2011; Tatone & Csibra, 2020; Wang & Henderson, 2018a) or their competitive acquisition (e.g., priority of access; Mascaro & Csibra, 2012). This evidence suggests that a cognitively frugal concept of possession as relative resource control (based on geometric proxies such as relative distance from an object) is available from early on to understand a variety of (antagonistic and altruistic) interactions. Thus, even without a concept of ownership as socially acknowledged right of use, infants can infer the goals of some (but not all, e.g., lending) types of material transactions. Just as importantly, infants also form expectations about appropriate resource allotment in social interactions: They infer that agents who worked together toward a common goal should share the resulting rewards (e.g., Vorobyova, 2021; Wang & Henderson, 2018b); that differential contributions to a task should be reflected in proportional dispensation (Sloane, Baillargeon, & Premack, 2012); that third parties should rectify acts of taking violating equity principles (Stavans & Baillargeon, 2019); and so forth. This work suggests that infants use estimates of cooperative value (e.g., two agents collaborating) to update representations of potential resource conflict (e.g., only one agent seizes control of the product of joint labor) compatibly with a principle of effort compensation, where the short-term utility of monopolizing material rewards is traded off for the long-term utility of incentivizing the participation to cooperative ventures.

Would such events license infants to ascribe ownership to the agents over the resources acquired? In other words, would infants come to expect that the rewarded agents have enduring rights of use over the dispensed items? Existing studies cannot directly answer this question, as they do not measure infants' expectations beyond distributive outcomes. However, Boyer's claim about the minimal determinants of ownership intuitions suggests that the answer may be a positive one. After all, the scenarios discussed here fulfill the two-pronged premise of his model, since they features cues of resource conflict (i.e., multiple agents seeking finite resources) as well as cues of cooperative potential (i.e., these agents standing in a collaborative interaction). The combination of these cues should then, as per hypothesis, deliver ownership intuitions.

However, ownership concepts are not required to interpret cooperative interactions according to a retributive logic – or, differently put, to generate expectations about the patterning of

reward distribution among agents (be this synchronic, as in the case of dividing a resource lot, or diachronic, as in the case of repaying previous material favors through reciprocation). If infants can represent transfer events (Tatone, Geraci, & Csibra, 2015) and produce expectations about welfare-levelling acts of generosity (i.e., who should give back to whom?; Tatone & Csibra, 2020), all by simply updating possession relations based on relative resource control, there is no principled reason why they would not use this same mechanism to draw inferences about the resolution of mutualistic endeavors. Thus, while Boyer's model suggests ownership intuitions to be automatically supplied when agents coordinate over resource use, the argument offered here regards these intuitions as unnecessary to understanding how coordination for mutualistic ends is brought about.

This leaves us with two possibilities regarding the fate of Boyer's hypothesis in early social cognition. Perhaps Boyer is right, and we simply lack an experimental approach adequate to support his hypothesis. If so, given appropriate testing, we should eventually find that infants interpret resource access as granting rights of use functionally akin to ownership *selectively* when this constitutes a socially coordinated outcome (either produced in collaborative settings, e.g. joint action, or in competitive ones, e.g. dominance). Alternatively, Boyer's hypothesis may not find its footing in infant cognition, if it turns out that socially coordinated resolutions to resource conflict merely result in new configurations of basic possession relations. This possibility opens up an interesting puzzle: If infants do not need an ownership concept proper to reason about how resources should accrue to agents based on their prior interaction history, which other aspects of social living should motivate them to eventually adopt such concept? Tentatively, I would argue that a possible answer lies in appreciating that objects generate *prospective utilities*, not tied to their immediate use, but to their enduring access. Tools are an egregious example of this kind: Lending them when not needed allows have-nots to reap immediate utilities from their use at no cost for their makers, yet enduring ownership ties need to be established and recognized for the original possessor to reinstate prerogative of access when necessity arises (Ichikawa, 1995). Under this conjecture, the developmental emergence of a concept of ownership may then require an additional input representation over the two suggested by Boyer: Namely, a utility function that incorporates future resource fruition.

Irrespective of which of the two scenarios will be empirically vindicated, Boyer's model remains a critical catalyst for both: Either by suggesting a new hypothesis about the cognitive prerequisites for ownership attribution or by highlighting a developmental dissociation between forming expectations about the resolution of episodic distributive dilemmas, which may not necessitate an ownership concept, and representing diachronically enduring associations between objects, such as tools, and their manufacturers, which may.

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The curious origins of ownership

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Abstract

What are the origins of ownership as a conceptual domain? By combining experimental evidence from cognitive science, a theoretical proposal from developmental psychology, and the computational framework of reinforcement learning, I argue that ownership concepts can develop as a by-product of our curiosity-based exploration and become grounded via our experience of control in physical and social environments.

Most of our life is centred around objects, from the toys with which we play as toddlers, to the food we eat, to the clothes and tools we accumulate in our adult life. Although interactions with objects depend on understanding their physical nature, the fundamental cognitive ability to quickly identify, and differentially treat, what belongs to us from what belongs to other people is needed as well. Quite predictably, disregarding the more abstract ownership status of an object – whether an object is “mine” or “yours” – leads to costly, and potentially harmful, social conflicts.

Scientific and anecdotal evidence indicates that we (humans) all share a similar understanding of ownership and – at least for most of us, most of the time – an inclination to respect it. Given the underlying mutual interest to avoid such conflicts, a multidisciplinary effort has extensively explored the “motivational” problem of why ownership norms are respected (e.g., Sugden, 1986/2004). But where does the domain of abstract knowledge presupposed by these norms come from?

Given its evolutionary significance and cultural universality, it has been conjectured that the domain of ownership is part of our

biological endowment (Jackendoff, 2002; Stake, 2004), perhaps in the form of domain-specific principles that orient the development of a full-fledged naïve theory (Nancekivell, Friedman, & Gelman, 2019). Rooted in this tradition, Boyer maintains that the set of mental representations and cognitive processes making up our “ownership psychology” is a cognitive adaptation. However, in his view, the implicit theory which is at the origins of most of our intuitions about ownership derives from (computationally) linking a cognitive system evolved to support competition over resources with one evolved to take advantage of cooperation opportunities. As a cognitive adaptation, ownership is a by-product, so to say, of more fundamental ones.

Still, recent results from several studies in cognitive science suggest that knowledge of ownership status of objects shapes multisensory and motor “output” representations of a different kind from those addressed by Boyer. It has been shown, for instance, that knowing whether a graspable object like a cup is “yours” directly modulates the potentiation of actions towards it (affordance activation; Constable et al., 2011). In a simple grasp-to-lift task, such knowledge can alter the kinematic profile of movements in ways that suggest an automatic resistance to interact with objects owned by others (Constable et al., 2011). More subtly, knowledge of the ownership status of objects can influence the linguistic choice of spatial demonstratives in the form of a tendency to use “this” more often to refer to objects owned by the speaker rather than by someone else (Coventry et al., 2014). Intriguingly, a recent study has also provided evidence that the ownership status of an object can affect the multisensory representation of the space around the body (the peripersonal space; Patané, Brozzoli, Koun, Frassinetti, & Farnè, 2021) as measured by visuotactile interaction effects, which are differently modulated when manipulating objects that belong to someone else as if they are conceived as out of reach. Finally, intriguing evidence from a somatoparaphrenic patient denying ownership of her left hand revealed that she also displayed selective disownership of objects typically associated with it (e.g., a wedding ring, a garnet ring, a watch, etc.; Aglioti et al., 1996; for an experimental demonstration with healthy participants, see, e.g., De Bortoli Vizioli, Borghi, & Tummolini, 2020). Taken together, these studies strongly suggest that the abstract conceptual domain of ownership may in fact be, at least partially, grounded in and profoundly shaped by our sensorimotor experiences (Borghi et al., 2017; Scorolli, Borghi, & Tummolini, 2018). However, despite this mounting evidence, which kind of experiences may be sufficient to learn this conceptual domain has not been identified.

One possibility is that ownership as a conceptual domain derives from our experience of physical control over external objects – their possession – in the context of interaction with other people. The first formulation of this hypothesis is due to the developmental psychologist Lita Furby who proposed that an early understanding of ownership concepts may develop even in prelinguistic infants as a “byproduct” of their intrinsic motivation to explore, manipulate and control our immediate environment (Furby, 1980). More specifically, she conjectured that, because of such intrinsic motivation, during their first 2 years of life, infants are under pressure to identify the objects in their environment that give rise to feelings of efficacy and personal control, and to keep them apart from those that instead thwart such feelings owing to the interference from other people. The former class of controllable objects becomes the category of objects that are understood as belonging to the self, while the latter class includes those that are not. Furby’s hints at a

mechanistic explanation have been influential (e.g. Pierce, Kostova, & Dirks, 2003). However, as Boyer rightly suggests, such a developmental account has been insufficiently defended on explicit theoretical ground and no computational model has so far been proposed.

Fortunately, thanks to recent advances that have started to address the mechanisms behind intrinsically motivated learning and curiosity-driven exploration using the computational framework of reinforcement learning (e.g., Gottlieb, Oudeyer, Lopes, & Baranes, 2013), we may now have the resources to overcome these limitations. Building on this approach, we have recently proposed a neurocomputational model of concept learning based on an intrinsic motivation to acquire control (competence) over the environment (Mannella & Tummolini, 2023). Using a computationally specified process model, we have shown that a mechanism supporting the alignment in an internal representation space of the (multi)sensory and motor maps acquired during experience also supports the formation of a cross-modal categorization system with sufficient resources to re-enact its own multimodal experiences, and, on this basis, to kick-start the formation of concepts of objects grounded in the external environment. We propose that a similar architecture may also provide the resources to formally model Furby’s conjecture. By monitoring one’s competence (or lack thereof), the possibility to form concepts out of these internal, metacognitive experiences of controllability (Borghi, Fini, & Tummolini, 2021) may be able to show that ownership can in fact be a “byproduct” of quite a different process.

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Boyer’s minimal model should also represent multiple ownership without collective agency

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Abstract

Boyer’s minimal model of ownership psychology suggests that joint possession triggers representations of collective agency. However, many forms of co-ownership based on cooperation or competition can be represented as a set of P() or L() tags without inferring a unifying collective entity. Moreover, representations of partible ownership are required to engage in cooperative production and distribution of resources.

Pascal Boyer persuasively proposes that ownership intuitions derive from a two-tiered process engaging cognitive systems which have independently evolved for competition over resources and, respectively, cooperation. Elegantly minimal and capable of explaining both run-of-the-mill and puzzling ideas about ownership, the model should also account for intuitions about things belonging to more than one actor – a recurrent feature documented by anthropologists across cultures.

Collaborative provisioning of resources which are impossible or costlier to pursue alone is a core feature of human cooperation. Communal sharing and collective action involve various forms of multi-person ownership of things occurring from hunter-gatherers to large-scale societies (Widlok, 2016). When several people collectively catch an animal, inhabit a dwelling, or tend to a fire, P-cues indicate a thing’s relationships with two or more agents. Boyer argues that joint ownership produces intuitive representations of collectives as agents (e.g., nations, corporations, or lineage groups), but this only appears under special conditions, and without replacing ownership tags about individual agents.

If three people work cooperatively to produce a thing T, ownership psychology may produce a single P() label fusing all people in a single agent (“T-owners”), but also different P() labels for all agents. As children as young as 4 envision intermediary rights of members to group-owned things (Huh & Friedman, 2017), representations of collective ownership do not preclude thinking about individual ownership of a thing which also belongs to others. Arguably, separate entries are needed to calibrate the fair division of the benefits of cooperation (already present in preschoolers;

Baumard, Mascaró, & Chevallier, 2012). If an individual deployed more effort, time, or skill than the others, we intuitively consider she owns more of the collective product, while matching contributions suggest equal co-ownerships.

The collapse of collectivized agriculture after the 1989 Romanian Revolution offers an interesting test of multiple ownership intuitions with or without joint agents. When villagers in Sateni divided the socialist farm assets, a dozen villagers received a newly built stable as compensation for outstanding (and equal) payments (Umbres, 2022). They chalk-marked walls into sections which family teams demolished and carried home the scavenged materials from their part. While peasants knew the use value of a standing building was much larger than of its components, none entertained the idea of joint ownership (or thought that others might entertain it). On reception day, all came to the site with their horse-drawn carts prepared for instant division and smoothly coordinated upon the intuitive solution of slicing up the collective asset into privately owned things.

Nonetheless, Sateni villagers often entertain representations of joint ownership as land, animals, or households are usually perceived as owned by families rather than individuals. Moreover, the family is by far the fundamental cooperative social entity in this “amoral familism” culture with deep distrust toward, and almost no expectations of cooperation between, unrelated villagers. Arguably, had a family or a group of people connected by kin ties received the building, they could have coordinated around a shared L() label associating the ownership of the whole asset to a cooperative coalition based on trial-and-tested mutual trust. Indeed, the Sateni stable was partitioned between families represented (and acting) as agentive co-owners of shares in a larger but not agentively co-owned entity.

Intuitions of partible ownership without joint agency also appear in dilemmas such as who owns a buried treasure discovered by a tenant on a landlord’s property. Experiments (DeScioli & Karpoff, 2015) show that various principles drive intuitions of property rights (often diverging from actual legal decisions) but also that people often don’t have strong convictions one way or another. Respondents could thus have intuitions that both agents are owners yet choose the relatively stronger claim as required by experimenters (or legal demands). Moreover, a majority of children answer that first arrivers on an island and later arrivers own the island equally (Verkuyten, Sierksma, & Martinovic, 2015)

If two or more agents dispute a thing without a clear winner, the production of a P() tag could be deferred (no ownership intuitions until clear evidence of possession). A more likely alternative is the production of a P() tag which includes contenders as potential owners, subject to revision in light of new evidence. Even if produced under conditions of conflict over things, P-cues would trigger ownership intuitions with adaptive outputs, especially if one competitor also activates L-cues of cooperative assumptions and behavioral motivations (e.g., help your partner achieve full ownership).

Agent-like group ownership may become salient when all owners pursue the same goal regarding the thing as a coalition (Tooby, Cosmides, & Price, 2006); for example, when “they” defend or hide a possession threatened by another party (agent or group). Yet the same people can, at another moment, dissolve their collective ownership into individual shares. Conversely, members of a coalition can pool together things for collective enterprises while recording how much each contributed to the co-owned thing. Sateni families place their sheep in large flocks and receive relative shares of cheese produced from milk collected from the whole flock (Umbres, 2022).

A minimal model of ownership psychology should thus represent both individual and group tags in cases of multi-person ownership. A flexible, context-dependent deployment of several ownership intuitions about a single thing should thus deal with the ubiquitous cases of building up, governing, or dismantling collective ownership in cooperative and competitive social interactions.


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Hold it! Where do we put the body?

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Abstract

Boyer's formulation neglects that humans are embodied agents. It is a biological imperative to distinguish self from other. Ownership of ideas, bodies, objects, and locations is an inevitable extension of this. We argue that (1) the body's capability influences the inputs that guide future actions, and (2) bodies in action influence all of cognition, from perception to decision making.

Biological entities from single cells to organs and organisms all have boundaries. Yet these boundaries are semi-permeable, allowing fuel to enter, waste products to leave, and mechanisms for cooperation and competition with neighboring entities.

Boundary permeability therefore requires some means of recognition, allowing cells and organisms to distinguish between self and other, mine and not-mine (Mukherjee, 2022).

Decades of human behavioral research has documented that the psychological self extends to the ideas of one's mind, the parts of one's body, and the physical possessions and locations associated with one's body (Belk, 1988; Sommer, 2002). The "implicit rules of ownership" referenced by Boyer (2022) very much follow the implicit rules for possessing one's own body parts. An everyday example is road rage, where perceived infractions of an automobile's intentions are treated as direct bodily violations.

Boyer's framework for ownership proposes a unidirectional flow from inputs to outputs (Boyer, 2022), thus ignoring two critical features of humans as embodied agents. Our first point is that the specific capabilities of a body influence the inputs to the system. We privilege the inputs that correspond to the actions we are capable of performing, tending to ignore inputs for which we have no action possibilities. Our second point is that an agent's actions change the state of the body and its relation to the environment. This means that our actions directly contribute to our appraisal of the objects we encounter and what we consider as "ours" or "theirs" (Fig. 1).

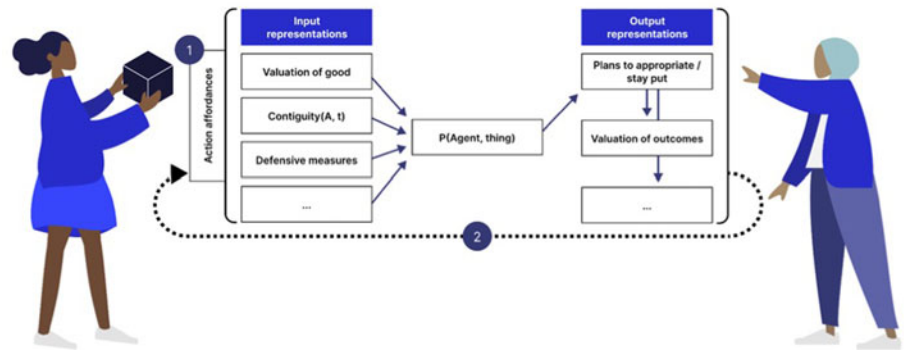
Action capabilities directly influence perceptual inputs

Boyer (2022) describes contiguity as a relevant cue that facilitates ownership intuitions. But he fails to point out that many other relations between agent and object have a powerful influence on the input channels that eventually lead to actions. For instance, experts in a given perceptual domain such as rock climbers, bird watchers, and automotive enthusiasts, all see and act on objects in their domain at a finer level of detail than novices (Tanaka & Philibert, 2022). This corresponds to what Gibson (1977) referred to as action affordances. How one is capable of acting on their world fundamentally changes perceptual inputs. It is not merely sharing space or time with an object that is vital to privileging its perception, it is *the capacity to act* on that object that fundamentally changes how we represent and feel about it. When objects are within reach, action-related areas of human cortex respond more vigorously than when they are out of reach (Gallivan, Cavina-Pratesi, & Culham, 2009). People are able to respond more quickly to perceptual input that is near one's hand (Perry, Amarasooriya, & Fallah, 2016; Reed, Grubb, & Steele, 2006), and to locations that are the target of actions (Andersen & Mountcastle, 1983; Snyder, 2000). These influences on the way we perceive an object then have a direct influence on the actions we plan and initiate (Barton, Matthis, & Fajen, 2017; Lee, Lishman, & Thomson, 1982; Sarpeshkar, Abernethy, & Mann, 2017; Savelsbergh, Whiting, & Bootsma, 1991; Todd, 1981; Witt, 2011). These and other studies strongly support the expansion of Boyer's input space to include the important role that humans acting on, and having the capacity to act on objects, has in determining ownership intuitions.

Actions influence the emotional and cognitive appraisal of objects

A wealth of research shows a much more intimate coupling between action and perception than the sequential stages of see → decide → act (Nakayama, Moher, & Song, 2023). Neurons in the premotor and motor regions of the brain implicated in self-action also respond when observing others perform the same

Figure 1 (Wispirski et al.). Boyer's framework requires at least two extensions to be consistent with a current understanding of embodied cognition (Foglia & Wilson, 2013) and the extended self (Belk, 1988). (1) The capabilities of a person's body have a direct influence on the inputs that govern their actions. (2) The actions taken by a body have direct influence on all of cognition, including perception, emotional appraisal, and decision making.



actions (Rizzolatti, Fogassi, & Gallese, 2001). Merely planning a movement increases the neural activity in human early visual and auditory cortices (Gale *et al.*, 2021; Gallivan, Chapman, Gale, Flanagan, & Culham, 2019). When we act on an emotionally neutral object, our actions enhance that object's appeal in subsequent evaluations (Chapman, Gallivan, & Enns, 2015; Peck & Shu, 2009; Wispirski, Lin, Enns, & Chapman, 2021). Conversely, ignoring some objects in order to act selectively on others decreases their subsequent emotional appeal (De Vito & Fenske, 2018; Fenske & Raymond, 2006; Griffiths & Mitchell, 2008; Kiss *et al.*, 2007; Raymond, Fenske, & Westoby, 2005; Silver, Stahl, Lioatile, Smith-Flores, & Feigenson, 2020). Even regular involuntary interaction with objects that are initially appraised as negative contributes to their increased emotional appeal over time (Dudarev, Manaligod, Enns, & Todd, 2022). Arbitrarily assigning some objects as “mine” and then moving them toward one's body leads to subsequent improved memory of those objects, compared to objects assigned as “yours” and/or moved away from one's body (Truong, Chapman, Chisholm, Enns, & Handy, 2016). All of these studies indicate that the actions we plan and take contribute to updating our perceptual states, which in turn make new objects and experiences available to us, and the cycle continues.

Conclusion

Humans are embodied agents and ownership intuitions follow directly from the extended self of every individual. First, we argue that our capabilities as active agents directly alter the perceptual inputs that give rise to ownership intuitions. Second, we argue that rather than modeling the extended self with the sequential stages of perceive → decide → act, we should consider a fully dynamical system, where the actions we take are as influential in determining the decisions we make as the perceptual inputs to those decisions (Nakayama *et al.*, 2023; Wispirski, Gallivan, & Chapman, 2020). From this perspective, we may not only be the recipients of intuitive notions of ownership via the shared evolutionary history of all humans, but we have the capacity to shape and even alter those intuitions, through the actions we take today and the decisions we make for the future.

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Author's Response

Ownership psychology, its antecedents and consequences

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Abstract

Commentators discussed the coherence and validity of a minimalist approach to ownership intuitions, in ways that make it possible to clarify the model, re-evaluate its cognitive underpinnings, and sketch some of its implications. This response summarizes the model; addresses issues concerning the need for a special technical lexicon when describing cognitive semantics; the psychology involved in contexts of competitive acquisition and their consequences for possession and use of rival resources; the role of cooperative expectations in creating mutually beneficial allocation of resources; the consequences of ownership psychology for social interaction and the production of social norms of property; and the relations between psychological processes and legal institutions in the domain, before proposing some final thoughts.

R1. Introduction

The minimalist model is an attempt to identify the computational processes that lead to common ownership intuitions. The model starts from the question, “What are such intuitions for?” They

regulate interaction between agents in two types of contexts. First, like many other animals, humans engage in the competitive acquisition of resources. Second, distinct from most other animals, they also engage in mutually beneficial cooperation. A central point of the model is that the evolved cognitive competencies and motivations activated in these two contexts are sufficient to explain many features, including apparent mysteries, of human ownership psychology. A consequence is that we do not need to posit a dedicated ownership capacity or mental theory of ownership, because the psychological processes activated in competitive acquisition and cooperation suffice, when combined, to account for the psychological, anthropological, historical, and legal evidence concerning ownership intuitions.

Humans compete with conspecifics for localized, fitness-enhancing rival goods such as territories, food, mates, etc. Various cues allow an agent to determine what other agents are deriving utility from what goods – cues such as contiguity, work to modify the thing, guarding the thing, etc. This agent–thing connection, in the mind of an observer, is what we call a P(agent, thing tag). All else (e.g., agents’ formidability and valuation of the thing) being equal, the formation of P(agent, thing) tags results in a Bourgeois equilibrium (Maynard Smith & Price, 1973) of possessors defending access to a thing from intruders (Gintis, 2007). Agents in such situations leave others’ things alone.

In situations of mutually advantageous cooperation, agents develop interactions around rival goods that go well beyond these equilibria ensured by P() tags. Each agent extends to some (but not all) agents encountered expectations of minimal cooperation, called, for example, Min(A, B) from A to B. The main hypothesis of the model is that, once there is such a Min() relation between two agents, the P() tags concerning the things they use are turned into a different representation, called an L(agent, thing) tag, characterized by inputs and inferences that support mutually beneficial interactions. Agents in such situations leave others’ things alone even in situations where competitive acquisition would suggest to acquire them, because this acquisition would eliminate the potential benefits of further cooperation.

These P() and L() tags are concepts that do not correspond to any of our common words for property, ownership, etc. They are functionally characterized as accepting specific inputs and delivering specific inferences, as described in Figures 1 and 2 of the target article.

A model of ownership psychology naturally carries implications to be assessed against the psychological, anthropological, historical, and legal evidence. That is why it is gratifying that the commentators on this target article discuss in detail the model’s implications in these diverse fields, and propose various extensions or revisions of the model. In the rest of this commentary, I address these various issues, starting from low-level processes activated in understanding linguistic expressions of ownership (sect. R2), as well as low-level perceptual and motivational processes that underpin P() tags and competition (sect. R3). This commentary then proceeds to issues concerning what happens after P() tags are assigned, or as a consequence of these P() tags. I consider what is sometimes called “legitimate” possession, that is, L(agent, thing) tags, based on expectations of cooperation between agents (sect. 3). Both competitive acquisition (producing P() tags) and cooperative expectations (producing L() tags) are rooted in unique features of human cognitive development (sect. 4). The commentary then broadens its scope to consider cultural consequences of ownership intuitions (sect. 5) and their interaction with legal norms and institutions (sect. 6)

before offering conclusions about the challenges of computational approaches to such common intuitions (sect. 7).

R2. Semantics and concepts of ownership

R2.1. The need for unambiguous expressions

The most frequent source of ownership intuitions consists of people's statements about particular things and individuals. That is why it is important to understand how human minds process such utterances. I argued that we cannot properly describe the psychological processes that underpin ownership intuitions using common terms like "ownership," "property," "possession," etc., because they carry unexamined assumptions. It would be greatly comforting if such worries were unfounded, and we could share **DeScioli's** commendable trust in the clarity of everyday English, including words like "possess" or "be kind."

Reading the commentaries, however, seems to justify one's worries, as these (perfectly relevant) contributions include no fewer than 10 statements to the effect that "ownership is" this, "ownership is founded on" that, or "the origin of ownership lies in" some other thing – a close reading of which suggests that the authors are using the same term in vastly different senses. So it is still worthwhile to use an abstract notation despite **DeScioli's** forceful objections to the horror of "computer code."

There is also a substantive question here. We should not assume that mental representations are always translatable as words of the natural language (Jackendoff, 1983, 1995). For example, the conceptual semantics of possession and ownership verbs, sketched by Jackendoff, requires a description of the sentence "Beth owns the doll" as

[State BE_{Poss}([DOLL]), Place AT_{Poss}([BETH])]

which may be cumbersome, inelegant, and difficult to learn, but conveys the precise semantic relations involved and nothing else (Jackendoff, 1983, pp. 191–192).

R2.2. Does language reveal implicit concepts?

It is tempting to assume that commonalities in linguistic forms may provide us with information about the mental concepts. **Kemmerer** rightly emphasizes the recurrence in many languages of a distinction between (what could be glossed as) "alienable" versus "inalienable" features of a person, metaphorically extended to different kinds of close or more distant possession. These are remarkable facts, but they raise the question of their connection to other mental concepts. The alienability feature expressed in some languages might be a foundational mental concept, but might also be a vague prototypical representation with little inferential potential.¹

If the latter is the case, one may expect that verbal communication can be parsimonious and efficient, despite expressing categories (like alienable/inalienable) that are vague and often arbitrarily applied, *because* non-verbal mental concepts related to ownership are precise and provide rich inferences. That is, conceptual knowledge about the connections between people and their shadows, people and their thoughts, people and their shoes, etc., is perhaps rich and precise enough that some extremely vague "alienability" distinctions can be used appropriately in most contexts. This would be the null hypothesis in a Whorfian project to measure the effect of such distinctions. That is of course speculative – as **Kemmerer** rightly points out, there is very little research in this direction.

R2.3. A unified ownership concept? The evolutionary perspective

Concerning the (non-linguistic) mental concepts activated, the model is minimalist in the sense that we do not assume that a mentally represented concept underlies all the uses of possessive terms, verbs like "own" and "possess," and all motivations or emotions connected with these terms. Rather, we start from a functional description of what an ownership psychology is for. In humans as in other animals, some cognitive process supports the competitive acquisition and use of rival resources; in humans in particular, rival resources are also crucial to the deployment of cooperative relations. The goal is to describe how the psychological processes involved in these two domains of selective pressure would account for many aspects of ownership intuitions.

As a consequence, the model is relevant to many aspects of these intuitions, for example, it does include the valuation of some possessed objects as more important than others (*contra Kemmerer*), but leaves aside adjacent phenomena that are not relevant to this evolutionary background. That is why **Morewedge** is right that the model does not include some phenomenologically important phenomena, like one's attachment to a deceased relative's belongings, a private diary, etc. In the same way, **Hood** mentions people's motivation to guard or cherish "otherwise worthless sentimental objects, sacred artefacts or memorabilia." These representations are not produced by the systems that regulate the use of rival things among con-specifics, and therefore lie beyond the scope of the model.²

R3. Competitive acquisition: The construction of P() tags

R3.1. Definition

The model specifies that various cues (such as contiguity, usage, etc.) called P-cues, result in a represented P(agent, thing) tag. Frustrated by what seems "enigmatic" to him, **DeScioli** asks "Does the P allude to possession, property or something else?" The P() tag does not mean any of these things, because none of these common words is at all precise. What matters here is that the term P() can be computationally described, in terms of its inputs, inference rules, and outputs. That is also why, as **Belk & Atasoy** lament, the term "possession" is not defined in the target article, as it is not part of the technical terms in the model.

As described in section 3, the P() cues are species-specific, being relevant to the kinds of competitive interactions that humans can establish. Although **Arnhart** claims that the model provides "no evolutionary explanation" for P() intuitions of associations between agents and things, it would seem that the existence of external, localized, rivalrous, and partly excludable fitness-relevant resources provides the selective pressure for such concepts, as observed in many different species (Eswaran & Neary, 2014; Strassmann & Queller, 2014). This explains why humans and other animals sometimes use similar P() cues, as described by **Kangiesser**, who also notes that the likelihood of prevailing in a conflict is crucial in many primates. This was probably true of early hominins as well. In many apes and humans, as noted by **Merker**, one crucial domain of P() cues would concern territories (DeScioli & Wilson, 2011).³

Beyond territories, humans in prehistory probably extended P() representations to tangible objects like tools. It may be the case, as **Merker** proposes, that incipient property in tools was a watershed in ownership representations, as the strength of P() tags about tools would reflect the amount of past investment,

not just immediate utility. Also, tools illustrate another aspect of ownership, the possibility of priority in future access to the thing, which becomes central in human ownership intuitions (Tatone). Indeed, many of the P() cues that are specific to human interactions concern access to future utility, and the exclusion of others from that future access (Pesowski & Powell, 2023).⁴

R3.2. What processes create P() tags?

The ownership psychology model describes generic P() cues. In actual situations, domain-specific information makes these cues more precise. What counts as contiguity for ideas is not the same as for objects. As far as tangible, physical objects are concerned, it is clear that some low-level perceptual processes provide P() cues that remain implicit, as emphasized by Tummolini. In particular, the spatial contiguity between people and material objects triggers a specific form of processing, which in a way primes the expectation of special associations between person and thing, leading to the P() tags described in the model. For instance, it is quite striking that, as Tummolini reports, when a tag becomes activated, observers perceive the thing as further away from themselves.

The developmental emergence of P() and L() intuitions may also be linked to control, as Tummolini suggests, although as he points out, there is no systematic study of that process. He proposes that some form of conceptual learning process may lead from maps of controllable objects, to a more abstract concept that would be a precursor of P() tags. This however would not be the starting point of P() concepts, because as Tatone demonstrated, elements of both P() tags and even the GIVING relation appear very early in infancy, before children have much experience of which parts of the world are under control. The point is that control provides gradual enrichment of the database of things that become the *t* in P() tags. That is why Wispinski et al. are right that people's representations of things that they control certainly take into account possible actions, the limitations of one's body, etc. This is very much assumed by the description of P() cues in the minimalist model. For instance, contiguity between agent and thing is a parameter that depends on species-specific cues, which themselves certainly integrate expectations about agents' mobility – that is why the extension of a territory for instance may vary a lot between species.

P() tags are based on cues that may be processed very differently by two agents in interaction, which is one major reason why it is important to focus on disagreements, as Echelbarger & Tully point out, and as developmental psychologists have done for some time (Blake & Harris, 2009; Noles & Gelman, 2014). Indeed, ownership disputes (outside the legal system) are almost never about the explicit principles, but about the relevant facts. The study of disagreement can also reveal that people's intuitions about their own connection to things are of course different from other people's perception of that connection. As Morewedge illustrates, Yasser and Yitzhak may have misperceptions of each other's attachment to a piece of land. A third party will not share or represent those feelings.

R3.3. Are P() tags related to body representation?

It is tempting to speculate that P() cues result from some more "primitive" processes in the mind. For instance, Arnhart writes that the "best explanation" for how agents could have representations of possessing objects (which he calls "ownership," illustrating the problem of using such terms) lies in the neurobiology of

"self-ownership." Also, Wispinski, Inns, & Chapman state that the implicit rules of ownership for things "very much follow the implicit rules for possessing one's body parts." Many intellectual traditions assume that ownership has its "origins" in ownership of one's own body. This can also be seen in developmental arguments, see for instance (Rochat, 2014).

There may well be connections between the domains of self-perception and ownership intuitions. But it is difficult to state that the latter are "grounded in" or "founded upon" the former, because those terms do not by themselves denote any precise, tractable computational process. They may imply that, ontogenetically, humans develop their ownership intuitions as an inferential outcome of representations self and other. That is tempting, and psychologists like Rochat have indeed followed that path (Rochat, 2011). But that cannot be the whole story. As mentioned before, infants do have intuitions about transfers of possessions, which do not seem to be extracted from their intuitions about their own bodies (Tatone, Geraci, & Csibra, 2015).

R3.4. Are P() tags represented as extensions of the self?

A distinct but related claim is that owned things are in some way represented as parts of or extensions of the self. Hood for instance emphasizes that "owned items can represent part of own's identity," a sentiment echoed by Nancekivell & Pesowski, who emphasizes similarities between the way we represent (some) things possessed and our representations of ourselves. Rochat also links the development of possession or ownership concepts to other important conceptual changes after infancy, also connecting ownership to control and the body.

The notion of possession as extending the self raises difficult questions. First, we would need to complete it with a description of the processes that are specific to non-really-self objects, since humans do not represent their connection to their coats or money *exactly* like their connection to other aspects of their selves. Second, if we claim that possessions are extensions of the self, we must also explain how these self-extensions ensure the efficient management of competitive acquisition or the cooperative interactions around property. What cues would make people understand that a thing is an extension of a particular individual's self, as opposed to others agents?

Nancekivell & Pesowski describe the extended-self perspective as more minimalist than the minimalist model. Without wishing to escalate this competition in parsimony, one should point out that the model is minimal in the following sense – that we do not need to postulate any psychological processes, beyond two mechanisms (competitive acquisition and mutualistic cooperation) that are already independently documented in a vast literature. By contrast, the extended-body or extended-self metaphors are additional mechanisms postulated specifically in order to explain ownership phenomena.⁵

R4. Cooperation: The construction of L() tags

R4.1. Beyond Bourgeois equilibria

Humans differ from other apes in (among many other things) two relevant features: (a) Having a special attitude to things used by other agents, and (b) maintaining extensive cooperation with non-relatives. In the minimalist model, that is not a coincidence, as attitudes to others' possessions are driven by cooperation expectations. Human ownership intuitions and motivations do not reduce to the representation of P() cues – they are vastly

different from the representations that underpin the Bourgeois equilibria of evolutionary game theory.

This argument goes against a possible “cynical” interpretation of ownership, following which agents just follow the Bourgeois strategy, with an added veneer or cover of respectability provided in the human case by moral justifications. This is what **Shechter, Gilead, & Bereby-Meyer (Shechter et al.)** seem to suggest, arguing that ownership principles are in effect formulated by the haves against the have-nots, as a justification for material dominance. Even allowing for some exaggeration, is this perspective justified? The evidence from psychology suggests the opposite. Children from an early age and adults in all known cultures make a sharp distinction between mere possession and accepted, “legitimate” possession, between P() and L() tags. As **André, Fitouchi, & Baumard (André et al.)** point out, in this domain, people just do not assume that might be right, and the inferences from L() tags are often exactly the opposite of what competitive acquisition would recommend – which is why people generally do not condone that a thief appropriate an old lady’s things (see sect. 8.2.2). It is also difficult to follow **Shechter et al.** when they state that “legitimate ownership of one object can influence perceptions of legitimate ownership of another object,” so that $P(A, t_1)$ would justify a representation $L(A, t_2)$. That generally does not happen, as $L(A, t_2)$ requires its own cues.

Comparative psychology too suggests that human ownership psychology does not reduce to P() cues. Interactions around the use of rival resources among apes can be described entirely in terms of competitive acquisition, with P() cues (including rank, relative formidability, etc.) providing the required information. But as **Kangiesser** reports, non-human apes do not seem to engage in any of the behaviors associated with “respect” to legitimate possession.

The addition of L() tags to competitive acquisition may be one of those features that allowed human communities to become gradually larger and more complex. The study of social evolution provides many descriptive and explanatory models of complexification processes (Dubreuil, 2010; Johnson & Earle, 2000; Marcus, 2008; Sanderson, 2014; Service, 1962). **Dale** connects this increase in group size to ownership, pointing out that “at a certain point, the costs of intragroup competition become so high that they begin to outweigh the benefits of group living.” That would describe groups in which interactions are ruled by people’s P() cues about possession and competitive acquisition. By contrast, a group in which ownership is “respected” can grow much larger, as this vastly reduces the costs of competition, and indeed increases the opportunities for mutualistic cooperation.

It may be that **Dale’s** argument is on the right track, albeit once formulated in a broader frame. Recall that, in the minimalist model, ownership intuitions are explained by the broader set of cognitive mechanisms that support mutualistic cooperation via partner choice and reputation (André & Baumard, 2011). In other words, a parsimonious description of the complexification process would be that the emergence of partner-choice cooperation ushered in both the possibility of large-scale communities and a generalized “respect” for property.

R4.2. Discrepancies between inferences from P() and L() tags

The discrepancy between P() and L() tags should be emphasized as it may lead to misunderstandings. For instance, **Friedman** points out that we should not directly equate the perceived legitimacy of an ownership claim (“It *really* is her car”) with an

argument’s willingness to fight to keep a thing. Willingness to fight is also influenced by both the likelihood of prevailing, and the intrinsic value of the thing to the current user. That is true and should have been emphasized, as **André et al.** also make that point. True, the model does stipulate that L() tags inherit information from P() tags, notably as concerns the strength of association. But that does not mean that L() tags reduce to the information in P() tags. Indeed, in many cases, L() tags support inferences that counter those from P() tags. That is clearly true when cooperation leads to “respecting” property, as described in section 8.2. In such cases, the motivation to preserve Min() interactions over-rides the advantages of acquisition.

That is also why people can be seen as “owners” of things they don’t particularly like, as **Friedman** points out. The fact that I have Min() expectations toward Melanie means that I cannot leave the party with the coat she was wearing on her way in. That is independent from the value of that coat to Melanie, because cooperative interactions (made possible by Min() expectations) require that we do not impose any uncompensated costs on others, even if those costs were minimal (e.g., if she did not like that coat at all). Indeed, when the value of partners is extremely high (e.g., with one’s spouse), people can even engage in what would seem to be violations of L() tags, as noted by **Fonn, Zahl, Kristensen, Margoni, & Thomsen (Fonn et al.)** One can for instance borrow their things without asking. As mutualistic cooperation models predict, people may accept interactions in which they willingly incur costs to benefit others’ fitness – see models of friendship (Tooby & Cosmides, 1996) and fitness interdependence (Barclay, 2016).

On a related point, **Friedman** also points out, quite rightly, that L() tags are generally not based on explicit computations about the cues concerning willingness to compete. That is, we routinely go about interacting with people without explicitly representing how strongly they would resist if we tried to seize their coats or their shoes. Rather, by activating Min() expectations toward them, we assume by default that all the things they use, for which we have P() cues, are also described by default L() tags (see sect. 7.2.3). The person who is wearing the shoes is by default assumed to be in an L() relation with those shoes – a default assumption that is of course defeasible.

R4.3. Cooperation and moral psychology

The activation of cooperation expectations (Min() in the model) is the reason why many aspects of ownership intuitions are moralized. People do not just “respect” property but feel that they ought to do so, and that others should too. This is not surprising, as moral intuitions and emotions are grounded in natural selection for cooperation (Baumard, André, & Sperber, 2013; Curry, 2016).

In the minimalist model, there is no moral intuition about ownership intuitions that is not in fact derived from a moral intuition about cooperation. There is no special morality of ownership. That of course runs against **Atari & Haidt’s** proposal that ownership should be seen, alongside care/harm, fairness, purity, loyalty, authority, and liberty, as one of the separate domains or “foundations” of morality (Haidt & Joseph, 2007). It is an empirical question, whether the psychology of morality, in its different domains, requires distinct cognitive processes (Curry, Alfano, Brandt, & Pelican, 2022; Haidt & Joseph, 2007) or can be derived from a common set of cooperative assumptions (André, Debove, Fitouchi, & Baumard, 2022). The point of the model was not to adjudicate these general debates. However, in the domain of

ownership, it does seem that all the intuitions concerning interactions and their moral aspects could be derived from cooperative fairness computations.

In the minimalist model, P() tags lead to L() tags but only within the range of Min() cooperation expectations. This suggests, as mentioned in section 10.3, that communities with different assumptions about the range of Min() would have different levels of “respect” for property. But the shift from cooperation to competitive acquisition may also result from transient aspects of a situation. **Mitkidis & Elbaeck** point out that extreme scarcity or cues of competition may lead to ignoring Min() expectations, with the consequence that people are back in competitive acquisition, and that L() tags concerning people and things are not activated anymore. So changes in P() cues can have a deep effect on people’s activation of moral inferences concerning the taking and sharing of resources, activating what **Mitkidis & Elbaeck** call a “maximizing mindset” (Elbaeck, Mitkidis, Aarøe, & Otterbring, 2021). They also predict that particular, temporary cues may get people to shift in and out of that mindset, in contrast with the literature that generally focuses on stable, general traits of a community like generalized social trust.

R4.4. Is cooperation sufficient?

The minimalist model specified that cooperation is necessary for L() tags. But one may want to argue that cooperation is actually sufficient, as **André et al.** suggest. In their view, the intuitions delivered by cooperation systems are very different from those of competitive acquisition, whose input is not actually relevant to ownership intuitions as such, or L() tags. In that proposed modification of the minimalist model, once two agents entertain cooperation expectations, what I called Min(), the input from P() cues would be entirely shut off. All inferential processes concerning who owns what, and what can be done, would be derived from the cooperation systems only.

That is of course possible but may not be parsimonious, because (a) there is evidence that human minds automatically activate P() tags from P-cues (see discussion of the psychophysics in sect. R3.2 above), and (b) the information contained in these P-cues is in many cases precisely the same as the information used by cooperation systems. So it would be surprising if one cognitive system (managing cooperation) ignored the output of another system (managing competitive acquisition) but also happened to re-create the information already provided by that other system.

For instance, as described in section 7.4, the fact that Melanie worked a lot on her garden would explain why (in contexts of competitive acquisition) she will defend it with greater energy than if she had not done much work, and (in contexts of cooperation) why people will be more motivated to leave her flowers alone than if she had not, why they will be more motivated to help her defend her garden against intruders, etc. So the same information (work, contiguity, etc.) with the same inferential outcome (Melanie’s association with the garden is stronger than if she had done no work) is activated in both contexts. It would be strange if the cooperation system ignored that information and then created it anew.

To take another example, people standing in line occupy a position whose value is a direct function of its proximity to the head of the queue. In a situation of competitive acquisition, we can expect that people near the head of the line will defend their position against intruders with more vigor than the ones

near the end, and that is actually the case (Fagundes, 2017; Mann, 1969). In situations of cooperative trade, when people sell their place in line, we can expect that places near the head of the queue will command a higher price than those at the tail, and that is actually the case (El Haji & Onderstal, 2019; Humphrey, 1991; Zhou & Soman, 2008). Again, one might say that cooperative trade re-creates some information that was already available from competitive interaction, but parsimony would suggest otherwise.

It is of course an empirical question, whether this coincidence – the L() tags inherit information already contained in P() tags – is the general case as described in the minimalist model. I would argue that it is very general.

Evolutionary considerations would support this inheritance interpretation. Our environments of evolution included many situations in which (a) one might interact with both Min() cooperators and non-cooperators (e.g., tribal outsiders), (b) one might be unsure whether the interaction with a particular agent A falls under Min() or not, and (c) that situation might change, so that one extends Min() expectations to previous non-cooperators, or vice-versa. In all these situations, an agent may, first, need to consider both perspectives simultaneously (the two of us may be in competition or perhaps in cooperation) with their respective costs and benefits, and second, be able to shift easily between these alternative readings if the situation changes. Given the likely frequency and fitness relevance of such situations, it would be odd to expect that the computations of one system ignore the output of the other.

R5. Proximate questions: Cognitive development

R5.1. Why development matters

Developmental psychology is a major contributor to our understating of ownership, thanks in particular to Ori Friedman and his collaborators and students (Friedman, 2010; Friedman & Neary, 2008; Friedman & Ross, 2011; Friedman, Neary, Defeyter, & Malcolm, 2011; Nancekivell, Friedman, & Gelman, 2019), several of whom commented on the target article. More generally, the models of ownership psychology proposed by developmentalists (Friedman et al., 2011; Gelman, Manczak, & Noles, 2012; Rochat, 2011) provide a rich source of hypotheses in a field often neglected by non-developmental cognitive psychology.

The developmental process may be complex, as **Rochat** points out, and it may not be entirely clear how it maps to the adult concept. For instance, Rochat suggests that there is a connection between the development of a sense of control over things and the emergence of explicit P() tags. This is confirmed by the low-level psychophysics of possession, as commented on by **Tummolini**. But we must also be cautious of reading our adult intuitions in infant behavior. For instance, is the infant’s familiar game of gaining and losing and regaining control over objects necessarily related to ownership? One might as well consider it as, precisely, a control game, that is, prompted by a motivation to develop motor capacities that allow control and release of objects, independent of any inferences concerning ownership or possession.

It is also possible that **Noles** is correct in proposing that there is a trade-off between the generality of the model, which applies to many domains of adult intuitions, and its explanatory power in the domain of development. That is also the substance of **Blake**’s detailed comments on possible discrepancies between the minimalist model and some aspects of development, discussed below.

R5.2. Does the developmental sequence match the model?

Blake describes how young children may both defend a third-party's access to a thing, but it is later that they “respect” another child's property in dyadic interactions. This seems to go against the sequence suggested in section 7.2, which describes the dyadic, triadic, and then generalized (default) creation of L() tags. But the order in the model is a logical order, that is, it describes the interactions from most reduced to most extended. The point is that the inferences described in generalized interactions (hypothesis 4) could be represented by an agent using a concatenation of dyadic or triadic interactions (described in hypotheses 2 and 3). That does not imply a chronological sequence, whereby people start by interacting in dyads and then gradually complexify their social world.

Such discrepancies are of interest, because they illustrate how cognitive development certainly does not consist of a coherent piling-up of complex, detailed structures on top of simpler, more general ones. Developmental sequences may reflect constraints other than conceptual coherence, as I discuss below.

Another challenge to the minimalist model stems from infancy research. As **Tatone** comments, there is no evidence that the sort of intuitions captured by L() tags is available to very young infants. But, by contrast, there is ample evidence that infants have sophisticated expectations about the transfer of control over objects, as described in section 10.1.1 for giving, but also concerning competitive acquisition and the allocation of resources. So, some parameters of P() tags seem to be available at that early stage of development. **Tatone** also points out that these could be interpreted as incipient L() tags, to the extent that they are connected to social interaction between the agents. As briefly mentioned in that same section 10.1.1, a voluntary transfer of control over a thing *t* from A to B predicts subsequent social interaction between the agents. **Tatone** proposes that the early concepts of resource control, voluntary exchange, and elementary debt monitoring, do all the work that is supposed to be done by an ownership system. Why develop an ownership system then? **Tatone** would suggest that this is because the utility of things around us is complex enough, that it needs to be detached from the rough expectations delivered by the P() tags. For instance, potential and deferred utility may be one situation that makes it necessary to go beyond the P() tags. That is very much in the same spirit that I propose more general (and more speculative) explanations below.

R5.3. A functional speculation

One may be tempted to speculate, on the basis of these commentaries by **Blake**, **Noles**, and **Tatone**, that the order in which different aspects of ownership psychology emerge in development may obey constraints that have little to do with conceptual coherence (one concept appearing *after* its presuppositions appeared), and much to do with efficiency given ecological constraints.

Specifically, the minimalist model proposes that (adult) ownership intuitions are grounded in competitive acquisition and mutualistic cooperation. Now these evolutionary aspects of human interaction have different consequences at different developmental stages. As a consequence, one may hypothesize that the various conceptual components emerge at times when they favor a child's welfare (in typical ancestral conditions of human evolution). That way of considering development may not be totally eccentric. For instance, it provides a simple account for the

developmental emergence of different anxiety targets (Boyer & Bergstrom, 2011).⁶

This may illuminate apparent paradoxes of development. Relevant to **Tatone's** remarks, one might hypothesize that infants need to figure out the parameters of agency and causation, the interaction of third parties around them, including relations of dominance, the possibility of forced and unforced transfers, the role of transfers in creating social relations – because all these are involved in early interactions. By contrast, the long-lasting aspects of ownership (L() tags) are irrelevant to their social interactions. **Blake's** point about the discrepancy between norms and own behavior may also stem from ecological conditions. In the model of cooperation assumed here, agents must balance two independent sets of factors in their cooperation decisions – direct costs/benefits, and reputation costs–benefits. Survival in a partner-choice social exchange context requires that one be chosen as a cooperator, so that reputation is crucial (Baumard et al., 2013). But the welfare of young children depends, not on social exchange, but on provision from parents, motivated by inclusive fitness. So we should expect that a crucial aspect of adult exchange computation (How does my current behavior affect my status as a potential cooperator?) has no impact on their welfare. By contrast, understanding local norms and monitoring their observance are fundamental to organizing interaction with other children and adults at that age, which is why even preschoolers see norms as imperative (even if local) and why they resent violations (Rakoczy & Schmidt, 2013; Rakoczy, Warneken, & Tomasello, 2008).

R6. Cultural norms and domains of ownership

R6.1. An evolutionary model predicts local variations

The minimalist model is based on the assumption that evolution by natural selection results in very specific cognitive capacities, which make it possible to acquire vast amounts of information from con-specifics and govern inferences from that information (Sperber, 1996; Tooby & Cosmides, 1992). That is why, *contra* **Belk & Atasoy**, one should not try to separate the “innate” and “learned” aspects of ownership intuitions, as such distinctions are both misguided and misleading (Boyer, 2018, p. 272ff). A related and common misconception is that evolutionary considerations could only explain cultural universals, which is certainly not the case (Boyer & Petersen, 2012).

In the domain at hand, as local cooperation parameters (notably the extension of Min() expectations) vary a great deal between times and places, we would expect corresponding differences in ownership intuitions. Indeed, the model results in specific predictions about, for example, differences in ownership that stem from differences in social trust (see sect. 10.2.). Although **Atari & Haidt** “warn against” ignoring cultural differences, those are precisely what the model allows us to explain.

R6.2. The case of slavery, a widespread institution

A striking case of cultural variation is the acceptance of slavery. The model specifies that the difference between accepting and rejecting the institution of slavery rests not on differences in ownership principles, but on the extension of the Min() cooperation expectations. But **Starmans** argues that the rejection of slavery stems from other considerations.⁷ Specifically, our psychology would stipulate that one cannot own things with autonomy.

Indeed, children readily exclude from the domain of ownership things with some “autonomy” (Starmans & Friedman, 2016), as they see control as a crucial feature of ownership (Espinosa & Starmans, 2020). It is of course tempting to infer that, if human minds assume that “autonomy” → “cannot-be-owned,” they would also assume that “can-be-owned” → “is-non-autonomous.”

But is that the case? Historical data suggest otherwise. Slavery was practiced in all kinds of societies for as long as historical documents are available. In many of these cases, there is every indication that people construed slaves as both (a) property that can be traded, stolen, guarded, etc., as well as (b) autonomous agents with volition, cognition, emotions, etc. To consider an extreme example, the Arab scholar Ibn Qutaybah, writing in classical Baghdad, celebrated the exceptional talent of several women poets, whom many rich people were very keen to *buy* from their *owners* (Qutaybah, 2019).

R6.3. Collective action and private ownership

In the model, it was suggested that, when people represent an abstract collection or institution as “owning” something, that may result in (or be caused by) representations of that institution as an agent. This happens often enough, when we consider that, for example, the state “does not want to sell” some asset. But, as **Umbres** points out, in many socially important situations, people manage collective rights in resources without generating a notion of ownership by a collective agent. That is for instance the case in commons management. Also, as **Umbres** writes, in many forms of collective action, people have access to the collectively generated benefits but they privatize them upon receipt.

As **Umbres** also notes, the notion of ownership by a quasi-agent becomes much clearer, when people engage in a collective action to which they apply coalitional psychology (Tooby, Cosmides, & Price, 2006). That is because coalitions are themselves represented as quasi-agents to begin with (Boyer, 2018, pp. 217–225). So, if people consider that coalitions “want this” or “remember that,” it is quite natural to think that they can “own” a thing. Engaging coalitional psychology also creates an intuition of similarity between members of an alliance, which **Grüning & Krueger** rightly describe as a crucial factor in facilitating coordination. But similarity needs to be unpacked. For one thing, people cannot really engage in efficient competitive acquisition if they do not have some expectation that P() cues are represented in the same way by the different agents they interact with. But also, people could not extend cooperation to others if they did not have some mental representation of what their Min() expectations consist of. Some of this similarity is of course given “for free” by the fact that different agents belong to the same species, therefore have highly similar capacities. But another set of expected similarities stems from exposure to the same cues, for example, by belonging to the same larger community of norms. The fact that commons can be efficient or unravel shows that the Min() expectations may be necessary but not sufficient.

R6.4. Coordination and institutions

Interactions around rival goods require coordination, specifically in the form of coordination games. That is true of competitive acquisition, in the form of Bourgeois equilibria, and also of cooperative interactions, in the form of mutualism. Because coordination games often have multiple equilibria, arbitrary cues can motivate the choice between strategies, for example, between

driving on the right or on the left. The cost of subsequent changes of strategies, which escalates as the number of coordinated agents increases, ensures the stability of such choices, which we call path dependence.

The fact that coordination points may be arbitrary leads **Blazsek & Heintz** to emphasize what they see as the unbounded variety of ownership institutions. But that may be an exaggeration. First, the fact that some cue is arbitrarily chosen does not imply that its use stems from arbitrary processes. For instance, it is arbitrary that men wear neckties and women skirts, but it is certainly not arbitrary that fashion cues emphasize gender distinctions. In the domain of ownership, there are similar situations. The “choice” between matri- and patrilinear inheritance is a good example. Even if the coordination cue is arbitrary, people find the rules intuitive because they rely on evolved intuitions about genetic relatedness.⁸ In the same way, when ranchers and farmers coexist, they have to “choose” which of the two groups will have to enclose their resources. But their inferences from that “choice” follow the intuitive path of optimizing mutual benefits (Ellickson, 1991). Generally, there are striking similarities in the manifestations of the “property instinct” across the species (Stake, 2004).

In this as in other domains, it may be misleading to think of institutions as fundamentally distinct from evolved intuitions. Institutions require mental representations of the distribution of particular mental representations in people’s minds in one’s social environment (Heintz, 2004; Sperber, 2006). That is why many institutions owe their persistence not just to path dependence, which would be vulnerable to random drift, but also to their “fit” with evolved intuitive understandings of the domain at hand (Boyer & Petersen, 2012). Intuitions constrain inferences from arbitrary choices, which is why legal regimes of ownership are much less varied than we may expect – as discussed below.

R7. Legal norms and their psychological background

R7.1. Why the law matters

Ownership psychology consists of intuitions, that sometimes prompt explicit, reflexive thoughts about principles, which themselves can influence the production of legal norms (sect. 8.1.1, Fig. 2). One can only agree with **Feeney & Hickey**, as well as **Patrick** and **Blazsek & Heinz**, that there should be greater integration between the psychology of *intuitions* with the study of legal *institutions*. Indeed, legal scholars were far ahead of psychologists in putting forth sophisticated models of ownership. First, they accepted deflationary (or, one might say, minimalist) accounts of ownership for a long time. A clear example is Honoré’s proposal that ownership is not a single unified right, but rather a “bundle” of distinct, conceptually independent rights, combined in different ways in different domains and different societies (Honoré, 1961; see also Hohfeld, 2014[1923]). This view is largely shared by legal scholars to this day (Attas, 2006; Glackin, 2014). Second, legal scholars and economists have long recognized that ownership decisions cannot just be construed as a matter of dominion over a thing, but include trade-offs to do with externalities (Coase, 1960).

R7.2. The intuitive basis of norms and the law

Legal scholars have documented the influence of intuitive understandings on the law in the domains of criminal justice

(Robinson, Kurzban, & Jones, 2007; Sznycer & Patrick, 2020) and more recently of morality (Lieberman & Patrick, 2018). Patrick argues that the domain of ownership leads to the same conclusion – legal nuances about squatters’ rights, for instance, seem to mirror uncertainties in our intuitions (sect. 8.3). In the same way, failure to protect or defend one’s things leads to a diminished intuition of ownership, an L(A, t, s) tag with small s parameter, but also to a weaker legal claim on property.

More generally, even though legal systems are somewhat detached from our intuitions, they also require that intuitive background. For instance, Honoré’s notion of ownership as a bundle of independent rights does in fact imply some shared intuitions about ownership – otherwise there would be no reason to think that the different rights are related at all, that they are about the same problem (Harris, 1996). In the same way, decisions about externalities often require intuitively grounded judgments about what externalities must be internalized (Glackin, 2014, p. 22ff), a point that is at the center of recent accounts of ownership (Feeney & Hickey) and of legal decisions about liability (Patrick).

This raises the question, how intuitive representations and the explicit legal principles coexist in lawyers’ minds. Feeney & Hickey suggest that they may be juxtaposed without much interaction, or that they may actually interact, although there are no studies of that process. As empirical studies in the “law and norms” tradition suggest, it may happen that people know the legal norm though they abide by the informal norms, but it also happens that people follow their intuitive norm and wrongly assume that they are following the law (Ellickson, 1991). More generally, legal knowledge is certainly “meta-represented,” like many aspects of scientific knowledge (Sperber, 1997).⁹

R7.3. Possible effects of laws on folk notions and intuitions

Information may also flow in the opposite direction, from institutions to intuitions. The law can serve as the coordination point described by Blazsek & Heintz, as suggested by Kleiman-Lynch & McCullough’s study, in which participants seem to have conflicting intuitions about who actually “owns” the money owed for taxes. Note that people’s representations of whether the state “owns” the money you pay in taxes or not, belong to those explicit, “reflexive” beliefs described in section 8.1.1, as a response to intuitions delivered by cognitive systems. In this case (and that is not limited to taxes), it is plausible that our intuitive systems deliver no clear intuition at all. As Kleiman-Lynch & McCullough suggest, participants may interpret the situation as one of contested ownership. That indeed seems quite plausible.

Taxation indeed triggers very different intuitions. People in some countries are happy to contribute to the nations’ maintenance, for example, in Scandinavia, while in other places they see taxes as illegitimate, for example, in Russia (Rothstein, 2005). In one case, people consider that they are contributing to a collective action. In the other, people assume that payment of taxes only reflects their lack of bargaining power, as they cannot resist a powerful predatory state. These differences are correlated with general social trust, as suggested by the minimalist model (sect. 10.2).

R8. Epilogue: Two obstacles to progress

There is still a lot to describe and understand in the psychology of ownership, and in the combination of a “property instinct” with social interaction and legal norms (Stake, 2004). It might be of

help at this point to describe two general obstacles to the study of many cognitive systems, which hindered a proper understanding of ownership psychology in particular, and may still prove difficult to overcome.

One obstacle consists of our spontaneous belief that our everyday ontology of social or psychological things does correspond to scientifically relevant kinds. In the case at hand, what we usually call “ownership” may encompass highly disparate phenomena, so that there is simply no object for a unified theory of ownership.

A second, more serious obstacle consists of cognition blindness, a form of our more general “instinct blindness” (Cosmides & Tooby, 1994; Tooby & Cosmides, 1992). Because our intuition systems work seamlessly, we tend to ignore their operation. For instance, our common 3D representations of the world may seem obvious, though in fact computing them from 2D retinal images requires complicated computation. In the same way, it may seem obvious that the coat that was on my shoulders when I arrived at the party is associated with me, in the minds of all present, in a way that does not apply to other coats. It may seem equally obvious that this association perdures even when I am not present to guard the coat and stop others from taking it. But these associations require dedicated computational processes that we are only beginning to uncover. In this domain as others, a great advantage of an evolutionary approach is that it makes the ordinary somewhat puzzling, and worthy of scientific investigation.

Notes

1. This can be observed in other domains. For instance, Bantu nominal classes (Katamba, 2003) or the numerical classifiers of many languages (Aikhenvald & Mihas, 2019) seem to denote prototypical categories like “animate-like beings,” “plants and inanimate natural things,” “liquids,” or even “long and thin objects,” but we would not infer that these very approximate prototypes correspond to fundamental semantic categories in human minds.
2. These motivations and emotions are indeed found in domains where there is no possession or use of things. If someone takes your diary and reads it out, or rips off pages to light a fire, you may feel strong emotions. In the same way, there may be strong motivations in one’s representation of an ethnic signal or a sports team symbol, things that seem to “belong” to us (Morewedge, 2021). There are similar reactions when someone makes fun of a name that happens to be your mother’s, or if they ridicule values that you hold dear. It would be odd to claim that you “own” your mother’s name in any sense.
3. Hood mentions that people often dispute territories that may seem worthless to others. But control of a territory is of course far from worthless. In situations of coalitional rivalry, the very fact that one can intrude into your territory is a strong cue of weakness – that is of course independent of what can be extracted from the place (DeScioli & Wilson, 2011; Pietraszewski, 2016).
4. This important article describing ownership intuitions in terms of privileged utility (Pesowski & Powell, 2023) appeared too late to be discussed in the target article or to be considered by the commentators.
5. Perhaps the notion of “possessions as extensions of the self,” despite all these difficulties, is intrinsically appealing because it provides a metaphorical account of some of our common experiences. For example, we may feel that people who defile our things attack us. We may feel less important to others if we cannot give anything to them or exchange with them. We feel that it would be the end of us, if others could just appropriate our things at will. That metaphorical notion of things as extended self would be part of those explicit considerations on ownership, described in section 8.1.1, through which we try to explain our own intuitions to ourselves, even though such metaphors do not lead to scientifically precise models.
6. For example, stranger anxiety appears when infants are more likely to be handled by strangers (Hahn-Holbrook, Holbrook, & Haselton, 2011), extreme food conservatism appears when they would typically roam around and encounter new plants (Cashdan, 1994), social anxiety when the child’s social

status begins to depend on allies rather than relatives (Kendler, Gardner, Annas, & Lichtenstein, 2008), and so forth (Boyer & Bergstrom, 2011).

7. Note that the article did not actually say that slavery was abolished because the “moral circle” was extended, but that such vague expressions do reflect the more precise Min() expectations. This again illustrates how ordinary language (e.g., the “circle of trust”) can be misleading.

8. Indeed, matrilinear systems are notoriously vulnerable to structural problems, caused by our asymmetrical mating and parenting psychology – father and mother are not symmetrical positions between which a choice would be entirely arbitrary (see discussion in Boyer, 2018, p. 126ff).

9. Physicists for instance know that most solid objects are empty space and that force predicts not velocity but acceleration, but in everyday contexts use intuitive physics notions of solid objects and speed (Vicovaro, 2021).

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